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UNITED STATES NATIONAL MUSEUM.

THE COLLECTION OF BUILDING AND ORNA-
MENTAL STONES IN THE U. S. NATIONAL
MUSEUM: A HANDBOOK AND
CATALOGUE.

BY

GEORGE P. MERRILL,

Curator of the Department of Lithology and Physical Geology.

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ERRATA.

Page 299, first line ; for *lime* read *iron*.

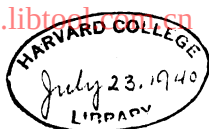
Page 471, thirty-fourth line ; for *Bates* read *Bedford*.

Page 505, under analysis of Pleasantville (N. Y.), dolomite ;
for 64.62 *per cent.* read 54.62 *per cent.* carbonate of
lime.

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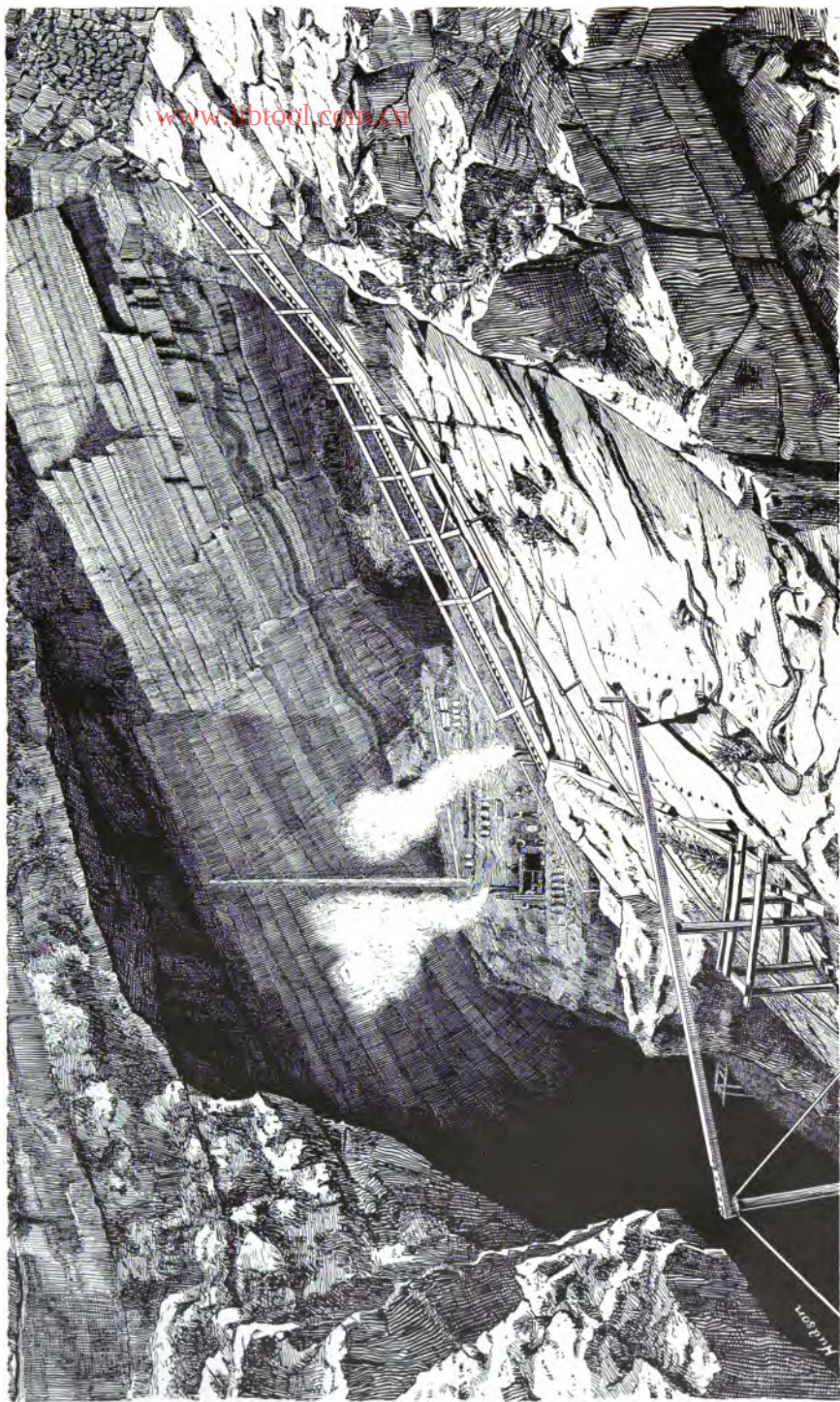


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INTERIOR VIEW OF MARBLE QUARRY, WEST RUTLAND, VERMONT. (See p. 387.)
Drawn from a photograph.

THE COLLECTION OF BUILDING AND ORNAMENTAL STONES IN THE U. S. NATIONAL MUSEUM: A HAND-BOOK AND CATALOGUE.

By GEORGE P. MERRILL, *Curator, Department Lithology and Physical
Geology.*

PREFATORY NOTE.

The collection of building and ornamental stones in the National Museum is made up very largely from materials received from the Centennial Exposition at Philadelphia in 1876, and from the Tenth Census at the close of the investigation of the quarrying industries of the United States in 1880. By far the greater part and more systematic portion of the collection is from the latter source, and as the late Dr. George W. Hawes, then curator of this Department, was also in charge of that branch of the census work, it may be said to be due to his efforts more than to those of any other individual that the collection has been gotten together. Having once assumed such proportions as to attract national attention, it has been a matter of comparative ease to obtain materials from localities that were but poorly, if at all, represented at the time of Dr. Hawes' death. The present collection comprises upward of 2,900 specimens, a large part of which are from quarries in the United States, though very many foreign varieties are represented. It is the intention to add to it from time to time such new materials as shall be discovered in this country, and also the principal varieties from foreign sources, particular attention being paid to such as are imported into the United States.

In preparing the exhibit the stones have been arranged by States, and under States by kind; this method seeming best adapted to the wants of the general public.

The specimens are as a rule dressed in the form of 4-inch cubes, the various faces of which are finished as follows: Polished in front, drafted and pointed on the left side, drafted rock face on the right side, rock face behind, and smooth-sanded on the top and bottom. Stones that do not polish have the face simply rubbed smooth. When of any other size or shape than that of a 4-inch cube the approximate size is here stated in inches. Each specimen is accompanied by a printed label, giving, so far as obtainable, its scientific name, geological age, color, and

texture, together with the locality from whence it was obtained and the name of the donor or collector.

The data for the accompanying hand-book has been likewise in part supplied by the Tenth Census, in Vol. x, Report on Building Stones and Statistics of Quarrying Industries. So far as possible statements taken from this work have been verified by reference to the original schedules now on file in this Department. The time that has elapsed since the publication of the census report has, however, enabled me to gather much new material, and to supply many facts there altogether omitted. As the work is intended for popular use, it has seemed advisable to go into considerable detail regarding the nature and composition of each class of rocks, stating, so far as possible, the qualities that render them of value for architectural purposes. Indeed it may be said that in putting the matter in its present shape the curator has been guided largely by the character of the requests for information which are being so constantly received. These requests are from persons in all stations of life, but most largely, as a matter of course, from those who are actively employed either in quarrying, building, or dealing in building materials. With such it has rarely been found sufficient to give merely the name of a stone submitted or inquired about, but such details as mineral composition, suitableness for any particular purpose, qualities good and bad, how it differs from other stone with which it may be brought into competition, etc., are almost invariably insisted upon.

Inasmuch as the market value of a stone is so largely dependent upon the cost of quarrying and dressing, it has been deemed advisable to devote a few pages to an explanation or description of the various machines, implements, and methods employed in this work. It is to be understood that none of these machines are actually on exhibition otherwise than by photograph or engraving. Only such are described as have been found by the writer in actual use in the quarries, or which seem sufficiently promising to merit attention.

It is doubtless scarcely necessary to state that the results given in Table 8 were not obtained from tests applied on these individual specimens, nor at the Museum. They are compilations from a variety of undoubtedly reliable sources, and a part of which have never before been published.

In speaking of any particular stone or group of stones it will be observed I have not limited myself to a mere description of the sample as it appears in the Museum collections, but have gone more into detail regarding the quarries from whence it was obtained, its mode of occurrence, use, and the natural facilities for quarrying and transportation. This for the reason that, while many an outcrop is capable of furnishing samples of excellent quality for purposes of exhibition the stone may be practically worthless owing to difficulties in the way of quarrying, lack of transportation facilities, or distance from market.

NATIONAL MUSEUM, *July*, 1887.

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PART I.

INTRODUCTORY.

A.—HISTORICAL AND GENERAL.

The use of any kind of stone for building purposes in the United States, or indeed in America, of necessity dates from a comparatively recent period. The early settlers were too poor and too thoroughly occupied in the struggle for existence to give a thought to other constructive material than wood, and hence it is not surprising that over one hundred years elapsed from the time of the landing of the pilgrims at Plymouth before the first stone structure of importance was erected. As, however, wealth increased, towns became cities, and matters assumed a more permanent aspect, there naturally arose a demand for a more durable and highly ornamental material; for such, fortunately, the early settlers of eastern Massachusetts had not far to look. The first stones quarried in this State are thought by Professor Shaler to have been the clayslates in the vicinity of Boston. These, however, were worked only in a small way and the product used for grave- and mile-stones, and a few lintels.

Granite came into early use for building purposes, probably more on account of its ready accessibility than from any desire on the part of the people for so refractory a material, the matter of transportation then, as now, being an important item in deciding what material was to be used.

According to Shurtleff* one of the first stone buildings in Boston was the house of Deacon John Phillips, which was erected about 1650, and which continued to stand until 1864. It is supposed to have been built from granite bowlders found in the immediate vicinity. In 1737 was built of bowlders of Braintree granite the old Hancock house, since torn down, and in 1749-'54 King's chapel, which is still standing on the corner of School and Tremont streets. This last was at the time the greatest stone construction ever undertaken in Boston, if not in this country. Like those already mentioned, it was built from bowlders, and considering the method of cutting employed (to be noticed later), was indeed a remarkable structure. The granite bowlders scattered over the commons had been very generally used in Quincy and vicinity

* History of Boston, p. 589.

for steps and foundations for some years previous to this, until at last the inhabitants fearing lest the supply should become exhausted, assembled in town meeting and voted that "no person shall dig or carry off" any stone "on the said commons or undivided lands upon any account whatever without license from the committee, upon penalty of the forfeiture of 10 shillings for every and each cart-load so dug and carried away."

It was not, however, until the early part of the present century that granite began to be used at all extensively in and about Boston, when the material was introduced in considerable quantities by canal from Chelmsford,* 30 miles distant. It was from Chelmsford stone that was constructed in 1810 the Boston court-house; in 1814 the New South church; and about the same time the Congregational house on Beacon street; the old Parkman house on Bowdoin square; University hall in Cambridge; and in 1818-'19 the first stone block in the city, a portion of which is still standing, on Brattle street. In this year also a considerable quantity of the stone was shipped to Savannah, Ga., for the construction of a church at that place. The greater part of this granite was, however, obtained from bowlders, and it was not until the opening of quarries at Quincy, in 1825, that the business assumed any great importance. From this time the use of granite for building material increased in a marked degree, and the history of stone quarrying in Massachusetts may properly begin with this date.

The opening of quarries at Quincy was due very largely to the demand for stone for the construction of the Bunker Hill monument. Prior to this time it is stated not much thought had been given to the quarries of the vicinity, although the business had been carried on in a small way by several parties. The quarry at Quincy from whence the stone for the monument was taken is stated to have been previously purchased by a Mr. Gridley Bryant in 1825 at a cost of \$250. This gentleman afterwards sold the same to Mr. Amos Lawrence, acting for the monument committee. The development of this quarry led to the discovery of others in the immediate vicinity, and with slight retardations there has been a gradual increase ever since. It is stated that in 1837 the total amount of stone quarried in the town was 64,590 tons, valued at \$248,737, in the production of which some 533 men were employed; in 1845 the value of the total product had increased to \$324,500, though the number of men employed was but 526. In 1855 there appears to have been a falling off, since the value of the product for that year was but \$238,000, and but 324 men furnished with employment. Twenty-five years later (1880) the census returns for the towns of Quincy and West Quincy show a total of thirty quarries, producing annually not less than 723,000 cubic feet of stone, valued at some \$226,940, and giving employment to some 820 men.

* It is stated by Hitchcock, Geol. of Mass., Vol. I, p. 148, that the so-called Chelmsford granite in reality came from Westford and Tyngsborough, in the same State.

In 1824 a Mr. Bates, of Quincy, went to Sandy Hook, in the adjacent town of Gloucester—a town heretofore noted only for its fishery interests—and opened a granite quarry there. Not long after other quarries were opened at Anisquam, where an extensive industry was carried on for some years, though finally abandoned. Quarries were opened at Rockport, just beyond Gloucester, in 1827, and are still in active operation, and doing a profitable business, although the first year's experience is said to have resulted in a net loss of \$15.

In 1848 the quarries at Bay View were opened, which have since become the property of the Cape Ann Granite Company, and form now one of the best equipped quarries in the country, producing annually not less than 480,000 cubic feet of stone, valued in the rough at \$250,000.

Although the Massachusetts quarries were the first systematically worked to obtain granite for building purposes, other States were not far behind. Thus we are told by Dr. Field* that as early as 1792 granite quarries were reported to have been opened at Haddam Neck, in Connecticut, and as many as ninety hands were employed in this and other quarries in the vicinity as early as 1819. This material is, however, a gneiss rather than a granite, and, splitting readily into slabs, was used nearly altogether for curbing and paving, for which purpose it brought from 10 to 20 cents per cubic foot. The principal markets for the material were Rhode Island and the cities of Boston, New York, Albany, and Baltimore.

The rocky coast and adjacent islands of Maine are competent to furnish for many years immense quantities of granitic rock of a color and quality not to be excelled. The rare excellence of many of these sites for quarries, together with the ready facilities of transportation by water to all the leading cities, early made itself apparent to the shrewd and pushing business men of New England, and a very few years after the commencing of works at Quincy saw similar beginnings made at various points both on the coast and farther inland.

The years 1836-'37 appear, for some reason, to have been peculiarly prolific in schemes for speculation in this industry.

It is stated by North† that during the latter year, out of one hundred and thirty-five acts of incorporation granted by the State legislature, thirty were for granite companies, three of which were located in Augusta. One was called the Augusta and New York Granite Company, and was for working, rending, transporting, and dealing in granite from the Hamlen ledge, situated about 2 miles from the river by way of Western avenue. Another, named the Augusta and Philadelphia Granite Company, owned the Ballard ledge, a mile and a half from Kennebec bridge by way of Northern avenue. A large portion of the granite for the state-house, court-house, and new jail was obtained from this ledge.

* Centennial address and historical sketches of Middletown, Cromwell, Portland, Chatham, and Middle Haddam.

† History of Augusta, Me., p. 582.

The other company, called the Augusta Blue Ledge Company, purchased Hall's ledge, on the east side of the river, near Daniel Hewin's house, some $2\frac{1}{2}$ miles from the bridge.

It is further stated by this same authority* that during the erection of the state-house blocks of granite for the colonnade, 21 feet long by nearly 4 feet in diameter, were obtained from the "Melvin ledge," in Hallowell, about 3 miles away. Convenient and abundant as are these quarry sites, it seems a little singular that they should not have been earlier discovered and worked. In building the Kennebec bridge in 1797 the piers and abutments were constructed of stone split from drift boulders, and the houses of Capt. William Robinson, Judge Bridge, and Benjamin Whitwell, built about 1801, had for underpinning granite brought at great expense from near Boston, probably Quincy, or perhaps Chelmsford. Most of the stone of large dimensions of which the old jail was built in 1808 were also, it is stated, obtained with great labor from boulders, though an unsuccessful attempt was made to work the Rowell ledge at the time. Some of the top strata were broken off by means of wedges driven under the sheets, but the process was laborious and slow. The first successful attempt to work a ledge in town is stated to have been made by Jonathan Matthews on the Thwing ledge, in 1825. Powder was not used until the state-house was built, and then at first with only one hole, by means of which irregular masses were thrown out. Later two holes short distances apart were fired simultaneously, by means of which long, straight seams were opened. These seams were again charged with powder, and thus masses of stone of considerable size were moved from the bed to be afterwards broken up by wedges. The Frankfort Granite Company, located at the base of Mosquito Mountain, began operations in May, 1836, and within the next two years took out and sold upwards of \$50,000 worth of material. What is now the Hallowell Granite Company opened its quarries in 1838, and during the first ten years is stated to have sold \$500,000 worth of stone.

It is stated by Professor Seely† that the earliest attempts at quarrying marbles in New England were those of Philo Tomlinson, who began operations at Marbledale, in the town of New Milford, Conn., about 1800. Other quarries were soon after opened, and in 1830 as many as fifteen were in active operation within a distance of 3 miles. The product was sent to all parts of the country. Soon after this date competition set in from other localities, particularly from Dover, N. Y., and Rutland, Vt., and by 1850 the business had proved so unremunerative that the last quarry at Marbledale was abandoned. Marble quarries and mills were also put in active operation at West Stockbridge, in Massachusetts, as early as 1802 or 1803, and these furnished the marble for the city hall in New York City. Work was stopped here in 1855, owing to competition of Vermont and Italian marbles.

* *Op. cit.*, p. 582.

† *Marble Border of New England*, p. 27.

Of the many marble quarries in Vermont, those in East Dorset are believed to have been longest worked, Professor Seely stating one Isaac Underhill began operations here as early as 1785, the product being utilized for fire jams, chimney backs, hearths, and lintels. Other quarries soon opened, and from 1785 to 1841 nine were in operation at this place. The first marble gravestone ever finished in the State is believed to have been the work of Jonas Stewart in 1790. Prior to the introduction of Italian and Rutland marble, about 1840, the supply of the Dorset stone was not equal to the demand.

At West Rutland, which is now the great marble producing center of the country, works were first put in successful operation about 1838. At the present time not less than fifteen quarries are in operation, affording employment altogether to about 2,000 men.

The first stone quarried and used in Philadelphia is said to have been the micaceous and hornblende gneiss which occurs in inexhaustible quantities in the immediate vicinity. This was at first used only for foundations and rough construction. The first house built within the city limits, if not the first in the State, that built in Letitia court by order of William Penn, was constructed on a foundation of this stone about the year 1682. The Old Swedes church, built in 1698, Independence Hall, and numerous other structures are said to have had similar foundations. Later, entire walls were made of this material, as in the house of John Penn, erected in 1785, and which is still standing.

The quarrying of marble in Montgomery County, Pa., is said to have been commenced by a Mr. Daniel about the time of the Revolution.* This stone seems to have immediately become a favorite for trimming purposes, and to have been used in Philadelphia to the almost entire exclusion of other material until as late as 1840. During this time many fine buildings were constructed from it, as will be noted later.

Sandstone quarrying in the United States doubtless began with the itinerant working of the extensive beds of Triassic brownstone in the vicinity of Portland, Conn. It is stated† that the first quarry here was opened "where the stone originally rose high and hung shelving over the river." The value of the material was early recognized, and it began to be utilized for building and for monuments soon after the settlement of Middletown on the opposite side of the stream. The quarries were at this time regarded as common property, and were worked as occasion demanded both by people in the immediate vicinity and by those living at a distance, who carried off the material in scows or boats of some sort, nor thought of giving anything as an equivalent. This system of free quarrying had assumed such proportions as early as 1665, that on September 4 of that year the citizens of Middletown assembled in town meeting and voted "that whoever shall dig or raise stone at ye rocks on the east side of the river (now Portland) for any

* First Geol. Survey Penna., Vol. 1.

† Centennial Address and Historical Sketches of Middletown, Cromwell, Portland, Chatham, and Middle Haddam, by D. D. Field, 1853.

without the town, the said digger shall be none but an inhabitant of Middletown, and shall be responsible to ye towne twelve pence pr. tunn for every tunn of stones that he or they shall digg for any person whosoever without the towne; this money to be paid in wheat and pease to ye townsmen or their assignes for ye use of ye towne within six months after the transportation of the said stone."*

How soon the surface rock was exhausted and it became necessary, as now, to go below the level of the ground for suitable material is not stated, but the quarry thus opened was at length disposed of by the town and passed through various hands, among whom the names of Shaler & Hall are conspicuous. These parties pursued the business vigorously and made a handsome profit. For several years between 1810 and 1820 some thirty hands were employed for the eight months comprising the quarrying season, and from four to six teams. Some 50 rods south of this quarry another was opened about 1783, and was owned by Messrs. Hulburt & Roberts. About 1814 this was purchased from the heirs of Aaron Hulburt and deeded to Erastus and Silas Brainard, who carried on the business conjointly until the death of the latter in 1847. The business is carried on under the name of Brainard & Co. to the present time. For some five years after this firm began work they employed but from seven to ten hands and two yoke of oxen. In 1819 a quarry was opened north of the Shaler & Hall quarry by the firm of Patten & Russell. It was afterwards known as the Russell & Hall quarry, and finally in 1841 was united with that of Shaler & Hall, the firms combining to form the Middlesex Quarry Company. Some years later still another opening was made below the Brainard quarry near the ferry between Portland and Middletown. This also was known as the Shaler & Hall quarry; the original firm by this name having been incorporated with the Middlesex Quarry Company.

The three firms above enumerated continue to monopolize the quarrying industry at this place. The quarries extend from a point near the ferry northward along the river for some three-fourths of a mile, and vary in depth from 50 to 150 feet. Their yield of stone of all grades during the time of their operation has been roughly estimated at 4,300,000 cubic feet. The rate of progress is given as follows: In 1850 the number of men employed at the three quarries was about 900 and 100 yoke of oxen; thirty vessels being regularly employed to convey the quarried material to the markets, each vessel conveying from 75 to 150 tons and making from twenty to thirty trips each season. Two years later the number of workmen regularly employed had increased to 1,200, while 200 more were engaged on contract work. The stone, even at this date, had found its way to markets as far west as Milwaukee and San Francisco. The census returns for 1850 showed the total number of men employed to be but 925, with 80 yoke of oxen and 55 horses and mules. The falling off in numbers may doubtless be considered due to

* Freestone Quarries of Portland, Conn., by Prof. J. Johnson, Nat. Mag., 1853, p. 268.

the introduction of machinery and improved methods of working. The total product of the three quarries for this year was about 781,600 cubic feet, valued at not less than \$650,000. A fleet of twenty-five vessels of various kinds was regularly employed in transporting this material to market.

The quarrying of slate for roofing purposes is an industry of comparatively recent origin in the United States, few of the quarries having been operated for a longer period than twenty or thirty years. The earliest opened and systematically worked are believed to have been those at West Bangor, Pa., which date back to 1835.

The abundance of slate tombstones in many of our older church-yards, however, would seem to prove that for other purposes than roofing these stones have been quarried from a much earlier period. It is stated, moreover, that as early as 1721 a cargo of 20 tons of split slate was brought to Boston from Hangman's Island, in Braintree Bay, which may have been used in part for roofing purposes; but the greater part of the material for this purpose was imported directly from Wales. It is also stated* that slates were quarried at Lancaster, Massachusetts, as early as 1750 or 1753, and were in extensive use in Boston soon after the close of the Revolution. The old Hancock house on Beacon street, already noted (ante, p. 285), was covered with slate from these quarries, as was also the old State House and several other buildings. This quarry was worked more or less for fifty years and formed at one time quite an important industry, but which finally became unprofitable, and about 1825 or 1830 the works were discontinued, not to be again started till about 1877.

The first quarry opened in what is now the chief slate-producing region of the United States was that of Mr. J. W. Williams, situated about a mile northwest of Slateford, in Pennsylvania. This dates back to the year 1812.†

The Vermont slate quarries are of still more recent development, work not being begun here till 1845, when Hon. Alason Allen began the manufacture of school slates at Fairhaven.‡

It is interesting to note, in this connection, that during the business depression of 1876-'80 almost the entire product of the American quarries was exported to England, where it sold for even less than the Welsh slates, though necessarily at very small profits. The return of more prosperous times, however, created a local demand, and the export trade has proportionally decreased, though considerable quantities are still sent to the West Indies, South America, England, Germany, and even New Zealand and Australia.

At present not far from \$3,328,150 are invested in the slate quarries of the United States, and the value of the annual product is some \$1,529,985.

* Marvin's History of Lancaster, Mass.

† Rep. D. 3, second Geol. of Penna., p. 85.

‡ Geol. of Vt., Vol. II, 1861, p. 791.

B.—THE MINERALS OF BUILDING STONES.

~~Rocks are mineral aggregates.~~ As a rule the number of mineral species constituting any essential portion of a rock is very small, seldom exceeding three or four. In common limestone, for instance, the only essential constituent is the mineral calcite; granite, on the other hand, is almost invariably composed of minerals of at least three independent species. Upon the character of these minerals and the amount of their cohesion is dependent, to a very considerable extent, the suitability or desirability of any stone for architectural purposes. Microscopic examination will usually result in increasing the apparent number of mineral species, and it not infrequently happens that those present, even in minute quantities, are of great economic importance.

In the arrangement here adopted rock-forming minerals are divided into four classes: (1) Essential; (2) accessory; (3) original; (4) secondary.

(1) The essential minerals are those which form the chief ingredients of any rock, and which may be regarded as characteristic of any particular variety; *e. g.*, quartz is an essential constituent of granite; without the quartz the rock becomes a syenite.

(2) The accessory minerals are those which, though usually present, are of such minor importance that their absence does not materially effect the character of the rock; *e. g.*, mica, hornblende, apatite, or magnetite, are nearly always present in granite, yet a rock in which any or all of these are lacking may still be classed as a granite. The accessory mineral which predominates is called the *characterizing* accessory and gives its name to the rock. Thus a biotite granite is one in which the accessory mineral biotite prevails.

(3) The original constituents of a rock are those which formed upon its first consolidation. All the essential constituents are original, but all the original constituents are not necessarily essential. Thus, in granite, quartz and orthoclase are both original and essential, while beryl and sphene, though original, are not essential.

(4) Secondary constituents are those which result from subsequent changes in a rock, changes due usually to the chemical action of percolating water. Such are the calcite, chalcedony, quartz, and zeolite deposits which form in the drusy and amygdaloidal cavities of traps and other rocks.

In the following list is included all those minerals which ordinarily occur in such of our rocks as are used for building or ornamental purposes. In the first column are given those which compose any appreciable part of the rocks, and any one of which may at times become the principal ingredient or characterizing accessory. The second column contains those which, if present at all, occur only in small quantities:

1. Quartz.
2. Feldspar.
 - Orthoclase.
 - Microcline.
 - Albite.
 - Anorthite.
 - Labradorite
 - Andesite.
 - Oligoclase.
3. Mica.
 - Muscovite.
 - Biotite.
 - Phlogopite.
 - Lepidomelane or Annite.
4. Amphibole.
 - Tremolite.
 - Actinolite.
 - Common hornblende.
5. Pyroxene.
 - Malacolite.
 - Sahlite.
 - Augite.
 - Diallage.
 - Enstatite.
 - Hypersthene.
6. Olivine.
7. Epidote.
8. Elaeolite.
9. Calcite.
10. Aragonite.
11. Dolomite.
12. Gypsum.
13. Serpentine.
14. Talc.
15. Chlorite.

ELEMENTS.

Carbon.
Graphite.

SULPHIDES.

Galenite.
Sphalerite.
Pyrite.
Marcasite.

CHLORIDES.

Halite (common salt).

FLUORIDES.

Fluorite (fluor-spar).

OXIDES.

Trydimite.
Hematite (specular iron).
Menaccanite (titanic iron).
Magnetite (magnetic iron).
Chromite (chromic iron).
Limonite (hydrous iron oxide).
Rutile.

ANHYDROUS SILICATES.

Acmite.
Beryl.
Danalite.
Garnet.
Zircon.
Zoisite.
Allanite.
Scapolite.
Sodalite.
Tourmaline (shorl).
Titanite (sphene).

HYDROUS SILICATES.

Laumontite.
Natrolite.
Alalcite.
Chabazite.
Stilbite.
Kaolin.

PHOSPHATES.

Apatite.

CARBONATES.

Ankerite.
Siderite.

As these are all fully described in the numerous works on mineralogy it is not deemed necessary to enter into any elaborate discussion of their properties here, excepting in the case of those few which from their abundance, or from other causes, have a pronounced effect upon the rocks in which they occur.

QUARTZ.—*Chemical composition* : Pure silica, SiO_2 . Hardness, 7.*

This is one of the commonest minerals of the earth's crust, and is an essential constituent of granite, gneiss, mica schist, quartz porphyry, liparite, quartzite, and ordinary sandstone, occurring in the form of crystals, crystalline grains, and fragments of crystals. It is usually easily recognized by its clear, colorless appearance, irregular, glass-like fracture, hardness, and entire insolubility in acids. Its hardness is such that it scratches glass, and in this respect alone it differs from any other of the essential constituents. It is, however, brittle, and hence, though the hardest mineral, is by no means the most refractory; stones like granite, which are rich in quartz, working more easily than the trap rocks, in which it is, as a rule, entirely lacking.

Although ordinarily one of the most indestructible of minerals, and infusible in the hottest flame of the blow-pipe, yet highly quartzose rocks like granite are by no means fire-proof, but scale badly when subjected to the heat of a burning building. This peculiar susceptibility of the rock to heat is thought by some to be due to the microscopic fluidal cavities which exist in the quartz, and which are at times exceeding abundant.

THE FELDSPARS. Hardness, 5 to 7.

The feldspars are essentially silicates containing alumina together with potash, soda, or lime. There are six varieties that are common constituents of building stones, viz, orthoclase, microcline, albite, oligoclase, labradorite, and anorthite. Of these, albite, oligoclase, labradorite, and anorthite are usually indistinguishable from one another by the eye alone, especially in fine-grained rocks, and are therefore designated by the convenient term *plagioclase feldspars* or simply *plagioclase*. Orthoclase is the prevailing feldspar and most important constituent in granites and gneisses, and is usually accompanied by albite

* For convenience in determining minerals the "scale of hardness" given below has been adopted by mineralogists. By means of it one is enabled to designate the comparative hardness of minerals with ease and definiteness. Thus, in saying that serpentine has a hardness equal to 4 is meant that it is of the same hardness as the mineral fluorite, and can therefore be cut with a knife or other tool, but less readily than calcite or marble.

1. *Talc*.—Easily scratched by the thumb-nail.
2. *Gypsum*.—Can be scratched by the thumb-nail.
3. *Calcite*.—Not readily scratched by the thumb-nail, but easily cut with a knife.
4. *Fluorite*.—Can be cut with a knife, but less easily than calcite.
5. *Apatite*.—Can be cut with a knife, but only with difficulty.
6. *Orthoclase feldspar*.—Can be cut with a knife only with great difficulty and on thin edges.
7. *Quartz*.—Can not be cut with a knife; scratches glass.

or oligoclase, or frequently microcline. Anorthite and labradorite are equally important constituents of basic eruptive rocks, such as diabase, basalt, and andesite.

The physical condition of the feldspar in a building stone is a matter of the greatest importance. In those rocks which withstand the effect of the weather through long periods of years without change or disintegration, the feldspars, if examined with a microscope, will be found hard, compact, and fresh, containing but few cavities or impurities. On the other hand, the feldspars of many rocks, if thus examined, will be found filled with minute cavities and flaws which are often so filled with impurities and products of decomposition as to be quite opaque (Hawes). Such rocks will not for any length of time withstand the weather, since infiltrating waters containing minute quantities of carbonic and other acids, aided by heat and frost, can not fail to produce the dire result of disintegration.

The feldspars have also an important influence upon the cutting of a stone. The hardness and toughness of many granites and other crystalline siliceous rocks are due, not to the hard and brittle quartz, but to the feldspathic constituent, which is quite variable. The soft granites consist of the same constituents, but the feldspars are porous and therefore offer less resistance to the cutting tool. The feldspars also possess a distinct cleavage, that is, they split or cleave in one or two directions much more readily than in others. It therefore, sometimes happens, especially in coarse-grained and porphyritic rocks, that it is very difficult to obtain the perfect surface necessary for polishing, since little particles of the feldspars are constantly splitting out, leaving small cavities or "nicks."

The color of a rock frequently depends largely upon its feldspathic constituent. If the feldspar be clear, transparent, and glassy, the light enters it and is absorbed, giving to the stone a dark color, as is the case with the Quincy granites and many quartz porphyries and diabases. If the feldspar is soft and porous, the light is reflected from the surface and the rock appears white. In all the pink and red granites and gneisses the color is due to the pink and red orthoclase they contain. It sometimes happens that the orthoclase and plagioclase—when both are present in the same rock—are differently colored, the orthoclase being pink or red, while the plagioclase is nearly white.

THE MICAS. Hardness 2.5 to 3.

Two kinds of mica occur as prominent constituents of building stones, especially the granites and gneisses.

These are black mica or biotite, and white mica or muscovite. Both kinds occur in small shining scales which are sometimes hexagonal in outline, though more frequently of quite irregular form.

The composition of the micas is complex, but the black variety is essentially a silicate of iron, alumina, magnesia, and potash, while the

white variety is a silicate of alumina and potash with small amounts of iron, soda, magnesia, and water.

The kind, amount, and disposition of mica in a building stone has a very important bearing upon its working and weathering qualities as well as general fitness for architectural purposes. If it occurs in any abundance and the folia are arranged in parallel layers the rock splits much more readily in a direction parallel to the mica laminae than in that at right angles to them. Mica is itself moreover "soft and fissile, and hence is an element of weakness." It also receives a polish only with difficulty and which is soon lost upon exposure to the weather. Black mica, moreover, owing to its large percentage of iron, is liable to succumb to atmospheric agencies.*

The finest grades of building stone should contain mica only in small flakes, and these evenly distributed throughout the mass of the rock.

From the marked contrast in color of the two micas it follows that they have a decided influence upon the color of the rock containing them. Folia of black mica in any abundance naturally give the rock a dark-gray hue, while the white mica, being nearly colorless, has a neutral effect. Hence, other things being equal, muscovite granites are much lighter in color than those in which biotite is the characterizing accessory.

Other micas common in such stone as are used for building are lepidomelane and phlogopite. The first of these is black in color and closely resembles biotite, from which, however, it differs in containing smaller proportions of the protoxide of iron and in the folia being opaque and inelastic. For all practical purposes this mica is, however, identical with biotite, and no distinction has been attempted in the present work. Phlogopite is colorless like muscovite, from which it can often be distinguished only with difficulty. It is a common constituent of many limestones, dolomites, and serpentinous rocks.

AMPHIBOLE. *Hornblende.* Hardness, 5 to 6.

Two principal varieties of this mineral are recognized: (1) The non-aluminous, including the white, gray, and pale green, often fibrous forms as tremolite, actinolite and asbestos, and (2) the aluminous, which includes the dark-green, brown, and black varieties. The aluminous variety, common hornblende, is an original and essential constituent of diorite, and of many varieties of granite, gneiss, syenite, schist, andesite and trachyte, and is also present as a secondary constituent in many rocks, resulting from the molecular alteration of the augite. The

* Dr. P. Schweitzer while studying the superficial decomposition of the gneiss of New York Island, discovered that the black mica, after getting first coated with a brown film of oxide of iron, "rapidly disintegrated and disappeared," while the white mica possessing greater powers of endurance remains fresh and intact.—Chem. News, IV, 1874, p. 444.

The same phenomena may be noticed in the mica schists about Washington, D. C.

non-aluminous varieties occur in gneiss, crystalline limestone, and other metamorphic rocks.

The hornblende in such rocks as are used for building purposes can be readily recognized by its dark-green or almost black color and the compactness and tenacity of its crystals which are not easily separable into thin leaves or folia as is black mica, with which it might otherwise be confounded. Hornblende acquires readily a good and lasting polish and as the mineral itself is strong and durable, its presence in a rock is thought to be preferable to that of mica.

THE PYROXENES. Hardness, 5 to 6.

Two principal varieties of this mineral are recognized, as with the amphiboles, (1) the non-aluminous, including the light-colored varieties malacolite, sahlite, and diallage, and (2) the aluminous, including the dark variety, augite.

The lighter-colored non-aluminous varieties, malacolite and sahlite, are common in mica and hornblende schists, gneiss, and granite, though seldom in sufficient abundance to be noticeable to the naked eye. The foliated variety, diallage, is an essential constituent of the rock gabbro, and is also common in serpentine. The darker-colored aluminous variety, augite, is an essential constituent of diabase and basalt, and also occurs in many syenites, andesites, and other eruptive rocks.

In such rocks as are used for building purposes the pyroxene can not usually be distinguished by the unaided eye from hornblende. With the exception of the Quincy granites and the New Castle, Del., gneisses, pyroxenes do not occur in any of our granitic rocks now quarried, but in the diabases and basalts the augite is a very important constituent. It is usually a compact and tough yellowish-green or nearly black mineral, and, like hornblende, readily acquires a good and lasting polish. The pyroxene of the Quincy granite, however, proves an exceptionally brittle variety, and the continual breaking away of little pieces during the process of dressing the stone makes the production of a perfectly smooth surface a matter of great difficulty.

CALCITE. *Calc-spar.*—*Composition:* Calcium carbonate, CaCO_3 = carbon dioxide, 44 per cent.; lime, 56 per cent. Hardness, 3.

This is an original constituent of many rocks, such as limestone, ophiolite, and calcareous shale, and is the essential constituent of most marbles, of stalactites, travertine, and calc-sinter. It also occurs as a secondary constituent resulting from the decomposition of other minerals, filling wholly, or in part, cavities in rocks of all ages, such as granite, gneiss, syenite, diabase, diorite, liparite, trachyte, andesite, and basalt.

Calcite when pure is white in color, and soft enough to be cut with a knife. It can be readily distinguished from other minerals (excepting aragonite) by its brisk effervescence when treated with a dilute acid.

ARAGONITE.—*Composition*: Same as calcite. Hardness, 3.5 to 4.

This mineral has the same chemical composition as calcite, but differs in its crystalline form and specific gravity. It sometimes occurs in deposits of sufficient extent to be quarried as marble. The beautiful "onyx marble" of San Luis Obispo is nearly pure aragonite.

DOLOMITE.—*Composition*: $(\text{CaMg})\text{CO}_3 = \text{Calcium carbonate}$, 54.35 per cent.; magnesium carbonate, 45.65 per cent. Hardness, 3.2 to 4.

This mineral closely resembles calcite, but can be readily distinguished from the same by its greater hardness and from its being acted upon but little, if at all, by a dilute acid. Like calcite, it frequently occurs in compact crystalline massive forms, and is quarried for building material or for making lime. Many of our marbles are dolomites, as for instance those of Cockeysville, Md., and Pleasantville, N. Y.

GYPSUM. Calcium Sulphate.—*Composition*: $\text{CaSO}_4 + 2\text{aq} = \text{sulphur trioxide}$, 46.5 per cent.; lime, 32.6 per cent.; water, 20.9 per cent. Hardness, 2.

Gypsum rarely occurs in crystalline rocks, but forms extensive beds among stratified rocks such as limestones and beds of clay. The fine translucent variety is used for ornamental purposes, and is known as alabaster. It is soft enough to be readily cut with a knife or scratched with the thumb-nail, and it is not at all acted on by acids. It is therefore readily distinguished from calcite, which it somewhat resembles.

SERPENTINE.—*Composition*: A hydrous silicate of magnesia, $\text{Mg}_3\text{Si}_2\text{O}_7 + 2\text{aq} = \text{silica}$, 43.48 per cent.; magnesia, 43.48 per cent.; water, 13.04 per cent. Hardness, 4.

This mineral occurs mixed with calcite or dolomite, forming the so-called verdantique marble or ophiolite. As a secondary product it is sometimes found resulting from the alteration of olivine and other magnesian minerals in various eruptive rocks, such as basalt, diabase, dunite, and lherzolite. It often occurs in extensive deposits, usually mixed with more or less chromite, magnetite, enstatite, or similar minerals, and is of value as a building or ornamental stone, as will be noticed later.

Serpentine can usually be recognized from its green or yellowish color, slightly soapy feeling, lack of cleavage, and softness, it being readily cut with a knife. It is, however, not so soft as talc, with which it might possibly be confounded by any but a mineralogist.

TALC. Steatite.—*Composition*: A hydrous silicate of magnesia = silica, 63.49 per cent.; magnesia, 31.75 per cent.; water, 4.76 per cent. Hardness, 1.

This is a common mineral, occurring as an essential constituent of talc schist or as an alteration product, replacing hornblende, augite, mica, and other magnesian minerals. The common form is that of small, greenish, inelastic scales. It often occurs massive, and is known by the name of soapstone, and is used extensively in stoves and furnaces. The finely granular crypto-crystalline variety is known as *French chalk*, used by tailors and others. In its common form this mineral might be mistaken for a mica, but for its soapy feeling and softness, which is such that it can be readily scratched by the thumb-nail.

OLIVINE. *Chrysolite. Peridot.*—*Composition*: Silicate of lime and magnesia. *Hardness*, 6 to 7.

Olivine is an essential constituent of **basalt, dunite, limburgite, hornblende, and picrite**, and is a prominent ingredient of many lavas, diabases, gabbros, and other igneous rocks, where it occurs in the form of rounded blebs of a bottle-green color. It also occurs occasionally in metamorphic rocks and is a constituent of many meteorites. Olivine is subject to extensive alteration, becoming **changed** into serpentine. Many beds of serpentine result entirely from the alteration of **olivine-bearing rocks**.

GARNET.—*Composition*: Variable; essentially a silicate of alumina, lime, iron, or magnesia. *Hardness*, 6.5 to 7.5.

This mineral is an abundant accessory in mica schist, gneiss, granite, crystalline limestone, and occasionally in serpentine, volcanic tuff, and lava.

The presence of garnets in stones designed for finely finished work is always detrimental, since, owing to their brittleness and hardness, they break away from the stone in the process of dressing and render the production of smooth surfaces a matter of difficulty. Those garnets which are found in such stone as are used for building are nearly always of a red color and rounded form.

EPIDOTE.—*Composition*: Silica, 37.83 per cent.; alumina, 22.63 per cent.; iron oxides, 15.98 per cent.; lime, 23.27 per cent.; water 2.05 per cent. *Hardness*, 6 to 7.

This mineral is a common constituent of many granites, gneisses, and schists, especially the hornblendic varieties. It is also found as a secondary constituent in the amygdaloidal cavities of many trap rocks, and is readily recognizable from its green color. Although a common constituent in small proportions of many rocks, those cases in which it is sufficiently abundant to give them a specific character are extremely rare. Certain of the New Hampshire and Massachusetts granites contain it in such quantities as to be recognizable as greenish specks on a polished surface, as does also the melaphyr quarried at Brighton, in the latter State.

CHLORITE. *Viridite.*—*Hardness*, 2 to 3.

Under the general name chlorite are included several minerals occurring in fibers and folia, closely resembling the micas, from which they differ in their large percentage of water, and in their folia being inelastic. The three principal varieties recognized are ripidolite, penninite, and prochlorite, any one of which may occur as the essential constituent of a chlorite schist. Chlorite as a secondary product often results from and entirely replaces the pyroxene, hornblende, or mica in rocks of various kinds, and also occurs filling wholly or in part the amygdaloidal cavities of trap rocks. In this form it is frequently visible only with the microscope, and owing to the difficulties in the way of an exact determination of its mineral species is called *viridite*, from the Latin

viridis, green, this being its usual color. The characteristic greenness which gave the name *greenstone* to the diorites and diabases is due in large part to the secondary chlorite contained by them.

IRON PYRITES.—*Composition*: Iron disulphide, FeS_2 = sulphur, 53.3 per cent.; iron, 46.7 per cent. *Hardness*, 6 to 6.5.

A very common accessory in rocks of all kinds and all ages, usually occurring in small cubes or irregular masses of a brassy yellow color.

It may be set down as a rule that rocks containing this mineral should not be used for ornamental work that is to be exposed to the weather, since it is very liable to oxidation in time, staining the stone and perhaps causing the more serious result of disintegration. This form of the iron disulphide is, however, less objectionable than that known as *marcasite* or the gray iron pyrites.

For some unexplained reason this form of the mineral decomposes even more readily than the pyrite, and hence its presence is always to be avoided in all rocks where permanency of color or durability is desired.

A microscopic study of pyrite-bearing rocks has shown that there are many important considerations bearing upon the weathering properties of this mineral. Thus it is found, as in many of the Ohio limestones and dolomites, occurring not only in well-defined cubes of a brassy yellow color, but also in an amorphous granular condition in a very fine state of subdivision which appears almost black under the microscope. Experience has shown that in the latter form it is much more liable to oxidation than when in cubes, and hence we see the necessity of a microscopic examination of a stone as one of the guides to its probable weathering qualities. In this finely amorphous condition the pyrite is stated by Hawes to have an important effect upon the color of the stone. Thus the Springfield and Covington (Ohio) dolomites present in different layers two well-defined colors—a blue and a yellow. An examination with the microscope shows that they differ only in that the blue variety contains the pyrite in the finely disseminated unoxidized state, while in the yellow it has become changed into the hydrous oxide. This change having taken place while the stone lies in the quarry, is unaccompanied by results of a serious nature, unless the uniform change in color be so considered. Had the change taken place in the quarried stone after being laid in the walls of a building, the results would in all probability have proved more undesirable. Pyrite when imbedded firmly in rocks of a close, compact nature is less liable to oxidation than when contained in one of a loose and porous texture. In the magnesian limestones of Dayton, Ohio, the microscope reveals many minute cubes of pyrite which are imbedded so firmly in its mass as to be not at all deleterious, since beyond the reach of atmospheric agencies. In many close-textured rocks, as the slates, pyrite is proverbially long-lived, and hence as a rule we can only regard it with suspicion, as an

ingredient whose presence can result in little that is good and perhaps a great deal that is bad. It should be noted that pyrite on decomposing, may give rise to sulphates and perhaps to free sulphuric acid, which in themselves aid in the work of disintegration.

"In limestones or dolomites the presence of iron pyrites operates disastrously; for, if magnesia be present, the sulphuric acid from the decomposing iron pyrites produces a soluble efflorescent salt, which exudes to the surface and forms white patches, which are alternately washed off and replaced, but leaving a whitened surface probably from the presence of sulphate of lime. If the limestone be entirely calcareous, the salt formed (a sulphate of lime) is insoluble, and therefore produces less obvious results. In some cases, however, the lime of which the mortar or cement is made may contain magnesia, and the decomposition of the iron pyrites in the adjacent stone produces an efflorescent salt which exudes from the joints. This condition is not unfrequently observed in buildings constructed of the bluestone of the Hudson River group. As an example, we may notice the efflorescent patches proceeding from some of the joints between the stones of St. Peter's Church, on State street, in Albany."*

MAGNETITE. Magnetic Iron Ore.—*Composition*: $\text{FeO} + \text{Fe}_2\text{O}_3$ = iron sesquioxide, 68.97 per cent.; iron protoxide, 31.03 per cent. Hardness, 5.5 to 6.5.

This occurs as an original constituent in many schists and granites; in the latter usually in minute crystals visible only with the microscope. It is almost invariably present in igneous rocks such as diorite, diabase, and basalt. When present in considerable quantities it sometimes becomes converted entirely into the sesquioxide of iron through taking oxygen from the atmosphere. It then stains the rock a rusty red color, as is observable in many diabases.

HEMATITE. Specular Iron Ore.—*Chemical composition*: Anhydrous sesquioxide of iron, Fe_2O_3 , = iron, 70.9 per cent.; oxygen, 30.20 per cent.

This mineral occurs in varying proportions in rocks of all ages. In granite it usually occurs as minute scales of a blood-red color. In the amorphous form it often forms the cementing material of sandstones, when it imparts to them a red or reddish-brown color. This form of iron oxide is, however, less common as a cementing substance than the hydrous sesquioxides *turgite* and *limonite*, which are the forms occurring in the Triassic sandstones of the eastern United States.†

* Hall. Report on Building Stone, p. 50. The white efflorescence so frequently seen on stone and brick buildings, seems, according to good authorities, to be, in most cases, due to the mortar in which the stone is laid, and is not an inherent quality of the stone itself. The subject is, therefore, not more fully dwelt upon in the present work.

† Julien, Proc A. A. S., 1878.

C.—PHYSICAL AND CHEMICAL PROPERTIES OF ROCKS.

A little ~~space may be well~~ devoted here to a consideration of those properties of rocks which can be grouped under the heads of density, hardness, and structure, together with notes on their color and chemical composition.

(1) DENSITY AND HARDNESS.

Density.—This is an important property, since upon it are dependent to a large extent the weight per cubic foot, the strength, and the absorptive powers of the stone. Among rocks of the same mineral composition, those which are the densest will be found heaviest, least absorptive, and usually the strongest.

To ascertain the weight of a rock it is customary to compare its weight with that of an equal bulk of distilled water, in other words to ascertain its specific gravity. The specific gravity multiplied by 62.5 pounds (the weight of a cubic foot of water) will thus give the weight per cubic foot of stone. The weights given in the tables have been thus computed. (See p. 494.)

Hardness.—The apparent hardness of a rock is dependent upon (1) the hardness of its component minerals and (2) their state of aggregation. However hard the minerals of a rock may be, it appears soft and works readily if the particles adhere with slight tenacity. Many of the softest sandstones are composed of the hard mineral quartz, but the grains fall apart so readily that the stone is as a whole soft. (See under State of Aggregation.)

(2) STRUCTURE.

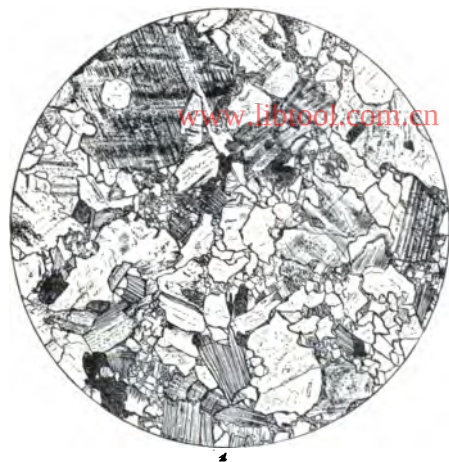
Under this head are considered those characters of rocks which are dependent upon the form, size, and arrangement of their component minerals.

All rocks may be classified sufficiently close for present purposes under one of the three heads (1) crystalline, (2) vitreous or glassy, and (3) fragmental. Of the first, granite and crystalline limestone may be considered as types; of the second, obsidian and pitchstone, and of the third, sandstone. Many structural properties are common to all, others are confined to rocks of a single type. Accordingly as the structure is or is not readily recognizable by the unaided eye, we have:

(1) *Macroscopic structure, or structure which is distinguishable in the hand specimen and without the aid of a microscope.*—Under this head are comprehended structures designated by such names as *granular, massive, stratified, foliated, porphyritic, concretionary*, etc.; terms whose precise meaning is given in the glossary, and which, with perhaps one or two exceptions, need not be further considered here; and

(2) *Microscopic structures.*—Many rocks are so fine grained and compact that nothing of their mineral nature or structure can be learned from study with the eye alone, and recourse must be had to the micro-

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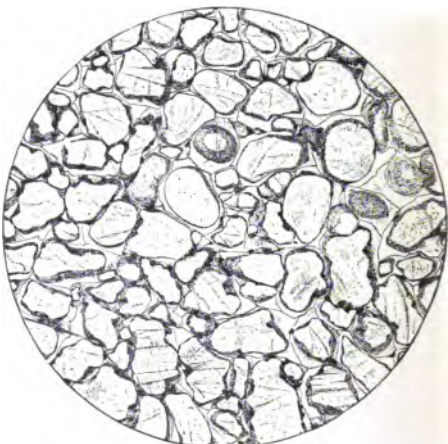
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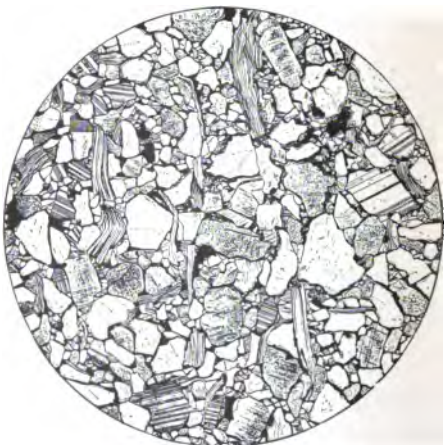


5



C.B. Hudson

3



6

SHOWING THE MICROSCOPIC STRUCTURE OF ROCKS.

scope. In such cases it is customary among lithologists to grind a small chip of the rock so thin as to be transparent, and then, when properly mounted in Canada balsam, to submit it to microscopic study. By this method many important points of structure and composition are brought out that would otherwise be unattainable. The physical condition of the minerals of a rock, their freedom from decomposition, and methods of arrangement can often only be ascertained by this method. By it the presence of many minute and perhaps important ingredients is made known whose presence would otherwise be unsuspected. This subject is further treated under the head of Rock-forming minerals and the descriptions of the various kinds of rocks.

In Fig. 1 of Pl. II is shown the structure of the muscovite biotite granite of Hallowell, Me., drawn as are the other figures on this plate from thin sections and under a magnifying power of about twenty-five diameters. This is a granite of quite complex structure, consisting of (1) orthoclase, (2) microcline, (3) plagioclase, (4) quartz, (5) black mica, or biotite, and (6) white mica or muscovite. There are also little needles of apatite, scattering grains of magnetite, and occasionally small garnets present, which, however, do not show in the figure. The quartz, moreover, is pierced in every direction by minute hair-like crystals which are supposed to be rutile. The structure, as in all granites and gneisses, is crystalline throughout, as in the marbles (Fig. 3) and diabase (Fig. 4). The crystals are, however, very imperfect in outline, owing to mutual interference in process of formation. Although the rock contains a very large proportion of the hard minerals quartz and feldspar, these do not interlock so thoroughly as do the augite and feldspars in the diabase. As, moreover, quartz is a brittle substance, these rocks work much more readily and will crush under less pressure than those of which Fig. 4 is a type.

In Fig. 2 of the same plate is shown the structure of an oolitic limestone from Princeton, in Caldwell County, Kentucky. It will be noticed that the first step in the formation of this stone was the deposition of concentric coating of lime about a nucleus which is sometimes nearly round, but more frequently quite angular and irregular. After the concretions were completed there were formed in all cases about each one narrow zones of minute radiating crystals of clear, colorless calcite; then the larger crystals formed in the interstices. An examination of the section in polarized light shows that while the concentric portions are nearly always amorphous the nuclei (and always the interstitial matter) is frequently crystalline. The nuclei are composed in some cases of single fragments or, again, of a group of fragments. Certain of the oolites present no distinct concentric structure, but appear as mere rounded masses merging gradually into the crystalline interstitial portions. On the application of acetic acid to an uncovered slide of this rock a brisk effervescence at once set in, which, when the slide was again placed on the stage of the microscope, was seen not to arise from all

portions of the slide alike, but to be confined almost exclusively to the outer non-crystalline portions of the oolites, so that in time these almost completely disappeared, leaving the crystalline nuclei and cementing material till the very last. Some of the outlines thus left are peculiarly deceptive, having almost the appearance of a cross-section of coral or a crinoid stem. This structure is common, so far as I have observed, to all the oolitic limestones of both Kentucky and Indiana. In the weathering of these stones then we would have produced an effect precisely the opposite of that produced in fragmental siliceous rocks. In the latter case the cement is removed and the grains themselves are but slightly acted upon; in the former, the grains themselves disappear and the cementing material remains.

It should be remarked, however, that we have as yet no proof that the action of an acid atmosphere on one of these oolites would proceed with other than extreme slowness. In fact, their compactness, freedom from cleavage, fractures, and flaws would seem to indicate just the contrary. Further investigations on this point are necessary before one can speak definitely.

The microscopic structure of ordinary white crystalline limestone is shown in Fig. 3, drawn from a magnified section of a West Rutland marble. The entire mass of the rock, it will be observed, is made up of small calcite crystals of quite uniform size closely locked together, and with no appreciable interspaces. The dark stripes across the crystals are caused by twin lamellæ and cleavage lines. All traces of its fossil origin, if such it had, have been obliterated by metamorphism.

Fig. 4 is that of a diabase from Weehawken, N. J. The elongated, nearly colorless crystals, shaded with long parallel lines, are a plagioclase feldspar, the very irregular ones augite, while the perfectly black and opaque are magnetite. The figure is, however, given to show the structure rather than the mineral composition of the rock. It will be noticed that every portion of available space is occupied, there being no residual spaces to be filled by cement, as in the sandstone; also that the feldspars and augites so closely interlock that they can not be forced apart without breaking. As both of these minerals are quite tough and hard, the great strength, durability, and hard-working qualities of the rock can readily be understood, although the constituents themselves are not harder than those that go to make up some of the most friable sandstones.

As showing the differences in structure and composition of the sandstones, Figs. 5 and 6 are given, drawn from thin sections of the brown Triassic stone from Portland, Conn., and a reddish Potsdam stone from quarries in the town of Potsdam, N. Y. In the first mentioned, Fig. 6, the stone, it will be noticed, is composed of (1) clear, angular grains of quartz, (2) clouded grains of orthoclase and plagioclase, the latter being recognized by its parallel banding, and numerous irregular and contorted shreds of black and white mica. These are all crowded into a

loosely compacted mass and the interstices filled by a cement composed of an amorphous mixture of iron oxides, carbonate of lime, and clayey matter. These are represented in black in the figure. It will be observed that only the quartzes and a few of the feldspars are in a fresh and undecomposed condition, nearly all of the latter being badly kaolinized. The Potsdam stone (Fig. 5) shows, however, a markedly different structure. Here the granules are wholly of quartz, and very much rounded in form. No feldspars, mica, or other minerals are present. The original rounded outline of the quartz granule is shown by the dotted lines and deeply shaded portions, while every portion of the interstices is occupied by a clear, colorless, siliceous cement binding the rock into a hard, compact, and impervious quartzite almost absolutely unaffected by chemical and atmospheric agencies.*

The cause of the wide variation in relative durability of stones of these two types becomes now at once apparent. In the first case the abundant amorphous cement is not only slightly soluble, and liable to partial removal by the water from rains, but it also facilitates the absorption of a proportionally large amount of moisture. On being subjected to repeated freezing and thawing while in this saturated condition, the grains gradually become loosened and the characteristic scaling results. Stones of the Potsdam type, on the other hand, are practically non-absorptive and insoluble, and are susceptible to no other natural influences than the constant expansion and contraction caused by changes in temperature. They are consequently vastly more durable. Unfortunately they are also much harder, and hence can be utilized only at greatly increased expense.

(3) STATE OF AGGREGATION.

This is one of the most important properties of building-stone, since is dependent upon it very largely the hardness or softness of a rock and its consequent working qualities. Many rocks composed of hard

* This rock shows to beautiful advantage the secondary enlargement of quartz granules by deposition of interstitial silica having the same crystallographic orientation as the granules themselves, a peculiarity first noted by the Swedish geologist Tornebohm, later by Sorby (*Quar. Jour. Geol. Soc.*, 1880, p. 58), and since described in great detail in American rocks by Irving and Van Hise, (*Am. Jour. of Sci.*, June, 1883; also *Bull. No. 8, U. S. Geol. Survey*). I may say further here that the red and brown colors of our Triassic sandstones seem to be due not merely to the thin pellicle of iron oxides with which each granule is surrounded, but the feldspathic grains—often badly decomposed—are stained throughout by the same material, and which also occurs mixed with clayey, calcareous and silicious matter forming the cement. This is never the case, so far as I have observed, in the Potsdam stones, in which the oxide occurs only as a thin coating around each granule, as shown by the shaded portions in Fig 5. My own experience, also, is to the effect that the fragments, of which the Triassic stones are composed, are much less rounded by attrition than seems ordinarily supposed, or as they are represented when figured. Fig. 4 is very typical of the Portland stone, but it does not in the least resemble that given in Fig. 6, Plate XII, *Lith. & Min. of New Hampshire*. Naturally, however, samples selected from different beds, or from different localities, will be found to vary greatly.

materials work readily because their grains are but loosely coherent, while others of softer materials are quite tough and difficult to work owing to the tenacity with which their particles adhere to one another. Obviously a stone in which the grains adhere closely and strongly one to another will be less absorbent and more durable under pressure than one which is loose textured and friable. A rock is called *flinty* when fine grained and closely compacted like flint; *earthy* when partially decomposed into earth or loam; *friable* when it falls easily into powder or crumbles readily under the tool. Upon the state of aggregation and the fineness of the grain is dependent very largely the kind of fracture possessed by a rock. Fine grained, compact rocks like flint, obsidian, and some limestones, break with concave and convex shell like surfaces, forming a conchoidal fracture; such stone are called *plucky* by the workmen and they are often quite difficult to dress on this account. Others break with a rough and jagged surface called *hackly* or *splintery*. When as in free-working sandstone and granite the broken surface is quite straight and free from inequalities they are referred to as having a *straight* or *right* fracture.

(4) RIFT AND GRAIN.

The rift of a rock is the direction parallel to its foliation or bedding and along which it can usually be relied upon to split with greatest ease. It is best represented in mica schist, gneiss, and other rocks of sedimentary origin. It is a property, however, common to massive rocks, though usually much less pronounced. The *grain* is always in a direction at right angles with the rift.

These are two most important qualities in any stone that it is desired to work into blocks of any regularity of shape. Without them the production of rough blocks for street paving or for finely finished work would be possible only with greatly increased expense, and only the very softest stones could be worked with any degree of economy. With them the hardest rocks are sometimes most readily worked. Thus the Sioux Falls (Dak.) quartzite, one of the hardest known rocks, is as readily broken out into square blocks for paving as a granite or soft sandstone.

(5) COLOR.

The color of a stone is as a rule dependent more upon its chemical than its physical properties. As will be noted, however, the color of the granites and similar rocks is sometimes varied in shades of light and dark accordingly as the feldspar are clear and glassy and absorb the light or white and opaque and reflect it. The chief coloring matter in rocks is iron, which exists either in chemical combination with the various minerals or in some of its simpler compounds such as the sulphide, carbonate, or oxide disseminated in minute particles throughout the mass of the rock. The oxides of iron impart a brownish or reddish hue, the carbonate or sulphide a bluish or gray. A very light or nearly white

color denotes the absence of iron in any of its forms. On the condition of the iron is dependent also the permanency of color. Either the sulphide, carbonate or other protoxide compounds, are liable to oxidation, and hence stones containing it in these forms fade or turn yellowish and stain on exposure. The sesquioxide on the other hand can undergo no further oxidation, and hence the color caused by it is the most durable. Hence, as a rule, the decidedly red colors may be considered most permanent.

The blue and black colors of marbles and limestones are due largely to carbonaceous matter.

The effects of the various mineral constituents in varying the shades of colors are mentioned in the chapter on rock-forming minerals and in the descriptions of the different kinds of stones. Great care and judgment is needed in the selection of proper colors in building. Heavy rock-faced walls of dull brown sandstone, dark gneiss, or diabase always impart an appearance of gloom, while warm, bright colors are cheering and pleasing to the eye. The late Architect Richardson, without doubt, owed a considerable share of his success to his power of selecting for any particular piece of work stone of such color as to be most effective and harmonious in the finished structure.

(6) THE CHEMICAL CHARACTERS OF ROCKS.

This naturally varies with the mineral composition and their ever-varying proportions. Nevertheless, it is possible to obtain general averages from which the stones of each particular kind will not be found to vary widely. It is customary to consider rocks which, like granite, are rich in silica as *acidic*, while those in which, as in basalt, the average percentage falls below fifty are called *basic*. Various descriptive adjectives are applied to the names of rocks according as they vary in composition. *Calcareous* rocks consist principally of lime, or contain an appreciable amount; *argillaceous* contain clay, which can usually be recognized by its odor when breathed upon; *siliceous* contain some form of silica; *ferruginous*, iron in the form of oxide; *carbonaceous*, more or less carbon; *bituminous* contain bitumen, which can often be detected by the odor of petroleum given off when the rock is freshly broken. Calcareous rocks can always be detected from their effervescing when treated with a dilute acid. The chemical composition of a stone is often a guide to its suitability for structural purposes. Those containing much lime are more liable to be unfavorably affected by the acid gases of cities, and the various forms of iron present are of importance both regarding the weathering properties of the stones and their colors, as will be noticed later under special cases. A table of rock compositions is to be found near the close of this volume.

D.—ROCK CLASSIFICATION.

The rocks now in use for constructive purposes may be classified sufficiently close for present purposes under the following heads:

A.—CRYSTALLINE AND VITREOUS.

I.—Simple Rocks.

- 1) Silicates :
 - (a) Talc (including Steatite and Soapstone).
 - (b) Serpentine. (In part.)
- (2) Sulphates :
 - (a) Gypsum (including Alabaster and Satin Spar).
- (3) Carbonates :
 - (a) Limestone and Dolomites.

II.—Compound Rocks.

- (1) Massive, with Quartz and Orthoclase; acidic:
 - (a) Granites and Granite Porphyries.
 - (b) Quartz Porphyries.
 - (c) Liparites.
- (2) Massive, without Quartz:
 - (a) Syenite.
 - (b) Quartz-free Orthoclase Porphyries.
 - (c) Trachytes and Phonolites.

(3) Plagioclase rocks; basic:

- (a) Diorites and Diorite Porphyrites.
- (b) Diabases, Gabbros, Melaphyres, and Basalts.
- (c) The Andesites:
- (4) Rocks without feldspars:
 - (a) The Peridotites. (Serpentines in part.)
- (5) Schistose or foliated rocks:
 - (a) Gneiss (included here with the Granites).
 - (b) The Schists.

B.—FRAGMENTAL.

- (a) The Psammites, including Sandstone, Conglomerate, Breccia, and Graywacke.
- (b) Pelites including Clayslates and Pipe-clay.
- (c) Volcanic fragmental rocks, Tuffs.
- (d) Fragmental rocks of organic origin (included here under the head of Limestones).

The order in which the rocks are mentioned above will be adhered to in the descriptions given in the following pages. For the benefit of those not familiar with the order of succession of the various rock formations in the earth's crust, the following table is also given :

E.—GEOLOGICAL RECORD;

OR

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ORDER OF SUCCESSION OF THE ROCKS COMPOSING THE EARTH'S CRUST.

Quaternary, or Post-tertiary.	The age of Man.	{ Recent, or Terrace. Champlain. Glacial, or Drift.
Tertiary, or Ceno- zoic.	Age of Mammals.	Tertiary.
		{ Pliocene. Miocene. Eocene.
Secondary, or Mesozoic.	Age of Reptiles.	Cretaceous.
	Age of Reptiles.	Jurassic.
	Age of Reptiles.	Triassic.
Primary, or Paleozoic time.	Devonian, or age Carbonifer- ous age.	Permian.
	Devonian, or age Carbonifer- ous age.	Carboniferous.
	Devonian, or age Carbonifer- ous age.	Subcarboniferous.
	Devonian, or age Carbonifer- ous age.	Catakill.
	Devonian, or age Carbonifer- ous age.	Chemung.
	Devonian, or age Carbonifer- ous age.	Hamilton.
	Devonian, or age Carbonifer- ous age.	Corniferous.
	Devonian, or age Carbonifer- ous age.	Oriskany.
	Devonian, or age Carbonifer- ous age.	Lower Helderberg.
	Devonian, or age Carbonifer- ous age.	Salina.
	Devonian, or age Carbonifer- ous age.	Niagara.
	Devonian, or age Carbonifer- ous age.	Trenton.
	Devonian, or age Carbonifer- ous age.	Canadian.
	Devonian, or age Carbonifer- ous age.	Upper.
	Devonian, or age Carbonifer- ous age.	Middle.
	Devonian, or age Carbonifer- ous age.	Lower.
		Archæan, Pre-Cambrian

F.—METHODS OF QUARRYING AND DRESSING.

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(1) JOINTS IN ROCKS AND THEIR UTILITY IN QUARRYING.

All rocks, whatever their origin, are traversed by one or more systems of natural seams or cracks, called joints. These vary greatly, according to the nature of the rock in which they occur, sometimes being so fine as to be almost imperceptible, or again perfectly distinct and capable of being traced for many yards, or even miles. In stratified rocks (limestones, sandstones, schists, etc.), according to Professor Geikie, the joints, "as a rule," run perpendicular, or approximately so, to the planes of bedding, and descend vertically at not very unequal distances, so that the portions of the rock between them, when seen from a distance, appear like so many wall-like masses. An important feature of these joints, as mentioned by this authority, is the direction in which they intersect each other. In general they have two dominant trends, one coincident on the whole with the direction in which the strata are inclined from the horizon, and the other running transversely at a right angle, or nearly so. The first are called "dip joints" or "end joints" by the quarrymen, since they run with the dip or inclination of the rock, while the last are called "strike joints," since they conform in direction to the strike of the rock. These last are also called "back joints."

In massive rocks like granite and diabase, joints, though prevalent, have not the same regularity of arrangement as in the stratified formations; nevertheless, most rocks of this class are traversed by two intersecting sets, whereby the rock is divided into long, quadrangular, rhomboidal, or even polygonal masses. Frequently, also, there exists a third series of joints running in an approximately horizontal direction, or corresponding more nearly with the bedding in stratified rocks. These are called by quarrymen "bottom joints," since they form the bottom or floor of the quarry. In some instances, as at the Hallowell (Maine) granite quarries, these bottom joints are so pronounced that no artificial means are required to start the rock from its bed after being freed at the sides and ends.

The cause of these joints has never been fully and satisfactorily explained. By some they are supposed to be due to contraction caused by cooling, and by others it is supposed that they are simply fractures produced by earthquakes. Obviously, the matter can not be discussed here, and the reader is referred to the various text-books on geology. But whatever may have been their origin, their presence is a matter of great importance to quarrymen, and, indeed, the art of quarrying has been well stated by Professor Geikie to consist in taking advantage of these natural planes of division. By their aid large quadrangular blocks

can be wedged off which would be shattered if exposed to the risk of blasting.*

(2) GRANITE QUARRYING.

The methods of quarrying naturally vary with the kind and quality of the material to be extracted. In all the object aimed at is to obtain the largest and best shaped blocks with the least outlay of time and money, and this, too, so far as possible, without the aid of explosives of any kind, since the sudden jar thus produced is extremely liable to develop incipient fractures and so shatter as to ruin valuable material.

In quarrying granite there is less to fear from the use of explosives than in either sandstone or marble, while, at the same time, the greater hardness of the stone renders the quarrying of it by other means a matter of considerable difficulty and expense.

In the leading quarries of Maine and Massachusetts no machinery is used other than the steam drill and hoisting apparatus. By means of the drills a lewis† hole or a series of lewis holes is put down at proper intervals to a depth dependent upon the thickness of the sheets. These are then charged, not too heavily, and fired simultaneously. In the Hallowell quarries, where the sheets of granite are entirely free from one another, this is all that is necessary to loosen the blocks from the quarry, and they are then broken up with wedges. In many quarries, however, where the sheets are thicker or the bottom joints less distinct, it is necessary to drill a series of horizontal holes along the line where it is wished to break the rock from the bed and then complete the process with wedges.

(3) MARBLE QUARRYING.

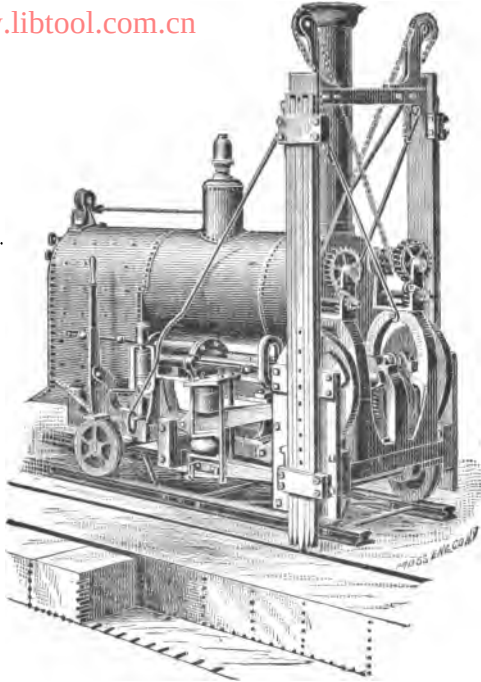
In quarrying marble and other soft rocks, channeling machines are now largely used. These, as shown in the illustration (page 312), run on narrow tracks, back and forth over the quarry bed, cutting, as they go, vertical channels some 2 inches in width and from 4 to 6 feet in depth. After the channels are completed a series of holes from 8 inches to 2 feet apart are drilled along the bottom of the block, which is then split from its bed by means of wedges. This under drilling is called by quarrymen "gadding," and special machines, which are known as "gadding machines," have been designed for the purpose. (See figures on pages 325 and 326.) At the Vermont marble quarries both the

* A good illustration of the utility of jointed structure as an aid to quarrying sedimentary rocks is offered in the Primordial conglomerates about Boston. These consist of a greenish gray groundmass, in which are embraced a great variety of pebbles of granite, quartzite, melaphyre, and felsite of all shapes and sizes. The beds are traversed by two series of vertical joints which cut the rock and its included pebbles, granite, quartz, melaphyre, and felsite alike, with almost as sharp and clear a cut as could be made by the lapidary's wheel. The joints are very abundant, and in many cases quarrying would be a practical impossibility without them. Whenever smooth walls are required the stone is laid on its bed with the joint face outward.

† I find the word also spelled *louis*. For description see Glossary.

Sullivan diamond-pointed drill and the Ingersoll impact drill are used for gadding. The bottom holes are usually drilled to a depth equaling

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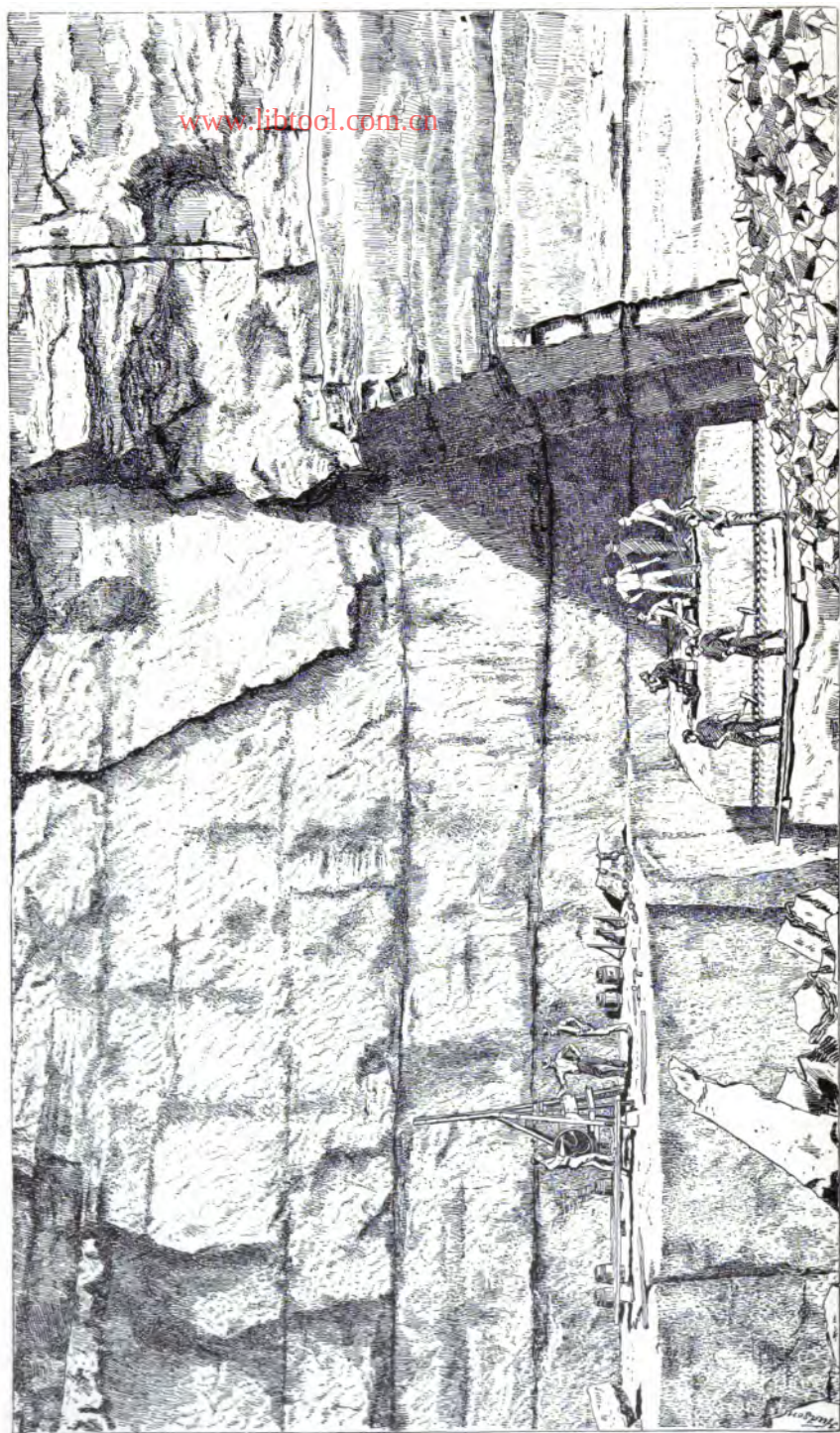
Wardwell channeling machine.

about one-half the width of the block to be extracted, though this depth, as well as the frequency of the holes, must necessarily vary with the character of the rift of the rock.

(4) SANDSTONE QUARRYING.

In the quarrying of the Triassic sandstones at Portland, Conn., the channeling machine is also used to some extent, but the prevailing method of loosening large blocks is by deep drill holes charged with heavy blasts of powder. These holes, which are made by a crude machine driven by cranks, like an ordinary derrick, are 10 inches in diameter and about 20 feet deep. Into these are put from 25 to 75 pounds of powder, contained in a flattened or oval tin cannister, with the edges unsoldered and closed at the ends by paper or cloth. This is placed in the hole in such a position that a plane passing through its edges is in line with the desired break, and fired. In this way large blocks are freed from the quarry, and these are then broken to any required size, as follows: The workmen first cut with a pick a sharp groove some 4 to 8 inches deep along the full length of the line where it is desired the stone shall break. Into this groove are then placed, at intervals of a few inches, large iron wedges, which are then in turn struck repeated

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QUARRYING SANDSTONE AT PORTLAND, CONNECTICUT.

Drawn from a photograph.

blows by heavy sledge-hammers in the hands of the quarrymen until the rock falls apart. This process will be made plain by reference to Plate III. In some of the quarries of softer sandstone no machines at all are used, the channeling being done entirely with picks and the stone forced out by means of iron bars alone, or split out with plug and feather. To allow of this, however, the stone must be evenly and thinly bedded, and the different sheets adhere to one another with but slight tenacity, as is the case with certain of the New York "bluestones" and Berea grits of Ohio. In the New York quarries the vertical joints are said to be so numerous as to practically do away with the necessity of channeling.*

Powder is still largely used in most of the smaller quarries, and in all those of granite rock for throwing off large masses. If properly used with these harder varieties, it is doubtful if any serious harm results, but in the quarrying of marble and other soft stones, its use can not be too strongly condemned. As suggested by Sperr† the rapid disintegration of the Carrara marble is no doubt caused in part by the incipient fractures induced through the crude methods of quarrying employed. Excepting when, as in the case of granite, no other means can be employed, explosives of all kinds are to be avoided. When necessary, they should be used in a lewis hole, whereby direction may be given to the force of the discharge and the shock distributed over large surfaces.

(5) CUTTING AND DRESSING STONE.

In cutting and dressing stone the same slow hand processes that were in vogue hundreds of years ago are still largely employed. There have been, it is true, many machines invented for this purpose, but the majority of them are far from satisfactory in their working qualities, or the cost of running them is so great that they can be used only by the larger and wealthier firms. After a large mass has been split from the quarry bed it is broken into blocks of the required size and shape by means of wedges. A series of holes, three-fourths of an inch in diameter and a few inches deep, is drilled along the line where it is desired the stone shall break, and into each of these two thin half round pieces of soft iron called "feathers" are placed, and a small steel wedge or "plug" placed between. The quarryman then moves along this line striking with his hammer each wedge in its turn till the desired strain is produced and the stone falls apart.

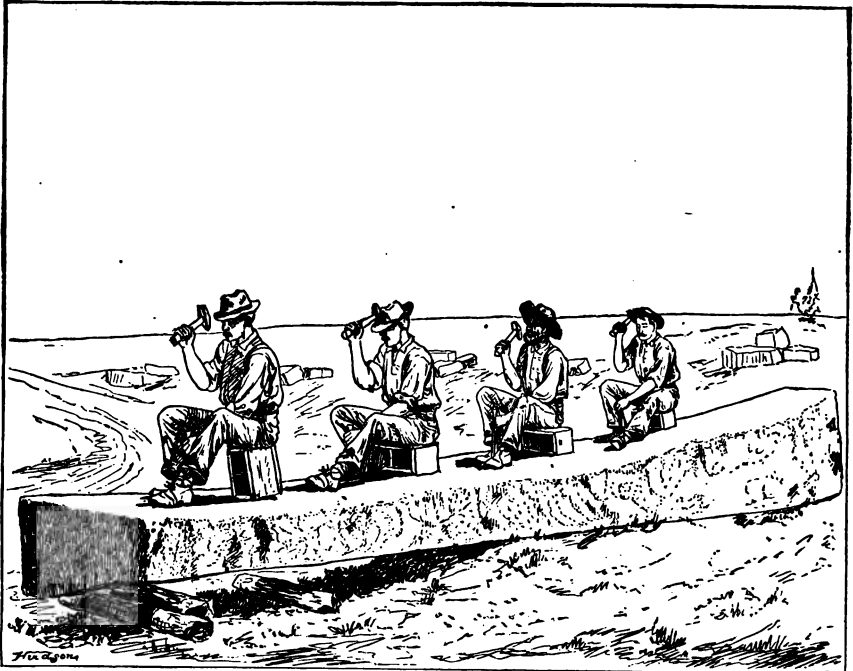
There is a chance for a greater display of skill in this work than may at first appear. Nearly every stone, however compact, has a distinct grain and rift, along which it can be relied on to split with comparative ease and safety. To know the rift and be able to take proper advantage

* F. W. Sperr. Report Tenth Census, p. 37.

† *Op. cit.*, p. 38.

of it is an important item, and it is astonishing how readily an experienced workman will cause a stone to take the desired shape through a knowledge of this property.

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Drilling holes for splitting stone with plug and feathers.

This process of splitting stone with wedges is said* to have been first brought into general use in this country by a poor mechanic named Tarbox, of Danvers, Mass. Through the influence of Governor Robins, who stumbled upon samples of his work by the merest accident, this man was induced in 1798 to go to Quincy and teach his art to the quarrymen of that place. So much did the adoption of this simple method facilitate granite working that the price of the cut material dropped within the space of a few months over 60 per cent. Prior to this time the stone after being blasted from the quarry in irregular blocks was squared down to the proper size by cutting a groove along a straight line with a sharp-edged tool called an axiammer, and then striking with a heavy hammer repeated blows on both sides of the groove until the rock was broken asunder.†

* Proceedings American Academy, Vol. iv, 1859, p. 353.

† In Pattee's History of Old Braintree and Quincy occurs this passage: "On Sunday, 1803, the first experiment in splitting stone with wedges was made by Josiah Bemis, George Stearns, and Michael Wilde. It proved successful, and so elated were these gentlemen on this memorable Sunday that they adjourned to Newcomb's hotel, where they partook of a sumptuous feast. The wedges used in this experiment were flat, and differed somewhat from those now in use."

As to who can justly claim to be the first to bring this method of splitting into

This method is said to have been introduced into Quincy somewhere about 1725-'50, by German emigrants, and, crude as it may seem, was a vast improvement over that used in preparing stone for the construction of King's Chapel, erected in 1749-'54, on the corner of School and Tremont streets, Boston. Here we are told the stone was first heated by building a fire around it and then broken by means of heavy iron balls let fall from a considerable height.

With such difficulties as these to contend with it is not surprising that the building should have been considered a wonder when completed, and that people coming to Boston from a distance made it a point to see and admire this great structure. The wonder, however, was not that the granite could be broken into shape by such methods, but "that stone enough could be found in the vicinity of Boston fit for the hammer to construct such an entire building. But it seemed to be universally conceded that enough more like it could not be found to build such another."

After a block is broken from the quarry bed it is trimmed to the desired size and shape by means of a variety of implements, according to the hardness of the stone and the character of the desired finish.

In dressing granite and other hard stone the tools ordinarily used are the set or pitching chisel, the spalling hammer, pean hammer, bush hammer, band hammer, chisel, and point. With the set the rough

general use the author has no means of ascertaining. That none of the above can justly claim to have *invented* the process is evident from the following:

"I told thee that I had been informed that the grindstones and millstones were split with wooden pegs drove in, but I did not say that those rocks about this house could be split after that manner, but that I could split them, and had been used to split rocks to make steps, door-sills, and large window cases all of stone, and pig-troughs and water-troughs. I have split rocks 17 feet long and built four houses of hewn stone split out of the rocks with my own hands. My method is to bore the rock about 6 inches deep, having drawn a line from one end to the other, in which I bore holes about a foot asunder, more or less, according to the freeness of the rock; if it be 3 or 4 or 5 feet thick, 10, 12, or 16 inches deep. The hole should be an inch and a quarter diameter if the rock be 2 feet thick, but if it be 5 or 6 feet thick the holes should be an inch and three-quarters diameter. There must be provided twice as many iron wedges as holes, and one-half of them must be fully as long as the hole is deep and made round at one end, just fit to drop into the hole, and the other half may be made a little longer, and thicker one way, and blunt pointed. All the holes must have their wedges drove together, one after another, gently, that they may strain all alike. You may hear by their ringing when they strain well. Then with the sharp edge of the sledge strike hard on the rock in the line between every wedge, which will crack the rock; then drive the wedges again. It generally opens in a few minutes after the wedges are drove tight. Then, with an iron bar or long levers, raise them up and lay the two pieces flat and bore and split them in what shape and dimensions you please. If the rock is anything free you may split them as true almost as sawn timber, and by this method you may split almost any rock, for you may add almost any power you please by boring the holes deeper and closer together."

(From letter of John Bartram to Jared Elliot dated January 24, 1757. See Darlington's *Mem. of Bartram and Marshall*, p. 375.) The precise date at which these four stone houses were built is not stated, but the work above quoted contains an illustration of John Bartram's house, near Darby, Delaware County, Pa. This house,

block is trimmed down to a line. Then the irregular surface is worked down by the point, which is driven by the hand hammer. After pointing, are used the pean and the patent or bush hammers in turn, beginning with the 4-cut and thence working down with the 6-cut, 8-cut, 10-cut, and 12-cut, or until the desired surface is obtained. The condition of the hammered surface at the completion of one of the hammerings should be such that each cut in the hammer traces a line its full length on the stone at each blow.

The single cut or pean hammer should leave no unevenness exceeding one-eighth of an inch, and each finer cut reduces the unevenness left by the preceding.

The 12-cut should leave no irregularities upon the surface of the stone other than the indentations made by the impinging of the plates in the hammer. The lines of the cut are made so as to be vertical in exposed vertical faces when the block is in position. On horizontal and unexposed faces they are cut straight across in any convenient direction. With sawn surfaces of course much of the preliminary work is done away with, as the surface is already sufficiently smooth. It is at present customary to saw only such stone as are designed for polishing or some kind of smooth finish.

In preparing a stone for polishing the surface is first made smooth as possible by sawing or by the means above designated. It is then fur-

which is of stone, was erected about 1730. Hence we must conclude that the art of splitting stone in this manner was known to some at least as early as this date.

It is stated (Grueber, *Die Baumaterialien-Lehre*, pp. 60, 61) that in Finland, even at the present day, granite is split from the quarry-bed through the expansive force of ice. A series of holes, from a foot to 15 inches apart and from 2 to 3 feet deep, according to the size of the block to be loosened, is driven along the line of desired rift after the usual custom. These holes are then filled with water and tightly plugged. The operation is put off until late in the season and until the approach of a frost. The water in the holes then freezes, and by its expansion fractures the rock in the direction of the line of holes. Blocks of 400 tons weight are stated to be broken out in this way. A more ancient method consisted in simply plugging the holes with dry wooden wedges and then thoroughly saturating them with water, the swelling wood acting in the same way as the freezing water. Another ancient and well-known method consisted in building a fire around the stone, and when it was thoroughly heated striking it with heavy hammers or throwing cold water upon it. In splitting stone the ancient Romans are said to have sprinkled the hot stone with vinegar, though whether they thereby accelerated the splitting or caused the stone to break along definite lines is not known. Quartz rocks, it is stated, can be made to split in definite directions by wetting them while hot, or laying a wet cord along the line it is desired they shall cleave. The wet line gives rise to a small crack, and the operation is completed by striking heavy blows with wooden mallets. According to M. Raimondi, the ancient Peruvians split up the stone in the quarry by first heating it with burning straw and then throwing cold water upon it. To carve the stone and obtain a bas-relief, this writer contends that the workmen covered with ashes the lines of the designs which they intended to have in relief, and then heated the whole surface. The parts of the stone which were submitted immediately to the action of fire became decomposed to a greater or less depth, while the designs, protected by ashes, remained intact. To complete the work the sculptor had but to carve out the decomposed rock with his copper chisel.

ther reduced by means of wet sand and emery of varying degrees of fineness. Small blocks are now usually ground on a revolving iron bed, on which the abrading material is shoveled and kept wet by a stream of water from overhead. With larger blocks a heavy slab of stone is drawn by the workmen back and forth across the surface on which the wet sand has already been placed. On the finer grades of white marble emery is not used, as it stains; fortunately, owing to the softness of these stones, it is readily dispensed with. After being ground, the surface is rubbed by a sharp, evenly gritted sandstone called a "hone," and then with pumice-stone.

On granites it is often customary to give a "skin coat" by rubbing the block, after the final emerying on the smooth, wet grinding bed, without any abrading material, until a perfectly smooth surface and dull polish is obtained. When this point is reached—and the surface must be quite free from scratches and blemishes, or a good polish is impossible—the polish is produced by means of polishing putty (oxide of tin) rubbed on with wet felt. In cheap work it is customary to use oxalic acid in connection with or entirely in place of the polishing putty. This enables the production of a polish with less labor, but it is also less durable.

A high grade of polish can only be produced by skilled workmen, and each one has his own peculiar methods, varying in trifling particulars from that given above. In many of the larger works where steam power is used, it is said to be customary to mix a quantity of very finely ground metallic lead with the putty. By this means a higher gloss is produced, and also one that is very durable. All the larger works now use machinery in both grinding and polishing. Descriptions of these will be given in the following chapter.

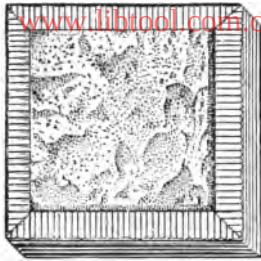
Sundry attempts have been made to utilize the sand-blast process, so extensively used in glasswork, for carving on stone; but so far, with few exceptions, these attempts have met with but poor success. In 1875-76, Messrs. Sheldon & Slason, of West Rutland, having a large Government contract in preparing head stones for soldiers' graves in national cemeteries, introduced the system with considerable success. The process consisted in covering those parts of the stone to be left uncut with an iron shield, while letters and figures of chilled iron were placed upon those portions which were to stand out in relief. The blast then being directed against the stone cut away very quickly the unprotected parts. By this means the name, company, regiment, and rank of soldiers, could be cut on a stone in less than five minutes, and two hundred and fifty-four thousand stones thus lettered and having dimensions of 3 feet in length, 10 inches in width, and 4 inches in thickness, were placed in the national cemeteries at a cost of but \$864,000. The sand-blast process has also been used with good results on the hard red quartzite of Sioux Falls, as will be noted later.

(6) QUARRYING AND SPLITTING SLATE.

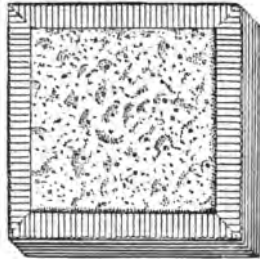
In quarrying slate the methods vary greatly according to the disposition of the beds, and no attempt will be made here at a detailed description. Ordinary blasting powder is employed in loosening the blocks, and great skill and sagacity is shown by experienced quarrymen in so manipulating the blast as to produce the desired effects of freeing the rock from the quarry bed without shattering the stone. After a block is removed from the quarry it is subject to special treatment according to the purpose to which the stone is to be put. If for roofing-slate, the block according to Mr. Sperr* is taken from the quarry to the splitters' shanty, where it is taken in charge by a splitter and his two assistants. The first assistant takes the block and reduces it to pieces about 2 inches in thickness, and of a length and breadth a little greater than those of the slates to be made. This is done by a process called "sculping," which is as follows: A notch is cut in one end of the block with the sculping chisel, and the edge of this notch is trimmed out with a gouge to a smooth groove extending across the end of the block and perpendicular to the upper and lower surfaces; the sculping chisel is then set into this groove and driven with a mallet until a cleft starts, which by careful manipulation is guided directly across the block. The upper surface of the block is kept wet with water so that the crack may be more readily seen. If the slate is perfectly uniform in shape and texture, and the blows upon the sculping chisel are directed straight with the grain, the crack follows the grain in a straight line across the block. Almost invariably, however, the crack deviates to the right or left, when it must be brought back by directing the blow on the sculp in the direction in which it is desired to turn the break, or by striking with a heavy mallet on that side of the block toward which it is desired the crack shall turn. Some slates can be sculped across the grain, but nearly all must be broken in this direction. From the first assistant or "sculper" the block goes to the splitter who by means of a mallet and broad thin chisel splits it through the middle, continuing to thus divide each piece into halves until the desired thinness is obtained. It is necessary to keep the edges of the blocks moist from the time they are removed from the quarry until they are split. From the splitter the thin but irregularly shaped pieces pass to the second assistant who trims them into definite sizes and rectangular shapes. This is done either by hand or by machine. To trim by hand a straight edged strip of iron or steel is fastened horizontally upon one of the upper edges of a rectangular block of wood some 2 to 4 feet in length. The trimmer then lays the sheet of slate upon the block allowing the edge to be trimmed to project over this strip, and then by means of a long heavy knife with a bent handle cuts off the overlying edge, thus reducing it to the required size and shape. Two kinds of

* Report Tenth Census, Vol. x, p. 39.

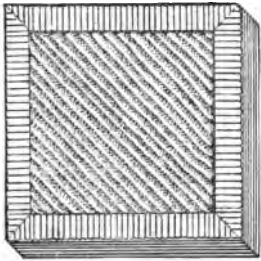
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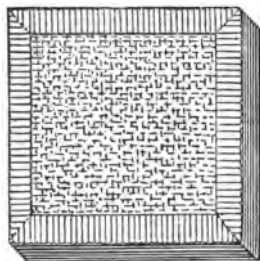
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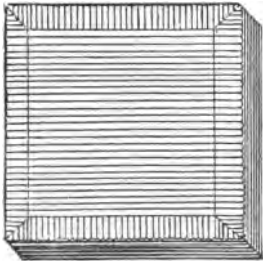
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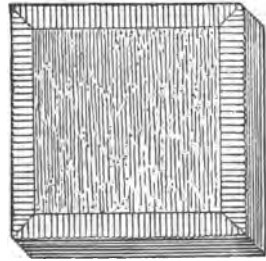
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5



6

KINDS OF FINISH.

FIG. 1. Rock face.

FIGS. 2, 3. Pointed face.

FIG. 6. Patent hammered.

FIG. 4. Tooth-chiseled.

FIG. 5. Square drove.

machines for doing this work are now in use. In general they may be said to consist of an iron frame-work some $2\frac{1}{2}$ feet high, with a horizontal knife-edge upon its upper edge. Against this knife is made to work by means of a treadle another knife, curved in outline, which is thrown upward again by means of a spring, after being brought down by the treadle-movement. At right angles to this knife-edge, on one side of the machine, an iron arm projects toward the workman; this arm has notches cut into it for the different sizes of the slate. The difference between the two kinds of machines is said to consist chiefly in the arrangement of the cutting-knife, one working as stated above, while the other revolves on an axle something in the manner of an ordinary corn cutter.

Slates are sawn by means of an ordinary circular saw, such as is used in sawing lumber, and are planed by machines such as are used in planing metals, as are other soft stone. Some of the hard slates used for tiling have to be cut by means of circular saws with teeth of black diamond.*

(7) KINDS OF FINISH.

The more common kinds of finish applied to stone are described below; the figures on Plate IV being drawn from samples in the national collections.

(1) *Rock face*.—This is the natural face of the rock as broken from the quarry, or but slightly trimmed down by the pitching tool. As in this and all the figures given, it is frequently surrounded by a margin of drove work.

(2) *Pointed face*.—In this finish the natural face of the rock has been trimmed down by means of the sharp-pointed tool called a point. It is used principally for exterior work, as in the walls of a building. Two common styles of pointing are shown.

(3) *Ax-hammered face*.—This finish is produced by striking upon the surface repeated blows with a sharp-faced hammer, called an ax or pean hammer. It closely resembles the next, but is coarser. Used in steps, house trimmings, and other exterior work.

(4) *Patent hammered*.—This finish is produced by striking repeated blows upon the smooth surface of the rock with the rough-faced implement called a patent hammer. Five grades of fineness are commonly recognized, the 4-cut, 6-cut, 8-cut, 10-cut, and 12-cut surfaces, made by hammers composed of four, six, eight, ten, and twelve plates, respectively. A very common finish for the finer kinds of exterior work.

(5) *Bush hammered*.—This finish resembles closely the tooth chiseled or very fine pointing. It is used mostly on soft stone. (See descriptions of bush and patent hammers on p. 329.)

* Detailed and very closely resembling accounts of the methods of working slate are given by F. W. Sperr, in Report Tenth Census, Vol. x, pp. 38-42, and E. Prince, jr., report D 3, Vol. 1, pp. 138-143, 2d Geol. Survey, Pennsylvania. To these the reader is respectfully referred.

(6) *Square drove*.—The square drove surface is made with a wide steel chisel with a smooth edge, called a drove. It is quite common to use this style of finish as a border to the rock-face or pointed surfaces in many kinds of exterior work.

(7) *Tooth chiseled*.—This finish is produced by means of a wide steel chisel with an edge toothed like that of a saw. This and the square drove are used principally upon limestones, marbles, and sandstones, the granites being too hard to be cut in this manner.

(8) *Sawed face*.—This is the surface of the rock as left by the saw; the saw used for the purpose being a thin smooth blade of soft iron fed with sharp sand or chilled iron. This and the following styles, although possessing distinctive characteristics easily recognizable by the eye, are of such a nature that their likenesses can not be well reproduced on paper. Hence no attempt at illustration has been made.

(9) *Fine sand finish*.—To produce this finish the chiseled or sawn surface of the marble is rubbed smooth by means of a block of stone and fine wet sand or on the machines yet to be described.

(10) *Pumice finish*.—This is a very smooth but unpolished surface produced by smooth rubbing with pumice or Scotch hone.

(11) *Polished surface*.—Two kinds of polished surfaces are made—the acid gloss and the putty gloss. For either the surface of the stone is made as smooth as possible by means of sand, or emery, and pumice, or hone, after which it is rubbed with moist woollen cloth and oxalic acid, or polishing putty. The latter produces the best and most lasting gloss, but requires more labor. Frequently the two methods are combined, especially in tombstone work.

G.—MACHINES AND IMPLEMENTS USED IN STONE WORKING.

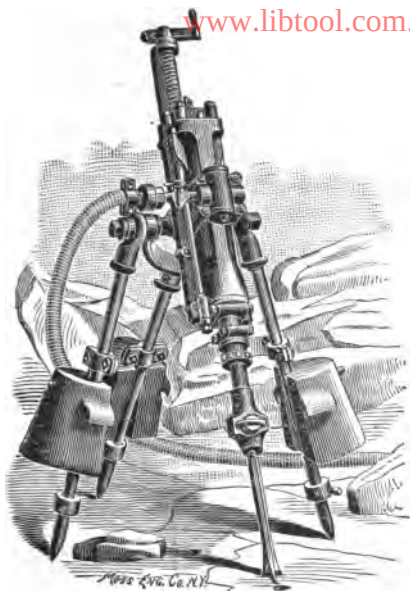
DRILLS AND DRILLING MACHINES.

Of the many machines that have from time to time been invented for working stone we can here mention only the principal ones that are to-day in actual use.

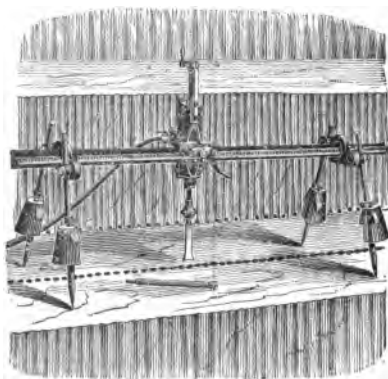
Drills.—The old-time method of drilling by means of a flat pointed drill called a "jumper," which is held by one workman while others strike upon it alternate blows with heavy hammers, although still in use in many quarries, has been largely superseded by steam-drills of various kinds. A simple form of the steam-drill, and one now in very general use, is that shown in the accompanying figure (page 321). The drill proper is fastened directly to the piston, which can be inclined at any angle, thus fitting it for ordinary quarrying or for tunneling. It is driven either by steam or by compressed air. A different adaptation of the same principle is employed in the channeling and gadding machines

used in getting out dimension stone. Figures of these are also here given. The drill and cylinder are attached to the horizontal bar by

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Eclipse Rock Drill.



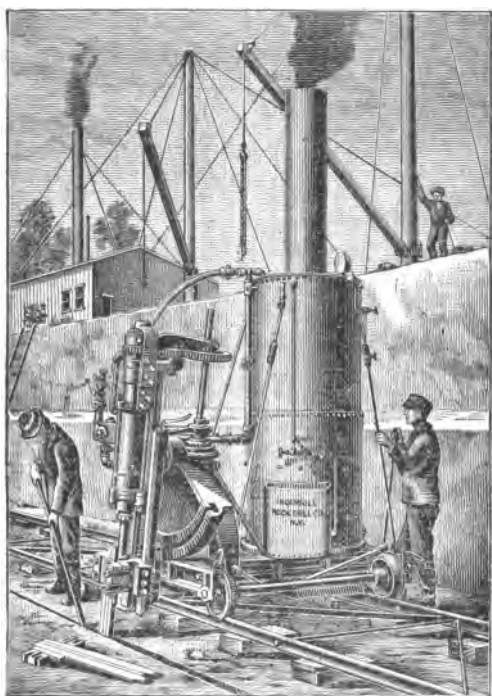
Improved Quarry Bar.

means of a clamp, which can be loosened or tightened at will. By this means a dozen or more holes can be cut by simply sliding the drill along the bar and without moving the entire machine.

(2) CHANNELING MACHINES.

The channeling machine shown on page 312 was invented by George J. Wardwell, of Rutland, Vt. The first successful machine was built by him in 1863, in connection with the Sutherland Falls Marble Company, and that original machine has been at work there constantly until within a few months (1885). These machines are now in operation in all the important quarries of sandstone, limestone, and marble in the country, and it is calculated that over 5,000,000 square feet have been cut by them. The channeler is essentially a locomotive machine driven by power, usually steam, moving over a steel rail track which is placed on the quarry bed. It carries a single gang-drill on one side, or two such drills—one on each side. These are raised and dropped by a lever and crank arrangement. The gang of cutters forming the drill is composed of five steel bars, 7 to 14 feet in length, sharpened at the ends and securely clamped together. Of the five cutters, two have diagonal edges; the other three have their edges transverse. The center of the middle largest extends lowest, so that the five form something like a stepped

arrangement, away from the center. The drill, lifted, drops with great force and rapidly creases a channel into the rock. The single-gang machine is operated by two men, the double by three. As it runs backward and forward over the rock the machine is reversed without stopping, and as it goes the cutters deliver their strokes, it is claimed, at the rate of one hundred and fifty per minute. The machine feeds forward on the track half an inch at each stroke, cutting half an inch or more every time of passing. The single machine will cut from 40 to 80 square feet of channel per day in marble or limestone and at a cost of from 5 to 20 cents per square foot. The double machine will do twice the amount of work. A good workman would formerly cut from 5 to 10 feet, that is, a groove 1 foot deep and from 5 to 10 feet long per day.

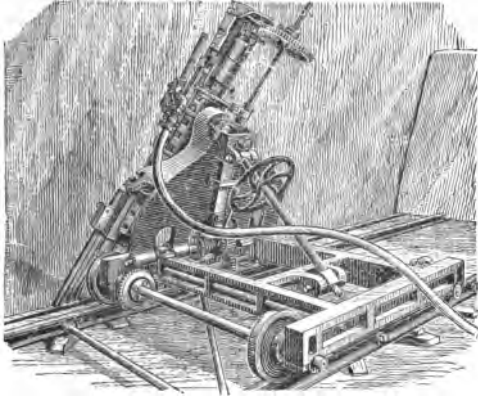


Saunders Channeling Machine with boiler attached.

For this he would receive from 25 to 30 cents per foot.* Another machine for doing the same work as that just described is the Saunders channeling machine shown in the illustration, and which has recently come into use in the Vermont quarries. This differs from the Wardwell in several important particulars, prominent among which are these: (1) The cutting tool is attached rigidly to the piston, so that the blow is dealt directly by the steam pressure in the cylinder and without the intervention of any cranks, levers, or springs. (2) The cutting tools are

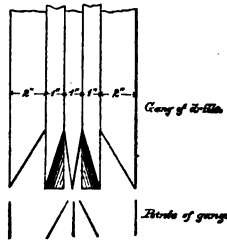
* The Marble Border of Western New England, p. 43.

made adjustable at any angle—to the right, left, forward, or backward. The machine is thus capable of making transverse and sidehill cuts, and does what is known as “cutting out the corners” in quarrying; and (3) it can be used in chambers where the distance between the floor and roof is but 6 feet and can be used in tunnels and headings.



Saunders Channeling Machine making sidehill cuts and with boilers detached.

The machine carries five drills in the gang, with three straight points and two diagonal ones. These are arranged as seen in the accompanying cut:



The average capacity of the machine, as claimed by the company's circular, is as follows:

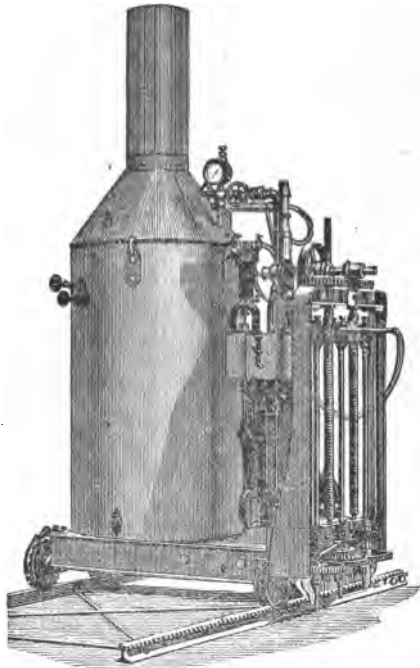
In marble, 80 to 100 square feet of channel in ten hours.

In sandstone, 150 to 200 square feet of channel in ten hours.

In limestone, 120 to 150 square feet of channel in ten hours.

The diamond channeling machine is shown in the figure on page 324. According to the company's circular this machine employs $1\frac{3}{4}$ -inch drill-bits, which are attached to drill-rods of varying lengths, adapted to any required depth of channel up to $9\frac{1}{2}$ feet. The channel may be made open or partly closed, the latter by leaving slight spaces between the holes, to be afterward chipped out. But the whole operation of a clear cut is made simultaneously with the boring by means of an intercutting guide, which answers this purpose very well. The drill can be made to

vary in direction from perpendicular to 50 degrees slant for putting down the tunnel and angle cuts. If necessary the boiler can be left at a distance from the machine, the steam being conveyed by hose.



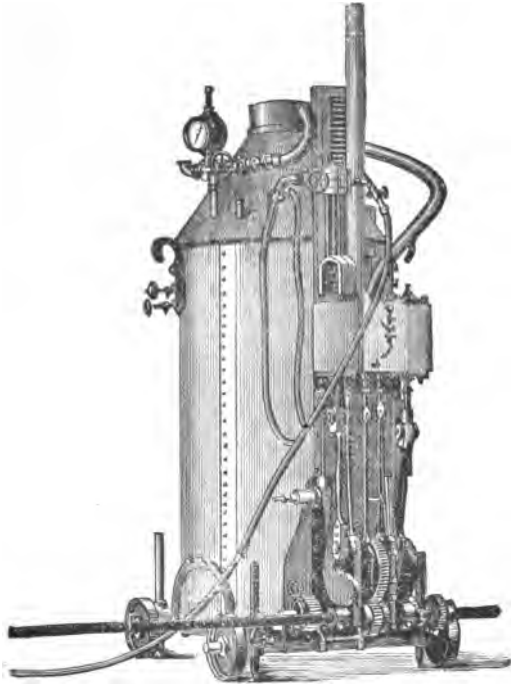
Diamond Channeling Machine.

(3) GADDING AND GADDING MACHINES.

The diamond gadder is shown on page 325. According to the company's circular the machine takes its name from the class of work for which it was especially designed and which is known among quarriers as "gadding." When the requisite channel cuts are made about a block of marble to be removed, it is necessary to undercut the block in order to release it. This is usually accomplished by drilling a series of holes beneath it, and then, by wedges, the block is split from its bed.

The machine is placed upon a platform on trucks arranged to run upon a track. When adjusted for work it may be braced by the pointed legs shown. The boring apparatus is attached by a swivel to a perpendicular guide-bar. This guide-bar is secured to the boiler behind it, which forms the main support of the machine. Upon the guide-bar the boring apparatus may be raised or lowered at pleasure, for the purpose of boring a series of holes in a perpendicular line if desired. Upon the swivel the boring apparatus may be turned, so as to bore in any direction within the plane of the swivel-plate.

The illustration shows the drill-rod or spindle placed near the base of the machine, and so as to bore horizontally. At one end of the spindle is the drill-head, armed with carbons, and supplied with small apertures or outlets for water. At the other end of the spindle is attached a hose for supplying water to the drill-head. A rapid revolving movement is communicated to the drill-spindle by the gears shown. The speed and feed movement may be regulated by the operator with reference to the hardness or softness, coarseness or fineness, of the material to be bored; and the feed movement may be instantly reversed at pleasure. The machine is so constructed that the drill-spindle may be re-



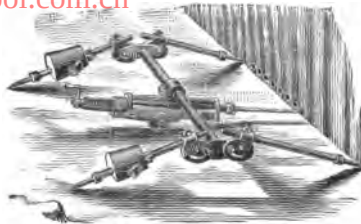
Diamond Gadder.

moved and another inserted in the same holder, adjusted to bore in the opposite direction, the boring apparatus being driven by a double-cylinder engine. A continuation of one of the piston-rods through the cylinder forms the plunger to a small pump placed above the cylinder, which supplies water to the boiler and forces water through the drill spindle and head. These jets of water wash out all the borings made, and keep the drill-head from heating. The usual feed of this drill in marble is from 4 to 5 inches per minute.

Still another style of gadding-machine is used in the Vermont quarries, and which is but an especial adaptation of the eclipse-drill shown on page 326. It is claimed that this machine will "put in holes close to the

bottom of the quarry, in a horizontal position along the bench, into the roof, or perpendicularly into the floor, as desired."

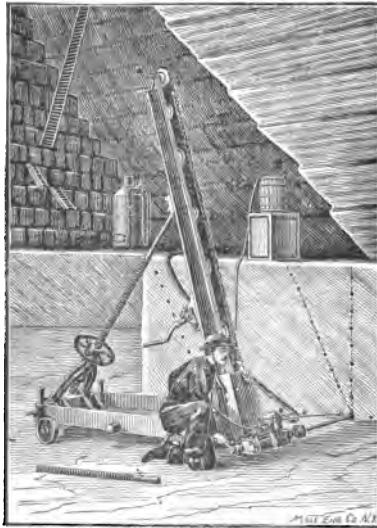
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Plain quarry frame in position for undercutting or gadding.

(4) GRINDING AND POLISHING MACHINES.

In the larger works the grinding and polishing already described is now done by steam power. For flat surfaces a circular, horizontally revolving iron plate or grating, attached to the lower end of a vertical shaft, with elbow joint, is used, the workman guiding it to any portion of the surface he may desire by means of the handle; the abrading substance being sand or emery, as before. With felt attached to the plate the same form of machine is also used for polishing. Blocks of such size as can be handled by the workmen are usually ground upon horizontally-revolving iron beds some 8 or 10 feet in diameter.



Ingersoll Standard Gadder at work.

In making straight or only slightly-curved moldings the form is first carved out with the chisel, and then a plate of cast iron, fitted as accurately as possible, is made, by means of a long arm, to travel back and forth over the stone with sand or emery, or putty powder and felt, as the case may be. These are called pendulum machines. The actual labor is thus greatly reduced, and a higher and more lasting polish obtained than is possible by the old hand methods.

(5) LATHES AND PLANERS.

For turning posts and pillars lathes are now very generally used for granite as well as for softer stone. In easy working varieties, as sandstone, limestone, or serpentine, the cutting tool is a simple chisel, much like that used in turning metals, and held in a clamp in the same manner. With the harder rocks, like the granite, however, this method is ineffectual, and the cutting tool is in the form of a thin steel disk some 6 or 8 inches in diameter, which is so arranged as to revolve with the stone in the lathe when pressed against it at a sharp angle. By this means large and beautiful columns can be made at far less cost than by the old hand processes.

A monster machine of this character, seen by the writer in the Vinal-haven quarries in 1880, is capable of taking a block 25 feet in length and 5 feet in diameter and turning it down to a perfect column.

With the softer varieties of stone a plain surface, sufficiently smooth for flagging, is produced by means of planing-machines similar to those in use for planing metals. For doing the same work on hard material like granite a planer, with revolving cutting disks of chilled iron, similar to those used in the lathes, has been devised. This machine is shown in the accompanying figure, page 328.

(6) MACHINES FOR SAWING.

In sawing marble and other soft stones the same method, with some modifications, is employed as was in use, according to Professor Seeley,* three hundred years before the Christian era.

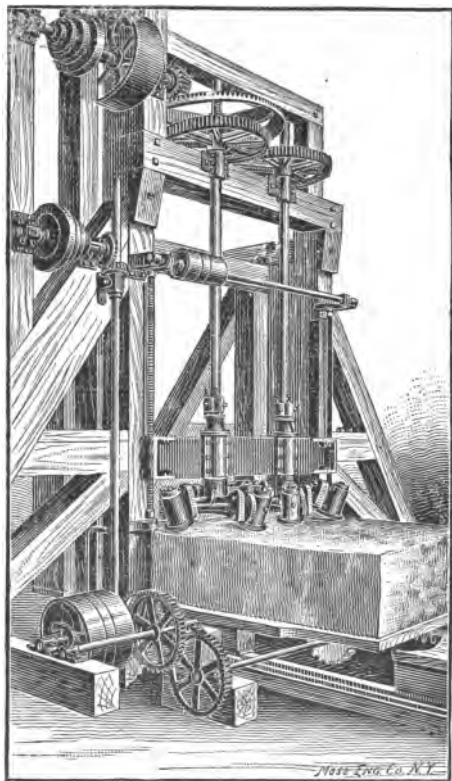
The principle consists simply of a smooth flat blade of soft iron, set in a frame and fed with sharp sand and water. The saws are now frequently set in gangs of a dozen or more in a single frame, and several gangs are tended by one man, who shovels on the wet sand as it is needed, while fine streams of water from overhead wash it beneath the blade as it swings backward and forward in its slowly deepening groove. Some attempts at automatic feeders have been made, but they are not as yet in general use.

This method has been found inapplicable to cutting granite, owing to the greater hardness of the material. Recently a sand composed of globules of chilled iron has been used to good advantage. The great drawback to the use of this material, so far as the author has observed, is the care necessary to avoid staining the stone by rust from the wet globules during the time the machine is not running. This is done by wetting down the stone and globules in the saw frame with a thick solution of lime-water (whitewash) prior to leaving the saws for the night. Circular saws, with diamond teeth, have been used to some ex-

* The Marble Border of Western New England. Proc. Middlebury Hist. Soc., Vol. 1, Part II, p. 28.

tent, but have been found too expensive for ordinary work. In sawing slate circular saws are used, such as are employed in sawing lumber. Philo Tomlinson, who was engaged in marble sawing at Marbledale, Conn., near the date 1800, is stated by Professor Seeley* to have been one of the first to successfully apply the gang-saw system in this country.

For sawing circular apertures in the tops of wash-stands or getting out tops for small tables a saw made of plates of soft iron bent into the form of a cylinder and revolved by a vertical shaft is used. Sand emery, or globules of chilled iron form the cutting material, as in the saws just mentioned.



McDonald Stone Cutting Machine.

A recent European invention for sawing stone consists of a twisted cord of steel, made to run around pulleys, like a band-saw. The cord is composed of three steel wires loosely twisted together, but stretched tightly over the pulleys, and is made to run at a high rate of speed. The swift successive blows from the ridges of the cord, delivered along the narrow line, disintegrates the stone much more rapidly, it is claimed, than the iron blades fed with sand, the usual rate of cutting in blocks of

**Op. cit.*, p. 29.

soft limestone being at the rate of about 24 inches an hour, and in Carrara marble a little more than 9 inches an hour. Brittany granite is cut at the rate of nearly 1½ inches an hour, and even porphyry can be worked at the rate of eight-tenths of an inch an hour. In certain Belgian marble quarries the saw is said to have been used to advantage in cutting the rock from the quarry bed. In thus utilizing it the floor is first cleared as for channeling machines, and then, by means of large cylindrical drills, fed with metallic sand, a shaft 27 inches in diameter is cut to the desired depth, the cores being removed entire, as in the common tubular diamond drills. Two of these holes are sunk at proper distances apart and guides set up in them, on which move frames carrying pulleys of a diameter somewhat less than that of the holes; over these pulleys the cord-saw is stretched; motion is then imparted to the pulleys by a simple system of transmission, and the saws cut without interruption until the bottom of the drill pit or shaft is reached.* A great saving of time and material is claimed for this invention, but although it seems to promise well none are at present in use in this country, nor has the author ever had opportunity for examining one.†

(7) THE SAND BLAST.

As already noted, the sand blast has been utilized to some extent in the work of lettering head-stones, and for producing delicate tracings on the Sioux Falls quartzite. That the process is still so little used is due, as I am informed, to the opposition of trades-unions, and not to any deficiency of adaptability in the process itself.

(8) HAND IMPLEMENTS.

Face hammer.—This is a heavy square-faced hammer, weighing from 15 to 25 pounds, and used for roughly shaping the blocks as they come from the quarry. It is sometimes made with both faces alike or again with one face flat and the other drawn out into a cutting edge (Fig. 10, Pl. v). The caviol differs only in having one face drawn out into a pyramidal point.

Ax or pean hammer.—A hammer made with two opposite cutting edges, as seen in Fig. 13, Pl. v. The edges are sometimes toothed roughly, when it is called the toothed ax.

Patent or bush hammer.—A hammer made of four, six, eight, ten, or more thin blades of steel, bolted together so as to form a single piece, the striking faces of which are deeply and sharply grooved. This hammer is said to have been invented by Mr. Joseph Richards, of Quincy, Mass., about 1831-'40. As first constructed the head was composed of a single piece, instead of several, as now (see Fig. 12, Pl. v). In some works this is called the bush hammer.

*Am. Arch. and Build. News, Nov. 7, 1885.

†This apparatus is figured and described in the Scientific American for March 6, 1886, p. 147.

Crandall.—This consists of a bar of malleable iron, about 2 feet in length, and slightly flattened at one end, through which is a slot three-eighths of an inch wide and 3 inches long. Through this slot are passed ten double-headed points of one-fourth inch square steel, 9 inches long, which are held in place by a key.*

The writer has never seen this instrument in use.

Hand hammer.—A smooth-faced hammer, with two striking faces, weighing from 2 to 5 pounds. It is used for hand-drilling, pointing, and chiseling in the harder kinds of rocks (see Fig. 16, Pl. v). The usual form has both faces alike.

Mallet.—This is a wooden implement, with a cylindrical head, used in place of the hammer in cutting the softer stones, as marbles and sandstones (Fig. 15, Pl. v).

Sledge or striking hammer.—A heavy, smooth-faced hammer, weighing from 10 to 25 pounds, used in striking the drills in hand-drilling or in driving large wedges for splitting stone, Fig. 11, Pl. v.

Pick.—An instrument resembling the ordinary pickax used in digging, but somewhat shorter and stouter. It is used on the softer varieties of stones for rough dressing or for channeling prior to wedging.

Pitching chisel.—A steel chisel, the cutting face of which is rectangular in outline and with sharp angles or corners. It is used for trimming down the edges to a straight line. See Fig. 7, Pl. v. The chipper (Fig. 6) is used for very similar purposes.

Chisel or drove.—This is a steel chisel, the cutting edge of which is drawn out wide and thin as shown in Fig. 2, Pl. v. It is used principally on the softer varieties of rock in producing the so-called "drove work."

Splitting chisel.—A steel chisel, made as shown in Fig. 8, Pl. v, and used for splitting and general cutting on hard stone like granite. Other forms of chisels, used only on soft stone and driven with the wooden mallet, are shown in Figs. 3 and 9.

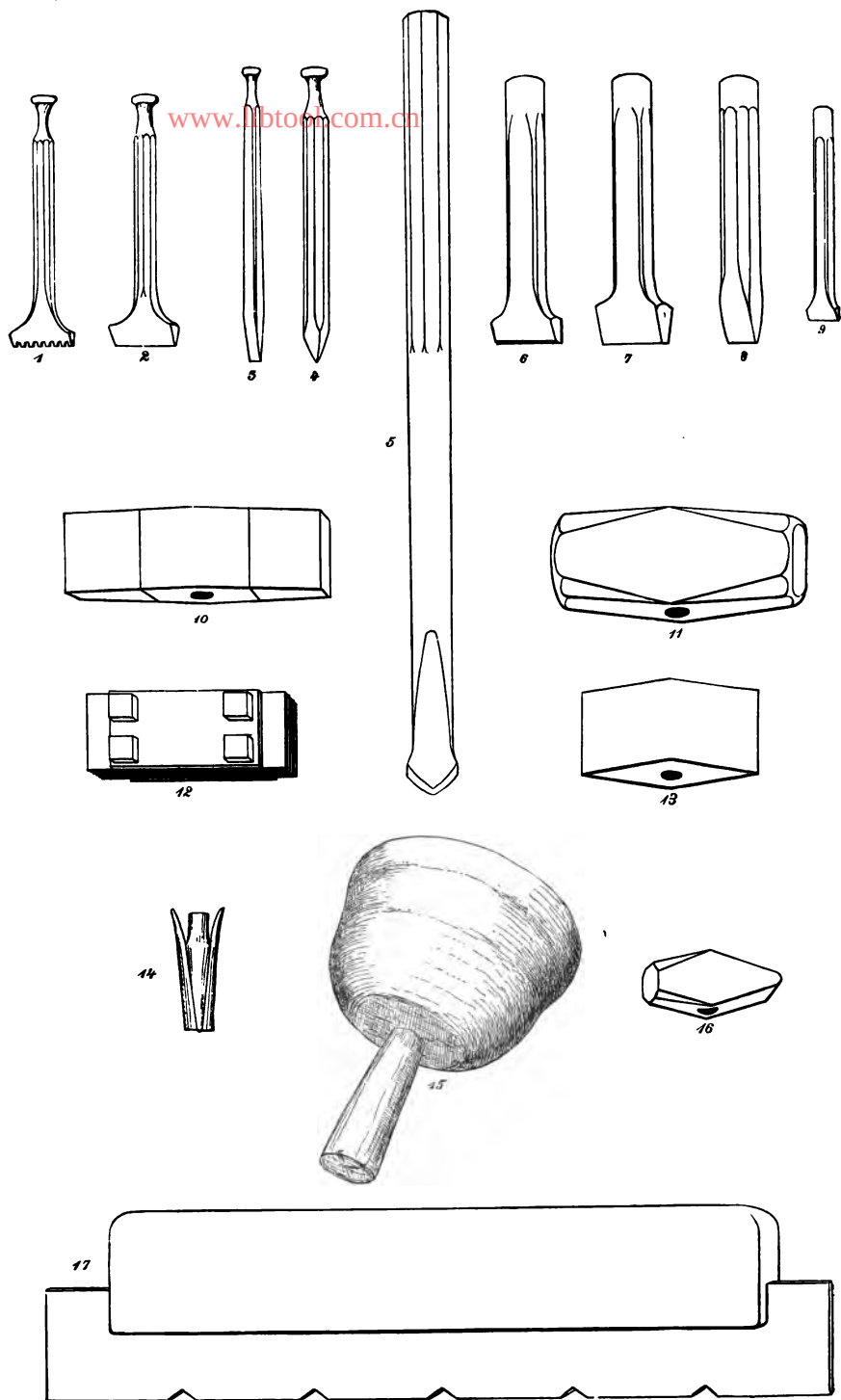
Tooth chisel.—A chisel like the drove chisel, but with the edge toothed like a saw (see Fig. 1, Pl. v), used only on soft stones like marble and sandstones.

Point.—A steel implement, with the cutting end in the form of a pyramidal point (see Fig. 4, Pl. v), used in the production of the finish known as point work and also in the smoothing down of rough surfaces prior to using the ax or some other tool for fine work. Points for use on hard stone and driven by the hammer have the upper end finished as shown in Figs. 6 and 7.

Wedge or plug.—Steel wedges vary greatly in size. Those used in the process of splitting, called plug and feather (Fig. 14, Pl. v), are but two or 3 inches in length, while those used in quarrying for splitting off large blocks are often a foot or more long and correspondingly large.

Hand drill.—A small steel drill from 8 to 15 inches in length, held in

* Man. and Builder, Feb. 1885, p. 38.



TOOLS USED IN STONE-CUTTING.

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one hand and driven by the hand-hammer (Fig. 5), used in making holes for "plug and feather" splitting and other light work.

Grub saw.—A saw for cutting stone by hand. It consists of a plate of soft iron from one-twentieth to one-tenth of an inch in thickness and from 6 inches to 4 feet in length; the blade is notched on the lower edge and fitted with a wooden back for convenience in handling and to prevent bending. Sand or emery is the cutting material, as with the steam saws (Fig. 17, Pl. V).

H.—THE WEATHERING OF BUILDING STONES.

The term weathering, as applied to stone, includes the series of physical changes induced by alternations of heat and cold, or by friction, as well as the more complex series of chemical changes, such as may be comprised under the heads of oxidation, deoxidation, hydration, and solution. Since a stone exposed in the walls of a building may be subjected to the influence of any one or the combined influences of several of these agencies, whereby serious consequences, as of discoloration or disintegration may result, it is important to consider, in more or less detail, their comparative energies under varying conditions and upon the various kinds of stone commonly employed for structural purposes.

(1) PHYSICAL AGENCIES.

Heat and cold.—It is safe to say that none of the conditions under which a stone is commonly placed are more trying than those presented by the ordinary changes of temperature in a climate like that of our Northern and Eastern States. Stones, as a rule, possess but a low conducting power and slight elasticity. They are aggregates of minerals, more or less closely cohering, each of which possesses degrees of expansion and contraction of its own. In the crystalline rocks these dissimilar elements are practically in actual contact; in the sandstones they are removed from one another by a slight space occupied wholly or in part by a ferruginous, calcareous or siliceous cement. As temperatures rise, each and every constituent expands more or less, crowding with resistless force against its neighbor; as the temperatures decrease a corresponding contraction takes place. Since with us the temperatures are ever changing, and within a space of even twenty-four hours may vary as much as forty degrees, so within the mass of the stone there is continual movement among its particles. Slight as these movements may be they can but be conducive of one result, a slow and gradual weakening and disintegration.

This constant expansion and contraction is often sufficient in amount to be appreciable in stone structures of considerable size. Thus Bunker Hill Monument, a hollow granite obelisk, 221 feet high by 30 feet square at the base, swings from side to side with the progress of the sun during

a sunny day, so that a pendulum suspended from the center of the top describes an irregular ellipse nearly half an inch in greatest diameter.*

Under such circumstances as these it is not at all strange that many stones show a decided weakening and tendency to disintegration after long exposure, and particularly on those sides of buildings exposed longest to the sun, and which are, therefore, subject to the full range of temperature variations. Professor Julien has called attention to the marked decay thus produced on the western face of the tombstones in Trinity church-yard and elsewhere. It is stated further that the ashlar base of the steeple of the church at Thirty seventh street and Fifth avenue, New York City, is beginning to exfoliate from this cause on the south side (where the sun shines the longest) but not on the north and east. Other examples are seen on the stone stoops of the east and west streets, where the western face of the dark-brown sandstone is badly disintegrated and exfoliated, while the eastern face remains much longer in a perfect condition. The author has observed similar effects, but in a less marked degree, on the Smithsonian building, at Washington, D. C. The south and west sides frequently show exfoliation, while the north and east, upon which the sun shines but a small portion of the day, are almost untouched.

This same expansion and contraction of stone sometimes produces disastrous effects other than those of disintegration within its own mass.

The difficulty of obtaining permanently tight joints even with the strongest cements led Colonel Totten to institute a series of experiments with a view to ascertain the actual expansion and contraction of granite, sandstone, and marble when subjected to ordinary temperatures. Upwards of thirty experiments on each of these varieties of stone showed the rate of expansion and contraction, which seemed to be uniform throughout the range of temperatures employed, to be for granite .000004825 inch per foot each degree Fahrenheit: for marble .000005668 inch, and for sandstone, .000009532 inch.†

Supposing, then, two coping stones each 5 feet long be laid in midsummer at a temperature of 96° Fahr. In winter the temperature falls to zero, a change of 96°. If the stones contract toward their centers, the whole length of stone put in motion will be 5 feet. In the case of granite, then, the shrinkage amounts to .027792 inch, in marble .03264 inch, and in sandstone to .054914 inch. This shrinkage, small as it seems, from necessity gives rise to cracks at the joints, which admit the passage of water; continual shrinkage and expansion must in time crumble the cement and leave the joint permanently open.‡

The effects of moderate temperatures upon stone of ordinary dryness are, however, slight when compared with the destructive energies of

* Dana, Manual of Geology p. 720.

† Adie found the rate of expansion for granite to be .00000438 inch, and for white marble, .00000613 in.—Trans. Roy. Soc. Edin., xiii. p. 366.

‡ W. H. C. Bartlett on Contraction and Expansion of Building Stone. Am. Jour. Sci., Vol. xii, 1832, p. 136.

freezing temperatures upon stones saturated with moisture. At a temperature of 30° Fahr. the pressure exerted by water passing from a liquid to a solid state amounts to not less than 138 tons to the square foot, or as Professor Geikie has strikingly put it, is equal to the weight of column of ice a mile high. Is it, then, astonishing that a porous sandstone exposed in a house-front to be saturated by a winter's rain and then subjected to temperatures perhaps several degrees below the freezing point shows signs of weakness and exfoliation after a single season's exposure?

Since, then, as every quarryman knows, no stone, however strong, can endure the enormous strain to which it would be subject if frozen solid when holding any considerable amount of water confined within its pores, it is but natural to conclude, as a matter of course, that other things being equal those stones are most durable which will absorb and retain the least moisture.*

This rule is not to be accepted, however, without a considerable grain of allowance, since a coarsely porous stone, though capable of taking up a large amount of moisture will also part with it readily, or if frozen while saturated will permit a considerable proportion of the expansive force of the solidifying water to be expended otherwise than in pushing apart the grains composing it. Otherwise expressed, the water will freeze out of a coarsely porous stone, while in one that is compact it may create sad havoc. This is well illustrated by the common occurrence of water freezing in straight cylindrical or widely-expanding vessels, and in narrow-necked pitchers and bottles. In the first instance the open space above is sufficient to allow all the expansion to take place vertically. The narrow-necked vessel, on the other hand, is almost invariably broken.

To ascertain, then, the porosity or ratio of absorption of any stone is an important test.†

Obviously the best method of ascertaining the power of a stone to withstand the effects of frost is to actually expose prepared blocks to such a temperature, when saturated with water, as to freeze them solid and then note the amount of disintegration, or loss in strength. Un-

* "Other things being equal, it may probably be said that the value of a stone for building purposes is inversely as its porosity or absorbing power." (Hunt, Chem. and Geol. Essays, p. 164.)

† Hunt in a series of tests obtained results as follows:

Potsdam sandstone, Canada, absorbed from 0.50 to 3.26 per cent. in twenty-four hours.

Medina sandstone, Canada, absorbed from 3.31 to 4.04 per cent. in twenty-four hours.

Sub-Carboniferous sandstone, Ohio, absorbed from 9.59 to 10.22 per cent. in twenty-four hours.

Lower Silurian limestones and dolomites, Canada, absorbed from 0.11 to 5.55 per cent. in twenty-four hours.

Tertiary limestones, Caen, France, absorbed from 15 to 16.05 per cent. in twenty-four hours.

fortunately this can not at all times of the year and in all places be done, and artificial methods must be resorted to. Brard's process, as modified by M. Héricart and Thury, consisted in boiling the cube to be experimented upon for half an hour in a saturated solution of sulphate of soda (Glauber salt) and then allowing it to dry, when the salt taken into the pores crystallized and expanded in a manner supposedly somewhat similar to that of water when freezing.*

This process is not now in general use, as experiment has shown that the salt exercised a chemical as well as mechanical action, and produces results somewhat at variance with that of freezing water. The most important series of experiments ever performed with the process in this country were those of Mr. C. G. Page, made with reference to the selection of material for the Smithsonian Institution Building at Washington.

The results are given in the following table.†

Materials.	Specific gravity.	Loss in grains.
Marble, close-grained, Maryland	2.834	0.19
Marble, coarse "alum stone," Baltimore County, Md.	2.857	0.50
Marble, blue, Maryland	2.613	0.34
Sandstone, coarse, Portland, Conn.		14.36
Sandstone, fine, Portland, Conn.	2.583	24.93
Sandstone, red, Seneca Creek, Md.	2.672	0.70
Sandstone, dove-colored, Seneca Creek, Md.	2.486	1.78
Sandstone, Little Falls, N. J.		1.58
Sandstone, Little Falls, N. J.	2.482	0.62
Sandstone, coarse, Nova Scotia	2.518	2.16
Sandstone, dark, coarse, Seneca Aqueduct, Peters's quarry		5.60
Sandstone, Acquia Creek, Va.	2.230	18.60
Sandstone, 4 miles above Peters's quarry, Md.		1.58
Sandstone, Beaver Dam quarry, Md.		1.72
Granite, Port Deposit, Md.	2.609	5.05
Marble, close-grained, Montgomery County, Pa.	2.727	0.35
Limestone, blue, Montgomery County, Pa.	2.690	0.28
Granite, Great Falls of the Potomac		0.35
Soft brick	2.211	16.46
Hard brick	2.191	1.07
Marble, coarse dolomite, Mount Pleasant, N. Y.	2.860	0.91

The specimens operated upon, it should be stated, were cut in the form of inch cubes. Each was immersed for half an hour in the boiling solution of sulphate of soda, and then hung up to dry, this performance being repeated daily throughout the four weeks which the experiment lasted.

The injurious effects of artificial heat, such as is produced by a burning building, are, of course, greater in proportion as the temperature is higher. Unfortunately sufficient and reliable data are not at hand for estimating accurately the comparative enduring powers of various stones under these trying circumstances. It seems, however, to be well proven that of all stones granite is the least fire-proof, while the fact that certain of the fine-grained siliceous sandstones are used for furnace

* Chateau, Technologie Du Batiment, Vol. I, p. 262.

† From Hints on Public Architecture by Robert Dale Owen, p. 119.

backings would seem to show that if not absolutely fire-proof, they are very nearly so.*

It must be remembered, however, that the sudden cooling of the surface of a heated stone, caused by repeated dashes of cold water, has often more to do with its disintegration than heat alone.

Effects of friction.—The amount of actual wear to which stones in the walls of a building are subjected is naturally but slight in comparison with those in the sills, steps, and walks, which are subject to the friction of feet and other agencies. Nevertheless it is sufficient in many cases to become appreciable after the lapse of several years. The striking effect produced by wind-blown sands in the Western States and Territories has often been alluded to† and even in the Eastern States, as at Cape Cod, Massachusetts, there may frequently be seen window-panes so abraded by blowing sand as to be no longer transparent.‡

This same abrading process is going on in all city streets, where the wind blows dust and sand sharply against the faces of the buildings; not with sufficient force, it may be, to perceptibly wear away the fresh stone, but yet forcibly enough to crumble away the small particles already loosened by atmospheric decomposition and thus expose new surfaces to be acted upon. Professor Egleston§ states that in many of the church-yards of New York City the effects of this abrasive action can be seen where the stones face in the direction of the prevailing winds. In such cases the stones are sometimes worn very nearly smooth and are quite illegible from this cause alone.

Effects of growing organisms.—It is in such exposed situations, as above mentioned, that a stone is often protected from serious loss by a coating of lichens or mosses, which by growing over its surface shield it from the abrasive action. The full effect of growing organisms upon the surface of stones is still, however, a matter of dispute. By some authorities|| it is thought that they give rise to small amounts of organic acids which exercise a corrosive influence. By others they are considered as beneficial, since they protect the stone from the sun's rays and the rain and wind. It seems probable that they may exert either a harmful or beneficial action according to the kind of stone on which

* Cutting's experiments (Weekly Underwriter) showed that up to the point at which they are converted into quicklime (that of bright redness), limestones are less injured by heat than either granite or sandstones, a result not fully borne out by the experiments of Winchell (Geol. of Minn., Vol. 1, p. 197-201).

† On the Grooving and Polishing of Hard Rocks and Minerals by Dry Sand. W. P. Blake. Proc. A. A. A. S., Providence meeting.

‡ There is on exhibition in the National Museum a plate of glass formerly a window in the light-house at Nauset Beach, Massachusetts, that was so abraded by wind-blown sand during a storm of not above forty-eight hours' duration as to be no longer serviceable. The grinding is as complete over the entire surface as though done by artificial means.

§ Am. Arch., September 5, 1885, p. 13.

|| See Winchell, Geol. of Minn., Vol. 1, p. 188.

they grow and its environment. More observations are necessary before anything definite can be said.*

(2) CHEMICAL AGENCIES.

Composition of the atmosphere.—The atmosphere in its normal state consists of a mechanical admixture of nitrogen and oxygen in about the proportions of four volumes of the former to one of the latter, together with minute quantities of carbonic acid, ammonia, and vapor of water. In the vicinity of large manufacturing cities, however, it carries in addition to increased proportions of carbonic acid,† appreciable quantities of sulphurous, sulphuric, nitric, and hydrochloric acids. These, when brought by rains into contact with the walls of buildings, are capable, throughout many years of time, of producing marked effects, especially when aided by the extreme diurnal ranges of temperature common in the eastern and northern United States.‡

* The vegetation of microscopic lichens takes place upon the surface of the stone, when, from any cause, that surface becomes roughened so as to afford a lodgment for the seeds or spores of these plants. These growing, still further hasten the disintegration of the stone, and accumulating about them the fine dust floated by the atmosphere becomes points for the absorption of more water, which, on freezing, still further roughens the surface, and the patch of lichen gradually extends. These lichens often gain attachment upon the surface of a finely dressed stone, from some little inequality of texture, or from softer material that more readily becomes decomposed or more readily accommodates the growth of the plant. Such stones in time become partially or entirely covered by lichens, and present an unsightly aspect. The amount and degree of this growth varies with position in reference to the sun and with a more or less elevated situation.

It should not be forgotten, however, that any stone giving root to lichens is not one of those which most easily disintegrates, for in these the destruction goes on so rapidly that the surface does not allow the growth of such plants. The lichen-covered rocks in nature are usually those of great strength and durability. None of the softer or rapidly decaying rocks produce this vegetation. (Rep. on Building Stones by James Hall, 1868, pp. 54 and 55.)

† Twenty-one tests of the air in various parts of Boston during the spring of 1870 yielded Mr. Pearson 385 parts of carbonic acid in 1,000,000. Eleven tests of the winter air of Cambridge yielded Mr. Hill 337 parts of the acid in 1,000,000 (Second Annual Report Massachusetts State Board of Health, 1871, p. 52). Dr. Kidder found the outdoor air of Washington to contain from 387 to 448 parts in 1,000,000. Mr. Angus Smith (Air and Rain, p. 52), after an elaborate series of experiments, reports the air of Manchester (England) to contain on an average 442 parts of the acid in 1,000,000.

‡ Dr. Smith (*op. cit.*) found the proportions of these acids in London, Liverpool, and Manchester to be as follows:

Localities.	Sulphuric.		Hydrochloric.		Nitric.	
	Grains per gallon.	Parts per million.	Grains per gallon.	Parts per million.	Grains per gallon.	Parts per million.
London.....	1.4345	20.49	.0872	1.250	.....	.840
Liverpool.....	2.7714	39.59	.7110	10.16	.....	.582
Manchester.....	2.9163	41.66	.4055	5.79	.....	.886

He also found the *total* acids for Manchester to average for 1870 3.7648 grains per gallon. It should be noted, however, that these acids were not considered as existing

Chemical action of the atmosphere.—The series of changes induced by these agencies are, as above indicated, chemical in their nature and may all, as first suggested, be conveniently grouped under the heads of oxidation, deoxidation, hydration, and solution. These may as well be considered in the order given.

Oxidation.—The process of oxidation is commonly confined to those stones which carry some form of iron as one of their constituent parts. If the iron exists as a sulphide (pyrite or marcasite), it very probably combines with the oxygen of the air on exposure, forming the various oxides of iron such as are popularly known as "rust." If the sulphide occurs scattered in small particles throughout a sandstone the oxide is disseminated more evenly through the mass of the rock, and aside from a slight yellowing or mellowing of the color, as in certain of the Ohio sandstones, it does no harm. Indeed, as suggested by Professor Winchell,* it may result in positive good, by supplying a cement to the individual grains, and thus increasing the tenacity of the stone. In all other than sandstones, however, the presence of a readily oxidizable sulphide is a serious defect, since crystalline rocks require no such cement, and the change in color can in very few cases be considered other than a blemish. This is well illustrated in some of the lower courses of granite in the new capitol building at Albany, New York, to which reference has already been made. More than this, the pyrite, in decomposing in contact with the gaseous atmosphere of cities, may give rise to small quantities of sulphurous and sulphuric acids, which by their corrosive action upon the various mineral constituents of the stone render it porous and more liable to the destructive effects of frost. (See p. 301.) The conversion by oxidation of a sulphide into a sulphate is moreover attended with an increase in volume; there is thus brought to bear a mechanical agency to aid in the work of disintegration.

Iron in the form of a ferrous carbonate is a common constituent of many calcareous rocks, and in the form of other readily decomposable protoxide compounds occurs not infrequently in the cementing material of fragmental rocks lying below the water level. All these compounds are susceptible to oxidation on exposure to atmospheric influences, and to these, more than to the presence of sulphides is presumably due the mellowing commonly observed in white marble or the light gray sub-Carboniferous sandstones.

in the atmosphere entirely in an uncombined state, but were probably in large part combined with other substances to form chlorides, sulphates, etc. L. P. Gratacap (School of Mines Quarterly, May, 1885, p. 335), from a series of tests at Staten Island, New York, computed the entire amount of chlorine brought down by the rains during 1884 to have been some 46.23 pounds for each acre of ground. This is regarded as in large part combined with sodium to form sodium chloride (common salt). Egleston (Cause and Decay of Building Stone, p. 5) estimates that the 4,500,000 tons of coal annually burnt in New York City discharge into the air 78,750 tons of sulphuric acid. In 65 cubic centimeters of rain-water caught during an exposure of forty-one days, this same authority found $4\frac{1}{2}$ milligrams of sulphuric acid.

* Geol. of Minn., Vol. I, p. 189.

Iron, in the form of magnetite—a mixture of the ferrous and ferric oxides—is liable to still further oxidation, becoming converted wholly into the hydrous or anhydrous ferric oxide. Thus, if abundant, the rock assumes a rusty hue, and perhaps gradually falls away to a coarse sand, as is the case with certain of our diabases.*

Black mica, hornblende, augite, and other silicate minerals rich in iron are also liable on long exposure to change through the further oxidation of this ingredient, but when a stone is placed high and dry, as in the walls of a building, this change must necessarily be so slow as to be of little moment, though of the greatest importance from a geological standpoint. Mr. Wolff, however, states† that tombstones of diabase in cemeteries about Boston have in some cases turned a rust-brown color, the change apparently occurring in the hornblende and augite. The feldspars of the granites used in this same city were also observed in many cases to have become liver-brown, rusty-red, or yellow owing to the higher oxidation of the iron contained by them.

Deoxidation.—The process of deoxidation, whereby a ferric is changed to a ferrous oxide, is possible generally only in presence of organic acids and continual moisture. It is likely, therefore, to affect only those stones used for foundations, and need not be further considered here. The same may be said in regard to hydration, whereby an anhydrous is changed to a hydrous oxide. The blotching and variegation of beds of sandstone, as those of Marquette, Mich., is due to the deoxidation and hydration of the iron oxides forming their cement, together with a partial removal of the same by the aid of organic acids. Such changes are presumably possible only in the quarry bed or in moist foundations and bridge abutments.

Solution.—The subject of solution can not, however, be passed over so lightly. Pure water alone is practically without effect on all stones used for building purposes. Rain-water, however, as already noted, may contain appreciable quantities of various acids which greatly add to its solvent power, as the rapid destruction of certain classes of rocks only too well attests. Carbonate of lime, the material of ordinary marbles and limestones, is particularly susceptible to the solvent action of these acids even when they are present in extremely minute quantities, and to this agent is largely due the rapid defacement of the marble tombstones in church-yards and the marble-faced buildings in cities.

It is to the ready solubility of calcium carbonate that is due in large part the poor weathering qualities of sandstones with calcareous cements. The calcite is slowly removed by solution; the silicious grains thus become loosened, and, falling away under the influence of wind and rain,

* In one part of the dikes that form the Hanging Hills at Meriden, Conn., the rock (diabase) is quite black, and the amount of iron (nearly 14 per cent. of magnetite) has been the cause of rapid disintegration. Hawes, *Am. Jour. Sci.*, Vol. IX, 3d, 1875, p. 188.

† Rep. Tenth Census,

expose fresh surfaces to be acted upon. Certain of the ferruginous cements are likewise susceptible to the influence of the acidulated rains, though the anhydrous oxides occurring in the Potsdam stones are, according to Julien, less soluble than are the hydrated forms occurring in those of Triassic age.* The feldspars of granites and other rocks are also susceptible to the same influence, though naturally in a much less degree. The acidulated rains aided by the disintegration produced by temperature changes may in time partially remove, in the form of carbonate, the alkalies—potash and soda—and the rock slowly disintegrates into sand and clay. The feldspars of the gneiss, used so extremely in years past in and about Philadelphia, are said to have proved peculiarly liable to this change, and it has been found necessary in many instances to paint some of the older structures formed from it to avoid serious disintegration.

(3) INDURATION OF STONE ON EXPOSURE.

The changes produced by weathering are not in all cases those of decomposition. All stones, and especially the limestones and sandstones, undergo at first a process of hardening on being removed from the quarry or when exposed in the quarry bed, as will be noted further on. This hardening is explained by Newberry and others on the supposition that the water with which the stones are permeated, holds in solution, or at least in suspension, a small amount of siliceous, calcareous, ferruginous or clayey matter. On exposure to the atmosphere this *quarry water*, as it is technically called, is drawn by capillarity to the surface of the block and evaporated. The dissolved or suspended material is then deposited, and serves as an additional cementing constituent to bind the grains more closely together. It is obvious that the amount of induration must in most cases be quite small, and limited to but a thin outer crust on each block; also that when this crust has once formed it can, if removed, never be replaced since the stone in the walls of a building is cut off from further supply of quarry water, and as a matter of course, after whatever quantity contained within its own mass has come to the surface and evaporated, no further hardening by this means can take place. This induration sometimes takes place in a peculiarly rapid and interesting manner. Dr. Wadsworth, in writing on some Potsdam and St. Peter's sandstones near Mazo Manie, Wis.,† states that those portions of the stone which are exposed to atmospheric influences have become by induration converted into compact quartzites, while the protected portions still retain their porous and friable nature. So rapidly does this change take place that an exposure of but a few months is sufficient to produce very marked results on a freshly broken surface.

It is on this account that the practice of setting rough stone in a

* Julien, Rep. Tenth Census, Vol. x, p. 776.

† Proc. Bos. Soc. Nat. Hist., Vol. xxii, 1883, p. 202.

wall, and leaving them to be carved when the structure is completed, is strongly condemned by some,* as in so doing the hard outer crust that began to form as soon as the stone was exposed to evaporation is entirely removed, and the delicate carving disintegrates much more rapidly than otherwise would have been the case. The carving, it is argued, should be done at once, while the quarry water is still present, and the crust then forms upon its surface, and it is thus better able to resist atmospheric action. The rescouring and housing of buildings and works of art is strongly objected to on similar grounds.†

(7) WEATHERING PROPERTIES OF STONES OF VARIOUS KINDS.

We will now consider the effects of the various agencies just enumerated upon the different classes of rocks in common use for building materials.

Granites are liable to disintegration chiefly from the constant expansion and contraction caused by natural temperatures. The chemical changes to which they are subject, such as the kaolinization of the feldspars or rusting of the micas, being as a rule scarcely noticeable in the walls of a building, while they are so compact as to be practically non-absorbent and hence not liable to injury by freezing alone. The same may be said respecting the diabases, melaphyrs, and basalts when not particularly rich in magnetite or secondary calcite. Dr. Hague, in describing the decay of the granite obelisk in Central Park, New York, says: "In my opinion the process of disintegration has been an extremely slow one, caused by a constant expansion and contraction of the constituent minerals near the surface, due to diurnal variations of temperature. In a climate like that of New York, where these diurnal changes are frequently excessive at all times of the year, the tension between the minerals would naturally tend to a mechanical disintegration of the rock. Granite being a poor conductor of heat, the effect of these changes would be felt only at short distances below the surface, causing in time minute fractures and fissures along lines of weakness. Into these openings percolating waters, upon freezing, would rapidly complete the work of destruction."‡

The decay of the obelisk since it reached New York, then, has been simply mechanical and not chemical. The same has been found true by Professor Julien of certain granites used for building in New York City.§

Helmerson explains the rapid disintegration of the Alexander column in St. Petersburg, Russia, on the grounds that it contains many large crystals of a triclinic feldspar, which when subjected to the extreme temperatures of Russian climate expand and contract unequally in the direction of their three crystallographic axes and hence cause the

* Le Duc, *Story of a House*, p. 143.

† See Chateau, under "Inconvénience du grattage à vif," p. 353.

‡ Science, December 11, 1885, p. 511.

§ E. g., the old "Tombs" building on Center street.

crumbling.* This view seems plausible, but we believe it yet remains to be shown that rocks rich in triclinic feldspars in reality disintegrate more rapidly than others.

Granite was for a long time popularly believed to be a nearly fire-proof material. The great fires of Portland, Boston, and Chicago not merely exposed this delusion but proved the direct opposite—that instead of being the most fire-proof it was the least so, ranking below either sand or limestone. The peculiar susceptibility of the stone to the effect of heat may be ascribed to its compact and complex structure, each of its constituent minerals possessing different degrees of expansibility.†

It has also been suggested by certain authors that the minute water-filled cavities in the quartz of these rocks may be an important factor, since, when highly heated, the water is converted into steam and an explosion results, causing the quartz to fly into fragments.‡

The relative durability of sandstones and granite under fire is stated to have been well shown not long since at the burning of St. Peter's Church at Lamerton, England. The church itself, which was built in great part of granite, was completely ruined, while the tower, built of a local freestone, around which the heat of the fire was so great as to melt six of the bells as they hung in the belfry, was left intact, although the granite window-jams and sills were destroyed.§

Limestones and dolomites, both marbles and the common varieties, are perhaps less affected than granite by the purely mechanical agencies, but make up for this in their susceptibility to the solvent action of gaseous atmospheres. Limestones are in this respect less durable than dolomites, so that, the tenacity being the same, a dolomite might, under the same circumstances, be considered as promising greater durability

* See Science, January 22, 1886, p. 75.

† The co-efficient of cubical expansion for several of the more common rock-forming minerals has been determined as follows:

Quartz	.000036	Tourmaline	.000022
Orthoclase	.000017	Garnet	.000025
Adularia (feldspar)	.0000179	Calcite	.00002
Hornblende	.0000284	Dolomite	.000035
Beryl	.000001		

The quartz, it will be noticed, has a co-efficient of expansion double that of the orthoclase, and nearly a third greater than hornblende. The matter is further complicated by the fact that each individual mineral expands unequally along the direction of its various axes. Thus quartz gives a co-efficient of .00000769 parallel to the major axis, and of .00001385 perpendicular to this axis; adularia gives .0000156, .00000659, and .00000294 for its three axes; and hornblende for the same axes gives .0000081, .00000084, and .0000095. (See Clarke's Constants of Nature, Smithsonian Misc. Coll., Vol. XIV.)

‡ After a microscopic examination of thin sections of all our granites, such as are used for building purposes, the author can but feel that in most cases the results thus produced are too small to need serious consideration.

§ Am. Arch., Vol. IV, 1878, p. 80.

than a limestone (see p. 350). A thoroughly crystalline or non-crystalline compact and homogeneous limestone or dolomite is scarcely, if any, more absorbent than a granite, and hence it is as little liable to injury from freezing. Professor Geikie, in studying rock-weathering as displayed by the marble tombstones in Scottish cemeteries, observed that the process presented three distinct phases, all of which were at times observable on the same slab. These were (1) *superficial solution*, caused by the carbonic and sulphuric acids of the atmosphere; (2) *internal disintegration*, accompanied or preceded by the formation of an exterior coat or film of sulphate of lime; and (3) *curvature and fracture*. The first phase manifested itself in loss of polish and gradual roughening of the surface, followed by the formation of minute rifts and final rapid disintegration. One case is mentioned in which a stone erected in 1785 became so far decayed as to require restoration in 1803, and at the time of writing (1880) was and had been for some years so corroded as to be entirely illegible.

The second phase, that of internal disintegration, manifested itself in a peculiar manner. In a number of cases examined it was found that the sulphuric acid brought in contact with the stone by rains had reacted upon the calcium carbonate, producing a superficial coating, • varying in thickness from that of a sheet of paper to a millimeter, of sulphate of lime. This, so long as it remained intact, seemed to protect the stone from other atmospheric influences. On the breaking of the crust, however, it was found that the cohesion of the crystalline granules beneath had been destroyed and the stone crumbled rapidly to sand, the cause of which is attributed largely to mechanical agencies.

The third phase, that of curvature and fracture, was observed only on thin slabs of marble which had been placed in a horizontal or vertical position and confined by a frame of sandstone. It manifested itself in the bulging outward of the slab like the bellying of a well-filled sail. In one case examined, that of a slab of marble $30\frac{1}{4}$ inches long, $22\frac{3}{8}$ inches wide, by three-fourths of an inch thick, which had been thus secured against a wall, the slab was found to have escaped from its fastenings at the sides, though still held at the top and bottom, and to have bulged outward sufficiently to allow the insertion of the hand and arm between it and the wall at the widest point. It had also expanded laterally so as to be one-half an inch wider in the center than at the ends. The outer surface of the slab where the greatest strain was produced by the bending was filled with minute cracks or rifts, the largest of which were some one-tenth inch in diameter. The cause of the bulging is believed by Professor Geikie to be due to expansion caused by the freezing of water absorbed from rains.*

Professor Geikie's conclusions from the examination of a large number of cases were to the effect that in all but exceptionally favorable and sheltered localities slabs of marble exposed to the weather in such

*Geol. Sketches, pp. 170-172.

a climate as that of Edinburgh lost their polish after an exposure of but a year or two and became entirely destroyed in less than a century; hence that the stone was quite unfitted for outdoor work in that vicinity. These results are greatly in exaggeration of what takes place in our own cemeteries. Professor Julien states that in the city cemeteries about New York the polish on marble tombstones often survives for ten years, and in protected places, as near the ground in suburban cemeteries, for half a century. He further states that while of the tombstones in St. Paul's churchyard in New York City, about one-tenth of the inscriptions dating back to the latter part of the eighteenth century are illegible, he has never seen the same effect produced in suburban cemeteries in the same length of time. The author's own observations on the subject are to the effect that in the cemeteries of the smaller towns and cities of New England marble tombstones will retain their polish for a period of ten or fifteen years and up to thirty or thirty-five present no sign of disintegration of a very serious nature. Beyond this time, however, the surface becomes rough and granular and the edges of the stone may be found filled with fine rifts into which particles of dirt become lodged or lichens take root, giving it a dirty and unkempt appearance.*

Such stone are frequently taken down, re-honed and polished, and again set up to do duty for another term of years. A closely crystalline or non-crystalline, compact, and homogeneous limestone is probably as little affected by frost as are the granites. Very many of the limestones and dolomites used for ordinary building are, however, by no means sufficiently non-absorbent to protect them from injury by freezing, nor are they sufficiently uniform in texture to weather evenly, the disintegration going on more rapidly in some layers than others, thus producing rough and unsightly walls. Professor Winchell, writing on the weathering of the Trenton limestone used at Saint Paul and Minneapolis, says:† "The stone itself has an attractive and substantial aspect when dressed under the hammer, the variegations due to the alternating shaly and limy parts giving the face a clouded appearance, as of gray marble, without being susceptible of a uniform polish. Where protected from the weather the shale will endure and act as a strong filling for the frame-work of calcareous matter for a long time; but under the vicissitudes of moisture and dryness, and of freezing and thawing, it begins to crumble out in a few years. This result is visible in some of the older buildings, both in Saint Paul and Minneapolis." Professor Hall, writing on rock weathering,‡ says: "In the gray or bluish-gray subcrystalline limestones the argillaceous matter, instead of being distributed throughout the mass, is usually present in the

* The fine grained saccharoidal marbles used for statuary are even less durable, and in extreme cases have shown serious disintegration at the end of three or four years exposure.

† Preliminary Report on Building-stones, etc., 1880, p. 13.

‡ Report on Building-stones, p. 36.

form of seams which are parallel to the lines of bedding or distributed in short, interrupted laminæ. These seams, whether continuous or otherwise, are fatal to the integrity of the stone, and there is scarcely a limestone structure in the country, of twenty-five years standing, which is not more or less dilapidated or unsightly, from the effects of absorption of water by the clay seams, and the alternate freezing and thawing. When laid in the position of the original beds, which is the usual mode, the separation by the clay seam is slower; but when used as posts or pillars, with the lines of bedding vertical, the change goes on more rapidly."

Sandstones, on account of their widely varying textures and degrees of compactness, together with an equal variation in composition and character of cementing materials, are influenced, to a greater or less extent, by all the atmospheric influences enumerated. In the order of its apparent importance may be mentioned first the effects of freezing. As will be noticed by reference to the tables in the appendix, sandstones will absorb from about one-fiftieth to one-eighth of their weight in water in twenty-four hours, or from 2 per cent. to 12½ per cent. The approximate amount which a stone may absorb with impunity cannot, of course, be stated, since much depends on its position in a building and the strength and structure of the stone itself. It is not too much to say, however, that any stone which will absorb 10 per cent. of its weight of water during twenty-four hours should be looked upon with suspicion until, by actual experiment, it had shown itself capable of withstanding without harm freezing when in this condition. Half of this amount may be considered as too large when the stone contains any appreciable amount of calcareous or clayey matter. (See foot-note, p. 348.)

It is to their great absorptive power that is due the large amount of disintegration and exfoliation seen in the softer sandstones, as the Triassic of the Eastern United States and the sub-Carboniferous of Ohio. When a stratified rock, and especially one that is distinctly laminated, is placed on edge the water filters into it from above, and, there freezing, from necessity produces the scaling so often noted in the Connecticut brownstone. If placed on the bed the effect is not nearly as disastrous, but with a porous stone the effect of continual freezing and thawing can but be injurious. It was with an apparent entire disregard of the probable effect of these agencies that was selected the soft and porous Juro-Cretaceous sandstone from Acquia Creek, Virginia, for the construction of the White House, central part of the Capitol, and other public and private buildings in Washington, a stone so susceptible to these influences, that it is only by a most prodigal use of paint and putty that the buildings are kept in a condition at all presentable.*

* Other reasons than that of lack of durability can be given against the use of a too porous stone in a house wall. "A red sandstone house may be a very handsome building, but then it may be holding tons of water, and such a wall, if exposed to the northwest, in an open country, in our neighborhood, in a rainy winter, would, no

Acid gases are naturally without effect upon the silicious particles of a sandstone, and can be productive of injury only in dissolving out the ferruginous and calcareous cements. This is actually accomplished in many cases, and much disintegration results as a consequence. Indeed, Egleston* seems to regard the serious decay into which the stone of Trinity Church, New York, has fallen, to be due chiefly to this cause, supplemented by the action of frost after the cement had been removed and the stone thus rendered porous. The relative solubility of the various ferruginous cements has been already alluded to (ante p. 339). Oxidation is likely to play a more noticeable part in sandstones than in most other rocks, owing to their porous nature, which allows ready access of water and air. The effect of oxidizing pyrite in producing the mellowing and other color changes in stones of this class is sufficiently dwelt upon elsewhere, as is also the effect of heat, both natural and artificial.

On account of their porosity and natural roughness of surface sandstones are of all stones most likely to afford foothold for the growth of algae, lichens, and mosses. While it is yet to be proven that these are actually injurious, they are at least suggestive of an unhealthy dampness. A stone once covered by these organisms will absorb more water and give it up more slowly to evaporation than one whose surfaces are not thus protected.

Serpentines when free from bad veins are as a rule non-absorptive and not affected by gaseous atmospheres, hence are durable if free from bad joints. The Pennsylvania serpentines sometimes turn whitish on exposure, but so far as observed do not disintegrate.

Soapstone, although too soft and possibly too slippery for general building, is nevertheless one of the most durable stones, being not only proof against atmospheric and chemical agencies, but when well seasoned fire-proof as well.

Gypsum is too soft and too soluble in ordinary terrestrial waters to be of great value.

I.—ON THE SELECTION OF BUILDING STONE.

(1) GENERAL CONSIDERATIONS.

From what has gone before it must be evident that there are many more factors which go to determine the value of stone for structural purposes than are ordinarily taken into consideration. It may therefore not be out of place here to mention a few general principles to be observed in selecting stone for any purpose in which durability or stability of color are matters of importance. It should be stated at the

doubt, get saturated. This means expending more fuel to convert part of this water into vapor. The difficulty is surmounted to a great extent by building hollow walls, the inner wall being of brick. Woe unto the man who has not taken this precaution." (T. Mellard Reade, in Proc. Liverpool Geological Soc., p. 445 and 446, 1883-84.)

*Cause and Prevention of Decay in Building Stone. Trans. Am. Soc. Civ. Engs. xv, 1886.

outset that the problem of ascertaining by laboratory or other tests the actual qualities, good or bad, of any stone, is peculiarly complicated and difficult.* In the present state of our knowledge nothing like definite rules of procedure with any probability of accurate and reliable results can be given. That the difficulties may be better appreciated it may be well to note here the main points to be considered. In the order of their apparent importance they are:

- (1) Resistance to changes in temperature.
- (2) Resistance to chemical action of the atmosphere.
- (3) Crushing strength and elasticity.
- (4) Resistance to abrasive action of feet and wind-blown sand.

The order as above given may be subject to modification to suit individual cases. In many instances the actual strength of a stone is a matter of little importance, and in protected situations the quality mentioned under (4) may be wholly left out of consideration. In still other cases, as in bridge abutments, strength and elasticity are matters of greatest import, while that of change of color can have no essential value. In the arrangement given above, especial regard has been had to stone exposed in the exterior walls of a building, and in a varied climate like that of the northern and eastern United States.

The first item for consideration is then the matter of climate. This, together with the location in which a structure is to be erected, with especial reference to proximity to large cities and manufacturing establishments, and even the directions of the prevailing winds and storms, are of primary importance and need consideration as well as do the physical and chemical properties of the stone itself.†

Our Northern and Eastern States, with an annual precipitation of some thirty-nine or forty inches and a variation in temperature amounting in some cases to not less than 120°, are necessarily more trying than those where the precipitation is less or the temperature more uniform. There is many a porous sand or lime stone which could endure an exposure of

* See article "On the testing of building-stone," by the writer in *American Architect* for February 16, 1889.

† "As an instance of the difference in degree of durability in the same material subject to the effects of atmosphere in town and country we may notice the several frustra of columns and other blocks of stone that were quarried at the time of the erection of St. Paul's Cathedral in London, and which are now lying in the island of Portland, near the quarries from where they were obtained. These blocks are invariably found to be covered with lichens, and although they have been exposed to the vicissitudes of a marine atmosphere for more than one hundred and fifty years they still exhibit beneath the lichens their original forms, even to the marks of the chisel employed upon them, whilst the stone which was taken from the same quarries and placed in the cathedral itself is in those parts which are exposed to the south and southeast winds found in some instances to be fast moldering away." (*Gwyllt's Encyclop. of Arch.*, p. 458.)

It is stated that in England the northern part of a building is always in a better state of preservation than the southern, owing to the more uniform amount of moisture and less heat from the sun.

hundreds of years in a climate like that of Florida or New Mexico, but which would probably be found in a sad state of disintegration at the end of a single season in some more northern State.

We are accustomed to hear a great deal regarding the wisdom of the ancients, and especially the Egyptians, as shown in the selection of enduring materials for their obelisks and monuments,* a wisdom or prudence which modern builders "admire more than they imitate," and we are referred to the still legible inscriptions and sharp sculptures on the surfaces of these obelisks, even after thousands of years of exposure, as proof of this marvelous foresight on the part of a semi-barbarous people. It must be borne in mind, however, that nature herself had vastly more to do in this matter than Egyptian foresight, and it is more than probable that at that time materials were selected with as little regard for their lasting qualities as they are to-day. The Syene granite, so durable under Egyptian skies, is no better than those in common use in this country, as the transported obelisks in New York and London have plainly shown. It is a matter of climate more than of material, and this fact should never for a moment be ignored. Were the climate of the United States like that of Egypt, southern Italy, or Mexico there would have arisen no occasion for the compilation of this chapter.†

(2) PRECAUTIONS TO BE OBSERVED.

The precautions which should be observed in selecting a stone for building purposes may here be briefly alluded to.

In those portions of the northern and eastern United States that have been subjected to glacial action,‡ and where the great mass

* *Vide Matériaux de Construction*, par L. Malécot, p. 30.

† "From the manner in which the buildings and monuments of Italy, formed of calcareous materials, have retained to a wonderful degree the sharpness of their original sculpturing, unless disfigured by the hand of man, it is clear that a dry and smokeless atmosphere is the essential element of durability. In this respect, therefore, the humid sky and gaseous atmosphere of British towns must always place the buildings of this country at a comparative disadvantage as regards durability." (Hull, p. 282.)

"La Grèce, la Basse Italie, et notamment la Sicile, dit-il, ont cet étrange privilège que tout s'y conserve intact, presque sans se détériorer, pendant des siècles consécutifs. Aussi les monuments, les statues, les marbres blancs eux-mêmes, qui, chez nous (en France), deviennent noirs en deux ans, ronges en dix ans, ruinés en cinquante, chez eux sont à peine noircis au bout de trois ou quatre siècles d'exposition en plein air. Sous terre ou dans un appartement ils gardent intactes leur forme et jusqu'à leur blancheur, à perpétuité pour ainsi dire.

J'ai vu retirer de terre à Ponzole, près de Naple, des marbres enfouis depuis plus de deux mille ans, qui avaient l'air de sortir des mains du sculpteur.

A Palerme, les statues et les marbres en plein air sont, il est vrai, assez noirs; mais ils n'ont jamais été touchés, m'a-t-on dit, depuis leur mise en place, et il y a là des statues qui datent de dix siècles." (E. Carrey, as quoted in *Malécot's Matériaux de Construction*, p. 31.)

‡ This includes all of New England and those portions of other States lying north of a line running irregularly from a point near the western end of Long Island

of rotten rock that had accumulated during previous geologic ages has been entirely removed, if the surface of the rock as displayed in the quarry or natural outcrops presents a fresh and undecomposed appearance, this may be construed as a strong argument in its favor, though it can not in all cases be accepted as conclusive.* A purely calcareous rock may weather rapidly and yet leave no débris, since its constituents are soluble and may all be carried away by running water, leaving no traces to tell of the havoc going steadily on. Impure limestones and all silicious rocks, however, leave more or less débris as mark of their decay.

But in regions south of the glaciated area the rock is still covered by the decomposed mass, and hence no clew can thus be obtained. In such cases one can only have recourse to structures that have already been erected from the stone in question and there observe its weathering qualities, or, if these are lacking, observe the stone in those parts of the quarry that have not recently been worked. In opening a new quarry, blocks should always be tested by allowing them to lie and season for at least a year before using. At the end of this time the presence of any readily oxidizable pyrite will have made its presence known, and the amount of disintegration, or induration, as the case may be, will furnish a slight clew regarding its future behavior. Indeed, this seasoning of stone prior to its introduction into a building should always be insisted upon, whatever its character. A good building stone, whatever its kind, should possess a moderately fine and even texture, with the grains well compacted, should give out a clear ringing sound when struck with a hammer† and show always a clean fresh fracture. It should also be capable of absorbing only a proportionally small amount of water.‡

across New Jersey; thence northwesterly across Pennsylvania into New York State south of Buffalo; thence southwesterly to near central Ohio; thence due south nearly to the Ohio River; westerly along the river to a point north of Louisville, Ky.; thence northerly again nearly to Indianapolis, Ind.; thence southwesterly so as to include nearly all of Illinois; thence northwesterly to a point near Saint Louis; westerly toward Jefferson City, Mo.; thence along the Osage River and northwesterly through Kansas near Topeka; through the eastern half of Nebraska, through Dakota west of Bismark, and thence onward into Montana.

* "No artificial structure or position will ever subject the stone to the same degree of weathering influence to which it is exposed in its natural position. * * * The rock which has withstood these influences is quite equal to withstand the exposure of a few centuries in an artificial structure." (Hall Rep. on Building Stone, p. 24.)

† In a report on some experiments on the transverse strength and elasticity of building stone, Mr. T. H. Johnson states "the resonance of each piece tested was proportional to the modulus of elasticity as found by the test." (Rep. State Geol. of Ind., 1881, p. 38.)

‡ En un mot, les qualités essentielles des pierres tant dures que tendres sont d'avoir le grain fin et homogène, la texture uniforme et compacte; de résister à l'humidité à la gelée, et de ne pas élater au feu en cas d'incendie. (Chateau, Vol. 1, p. 272.)

Any sandstone weighing less than 130 pounds per cubic foot, absorbing more than 5 per cent. of its weight of water in twenty-four hours, and effervescing anything but feebly with acids, is liable to prove a second-class stone as regards durability where there is frost or much acid in the air." (Notes on Building Construction, p. 36.)

The porosity of any stone is usually characteristically shown by its manner of drying after a rain; some will dry quickly, while others that have absorbed a larger quantity of water will remain moist for a long time. In the case of a sandstone it may be said that the grains should be closely compacted, so that the proportion of cement necessary to entirely fill the interspaces is comparatively small. Of all cementing materials the argillaceous and calcareous are the least durable, and the purely siliceous the most so, the ferruginous cements standing intermediate in the series. Indeed a purely siliceous sandstone cemented closely by a siliceous cement may be classed as one of the most durable of stones, although unfortunately on account of their hardness and poor colors such can be utilized only at a considerable expense and not always with good effect. Professor Geikie* mentions an instance in which a fine siliceous sandstone erected as a tombstone in Greyfriars churchyard about 1646, and defaced by order of the Government in 1662, still showed the marks of the defacing chisel upon its polished surface after a lapse of over two hundred years.

(3) COMPARATIVE DURABILITY OF STONES OF VARIOUS KINDS.

In this connection the following table upon the "life" of various kinds of building stone in New York City is of interest; by the term *life* being understood the number of years that the stones have been found to last without discoloration or disintegration to the extent of necessitating repairs.

	Life in years.	
Coarse brown-stone.....	5 to 15	
Fine laminated brown-stone.....	20	50
Compact brown-stone.....	100	200
Blue-stone (sandstone), untried, probably centuries.		
Nova Scotia sandstone, untried, perhaps.....	50	200
Ohio sandstone (best siliceous variety), perhaps from one to many centuries.		
Coarse fossiliferous limestone.....	20	40
Fine oolitic (French) limestone.....	30	40
Marble, coarse dolomitic.....		40
Marble, fine dolomitic.....	60	80
Marble, fine.....	50	100
Granite.....	75	200
Gneiss, 50 years to many centuries.†		

The fact that certain quarries have furnished good material in the past is no guarantee of the future output of the entire quarry. This is especially true regarding rocks of sedimentary origin, as the sand and limestones, different beds of which will often vary widely in color, texture, composition, and durability, though lying closely adjacent. In many quarries of calcareous rocks in Ohio, Iowa, and neighboring States, the product is found to vary at different depths all the way from a pure limestone to magnesian limestone and dolomite. The

* Geological Sketches, p. 175.

† Julien, Rep. Tenth Census, 1880, p. 391.

cause of this remarkable variation is little understood and can not here be touched upon,* but the fact that such occurs is of importance, since in many and perhaps the majority of cases an equal variation exists in point of durability. By English as well as many other authorities a dolomite is, other things being equal, considered more durable than a limestone, and beyond doubt this is the case in localities where the atmosphere is at all acidic, since dolomite, as already noted, is but little affected by these agencies. Aside from this it would seem yet to be proven that, in the United States, a pure limestone was less durable than one that contained the necessary magnesia to constitute a true dolomite.† Indeed, Professor Hall considers the magnesian limestones, as a whole, “more friable, more porous, and less firm” (and consequently less durable) than the pure limestone.‡

Stones which are mixtures of limestone and dolomite are liable to weather unevenly, the limestone crystals becoming eaten out, while the dolomite particles are left to project and impart a rough and lusterless surface.

Coarsely fossiliferous stones are usually to be avoided for exposed work, as they weather unevenly, owing to the unequal hardness of the fossils and the matrix in which they are embedded. Thus the coarse gray Niagara limestone from Lockport, N. Y., used in the construction of the Lenox Library building in New York City, began to show signs of decay even before the structure was completed. It should be remarked, however, that this extreme rate was due in part to the fact that the stone was laid on edge and not on the natural bed. Mr. Wolff§ mentions a case of a monument of shell marble in a Boston cemetery, in which, after seventy years' exposure, the fossil shells stand out in bold relief; the stone is also covered with fine cracks and is otherwise decomposed.||

Veined stones are also subject to unequal weathering when exposed; this being due to the unequal hardness of the vein matter and the mass of the rock. This is true of all stones, but is especially noticeable in

* Interested parties should consult such works as Geikie's text book of Geology and Prestwich's Chemical and Physical Geology and the authorities there alluded to.

† “The nearer a magnesian limestone approaches a dolomite in composition the more durable it is likely to be.” “In the formation of dolomite some peculiar combination takes place between the molecules of each substance; they possess some inherent power by which the invisible or minutest particles intermix and unite with one another so intimately as to be inseparable by mechanical means. On examining with a high magnifying power a specimen of genuine magnesian limestone * * * it will be found not composed of two sorts of crystals, some formed of carbonate of lime and others of carbonate of magnesia, but the entire mass of stone is made up of rhomboids, each of which contains both earths homogeneously crystallized together. When this is the case we know by practical observation that the stone is extremely durable.” (Smith's Lithology, Building Const., p. 40.)

‡ Rep. Tenth Census, p. 290.

§ Rep. on Building-Stone, p. 40.

|| The limestone of which was constructed the State capitol building at Nashville, Tenn., has proved so inferior, owing to the weathering out of the numerous fossil orthocera, that the quarries have been discontinued on this account alone.

the so-called verdantique marbles, where the white veins of calcite or dolomite lose their polish and crumble away more rapidly than the serpentine composing the bulk of the rock. Good examples of this are to be seen in the bases of the two statues in front of the City Hall in Boston. Stones which, like many marbles, contain seams of mica, talc, or other minerals, are objectionable for like reasons. Thus the marble column supporting the statue of Lincoln in front of the City Hall at Washington, though having been in place but some twenty years, is today cracked from top to bottom, owing to the opening of one of these seams of talc. It may be stated further that in the majority of marbles and such other stones as are used chiefly for decoration work, those variously colored lines and veins or structural features which give the stone its chief beauty are in reality flaws and lines of weakness. There is many a beautiful imported marble which when sawn into a thin slab will scarcely bear its own weight, but must be backed by cheaper and stronger material.

It may be said here that the essential qualities of a marble, aside from color, which may vary almost indefinitely, are that it shall possess a texture sufficiently compact and hard to take a smooth surface and acquire a high polish. The chief defect in nearly all American marbles, and one that does not as yet seem to be fully realized, is that they are too coarsely crystalline. This not only renders the production of a perfect surface difficult, but the cleavage facets frequently reflect the light from below the surface in such a way as to destroy its uniformity. However good the color may be, a stone of this nature must always rank lower than one that is so fine grained as to appear non-crystalline or amorphous. It is this fact, and this alone, that renders the American marbles now in the market inferior to such as are imported from Belgium, the French Pyrenees, Italy, or northern Africa. Those who are seeking new sources of material will do well to bear this in mind.*

Time of quarrying.—The season of year during which a stone was quarried may also, in certain cases, be worthy of note. It is well known that many stones can be quarried with safety only during the summer season, but Grüber goes a step further and states† that while the best time for quarrying is during the summer, the freshly quarried material should not be allowed to lie in the sun and dry too quickly, as it is liable thereby to become shaky. This he regards as particularly likely to happen to sandstone. Stone quarried in winter, or during very wet seasons, is liable, according to this authority, to have but slight tenacity when dried, and to remain always particularly susceptible to the effects of moisture. Finally, he states, a stone is liable to disintegration if built immediately into a wall without seasoning. Stones for carved work are to be quarried in the spring, since such longest retain their quarry water, and this, if once lost, no subsequent wetting can restore.

* Stone, Indianapolis, Ind., February, 1889,
Die Baumaterialien-Lehre, p. 61.

K. METHODS OF PROTECTION AND PRESERVATION.

www.libt(1).PRECAUTIONARY METHODS.

Position in wall.—All authorities agree that stratified stone should be placed in the walls with the bedding horizontal, or at right angles to the direction of greatest pressure. Not only are they as a rule strongest in this position, but as they will absorb less water they are correspondingly less liable to suffer from the effects of frost. This fact has already been sufficiently dwelt upon. The denser and harder stones should as a rule be used in the lower courses; the lighter ones in the superstructure. The non-absorbent stones should be used in the ground and in plinths, sills, strings, courses, and weather beds of cornices, etc.; the softer and more absorbent ones may be used for plain walling.*

The necessity of laying non-absorbent stones in the ground becomes apparent when we consider that in this position they are in contact with more or less moisture, which, when absorbed, is liable to cause discoloration and damp, unhealthy walls. If from necessity porous stone are used, a coating of water-proof material, as asphalt, should be interposed between those courses that are in contact with the ground and those of the superstructure.†

In laying the lower courses of Lee dolomite in the walls of the Capitol at Washington, the stone was observed to show a brownish discoloration, due to the absorption of unclean water from the mortar. This was finally remedied by coating the lower surfaces of the stones where they came in contact with the mortar with a thin layer of asphalt which prevented such absorption and thus removed the difficulty.‡

No one who has given the subject any attention can have failed to remark how, in town and city houses constructed of the Connecticut or New Jersey brown sandstones, the blocks in the lower courses—those in close proximity to the sidewalks—almost invariably scale after an exposure of but a few years, while those in the courses above remain intact for a much longer period. This is due to the fact that these lower courses are kept almost constantly wet, receiving not only the water that falls as rain upon the walls above, but also that which splashes from the walk or is absorbed from the ground. As noted by Chateau (*op. cit.*, p. 352), it is not those portions of a wall that receive the water from rains direct that are most and earliest liable to decomposition, but the under and partially protected portions, as those under the cornices,

* *Cyclopedia of Arts and Sciences*, Vol. VII, p. 839.

† T. Eggleston, *Am. Arch.*, Sept. 5, 1885. This authority states further, that in the exterior walls of Trinity Church, New York, the stone for the first 60 or 70 feet in height is more decomposed than above this point. This is accounted for in part on the supposition that the atmosphere near the ground contains a larger proportion of acid gases than at higher altitudes.

‡ *Sil. Jour.*, XXII, 1856, p. 36.

the entablatures and the "tablettes" of balustrades upon which the water drips or runs more slowly. It is for this reason that architects advocate the under-throating of window sills and other projections in order that the water may be thrown off from the building and not allowed to run down over the face of the stone beneath. The disastrous effects from neglect of this proceeding have been dwelt upon by Julien in reference to buildings in New York City. The author has in mind the costly residence of a former Cabinet minister in Washington in which the middle portion of the brownstone entablatures are almost continually wet throughout the winter months by the soaking through of water from above. The stone steps in the same house are constantly wet and show a whitish efflorescence. Both these defects are liable to appear in so porous a material, but might in large part have been averted by exercising proper care in building.

It may not be out of place here to comment on the folly of placing iron railing on steps, platforms, etc., of finely finished granite, since in spite of paint and other means of protection the iron invariably rusts, staining and badly defacing the entire surface beyond possibility of repair.

The method of dressing a stone has an important bearing upon its durability. As a rule it may be set down that the less jar from heavy pounding the surface is subjected to the better; this for the reason that the constant impact of the blows tend to destroy the adhesive or cohesive power of the grains, and thus renders the stone more susceptible to atmospheric influences. It is stated by Mr. Batchen that some of the dolomites used in Chicago, although apparently perfectly sound when quarried, shortly showed a tendency to scale on exposure. On examination it appears that in dressing these surfaces were both ax- and bush-hammered, the implements used weighing from 8 to 12 pounds, and capable of striking blows of not less than 150 or 200 pounds. The effect of these heavy blows was to "stun"* the surfaces for the depth of from one-sixteenth to one-eighth, or even one-fourth, of an inch, and on exposure scaling resulted, leaving them ragged and unsightly. Sawn surfaces of the same stone, on the contrary, do not usually show the slightest tendency to scale.

Results such as these are what one is naturally led to expect, but further experiments are necessary before it will answer to speak too positively regarding the merits or demerits of various kinds of finish. With compact crystalline rocks like the granites and diabases it would seem probable that rock-faced work, untouched by chisel or hammer, would prove most durable, since the crystalline facets thus exposed are best fitted to shed moisture and the natural adhesion of the grains has not been disturbed †.

* *I. e.*, to break the grains and produce minute fissures.

† The single experiment of Pfaff, in which a polished granite was found to weather more rapidly than one unpolished, seems too anomalous to be accepted until further

With the softer and more absorbent stones on the other hand, the rock surface from its irregularity and roughness is more susceptible to the attacks of moisture and atmospheric acids, and hence would probably be found less durable, although from its roughness at the start any disintegration is less noticeable than on finely-finished work. With such stones a smoothly-sawn or polished surface seems best adapted to our variable climate.*

(2) PROTECTION BY MEANS OF SOLUTIONS.

Many methods have been devised for checking or altogether preventing the unfavorable action of the weather upon building stone of various kinds, but none of them can be considered as really satisfactory. The problem, as may readily be understood, consists in finding some fluidal substance into which the stone may be dipped or which may be applied with a brush to its outer surface in such a manner as to fill its pores and thus prevent all access of moisture. Whatever the substance, it must be of such a nature as in no way to discolor or disfigure the stone.

Paint.—This is one of the substances most generally used, and which has been employed on the porous sandstone of the Capitol, White House, Patent Office, and other public buildings in Washington. It is

proof is offered. A polished surface must naturally shed water more readily than a sawn or tool-dressed one, and hence it would seem that it should be more durable. It is of course possible that, owing to the manner in which the smooth surface necessary for polishing was produced, the surface minerals were badly shattered, and hence succumbed the more readily on exposure.

* Professor Hall, writing on the methods of dressing certain argillaceous limestones (Rep. on Building Stones, p. 36-37), says: "In the dressing of limestone the tool crushes the stone to a certain depth, and leaves the surface with an interrupted layer of a lighter color, in which the cohesion of the particles has been partially or entirely destroyed; and in this condition the argillaceous seams are so covered and obscured as to be scarcely or at all visible, but the weathering of one or two years usually shows their presence.

"The usual process of dressing limestone rather exaggerates the cause of dilapidation from the shaly seams in the material. The clay being softer than the adjacent stone and the blow of the hammer or other tool breaks the limestone at the margin of the seam and drives forward in the space little wedge-shaped bits of the harder stone. A careful examination of dressed surfaces will often show the limestone along the seam to be fractured with numerous thin wedge-shaped slivers of the stone which have been broken off and are more or less driven forward into the softer parts. In looking at similar surfaces which have been a long time exposed to the weather, it will be seen that the stone adjacent to the seam presents an interrupted fractured margin, the small fragments having dropped out in the process of weathering. Limestones of this character are much better adapted to rough dressing, when the blows are directed away from the surface instead of against it, and when the entire surface shall be left of the natural fresh fracture. By this process the clay seams have not been crushed, nor the limestone margining them broken, and the stone withstands the weather much longer than otherwise. The attempt at fine hammer-dressing is injurious to any stone, for the cohesion of the particles is necessarily destroyed, and a portion of the surface left in a condition to be much more readily acted upon by the weather."

found necessary to renew the coating every two or three years, and even then the results are unsatisfactory.

Oil.—This, as stated by Julien,* always discolours a light colored stone, while it renders a dark colored one still darker. According to this authority the oil is applied as follows: The surface of the stone is washed clean, and after drying is painted with one or more coats of boiled linseed oil, and finally with a weak solution of ammonia in warm water. This renders the tint more uniform. This method has been tried on several houses in New York City, and the water-proof coating thus produced found to last some four or five years, when it must be renewed.

Paraffine.—This, dissolved in coal-tar naphtha, is spoken of,† but is not recommended. A better method, as suggested by Julien,‡ consists in brushing over the surface of the building with melted paraffine and then heating it gently until it has been nearly all absorbed into the pores of the stone. This produces little or no discoloration, but it is thought doubtful by some if the heating of the stone is not more injurious than the paraffine is beneficial.

The preparation used in coating the Egyptian obelisk in Central Park, New York, is said by Mr. Caffal§ to have consisted of paraffine containing creosote dissolved in turpentine, the creosote being considered efficacious in preventing organic growth upon the stone. The melting point of the compound is about 140° Fahrenheit. In applying, the surface to be coated is first heated by means of especially designed lamps and charcoal stoves, and the melted compound applied with a brush. On cooling it is absorbed to a depth dependent upon the degree of penetration of the heat. In the case of the obelisk, Mr. Caffal states that, in his belief, it was absorbed to the depth of half an inch. Some 67½ pounds of the material was used in going over the 220 square yards of surface. An equal surface of brown sandstone is stated to require ordinarily about 40 or 50 pounds. The cost of treating an ordinary 25-foot brownstone front, with a porch, is given by this authority at from \$200 to \$300. This process, like the last, has been objected to by some on the ground that the heating was liable to injure the stone. Just how much injury is likely to result from a temperature lower than that of boiling water, it is perhaps yet too early to say. It seems scarcely possible that a good quality of sandstone laid on its bed could be at all affected; neither, it is safe to say, would brick.

Soft soap and alum solution.—This, as given by Julien, consists of three-fourths of a pound of soft soap to 1 gallon of boiling water and one-half a pound of alum in 4 gallons of water. It is said to answer well in exposed situations in England, but to require frequent renewal.

* Tenth Census, p. 389.

† Notes on building construction.

‡ *Op. cit.* 389-90.

§ Trans. N. Y. Acad. Sci., Nov., 1885, p. 66.

Various solutions of beeswax, rosin, and coal tar have also been tried with indifferent success.

Ransome's process.—This consists in saturating the stone as far as practicable with a solution of silicate of soda or potash (water glass) and afterwards applying a solution of chloride of calcium. This last coming in contact with the silicate produces by double decomposition an insoluble silicate of lime, cementing the grains of which the stone is composed firmly together.*

"The solution of silicate is first applied in a dilute form so as to be absorbed readily into the pores of the stone. Several coats are applied with an ordinary whitewash brush and when thoroughly dry the surface is washed with rain water, again allowed to dry, and the calcium solution applied in the same manner. The precautions to be used are: (1) the stone must be clean and dry before applying the solution; (2) the silicate must be applied until the stone is fully saturated, but no excess must be allowed to remain on the surface; (3) the calcium must not be applied until after the silicate is dry; a clear day or so should intervene if possible; (4) care must be taken that either solution is not splashed upon the windows or upon painted work, as it can not be removed therefrom; (5) upon no account should the same brush be used for both solutions. Under ordinary circumstances about 4 gallons of each solution will be required for every 100 yards of surface."

Szerelmey's stone liquid is stated to be a combination of Kuhlman's process with a temporary wash of some bituminous substance. The wall being made perfectly dry and clean, the liquid is applied in two or three coats with a painter's brush, until a slight glaze appears on the surface. This composition was used with some success in arresting for a time the decay of the stone in the House of Parliament.†

Kuhlman's process consists in simply coating the surface of the stone with a silicate of soda or potash solution. It is open to the objection that the potash absorbs carbonic acid from the air and produces a disagreeable efflorescence, which, however, disappears in time.

M. Lewins' process consists in coating the surface of the stone with solutions of an alkaline silicate (silicate of potash) and alumina, the latter in the form of sulphate. It is stated that this wash will give so close a surface to sandstone that it can be polished.(?) Either of the solutions can be colored if desired.‡

Very many other solutions have been devised and tried both in Europe and in this country, but which, in the language of Professor Julien, "have in most cases resulted in complete failure, not arresting the exfoliation."

* Dobson, *Masonry and Stone-Cutting*, p. 141. See also *American Arch. and Builder*, 1877, II, p. 21, 38, and *Notes on Building Construction*, p. 79.

† *Notes on Building Construction*, p. 79.

‡ *Jour. Franklin Inst.*, 3rd, LXIX, 1875, p. 338.

PART II.

THE ROCKS.

A.—SOAP-STONE.

This, although not properly a building stone, is of sufficient economic importance to merit attention.

(1) COMPOSITION AND USES.

Pure soap-stone is a massive or schistose variety of the mineral talc. In this form it is often called steatite, soap-stone, or pot-stone; chemically, then, it is a hydrous silicate of magnesia of the following composition, according to Dana: * Silica, 62.8; magnesia, 33.5; water, 3.7. The mercantile varieties are, however, nearly always more or less impure, iron sometimes replacing a part of the magnesia, while anthophyllite, pyrite, pyrrohotite and quartz are common accessories. It is soft enough to be easily scratched by the thumb-nail, and has a marked soapy or greasy feeling, two characteristics which readily distinguish it from most other rocks. It can be sawn into slabs or turned on a lathe, and being, when well seasoned, very refractory, is much used for fire-stones in furnaces and stoves; it is also very extensively used for lining stationary wash-tubs. The finer varieties are, according to Dana, made into images in China, and into ink-stands and similar articles in other countries. It is cut into vessels for culinary purposes in Lombardy, and was so used to some extent by the aborigines of North America. The harder varieties are cut into gas jets, and it is also used in the manufacture of porcelain. "French chalk" is a fine, compact variety used for tracing on cloth and for removing grease spots. The waste fragments are sometimes ground up and used for lubricating machinery. It is also utilized to some extent in the manufacture of so-called mineral paints. The total product of the United States for 1882 has been estimated at about 6,000 tons, with an average valuation of \$15 per ton.†

* Manual of Mineralogy and Lithology, p. 305.

† Mineral Resources of the United States, 1883, p. 464.

(2) SOAP-STONES OF THE VARIOUS STATES AND TERRITORIES.

Arkansas.—Specimens of a fine, compact, brecciated steatite have been received at the museum from some 12 miles north of Benton, Salina County. The supply is stated to be abundant.*

District of Columbia.—A small bed of soap-stone of apparently fair quality occurs at Indian Hill, about 2 miles northwest of the city of Washington. It has not as yet been sufficiently quarried to demonstrate its value. Other beds of limited extent occur near Tennallytown, not far from the District line, and on the Woodley Lane road. The beds are interstratified with the micaceous and hornblendic schists of the vicinity, and have a northeasterly and southwesterly strike.

Massachusetts.—Quarries of soap-stone have been worked from time to time in Lynnfield and North Dana, in this State. The Lynnfield stone occurs in connection with serpentine. It is soft enough to be readily cut with an ordinary hand-saw when first quarried, but hardens on exposure. When quarried, which it has not been since 1880, it was used chiefly for stove-backs, sills, and steps. At North Dana the soap-stone quarries were opened as early as 1846, and have at times been quite extensively worked.

New Hampshire.—An extensive bed of fine quality soap-stone was discovered in 1794 at Francestown, in this State, and was worked as early as 1802. Up to 1867 some 2,020 tons had been quarried and sold. In this latter year some 3,700 stoves were manufactured by one company alone. The business has been conducted upon a large scale ever since. The bed has been followed some 400 feet, and the present opening is some 40 feet wide, 80 feet long, and 80 feet deep. Other beds constituting a part of the same formation occur in Weare, Warner, Canterbury, and Richmond, all of which have been operated to a greater or less extent. Five beds of soap-stone also occur in the town of Orford, and an important quarry was opened as early as 1855 in Haverhill. It has not, however, been worked continuously.†

New York.—Soap-stone or talc occurs in abundance in Fowler and Edwards, Saint Lawrence County, in this State. It is said to be of good quality, remarkably tough, and very refractory in fire.‡

North Carolina.—Soap-stone of fine quality occurs in several localities in the southwestern part of this State, the museum collection showing specimens from 7 miles northeast of Murphy, Cherokee County; from $4\frac{1}{2}$ miles from Greenborough, Guilford County; from Alamance County; from Nantehala River, Cherokee County; and from Deep River, Moore County. Of these the Nantehala stone is a pure, nearly white, compact talc, said to be fully equal to the best French chalk. It has been much used as a white earth. The Deep River "soap-stone" is a

*Agr. Min. & Timber Resources of Ark., 1884.

†Geology of New Hampshire, Vol. III, p. 86-88.

‡Geology of New York, 1838, p. 206.

compact variety of the mineral pyrophyllite. This is also used as white earth. Both these stones are shipped in bulk to New York, where they are ground and bolted. The stones from the other localities are of the ordinary type of soap-stones, but apparently of good quality.

Pennsylvania.—In the southern edge of Montgomery County, “extending from the northern brow of Chestnut Hill between the two turn-pikes, across the Wissahickon Creek and the Schuylkill to a point about a mile west of Merion Square,” occurs a long, straight outcrop of steatite and serpentine. The eastern and central part of this belt on its southern side “consists chiefly of a talcose steatite,” while the northern side contains much serpentine interspersed in lumps through the steatite. Only in a few neighborhoods does the steatite or serpentine occur in a state of sufficient purity to be profitably quarried. On the east bank of the Schuylkill, about 2 miles below Spring Mill, a good quality of material occurs that has long been successfully worked. It has also been quarried on the west bank of the river about a third of a mile away, and to a less extent on the west bank of the Wissahickon, opposite Thorp’s Mill. The material is now used principally for lining stoves, fire-places, and furnaces, though toward the end of the last century and the early part of the present one, before the introduction of Montgomery County marble, it was in considerable demand for door steps and sills. It proved poorly adapted for this purpose, however, owing to the unequal hardness of its different constituents, the soap-stone wearing rapidly away, while the serpentine was left projecting like knots or “hob-nails in a plank.”*

South Carolina.—Steatite or soap stone is said to occur in this State in the counties of Chester, Spartanburgh, Union, Pickens, Oconee, Anderson, Abbeville, Kershaw, Fairfield, and Richland. The Anderson County stone is said to have been much used for hearthstones. That of Pickens County is considered of value, but it has been quarried to a very limited extent.†

The writer has seen some of this material. The national collections contain a single specimen of a very compact, nearly black steatitic rock marked as from Yorkville, in York County, but there are no data concerning its occurrence or utility.

Texas.—Soap-stone of good quality and inexhaustible in quantity is stated to occur in large veins on the Hondo and Sandy Creeks, about midway of their courses through Llano County.‡

Vermont.—Most of the steatite of this State is found on the east side of the Green Mountains and near the eastern line of the talcose slate formation, beds of it extending nearly the entire length of the State. The rock occurs usually associated with serpentine and hornblende. The beds are not continuous and have, as a rule, a great thickness in

*Rep. C⁴, Geol. Survey of Pa., pp. 95, 96.

† South Carolina, Population, Resources, etc., 1883.

‡ Second Ann. Rep. Geol. of Tex., 1876, p. 26.

comparison with their length. It not infrequently happens that several isolated outcrops occur on the same line of strata, sometimes several miles apart, and in many cases alternating with beds of dolomitic limestone that are scattered along with them.

At least sixty beds of this rock occur in the State in the towns of Readsboro, Marlborough, Newfane, Windham, Townsend, Athens, Grafton, Andover, Chester, Cavendish, Baltimore, Ludlow, Plymouth, Bridgewater, Thetford, Bethel, Rochester, Warren, Braintree, Waitsfield, Moretown, Duxbury, Waterbury, Bolton, Stow, Cambridge, Waterville, Berkshire, Eden, Lowell, Belvidere, Johnson, Enosburgh, Westfield, Richford, Troy, and Jay.

Of the beds named those in Grafton and Athens are stated to have been longest worked and to have produced the most stone. The beds lie in gneiss. The quarries were profitably worked as early as 1820. Another important bed is that in the town of Weathersfield. This, like that of Grafton, is situated in gneiss, but has no overlying rock, and the soap-stone occurs in inexhaustible quantities. It was first worked about 1847, and during 1859 about 800 tons of material were removed and sold. The Rochester beds were also of great importance, the stone being peculiarly fine-grained and compact. It was formerly much used in the manufacture of refrigerators. The quality of the stone is represented to be unusually good and free from impurities.* The bed at Newfane occurs in connection with serpentine, and is some half a mile in length by not less than 12 rods in width at its northern extremity. The soap-stone and serpentine are strangely mixed, and the general course of the bed being like that of an irregular vein of granite in limestone.

Virginia.—Soap-stone occurs in this State, according to Professor Rogers,† near the mouth of the Hardware River, both in Fluvanna and Buckingham Counties. There is also a bed of it associated with the talcose slates in Albemarle County, a little west of the Green Mountain. Specimens have been received from near this locality which were of excellent quality. The beds from here extend in a southwesterly direction, passing through Nelson County, where they are associated with serpentine; thence they cross the James River above Lynchburgh, and present an outcrop about 2 miles westward of the town on the road leading to Liberty; also one about 2½ miles westward of New London. Continuing in the same direction it is seen at the meadows of Goose Creek, where it has been quarried to some extent. Continuing in the same general direction the soap-stone again appears in several nearly parallel ranges, of which the most eastern makes its appearance near the Pigg River, in Franklin County. A second belt occurs in the same vicinity near the eastern base of Jack's Mountain; a third still farther west, about 1 mile from Franklin Court-House, and a fourth yet more to the west, on

* Geology of Vermont, Vol. II, p. 783-91.

† Geology of the Virginias, p. 79.

the eastern slope of Grassy Hill. The material from near Franklin Court-House is stated to be the best of any of the above. About 30 miles southwest from Richmond, at Chula, in Amelia County, there are outcrops of soap-stone said to be of fine quality, and which in former times were quite extensively operated by the Indians. They have been re-opened within a few years, and the material is now in the market. Specimens of the stone in the Museum collection are by no means pure talc, but carry abundant long brownish fibers of some amphibolic mineral.

B. SERPENTINE, OPICALCITE, 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 varieties opicalcite, consisting of intermingled serpentine and calcite or dolomite, the serpentine is apparently in all cases derived by a process 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 silicomagnesian 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. 834, 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. 1, 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. 1, 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 variety 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 asbestos.

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.

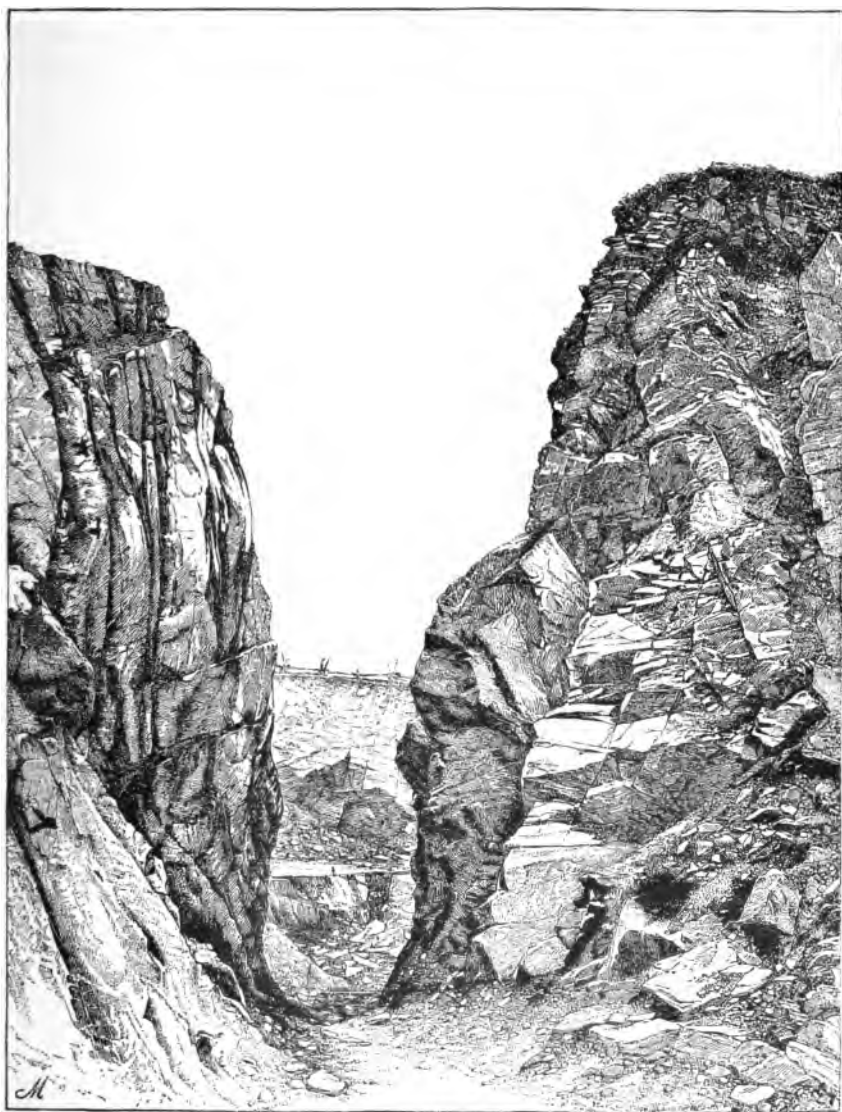
(2) SERPENTINES OF THE VARIOUS STATES AND TERRITORIES.

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.

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SERPENTINE QUARRY, CHESTER, PENNSYLVANIA.

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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 $2\frac{1}{2}$ 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 166 $\frac{1}{2}$ 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 Zoblit, 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, $2\frac{1}{2}$ 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. 1, 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 Missiseo 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.

C.—GYPSUM. ALABASTER.

This can scarcely be considered a building-stone, and it is used only to a small extent for ornamental purposes. We may, however, devote a little space to the subject.

(1) COMPOSITION AND USES OF GYPSUM.

Pure gypsum is composed of the sulphate of lime and water in the proportions of about 79.1 per cent. of the former to 20.9 per cent. of the latter (ante, p. 370). Three varieties are common: (1) crystallized gypsum or selenite, which occurs in broad, flat, transparent plates sometimes a yard in diameter and of value only as mineral specimens and for optical purposes; (2) fibrous gypsum, which includes the variety satin spar used for making small ornaments; and (3) massive gypsum, which includes the common white and clouded varieties used in making plaster, and the pure, white, fine-grained variety alabaster.*

(2) LOCALITIES OF GYPSUM IN THE UNITED STATES.

The principal localities of gypsum in the United States as given by Dana† are in New York, Ohio, Illinois, Iowa, Virginia, Tennessee, and Arkansas, where it occurs in extensive beds and usually associated with salt springs. It is also found associated with Triassic deposits in the Rocky Mountain region. Handsome selenite and snowy gypsum are also stated to occur near Lockport and Camillus, N. Y., in Davidson County, Tenn, and in the form of rosettes in the Mammoth Cave of Kentucky.

According to G. F. Kunz‡ the ornaments of satin spar sold at Niagara Falls and other "tourist places" are nearly all imported from Wales, though some few of the common white variety are cut from the beds of this stone found in the vicinity. The Italian alabaster is used extensively in making statuettes (see p. 473), but the common varieties found in this country and Nova Scotia are used chiefly for land plaster and as plaster of paris, or stucco. So far as the Curator is aware the gypsum quarried at Fort Dodge, Iowa, is the only one that has been at all used for structural purposes in this country.

According to Dr. White§ several residences, a railway station, and other minor structures, including a large culvert, have been built of gypsum at this place. In the construction of the culvert the lower courses that came in contact with the water were of limestone, as the gypsum had proven slightly soluble and hence less durable in such positions. The stone is regarded by Dr. White as very durable in ordi-

* Much of the material popularly called alabaster is in reality travertine (see p. 375.)

† Text book of Mineralogy, p. 393.

‡ Min. Resources of the United States, 1883-'84, p. 77.

§ Geol. of Iowa, Vol. II, p. 302.

nary situations, and the ease with which it can be worked renders it preferable to the limestones in the immediate vicinity. The method of quarrying is to bore holes with a common auger and then blast by means of powder. The blocks are then trimmed to the proper size and shape by means of common wood-saws and hatchets or axes.

D.—LIMESTONES AND DOLOMITES.

(1) CHEMICAL COMPOSITION AND ORIGIN.

Pure limestone consists entirely of calcium carbonate. In point of fact, however, none of our limestones are chemically pure, but all contain more or less foreign materials, such as magnesia, oxides of iron, silica, clay, bituminous matter, mica, talc, and other minerals.

In composition, texture, and general appearance, limestones vary almost indefinitely. They may be hard, compact, fine-grained rocks of almost flint like texture, or, again, coarsely porous, oolitic, or crystalline, the crystals varying in size from too small to be visible to the naked eye to an inch or more in length.

Pure limestone is white in color, but water blue, gray, green, pink, red, and black varieties are common, the colors being dependent upon various impurities, such as the oxides of iron and carbonaceous matter caused by animal and plant remains. The pink and red colors are caused by iron oxides, while the blue, gray, and black varieties owe their hues to the prevailing carbonaceous matter. The green color of some of the Vermont marbles appears to be due to talc.

Limestones are regarded by geologists as of either chemical origin or as resulting from the deposition of organic remains, such as shells and corals. Of the first kind are the tufas and travertines; of the second, the fossiliferous limestones, such as the encrinital stones of Ohio and the shell marbles of Tennessee. Either variety may have undergone the change called metamorphism, and all traces of their origin have been destroyed.

Limestones occur in stratified beds among rocks of all geological ages, from the Archæan to the most recent. The majority of those used for building and ornamental work belong either to the Cambrian, Silurian, Devonian, or Carboniferous ages.

(2) VARIETIES OF LIMESTONES AND DOLOMITES.

The following list includes all the principal varieties of limestone popularly recognized, the distinctions being founded upon their structure, chemical composition, and mode of origin:

Crystalline limestone. Marble.—An entirely crystalline, granular aggregate of calcite crystals. The crystals are usually of quite uniform size in the same marble, but often vary widely in those from different lo-

calities. The fine-grained white varieties which appear like loaf sugar are called *saccharoidal*. Common statuary marble is a good example of this variety.

Compact common limestone.—A fine-grained crystalline aggregate which to the eye often appears quite homogeneous and amorphous. It is rarely pure, but contains admixtures of other minerals, giving rise to many varieties, to which particular names are given. *Lithographic limestone* is an extremely fine-grained crystalline rock, with but a small amount of impurities, and of a drab or yellowish hue. *Bituminous limestone* contains a considerable proportion of bitumen, caused by decomposing animal or vegetable matter. Its presence is easily recognized by the odor of petroleum given off when the rock is freshly broken. *Hydraulic limestone* contains 10 per cent. and upwards of silica and usually some alumina. When burnt into lime and made into mortar or cement it has the property of setting under water. *Oolitic limestones* are made up of small rounded concretionary grains that have become cemented together to form a solid rock. These little rounded grains resemble the roe of a fish; hence the name, from the Greek word *ōōn*, an egg. Where the grains are nearly the size of a pea the rock is called *pisolite*. Such a rock is now in process of formation along the shore of Pyramid Lake, Nevada. Oolitic limestones suitable for building purposes are quite abundant in Iowa, Indiana, and Kentucky.

Travertine, or *Calc Sinter*, is limestone deposited by running streams and springs. It occurs in all gradations of texture from light flaky to a compact rock fit for building. A light, porous calc sinter has been deposited by the Mammoth Hot Springs of Yellowstone National Park, some of which is nearly pure carbonate of lime and snowy white in color. Travertine occurs in great abundance at Tivoli, in Italy, from whence it was quarried in building ancient Rome. The exterior of the Amphitheatrum Flavium, or Colosseum, the largest theater the world has ever known, was of this stone, as was also the more modern structure of St. Peter's, in the same city.* The Latin name of the stone was *lapis Tiburtinus*, of which the word "travertine" is supposed to be a corruption.

So far as is known the beds of this country are of limited extent and, with one or two exceptions, unfit for any kind of structural purpose. The pearly white and red "onyx" marble from San Luis Obispo and Suisun City, Cal., are properly travertine; so are also the celebrated "Mexican onyx" and so-called "Oriental alabaster" from Egypt.

Stalactite and *stalagmite* are the names given to the deposits of limestone on the roofs and floors of caves. Such are often beautifully crystalline and colored by metallic oxides, giving rise to beautiful marbles, which are incorrectly called onyx, as are also the travertines, from which they differ only in method of deposition.

* Hull, Building and Ornamental Stones, pp. 279, 281.

LIMESTONES COMPOSED LARGELY OF ORGANIC REMAINS.

Fossiliferous limestones.—Many limestones are made up wholly or in part of the fossil remains of marine animals, as is shown in the accompanying figure, which is drawn from a magnified section of a limestone of the Cincinnati group from near Hamilton, Ohio.



In some cases the remains are retained nearly perfect; again the entire fossil may have been replaced by crystalline calcite. In other instances stones are found which are made up only of casts of shells, the original shell material having decayed and disappeared, as in the Eocene limestone from North Carolina. Many of the most beautiful marbles belong to the group of fossil limestones, as, for instance, the red and white variegated Tennessee marbles. *Crinoidal limestones* are made up of fossil crinoidal fragments.

Shell limestones or *shell sand-rocks* as they are called by some authorities, are made up of shells usually much broken, though sometimes almost entire. The well-known *coquina* from Saint Augustine, Fla., is a good illustration of this variety. *Coral rock* is of the same nature, excepting that it is composed of fragments of corals. *Chalk* is a fine white limestone composed mainly of the minute shells of foraminifera.

MAGNESIAN LIMESTONES; ALSO CALLED DOLOMITIC LIMESTONES.

Under this head are included those limestones which contain 10 per cent. and upwards of carbonate of magnesia. They may be finely or coarsely crystalline; light, porous, or compact; fossiliferous or non-

fossiliferous; in short, may show all the variations common to ordinary limestones, from which they can usually be distinguished only by chemical tests. Many marbles are magnesian, as will be noticed by reference to the tables. When the carbonate of magnesia in a limestone rises as high as 45.65 per cent. the rock is no longer called magnesian limestone, but—

DOLOMITE. *

This in its typical form is a crystalline granular aggregate of the mineral dolomite, and is usually whitish or yellowish in color. It can in its typical form be distinguished from limestone by its increased hardness (3.5–4.5) and specific gravity (2.8–2.95). It is also less soluble, being scarcely at all acted on by dilute hydrochloric acid. Dolomite shows all the peculiarities pertaining to limestones, both in color and texture, and a chemical analysis is often required to distinguish between them. The pure white marble from Cockeysville, Md., is a dolomite, but by the eye alone can not be distinguished from the white crystalline limestones (marbles) of Vermont. The red-mottled marbles of Malletts Bay, Vt., are also dolomites, as are the white marbles of Lee, Mass., and Pleasantville, N. Y.

In composition there is no essential difference between a limestone or dolomite and what is popularly called a marble, but for convenience sake the subject will be here treated in two parts, the first to include those of this class of rocks as are put upon the market as marbles, and the second the rocks of the same composition but unfit for finer grades of building and ornamental work and known popularly as simply limestones.

(3) LIMESTONES AND DOLOMITES. MARBLES.

Under the head of marbles then are here included all those rocks consisting essentially of carbonate of lime (limestone) or carbonate of lime and magnesia (magnesian limestone and dolomite) that are susceptible of receiving a good polish and are suitable for ornamental work.

Alabama.—Beds of marble of great beauty are stated to occur along the Cahawba River in Shelby County of this State. The colors enumerated are gray with red veins, red and yellow, buff with fossils, white crystalline, clouded with red and black. A black variety veined with white occurs on the road from Pralls Ferry to Montevallo and on Six Mile Creek. Other good beds are stated to occur on the Huntsville road about 19 miles from Tuscaloosa and at Jonesborough, the latter rock being compact and of a red and white color; the same strata occurs at Village Springs. On Big Sandy Creek good marbles occur similar to those on the Cahawba.† None of the above are actively quarried, and the writer has had the opportunity of examining but a single

* So called after the French geologist, Dolomieu.

† Geol. of Alabama, First Bien. Rep., 1849, p. 45.

specimen; that a small block of fine and even texture, pure white color and excellent quality, said to be from near Talladega.

Arkansas.—Black and variously colored marbles mottled with white fossil shells and erinoids are stated by Owen * to occur in Independence, Van Buren, Searcy, Carroll, and Marion Counties. The author has seen none of the material and has no more definite information on the subject than that given above.

California.—Owing to the violent geological agencies that have been in operation since the formation of the marble deposits in this State, the stones found are said to be so broken and shattered in nearly every case that it is impossible to obtain pieces of large size free from cracks and flaws.† Near Indian Diggings, in Eldorado County, there occurs a fine-grained white, blue-veined marble that closely resembles the Italian "bardiglio," from the Miseglia quarries, but that the groundmass is lighter in color. It has been used only for grave-stones and to but a slight extent at that. In Kern County are deposits of marbles of various shades, but all so broken and shattered as to be very difficult to work. Near Colfax, in Placer County, are also beds of a dark blue-gray mottled magnesian limestone that takes a good polish and might be utilized as marble. Other deposits occur in Los Angeles, Monterey, Nevada, and Plumas Counties, but none of them are at present worked. The most beautiful of all the California marbles is the massive aragonite, or so-called "onyx," from San Luis Obispo. This stone, which is, as I understand, a travertine, is identical in composition and structure with the celebrated Oriental alabaster (wrongly so-called) from Blad Becam, near the ravine of Oned Abdallah. In color it is pearly white, and it is made up of fine, wavy parallel bands like the lines of growth upon the trunk of a tree. This stone is now being quite extensively introduced for small stands and ornamental work, which are often of exquisite beauty. No other travertines that can compare with this are at present quarried in the United States, though a beautiful variety is found in extensive deposits at Tecali, State of Puebla, Mexico.

Another travertine marble occurs in very limited amounts near the town of Suisun, Solano County. The quarry lies in a low hill near the town, and has been quite extensively worked, but no large pieces of even texture are obtainable, which is of course a drawback to its extensive use.‡

Specimens of this stone received at the National Museum are of a dull red or amber-yellow color, resinous luster and somewhat porous. A far more beautiful stone, but which also occurs in very limited amounts, is found near the falls of the Sacramento River in Siskiyou County. This is also aragonite and is of a beautiful emerald-green color. The color is however so delicate that pieces of considerable thickness (an

* Geol. of Arkansas, First Annual Report.

† Rep. Tenth Census, p. 279.

‡ Rep. State Mineralogist of Cal., 1884, p. 73.

inch or more) must be used in order to appear to advantage. The stone is found, as I am informed by Mr. J. S. Diller, of the U. S. Geological Survey, in a narrow seam in the gneissoid rocks of the region, and there is very little probability of its ever being obtainable in pieces of more than a foot or so in length.

Prof. H. G. Hanks, in a paper recently read before the San Francisco Microscopical Society, describes, under the name of "Inyo" marble, a pure white crystalline dolomite occurring in the White and other mountains of the Inyo range in this State. It is regarded by him as an excellent stone, and one promising of future usefulness. Besides this he mentions a yellow brecciated marble found at Tehachapi, in Kern County, and a black marble found near Colfax. The author has seen none of these stones.

Colorado.—No marbles are as yet quarried in this State, but the Museum collections show a small piece of a black white-veined breccia from Pitkin that might rival the imported "Portoro" from the Monte d'Arma quarries in Italy, if occurring in sufficient abundance. Concerning the extent and character of the formation the author knows nothing. In the marble yards of Denver the author was shown during the summer of 1886 a fine chocolate-colored stone, somewhat resembling the more uniform colors of Tennessee marble, which was stated to have been brought from near Fort Collins, in Laramie County, where it occurred in great quantities; also a fair grade of white blue-veined marble from Gunnison County. A beautiful breccia marble is stated* to occur in abundance a few miles north of Boulder City.

Connecticut.—In the northern part of Litchfield County, near the Massachusetts line, in the town of Canaan, East Canaan, and Falls Village, there occur massive beds of a coarsely crystalline white dolomite, which have in years past furnished valuable building marbles, though recently they have been but little worked. The stone is said to weather well and to be obtainable in large blocks eminently suited for building, but like the Lee dolomite it frequently contains crystals of white tremolite, which weather out on exposure. It is therefore not so well suited for finely finished or monumental work. The State-House at Hartford is the most important structure yet made from this material.

As already noted (ante, p. 288), it was at Marble Dale, in the town of Milford, in this State that marble quarrying was first systematically undertaken in this country, and at one time (1830) not less than fifteen quarries were in active operation in the vicinity. So far as can be learned not a single one of these is now being worked.

Delaware.—No marbles are at present quarried in this State, but a coarse white dolomite is found near Hockessin, New Castle County. This, so far as can be judged from the single specimen examined, might be used for general building, though not well suited for ornamental work.

* *Bien. Rep. State Geol. of Colo., 1880, p. 33.*

Georgia.—An important belt of marble is said to extend through the counties of Cherokee, Pickens, Gilmer, and Fannin in the northern part of this State, the material varying in color from pure white through blue and variegated varieties, some of which are remarkably beautiful. Variegated marbles also occur in the counties of Polk, Floyd, Whitfield, Catoosa, Chattooga, Gordon, Murray, Barton, and Walker; chocolate-red varieties similar to the marbles of Tennessee are said to occur in abundance in Whitfield County, the bed in Red Clay Valley extending in uninterrupted continuity for 10 miles, and varying from one-fourth to one-half a mile in width.* Of the beds above mentioned those in Pickens County are at present the most important and the only ones that have been worked to any extent, quarrying having quite recently been commenced here by the Perseverance and Georgia Marble Companies. Specimens of these marbles forwarded to the National Museum show them to be of uniform texture, but coarse, much coarser than the Vermont marble, which in other respects they much resemble. They are soft, work readily, and acquire an excellent surface and polish. In color they vary from snow white and pink to black and white mottled. The pink variety is unique as well as beautiful, and there is at present nothing like it produced in other parts of the country, though in color it closely resembles the pink marble from Cherokee and Macon Counties, N. C., to be noticed later. It is, however, coarser.

The ready working qualities of these stones, the fact that owing to the mildness of the climate the works can be in operation at all seasons of the year, together with the remoteness of regions where similar marbles are produced, all point to a rapid development of an extensive quarrying industry in this part of the country.

Iowa.—The calcareous rocks of Iowa are, as a rule, non-crystalline, dull in color, and with few qualities that render them desirable for ornamental purposes. But few of them are pure limestone, but nearly all contain more or less magnesia, iron, or clayey matter; very many of them being true dolomites.

Near Charles City, in Floyd County, on the banks of Cedar River, are extensive quarries in the Devonian (Hamilton) beds of magnesian limestones, certain strata of which furnish a coral marble at once unique and beautiful. The prevailing color of the stone is light drab, but the abundant fossils vary from yellowish to deep mahogany brown. These last, which belong to the class of corals called *Stomatophora*, are very abundant and of all sizes up to 18 inches in diameter. As seen on a polished surface imbedded in the fine, drab, non-crystalline paste of the groundmass, they present an appearance totally unlike anything quarried elsewhere in America—an appearance at once grotesque and wonderfully beautiful. The stone admits of a high polish, and would seem excellently adapted for all manner of interior decorations if obtainable in blocks sufficiently uniform in texture. A small amount of argilla-

* Commonwealth of Georgia, p. 135.

aceous matter and scattering particles of amorphous pyrite, which are occasionally visible, render its adaptability to outdoor work decidedly doubtful. The stone is known commercially as "Madrepore marble." A polished slab 2 by 4 feet is in the collections of the National Museum.

The light yellowish, buff, or brown sub-Carboniferous magnesian limestone, quarried near Le Grand in Marshall County, also contains massive layers beautifully veined with iron oxide, and which are suitable for ornamental purposes, though it is not considered suitable for monuments and other work subject to continuous exposure. I have not seen samples of this material, though it is well spoken of by White.* It is popularly known as "Iowa marble." The only other stone which, so far as I am aware, has ever been utilized for ornamental purposes is the so-called "Iowa City," or "Bird's-eye marble." This is nothing more than fossil coral ("Acervularia Davidsoni") imbedded in the common Devonian limestone and often perfectly consolidated by carbonate of lime so that it may be polished like ordinary marble. When so polished its appearance is very beautiful, for the whole internal structure of the coral is as well shown as it is in living specimens, and yet it is hard and compact as real marble." The stone would be valuable could it be obtained in blocks of large size. Unfortunately it occurs in pieces of but a few pounds' weight;† it is used therefore only for paper-weights, and small ornaments of various kinds.

Maryland.—The principal marble quarries of this State are located near Cockeysville and Texas, some 16 miles north of Baltimore, on the Northern Central Railroad. Here there occurs a small and isolated area of Lower Silurian (?) dolomite of medium texture and pure white color that has been very extensively used for general building purposes in Baltimore and Washington and the neighboring towns, and to a less extent in Philadelphia. In the quarries the stone lies in large horizontal masses, and blocks 28 by 10 by 3 feet have been quarried entire. This stone was used in the construction of Christ Church in Baltimore, the Washington Monument, and the columns and heavy platforms of the Capitol extensions at Washington, D. C.

Near Union Bridge, in Frederick County, there occurs a fine-grained and compact white magnesian limestone, but which has not been quarried to any extent.

The only true conglomerate or breccia marble that has ever been utilized to any extent in the United States is found near Point of Rocks, Frederick County, in this State. The rock, which belongs geologically to the Triassic formations, is composed of rounded and angular fragments of all sizes, up to several inches in diameter, of quartz and magnesian limestone imbedded in a fine gray calcareous groundmass. This composition renders the proper dressing of the stone a matter of some difficulty, since the hard quartz pebble break away from the softer parts in which they lie, leaving numerous cavities to be filled with colored wax

* Geol. of Iowa, vol. 2, p. 313.

† White, *op. cit.*, p. 316.

or shellac. It should therefore never be worked with hammer and chisel, but only with saw and grinding material, and no attempt made at other than plain surfaces. The stone was used for the pillars in the old Hall of Representatives in the Capitol at Washington, and a polished slab, 34 inches long by 20 inches wide, may be seen in the National Museum. The pebbles forming the stone are of so varied shades that to state its exact color is a matter of difficulty. Red, white, and slate-gray are perhaps the prevailing tints. On account of its locality this stone has been popularly called "Potomac" marble, or sometimes "calico" marble, in reference to its structure and spotted appearance. The formation from whence it is derived is said to commence near the mouth of the Monocacy River and to extend along the Potomac to Point of Rocks, and along the valley on the eastern side of the Catoctin Mountain to within 2 miles of Frederick. The Curator is informed, moreover, that the same formation occurs in Virginia, near Leesburgh, and that here the quartzose pebbles are almost entirely lacking, thereby rendering the stone much less difficult to work.

Massachusetts.—Crystalline limestones and dolomites of such a character as to assume the name of marble are now or have been in times past quarried in various towns of Berkshire County, in this State. The stones are all white or some shade of gray color, medium fine-grained in texture, and are better adapted for general building than for any form of ornamental work.

The quarries at Lee were opened in 1852, and the stone has been used in the Capitol extension at Washington and the new city buildings in Philadelphia; but little of it has been used for monuments. In the quarries the stone lies very massive, and it is stated cubes 20 feet in diameter could be obtained if necessary. The Sheffield quarries were opened about 1838. The rock here is massive, with but little jointing. Natural blocks 40 feet square and 3 feet in thickness can be obtained. The Alford stone is used mostly for monumental work and appears very durable. Much of the marble from these localities contains small crystals of white tremolite which weather out on exposure, leaving the rock with a rough pitted surface. This is very noticeable in the exterior walls of the Capitol building at Washington, already noted.

Missouri.—We have seen but few true marbles from this State, though colored marbles of fine quality equaling the variegated varieties of Tennessee are reported by Professor Broadhead as occurring in Iron, Madison, and Cape Girardeau Counties. The Iron County stone is reported as light drab in color, with buff veins. The outcrop occupies an exposure of several hundred feet of a low bluff on Marble Creek near the east line adjoining Madison County. The Madison County marble occurs near Fredericktown, and is described as the best-appearing marble in the State both in regard to color and texture, the colors being red, peach-blossom, and greenish, beautifully blended. The stone is represented as very durable, but liable to tarnish on a polished surface

when exposed to the weather. The Cape Girardeau stone is represented as of a variety of colors—purple, yellow, red, pink, gray, and greenish all being enumerated; the supply is unlimited. None of these marbles are at present systematically worked, owing to lack of capital and distance from market. Professor Broadhead further states that few of the marble beds of southeastern Missouri are thick enough to be economically worked, as there would be too large a portion of waste material.

No pure white crystalline marbles are as yet known to occur within the State limits. Other stones capable of receiving a polish and suitable for marble are stated to occur in the counties of Saint Louis, Saint Charles, Warren, Montgomery, Ralls, Calloway, Lincoln, Cooper, Pettis, Cass, Jackson, Livingston, and Clay.

Montana Territory.—This Territory as yet quarries no marble or other stone of importance. There were exhibited, however, at the Centennial, in Philadelphia, 1876, and since then in the National Museum at Washington, two samples from Lewis and Clarke County that are worthy of note, since they form the nearest approach to the imported Italian black and gold marble from the Spezzia quarries of any at present found in America. The rock is very close and compact, of a dark blue-gray color, and traversed by irregular wavy bands of varying width of a dull chrome-yellow color. So far as observed the stone is far inferior in point of beauty to its Italian prototype, and apparently would prove more difficult to work.

New York.—The belts of Archaean dolomite which lie to the north of New York City and cross the State in a northeasterly direction furnish a very fair quality of white and gray marbles that have at various times been quite extensively utilized. At present the quarries at Tuckahoe and Pleasantville, in Westchester County, furnish marble of good quality but of rather coarse texture. That from Pleasantville is particularly remarkable in this respect, being made up of large snow-white crystals, often an inch or more in length, whence it derives its popular name of snowflake marble. On account of its coarseness it is not well adapted for carved work or for use in long columns. The Tuckahoe stone is not quite so coarse in texture and has been more extensively employed for building purposes. St. Patrick's Cathedral, on Fifth avenue, New York City, is of this stone. At Sing Sing and Dover Plains are other quarries of rather coarse white dolomitic marble, but which are not extensively worked.

A very coarsely crystalline light-gray magnesian limestone of Archaean age occurs at Gouverneur, in Lewis County. Although too coarse for carved work it answers well for massive structures, and, as it acquires a good surface and polish, is used to some extent for ornamental work. It is believed to be durable, since gravestones in the vicinity which have been set upwards of seventy years still present clean and uniform surfaces, and are free from lichens and discolorations of any kind.

Two excellent varieties of colored marbles occur at Plattsburgh and Chazy, in Clinton County, in this State, and which are commercially known as "Lepanto"* and French gray. The first consists of a close, fine-grained gray groundmass with pink and white fossil remains, which are evidently crinoidal. The second is more uniformly gray and bears larger fossils. It is an excellent stone and, with perhaps the exception of the Tennessee marbles, has been used more extensively for mantels, table tops, tiling, and general interior decorative work than any other of our marbles.

At Glens Falls, on the Hudson River, occurs an extensive deposit of dark blue-black magnesian limestone, certain strata of which furnish the finest varieties of black marble at present quarried in this country. The stone is very fine grained and compact, and, when polished, of a deep, lustrous black color, though the uniformity of the surface is sometimes broken by the presence of a small white fossil. A two-foot cube of this stone is in the Museum collections. The finest quality of this marble occurs in a single stratum some 12 feet in thickness. The poorer qualities are burned for lime, of which they furnish material of exceptional purity. Black marble is also quarried to some extent at Willsborough, in Essex County. At Port Henry, in this same county, there is quarried a green and white speckled marble, composed of an intimate mixture of serpentine, calcite, and dolomite that has been used for interior decorative work. This stone has been noticed more fully under the head of serpentine.

At Lockport there is extensively quarried a soft gray crinoidal limestone in which the fossils are frequently of a pink or bluish opalescent color. It is used to some extent for mantels and other ornamental purposes.†

In the town of Warwick, in Orange County, there is found a beautiful, coarsely crystalline marble of a carmine-red color, sometimes slightly mottled or veined with white. But little of it has been used and the supply is reported as small.

North Carolina.—Although no quarries of marble are at the present time worked to any extent in this State, there occur within its limits numerous deposits of most excellent material that only require enterprise and capital to bring to a ready market. One of the most important of these is near Red Marble Gap, in Macon County. The rock is a beautiful bright flesh pink, sometimes blotched or striped with blue and yellow. The texture is fine and even, and it acquires an excellent surface and polish. The stone is stated by Professor Kerr to occur in the side of the mountain in cliffs 150 feet or more in height, and blocks of almost any size can be obtained. It is quite different from any-

* The Lepanto marble is figured on Pl. xxxii of the census report, where it is wrongly set down as from Isle La Motte, Vermont.

† J. S. Newberry in report on building and ornamental stones, Vol. III Inter. Ex. Reports, p. 158.

thing now in the market, and would doubtless find a ready sale if once introduced. Other marbles of white or blue-gray color occur in Murphy, and Valley Town, Cherokee County; Warren Springs, Madison County, and near Marion, in McDowell County. Lack of transportation facilities at present is a serious drawback to the introduction of any of these into our principal markets. We have also seen small pieces of very compact deep blue-black crystalline limestone, taking a high polish and suitable for the finest grades of ornamental work, from near Nantehala, Swain County, in this State. Portions of the stone are traversed by a coarse network of pure white calcite veins that greatly added to its beauty.

Pennsylvania.—The belt of Lower Silurian limestone that extends from Sadsbury and Bart Townships, in Lancaster County, in a general easterly direction through Chester County, and through the western half of Montgomery County, includes within its area the only quarries of merchantable marble at present worked within the State limits. According to Professor Rogers* this belt forms the bed of a narrow valley some 58 miles in total length, extending from near Abington, in Montgomery County, to the source of Big Beaver Creek, in Lancaster County. The prevailing colors of the stone throughout the larger portion of this area are yellowish or bluish, and it is, as a consequence, suitable only for making quicklime or for ordinary rough building purposes. On the southern side of the valley, however, between Brandywine and Wissahickon Creeks, the stone has become highly metamorphosed and converted into a crystalline granular marble, white or some shade of blue in color, though often variously veined or mottled. All the quarries as yet opened are situated in Montgomery County, on the steeply upturned or overturned edges of the outcrops within half a mile of the southern edge of the formation between Marble Hall and the Chester County line.

It is stated that quarries were first opened here about the time of the Revolutionary war, and that up to 1840 this stone was the favorite and almost only material used in the better class of stone buildings in and about Philadelphia. At about the latter date increased facilities for transportation brought the better varieties of eastern marbles and other stones into competition with it and its use has as a consequence considerably diminished. Among the important buildings constructed of the stone during its popularity were the United States custom-house and mint, the Naval Asylum, and Girard College, while the seemingly endless rows of red brick houses with the white marble steps, door and window trimmings are even now as characteristic of Philadelphia as are the brown-stone fronts of New York City.

The sarcophagi for General and Martha Washington, at Mount Vernon, are also of this material. While the Montgomery County stone

* Rep. of First Geol. Surv. of Penna., Vol. I, p. 211.

has shown itself to be very durable, in point of beauty it falls far short of the marbles from the more Eastern States, and hence its use for any form of ornamental work has almost entirely ceased. There were, however, on exhibition at the Philadelphia Exposition of 1876 (and since then transferred to the National Museum) samples of this limestone from along the Lebanon Branch of the Philadelphia and Reading Railroad, some of which gave promise of great utility. I would mention especially two samples from Myerstown and Mill Lane. These are very fine-grained and compact, of a drab or bluish color on a polished surface, and traversed by wavy and very irregularly anastomosing, nearly black lines. They seem in every way admirably adapted for decorative work, though I am not aware that they have as yet been at all used for this purpose. Newberry states* that a fine variety of black marble occurs in or near Williamsport, Lycoming County. I have never seen the stone and know nothing further regarding it. A black limestone that takes a fine polish and appears well suited for interior work is stated also to occur near the east end of Mosquito Valley, in the same county. For exterior work it is stated to be unsuited, as it splinters up badly on exposure.

Tennessee.—The valley of East Tennessee is underlaid by limestone of Lower Silurian age that furnishes some of the finest and most beautiful grades of colored marbles at present quarried in the United States.

The history of the quarrying industry in this part of the State, as given by Dr. Safford,† is substantially as follows: In April, 1838, the Rogersville Marble Company was formed by gentlemen in and near Rogersville, Hawkins County, for the purpose of sawing marble and establishing a marble factory in the vicinity. The company operated to a limited extent for several years, erecting a mill and selling several thousand dollars' worth of material annually, most of which was used within the State limits. In 1844 the company sold out to a Mr. Rice, who shortly after sent a block of the light mottled, strawberry variety to the Washington Monument; another block was subsequently sent, in accordance with an act of the State legislature. These blocks attracted the attention of the building committee of the National Capitol, who finally decided on the adoption of the material for the interior decorative work in the extensions of that building. As a consequence, what was known as the Government quarry was opened, at a point about 9 miles southwest of Rogersville, where the Holston River intersects the marble range. The rock here was in large part massive and the bed several hundred feet in width. Many thousand feet were taken out, being shipped by river and rail to Charleston or Savannah, and thence by water to Washington. Public attention having thus been drawn to the beauty of these stones, there has arisen a constantly increasing demand for them, to supply which other quarries have been opened, and

* Rep. of Judges, p. 138, 139.

† Geology of Tennessee.

now "Tennessee marble" is one of the widest known and most generally used of our ornamental stones.

At the present time the most extensive quarries are situated in Knox and Hawkins Counties. The prevailing colors found here are chocolate red and white, often coarsely variegated and fossiliferous; though finely and evenly crystalline varieties of a beautiful pink or "strawberry" color, with scarcely a trace of fossil remains, also occur. All of them cut to a sharp edge and acquire a beautiful and lasting polish not excelled and rarely equaled by any foreign or domestic marbles. Of foreign marbles, so far as the writer is aware, they have no exact counterpart, but perhaps resemble the "Rosso de Levante" from Spezia, or the Persian "fiorto," more closely than any other that can be mentioned.

Besides the localities above mentioned, colored marbles occur in the following counties in this part of the State: Hancock, Grainger, Jefferson, Roane, Blount, Monroe, McMinn, and Bradley; some also occur in Meigs, Anderson, Union, and Campbell Counties. The Hawkins County marble is part of a comparatively short belt of Trenton and Nashville rocks lying west of Rogersville. It is some 16 or 17 miles long, and from 50 to 300 feet in thickness. The supply is therefore practically unlimited and inexhaustible. The best variety of the stone is used only for ornamental work, owing to its high price, being valued at from \$2 to \$3 per cubic foot delivered at the nearest railway station.

The Knox County quarries are mostly situated within a few miles of the city of Knoxville. According to Dr. Safford* the entire thickness of the marble bed here is some 300 feet, the different layers of which vary from chocolate red and white variegated varieties through grayish white, pinkish, and more rarely greenish colors. The most esteemed variety has when polished a brownish red color, with white spots and clouds, due to fossil corals and crinoids. The grayish white variety, which is the nearest approach to a truly white marble of any now found in the State, is greatly esteemed for tombstones, monuments, tiling, etc., and is said to be very durable, tombstones which have been exposed for upward of thirty years showing no signs of disintegration or wear. Both the Hawkins County and Knox County stones are very strong and heavy, weighing about 180 pounds per cubic foot, which is some 14 pounds heavier than granite. Quite similar variegated marbles are said to occur in many of the counties of the Cumberland table-land, as in Franklin County, on the Elk River; at the Oil Springs, on Leipor's Creek, in Maury County. Some of the marbles of this latter place have a grayish groundmass, with fleecy clouds of red and green.†

A beautiful olive-green fossiliferous marble is also found in the eleventh district of Davidson County, though the extent of the deposit is not known by the writer. Near Calhoun, in McMinn County, just south

* *Op. cit.*, pages 236, 237.

† Tennessee and its Agricultural and Mineral Wealth, by J. B. Killebrew, page 149.

of the Chilhowee Mountain, occur breccia marbles of exceptional beauty, of pink and olive-green colors. One quite unique stone from this locality is composed of a grayish-ground mass, with large rounded and angular fragments of a lemon-yellow color. These same marbles also occur in Greene, Cocke, Sevier, and all the counties of the Unaka range, but they are not much worked, on account of the hardness of the included fragments.*

Dove-colored marbles are stated by the same authority to occur a few miles south of Manchester, Coffee County, and in Wilson and Davidson Counties. Dark limestones, almost black when polished, and often traversed by veins of calcite, forming a good black marble, are not uncommon, occurring in the vicinity of Jonesborough, Washington County, Greeneville and Newport, Cocke County, on the Pigeons, in Sevier County, and also in McMinn and Polk Counties. They are at present but little used.

Colored marbles are also said to occur† in the Western Tennessee Valley, which, though somewhat inferior in point of beauty to those of the East Valley, are still valuable stones. Perry, Decatur, Wayne, and Hardin Counties are mentioned as offering the best facilities. On Shoal Creek, in Lawrence County, are said to be beds of fawn-colored or brownish-red marbles, some 40 feet in thickness and extending on both sides of the creek for a distance of 15 miles. The stone is often variegated by fleecy clouds of green or red green and white colors. Owing to lack of transportation facilities it is not now in the market. In Wilson and Davidson Counties other beds of bluish or dove-colored marble occur, and in Rutherford County is a bed of pale-yellow marble with serpentine veins of red and black dots. The extent of the deposit is not known, and at present the stone is seen only in the form of small objects for paper-weights and curiosities.

Texas.—The resources of this State are as yet but little known. There have been received at the National Museum several samples of compact, light-colored cretaceous limestones, from the vicinity of Austin, Travis County, though few of them are of such quality as to be used as marbles. There was on exhibition at the New Orleans Exposition in 1884-'85 a marble fire-place and mantel of Austin marble that was worthy of more than passing notice. The stone was compact, very light drab in color, and interspersed with large fossil shells and transparent calcite crystal. This composition would render some care necessary in cutting, but the final result would seem to justify the outlay. The marbles received from Burnet and vicinity present a variety of colors, some of which are very pleasing. They range from blue-gray and distinctly crystalline to very fine and compact forms, designated as "mahogany-red," "red and white," "purple variegated," etc. The "mahogany-red" is dull in color, and traversed by a net-work of lighter lines. It is too hard and brittle to work economically. The most promising variety is the purple

* Geology of Tennessee, p. 221.

† Min. Resources of Tennessee.

variegated. This presents an extremely compact base of a grayish, or light lavender-tint, which is traversed by fine, irregular lines of a red and purple color. The stone acquires an excellent surface and polish, but is so hard as to work with great difficulty.

Utah.—A yellowish white crystalline limestone, that can scarcely be called a marble, was received at the Museum from Payson, in this Territory, and a compact nearly black stone, interspersed with numerous white fossil shells, from the San Pete Valley. Neither stone can lay any claim to beauty, though possibly the last mentioned might be made to do as marble under certain circumstances.

Vermont.—Since this is the leading marble-producing State of the Union a brief description of the chief geological features of the marble formations may not be out of place here. According to Professor Brainard* this formation extends along the western borders of the States of Connecticut, Massachusetts, and Vermont, between the Green Mountain elevation, which extends from the Canada line nearly to Long Island Sound, and the intermittent Taconic Mountains, which extend south of Lake Champlain, and in places admit the marble veins within the border of New York. Of these immense formations, which are from 1,000 to 2,000 feet in thickness, the lower portion, known to geologists as the calciferous (300 to 400 feet in thickness), is for the most part siliceous, partaking of the nature of the sandrock that underlies it. The upper portion, known as the Trenton (500 to 600 feet in thickness), is impure from the presence of clayey matter, partaking of the nature of the slate formation that overlies it. Only certain layers of the middle portions seem to have been fitted by their original constitution for the production of marble.

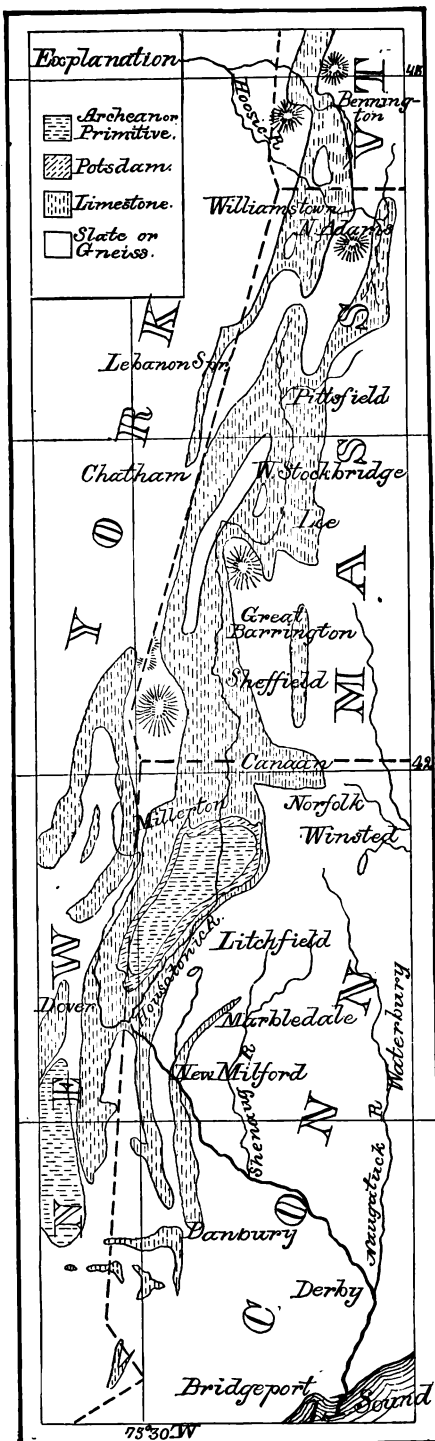
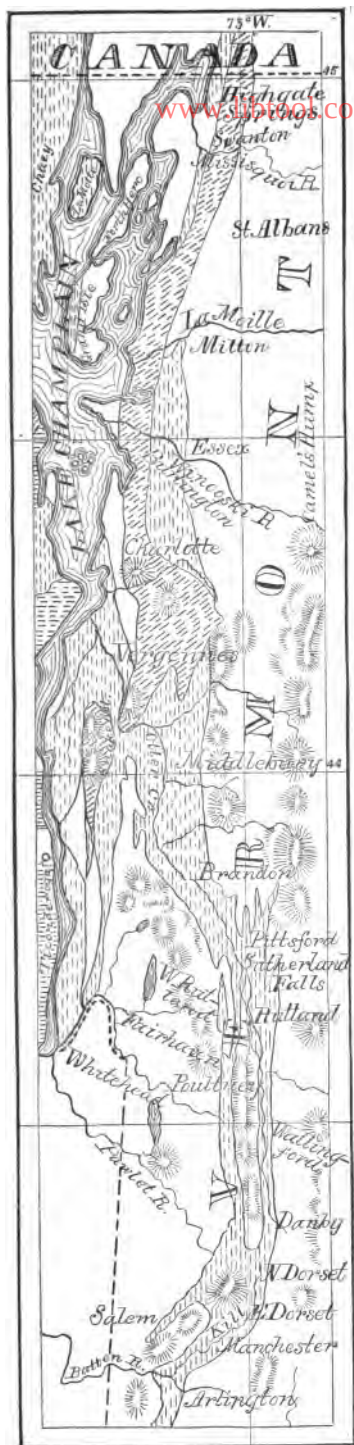
These strata in Rutland and Addison Counties appear in two parallel lines about 2 miles apart, stretching from the north line of Middlebury to the south line of Rutland, and are from 100 to 200 feet in thickness. The limits of the formation may be best understood by reference to the accompanying map (Plate VII), redrawn from Professor Brainard's report.†

Professor Hitchcock‡ conveniently divides the marbles of this State into four groups or classes: (1) the common white and bluish or Eolian marble (so called from its occurring extensively on Mount Eolus); (2) the Winooski; (3) the variegated of Plymouth, and (4) the dark, almost black, of Isle La Motte. Of these the Eolian is most abundant by far, and is most extensively quarried. In texture the stone is fine-grained and often saccharoidal, though less so than the Italian marbles. In color it varies from pure snowy white through all shades of bluish, and sometimes greenish, often beautifully mottled and veined, to nearly black, the bluish and black varieties being as a rule the finest and most durable.

* The Marble Border of Western New England, p. 9.

† By permission of the Middlebury Historical Society.

‡ Geology of Vermont, Vol. II, page 752.



MARBLE REGION OF WESTERN NEW ENGLAND.

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The stone occurs in beds usually but a few feet in thickness, which vary considerably in color, so that several grades, from pure white through greenish, bluish, and almost black, may be taken from the same quarry.* As a rule the best marbles in the State occur where the beds or strata stand at high angles, as at West Rutland. The quarries themselves at this village lie along the western base of a low range of hills, which, to the ordinary observer, give no sign of the vast wealth of material concealed beneath their gray and uninteresting exterior. In quarrying, the best beds are selected, and upon their upturned edges excavation is commenced, first by blasting, to remove the weathered and worthless material, and afterward by channeling, drilling, and wedging; no powder being used lest the fine massive blocks become shattered and unfit for use. The quarry thus descends in the form of a rectangular pit, with almost perpendicular, often overhanging, walls, to a depth of sometimes more than 200 feet, when the beds are found to curve to the eastward and pass under the hill, becoming thus more nearly horizontal; in following these the quarry assumes the appearance of a vast cavern from whose smoke-blackened, gaping mouths one would little suppose could be drawn the huge blocks of snow-white material lying in gigantic piles in the near vicinity (see Plate 1). Some of the quarries have been partially roofed over to protect them from snow and rain, and seem like mines rather than quarries. The scant daylight at the bottom is scarce sufficient to guide the quarryman in his work. As one peers cautiously over the edge into the black and seemingly bottomless abyss, naught but darkness and ascending smoke and steam are visible, while his astonished ears are filled with such an unearthly clamor of quarrying machines, the puffing of engines, and the shouts of laborers, as is comparable with nothing within the range of our limited experience.

The stone taken from the quarries is worked up in the companies' shops in the immediate vicinity or shipped in the rough as occasion demands. The supply is used for monumental, decorative, or statuary work and general building.

Other quarries in which the stone so closely resembles that of Rutland as to need no special description, are situated at East Dorset and Dorset, Wallingford, Pittsford, Sutherland Falls, Brandon, and Middlebury. At Sutherland Falls the stone is very massive, and large

* Professor Hitchcock (Geology of Vermont, Vol. II, p. 764) gives the following figures relative to the marble-beds at one of the West Rutland quarries, beginning at the eastern side or top layer:

1. Upper blue layer, 4 feet thick.	7. Wedged white layer, from 8 inches to 2 feet 6 inches thick.
2. Upper white layer, 3 feet 6 inches thick.	8. Muddy layer, 4 feet thick.
3. Gray limestone layer, 5 feet thick.	9. Striped green layer, 4 feet thick.
4. White statuary layer, 3 feet thick.	10. Camphor-gum layer, 3 feet thick.
5. Striped layer, 1 foot 8 inches thick.	11. White layer, 9 feet thick.
6. New white layer, 4 feet thick.	12. Blue layer, 3 feet 6 inches.

blocks are taken out for building purposes. Some of the most valuable, according to Professor Seely,* are known as the dark and light *mourning vein* varieties. The dark mourning vein has a ground of deep blue, while lines, nearly black, run through it in a zigzag course, presenting a beautiful appearance. The light mourning vein has similar veins, but the ground is lighter. The quarries at this place are described by Professor Seely as being in the form of a hollow cube cut into a hill with perpendicular walls on the north and west rising to a height of nearly 100 feet, open to the sky, and with an acre of rock forming its horizontal marble floor. Over this floor are running channeling machines, cutting out long parallel blocks which are afterwards cut up into convenient size, lifted from their beds, and taken to the mills to be sawn. Some sixty gangs of saws are kept running here day and night during the busy season, and not less than five hundred persons, all told, are employed in and about the quarries. The workmen are of many nationalities, including English, Scotch, Welsh, Irish, Canadian, and Italian.

As stated by Professor Hitchcock,† the beds of the Eolian variety of marble are not restricted to one locality but extend over a large portion of western Vermont, the formation in which it occurs extending the entire length of the State, usually interstratified with siliceous and magnesian limestones. The strata vary in thickness from a few inches to 6 or 8 feet, the thickest beds being usually found where the marble is coarse-grained and friable. From Dorset the beds thin out toward the north, the more northerly beds, though thinner, usually furnishing the finer grained and more compact stone. It is stated‡ that Pittsford has the honor of having one of the earliest quarries in the State, if not the earliest, Jeremiah Sheldon having worked marble here as early as 1795. There are three beds or veins of marble running through the town, north and south. The most easterly has a breadth of some 200 feet, and the stone is of the same character as that at Sutherland Falls or Proctor, as the town is now called. The middle bed is separated from the first by about 200 feet of lime rock. The bed itself is some 400 feet wide, and the stone varies in color from pure white to dark blue. The third or west bed which is thought to correspond to that of West Rutland is about half a mile west of the central and is about 400 feet wide. The stone is dark-blue and often beautifully mottled. Some of the beds here, as at West Rutland, furnish a beautiful snow-white saccharoidal stone suitable for statuary purposes, for which it has been used to a slight extent. The Vermont statuary marble, however, differs from its Italian prototype, in being of a dead white color and lacking the mellow, waxy luster so characteristic of the Italian stone.

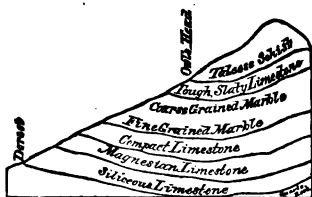
* *Op. cit.*, p. 41.

† *Geology of Vermont*, Vol. II, p. 772.

‡ *The Marble Border of Western New England*, p. 46.

Several outcrops of marble occur in Middlebury, and which have been worked for many years past; but in consequence of the thinness of the beds, their badly-pointed structure, and the interstratification of a magnesian state that produces numerous "rising seams," it is quite difficult to obtain perfectly sound blocks of large size.*

The quarries in Dorset are situated mostly upon the sides of Mount Eolus, or Dorset Mountain, as it is also called, a section of which (after Hitchcock) is here given.



The thickness of the slaty cap rock is estimated by Hitchcock at 498 feet, and the various beds of limestone below at 1,970 feet. Although but a small portion of this is suitable for quarrying, still the supply is readily seen to be inexhaustible. The prevailing colors of the stone, as at Rutland, are white and bluish, variously mottled and veined. According to Professor Seely† the first quarry opened in Dorset was by Isaac Underhill, in 1785; the stone being used chiefly for fire-jambes, chimney-backs, etc. The first marble grave-stones ever furnished here were the work of Jonas Stewart, in 1790.

The bed of primordial rock known to geologists as the "red sand-rock," which occur in the northwestern part of the State, bordering on Lake Champlain, is, as a rule, a hard, dark-red sandstone, containing some 8 or 9 per cent. of potash, with about the same amounts of iron and lime. The entire formation, which is some 2,000 feet in thickness, is, however, by no means uniform in composition, but includes considerable beds of limestone, dolomite, slate, and shale. It is the dolomitic layer which furnishes the peculiar red-and-white mottled stone popularly known as Winooski marble. According to a writer in the *American Naturalist*,‡ the beds of this marble appear first one or two miles north of Burlington and extend in a somewhat interrupted series north through Saint Albans, and end between that place and Swanton. More than thirty years ago a quarry was opened in this rock about 6 miles from Burlington, but owing to the hardness of the stone the enterprise proved a failure and the quarries were abandoned. Later quarries were opened at Saint Albans, and still more recently were re-opened at Burlington, the stone being used largely for flooring-tiles, wainscoting, and general interior decorative work. As a rule the stone is crystalline and very hard, much harder than ordinary marble. Its color is

* *Geology of Vermont*, Vol. II, p. 769.

† *Op. cit.*, p. 36.

‡ George H. Perkins, *American Naturalist*, Feb., 1881.

quite variable, though some shade of red mottled with white usually predominates. Some varieties are beautifully light pink and white, or pink and deep-blue gray or greenish. The very common chocolate-red and white variety is put upon the market as *Lyonaise marble*, and is used largely for tiling, its natural color being often rendered darker by oiling.

Chemically the stone is a dolomite, though varying widely in composition in samples from different localities. Some samples show a very decided brecciated structure, while in others this entirely disappears. It is as a rule very hard to work, and, as exhibited in the capitol at Albany, the surface is often disfigured by irregular cavities and flaws which are rather unsightly. The color is said to fade on exposure to the weather, and hence the stone is used mostly for interior work.

An excellent outcrop of this marble occurs on the shore of Mallet's Bay, in the town of Colchester. The strata at this point are nearly horizontal, and in many places form the banks of the lake. One of the best quarries is so situated that a vessel can be brought up alongside and loaded with blocks with as much ease as they are usually loaded upon carts or cars at inland quarries. The stone occurs in beds varying in thickness from 1 to 6 feet, and blocks of almost any size can be obtained. It is hard to work, but as a consequence is very durable when once finished, being not easily scratched or scarred.

The best developments of the rock for marble quarrying are at Colchester, as already mentioned, Milton, Georgia, Saint Albans, and Swanton. At the last-named place there also occurs a beautiful gray marble, with angular fossil fragments of a white and pink color, identical with the "Lepanto" marble of New York. There is also a fine and compact dove-colored marble here, admirably adapted for decorative work, but the quarries are now abandoned.

The Plymouth marble, so called, is a quite pure dolomite, an analysis by Dr. Hunt resulting as follows:

	Per cent.
Carbonate of lime.....	53.9
Carbonate of magnesia.....	44.7
Oxide of iron and alumina.....	1.3
	99.9

The stone occurs in the talcose-schist formation near the center of the town of Plymouth, at an elevation of 250 feet above the Plymouth pond. Quarries were opened here about 1835, but were soon abandoned, as the demand at that time was almost altogether for white marble. The beds dip 60° to the east, and the quarry walls, which have been exposed to the weather for twenty years, seem unaffected. In color the stone is blue or bluish-brown, diversified with long stripes and figures of various shapes in white. It is fine grained and compact, splitting with equal facility in every direction.*

* Geology of Vermont, Vol. II, p. 776.

The Isle La Motte marble derives its name from Isle La Motte, in Lake Champlain, where it occurs in considerable abundance. It also occurs on several other islands in this lake and upon its banks in many places. According to Professor Hitchcock* this was the first marble worked in the State, quarries having been opened prior to the Revolutionary war. The stone, which is largely used for flooring-tiles, is very dark, almost black in color, and highly fossiliferous, having undergone less metamorphism than the marble in the interior of the State. So far as the author has observed its color and texture are such as to preclude its obtaining a high rank for purely decorative purposes, but for floor-tiling is much esteemed and very durable. Fossil shells of great beauty are not uncommon, and, being snowy white in color, show up in strong contrast to the dark paste in which they are embedded.

Virginia.—The extensive area comprehended under the title of the Valley of Virginia embraces “all the portion of the State having for its eastern boundary the western slope of the Blue Ridge and its inflected continuation, the Poplar Camp and Iron Mountains, and for its western, the Little North and a portion of the Big North Mountain, with the southern prolongation of the former, Caldwell and Brushy Mountains; and near its southwestern termination the line of knobs forming the extension of Walker’s Mountain.”†

The central portion of the valley as thus outlined is underlaid largely by limestones of Silurio-Cambrian age, which are in several places, according to the authority above quoted, capable of yielding good marbles. The special varieties mentioned are: (1) a dun-colored marble met with near New Market and Woodstock, and on the opposite side of the Massanutten Mountain in Page County; (2) a mottled bluish marble to the west of New Market; (3) a gray marble occurring some three-fourths of a mile in a southeasterly direction from Buchanan, in Botetourt County; (4) a white marble of exquisite color and fine grain about 5 miles from Lexington, in Rockbridge County; (5) a red marble occurring only in the Cambrian formations lying among the mountains in the more southwestern counties; and (6) a shaded marble found in Rockingham County. This last is said to be compact, susceptible of a beautiful polish, and of a yellowish gray and slate color. None of the above have as yet received more than a local application.

At Craigsville, in Augusta County, there occurs a gray, sometimes pink-spotted encrinural limestone which acquires a good polish, and though in no way remarkable for its beauty is capable of extensive application for furniture and interior decoration. The Archæan area to the eastward of the Valley of Virginia also includes sundry areas of workable marble. It is stated by Rogers‡ that “near the mouth of the Tye River (in Nelson County) and the Rockfish, a true marble is

* *Op. cit.*, p. 776.

† Rogers, *Geol. of the Virginias*, pp. 203, 204.

‡ *Op. cit.*, pp. 81-83.

found, of a beautiful whiteness and of a texture which renders it susceptible of a fine polish as well as being readily wrought with the chisel. A few miles from Lynchburgh, in Campbell County, a good marble is likewise found. "The Tye River marble and one or more analogous veins" are further stated to "have all the characters of a statuary marble of fine quality, and should not some peculiarity, as yet unperceived, prevent their application to the purposes of the sculptor, they will no doubt be looked upon as very valuable possessions." The writer has seen none of the material from this locality. White and pink marbles of excellent quality also occur in the vicinity of Goose Creek, in Loudoun County. We have seen samples of the white, which for purity of color, fineness of grain, and general excellence, are not excelled by any marble now quarried in the United States, but the extent of the deposit is as yet unknown.

The stalagmitic deposits upon the floors of the caverns at Luray, in Page County, furnish, when cut, occasional fine pieces of the so-called onyx marble, but the stone is too easily fractured and too uneven in texture to be worked economically, even were the deposits of sufficient extent to warrant the opening of quarries. I am informed by Prof. G. B. Goode that it is a common thing to find mantels of stalagmitic marble in the dwellings of Virginia. These are, however, always made from blocks found loose in the field or in caves near at hand.

(4) LIMESTONES AND DOLOMITES OTHER THAN MARBLES.

Alabama.—A dark compact limestone has been received at the Museum from Calera, Shelby County, and a light-colored, finely fossiliferous one from Dickson, in Colbert County. The last mentioned closely resembles in general appearance the celebrated limestone from Bedford, Ind., to be noticed later. It appears of good quality, and works readily.

Arkansas.—Oolitic limestone suitable for building, and having the reputation of being very durable, is stated by Mr. Owen* to occur near Batesville, in Independence County.

Colorado.—The collections show from this State a coarse, reddish limestone from Jefferson County, and also a very compact, finely crystalline black stone, traversed by a coarse net-work of very fine white lines, from Pitkin in Gunnison County. This last stone takes a polish, and might almost be classed as a marble. Neither stone is now quarried to any extent.

Florida.—This State at present furnishes scarcely anything in the line of building stone, nor is there much demand for any other form of building material than wood. On Anastasia Island, about 2 miles from Saint Augustine, there was formerly quarried to a considerable extent a very coarse and porous shell limestone which was used in the construction of the old city of Saint Augustine and of Fort Marion, which was

*Geol. of Ark., Vol. I, p. 220.

built about the middle of the eighteenth century. The rock is composed simply of shells of a bivalve mollusk more or less broken and cemented together by the same material in a more finely divided state. Fragments of shells an inch or more in diameter occur. The rock is loosely compacted and very porous, but in a mild climate like that of Florida is nevertheless very durable. The quarries were opened upwards of two hundred years ago, but the stone is not now extensively used, owing in part to the dampness of houses constructed of it, and in part to the cheapness of wood. The rock, which is popularly known as *Coquina* (the Spanish word for shell), is of Upper Eocene age. In the quarries the stone lies within a few feet of the surface, and can be cut out with an ax, in sizes and shapes to suit.

The oolitic limestone occurring at Key West has been quarried and used in the construction of numerous private and public buildings in that vicinity.

Kansas.—The limestones and dolomites of this State are, as a rule, of a light color, soft and porous and incapable of receiving a polish such as will fit them for any form of ornamental work. Many of them are cellular and loosely compacted, being made up in large part of a small fossil rhizopod about the size of a grain of wheat and known under the name of *fusulina*. Such stones are obviously unfitted for exposed work in localities subject to great extremes of temperature, although they may be very durable in mild or dry climates. Those at present quarried are almost without exception of Carboniferous or Permian age, and occur only in thin beds, varying from a few inches to 8 or 10 feet in thickness.

Near Irving there occurs a light-colored, soft, thin-bedded stone, which, though not quarried during the census year, has in times past been used for building purposes in Atchison and Kansas City. It is soft and easily quarried and for ordinary construction requires but little dressing. At Frankfort a similar stone occurs which has been used to some extent for buildings, though principally for foundations. Some of the stone from these localities are of very poor quality, being soft and quite cellular through the breaking away of the small fossils above referred to. Atchison, in the same county, has quarries of a darker, more compact stone, which are worked for local use.

In the vicinity of Topeka there are quarried light-colored, compact, finely fossiliferous dolomites and limestones which work very readily, and which have been used in the construction of about thirty-five common buildings in that city, besides a church, school, and opera houses in Emporia. They have also been used in Parsons, in Labette County, and neighboring towns in Missouri.

Near Lane, in Franklin County, gray and buff limestones are quarried and used quite extensively in Ottawa and Garnett, in the same State, though some have been shipped to Chicago. The buff variety is sometimes oolitic, resembling to some extent the Bedford (Indiana) stone.

The texture is firm and compact, and it acquires a good surface and polish. The gray variety is coarser, and often somewhat cellular, owing to the imperfect filling of the spaces between the fossil particles of which it is composed. A section of the quarry shows the gray stone to occur in a bed about 4 feet in thickness, and the buff oolitic about 6 feet in thickness, the layers of which vary from 18 to 24 inches each.

Near Marion Center, in Marion County, there is quarried a light-drab cellular magnesian limestone of Permian age, that has been used in the construction of the asylum for the blind and insane at Wyandotte and Topeka, in this State. Similar stones are quarried at Cottonwood, in Chase County. The stratum of quarry rock here is some 6 feet in thickness and blocks of any desired size and of thickness not exceeding 2½ feet can be obtained. The principal markets for these stones are Kansas City, Mo.; Lincoln and Omaha, Nebr.; Pueblo and Denver, Colo., and Atchison, Topeka, and Leavenworth, Kans.

In the vicinity of Fort Scott are some half a dozen irregularly worked quarries which furnish stone for building foundations and pavements in the near vicinity. The stone is dark colored, fine grained, and semi-crystalline, and is said to stand the wear of from ten to fifteen years' exposure very well. It turns to a brownish color on long exposure and is strong enough for ordinary structures. The stone quarried at Winfield is a light-colored, fine-grained cellular rock and so soft as to be quarried by means of plug and feathers only, the holes being first bored by means of a common auger without point. It is a handsome stone and has a good reputation for durability. It is used mostly in this State, though some is shipped to Kansas City, Mo.*

Many of the towns in Butler County produce fine-grained, light-colored limestones suitable for rough building in the immediate vicinity, but not at all suitable for ornamental work.

Illinois.—No siliceous crystalline rocks of any kind are to be found within the State limits, almost the entire product being limestone or dolomites, with a few quarries of sandstone, which are noticed on p. 448.

The most notable of the limestones of this State is the fine grained, very light-colored Niagara stone, quarried in the vicinity of Lemont and Joliet, in Will County. According to Professor Conover,† the Lemont quarries lie on both sides of the Illinois and Lake Michigan Canal, and the beds of stone are quarried to their lower limits through a variable thickness of from 12 to 40 feet. The stone here is uniformly a fine-grained, homogeneous, light-drab limestone, occurring in beds from 6 to 24, and sometimes 30 inches in thickness. The beds are divided vertically by seams occurring at intervals of from 12 to 50 feet, and continuing with smooth faces for long distances, and also by a second set running nearly at right angles with the first, but only continuous between massive joints and at irregular intervals. This structure renders

*Professor Brodhead in Report of Tenth Census, pp. 275-277.

† Report of Tenth Census, p. 221.

the rock very easily quarried and obtainable in blocks of almost any required dimensions. The stone is soft and easily worked, taking readily a smooth surface, but no polish. It can be turned on a lathe, and is made into balustrades and other forms of ornamental work. It can be carved in bas-relief, but is not sufficiently tough for high reliefs that are to be exposed to the weather. To produce smooth surfaces for flagging, etc., the stone is planed by machines somewhat similar to those used in planing iron. The stone from the immediate vicinity of Lemont is said to contain less iron and to tarnish less readily than that a few miles distant at Joliet.

The stone in the quarry contains much moisture, and during cold weather care has to be taken to avoid injury by freezing until the quarry water has evaporated. This causes a considerable annual expense in making earth protections, except in those few quarries that are so situated that they can be flooded with water during the winter months.

The quarries extend for nearly 4 miles below Lemont, where a gap occurs, to just below Lockport, from which point a line of closely-adjointing quarries extend to below Joliet. The finer varieties of the stone do not seem well fitted for heavy masonry in damp situations. Fine clay seams abound, which are invisible when the stone is first quarried, and which under favorable circumstances do not develop at all, but when exposed to heavy pressure or to alternate moisture and dryness, accompanied by frost, they are soon developed, and often render the stone worthless. Even the best varieties of the stone tarnish after a short exposure, especially in cities where soft coal is burned.

The Joliet quarries extend from a point about a mile below Lockport to the same distance below Joliet. Two distinct varieties of stone occur. That quarried from the lower beds on the right bank of the river is as a rule rougher, more coarsely textured, and tarnishes more readily than that from the higher levels. It is now but little used, except for heavy masonry. In the quarries back from the river, on the higher levels, the stone is fine grained, more homogeneous, and in this respect fully equal to the Lemont stones. The beds now worked are from 3 to 4 feet in thickness, and large blocks are obtainable. Most of it seems to weather-stain rather more than that from Lemont. The value of the stone quarried at these two places is probably fully equal to that of all the other stone quarried in the State.*

Three large quarries are worked in these same formations at Batavia, but as a rule the stone is coarser and more difficult to work than those just described. Other quarries occur at Thornton and Blue Island, Cook County, and other parts of the State, as noticed in the catalogue

* These beds were formerly described as composed of light buff stone, while the deeper portions of the quarries now furnish "bluestone." The difference results from the difference in amount of oxidation of the small amount of iron disseminated through the whole mass, the change having resulted from atmospheric influences. The same change must ultimately take place in all the bluestone which is brought to the surface. (Geology of Illinois, Vol. iv, p. 220.)

of the Museum collection. Within the city limits of Chicago there is quarried from this same formation a coarser somewhat cellular stone, that from its unique character perhaps merits a special description. According to Hunt* this stone when pure is a nearly white granular crystalline dolomite, containing 54.6 per cent. carbonate of lime. It, however, contains so large a portion of bituminous matter, that blocks sometimes become quite black on exposure. The color fades somewhat in time, but the petroleum odor is often perceptible for long distances. The stone has been used to some extent for building purposes, as notably in the First Presbyterian Church in Chicago. The gummy bituminous matter causes the dust from the streets to adhere to exposed surfaces, thus giving the buildings a peculiar antique appearance. We are informed by Mr. Batchen that this pseudo-antique appearance is greatly admired by some. The presence of the bitumen is beneficial in at least one respect, in that it renders the stone less pervious to moisture, and hence less liable to disintegration by freezing. This stone is represented by an 18-inch cube in the Museum collections.

Lower Silurian (Trenton) limestones and dolomities are quite extensively quarried in Jo Daviess County, and make a handsome and very durable building material. Calhoun, Alexandria, and Ogle Counties also furnish good material, but which, for lack of space, can not be described here. At various points in Whiteside and Hopkins Counties there are outcrops of limestones belonging to the Cincinnati group, a part of which will furnish durable building material. The stone needs, however, to be selected with the greatest care, since all the beds are not of equal quality.

At Jonesborough, in Union County, there occurs a fine, even-grained, compact, beautifully oolitic stone that cuts to a sharp even edge, and seems admirably adapted for carved work and general building purposes as well. Specimens in the National Museum are of a lighter color than the Bedford, Ind., oolitic stone and take a better polish. We have had no means of ascertaining its lasting qualities, but it is stated† to be liable to injury from frost when exposed in damp places. The stone is of the Carboniferous age. Other oolitic stones occur at Rose-clair, in Hardin County. They are of a dark bluish-gray color and take a good polish.

There are many other localities in the State which furnish excellent varieties of building stone. These can not be mentioned here for lack of space. Interested parties are therefore referred to the catalogue of the Museum collections and to the report of the Tenth Census.

Indiana.—Few of the limestones at present quarried in the United States exceed in reputation and beauty the fine-grained oolitic stone of sub-Carboniferous age from the vicinity of Bedford, in this State, and popularly known as "Bedford limestones." The rock is of fine and

* Chemical and Geological Essays, p. 172.

† Report of Tenth Census, p. 225.

even texture, and is composed of small rounded concretionary grains of about the size of a grain of mustard seed compactly cemented together by crystalline lime or calcite. The stone is soft, but tenacious (specimens having borne a pressure of 12,000 pounds per square inch), and works readily in every direction. It is therefore a great favorite for carved work, and is used more extensively for this purpose than any other of our limestones. No better example of the adaptability of the stone for this purpose can be given than the elegant mansion of Mr. C. J. Vanderbilt, on Fifth avenue, in New York City. Unfortunately, as is usually the case with light limestones, this stains badly in cities where there is a great amount of manufacturing, as is only too well illustrated in the case referred to.

Although the quarries have been worked systematically for but a few years, the stone is already widely known, and is coming into very general use in nearly every city of importance in the country. At the principal quarries, which are situated near Bedford, Lawrence County, the stone occurs in a solid bed, that has been worked to a depth of 40 feet without reaching the bottom.

Stones very similar in general appearance, but not always so distinctly oolitic and often containing a considerable percentage of bituminous matter, also occur and are extensively quarried at Ellettsville, in Monroe County. Other localities not so extensively worked occur in Owen, Washington, Crawford, and Harrison Counties. Samples received at the Museum from near Corydon in the last-named county are of a beautifully fine and even oolitic structure, very light color, firm and compact. They resemble the oolitic stone from Princeton, Ky., more closely than any other, but are much more compact. The stone is stated to occur in inexhaustible quantities.

The Washington County deposit at Salem is said to be a very fine one, there being a solid bed of the oolite 30 feet in thickness, with only about 5 feet of cap rock.

Other limestones or dolomites of excellent quality, but lacking the oolitic structure, occur in many parts of the State. A compact, fine-grained drab stone, taking a very good polish and also of subCarboniferous age, occurs at Greencastle, Putnamville, and Okalla, in Putnam County, and is quarried for lime and for building purposes in the various cities and towns in the vicinity. There is quarried at Bedford also a fine grained semi-crystalline, dark-gray stone, which is capable of a variety of uses.

Near Silversville, in Lawrence County, there occurs a very fine-grained compact stone of a drab color, that acquires readily a smooth and even surface. An attempt has been made to utilize this for lithographic purposes, but, it is stated, with indifferent success. It bears a close resemblance to the darker variety of the well-known Bavarian lithographic stone, but is somewhat harder.

As will be noticed, nearly all the quarries mentioned lie in that por-

tion of the State south of Indianapolis. But few quarries of importance lie to the north of this point, and when worked the stone is used principally in the manufacture of quicklime. At Anderson, in Madison County, a light-colored, fine-grained stone occurs in beds of from 4 to 12 inches in thickness, which is used locally for flagging and general trimming purposes.

Iowa.—Although this State abounds in limestones and dolomites to the exclusion of almost all other varieties of building stone, but little of the material now quarried is of such a nature as ever to acquire more than a local reputation. Though having altogether more than three times the number of quarries found in Illinois, these are mostly small affairs, and the value of the total product is but little more than one-half that of the latter State. At the time of the taking of the Tenth Census the whole number of quarries in the State was 131, of which 128 were of limestones and dolomites, and the remaining 3 of sandstone, which are mentioned on p. 449.

At the present time the most important quarries are situated in the Niagara division of the Upper Silurian formations, in the vicinity of Stone City, Jones County; Farley, Dubuque County, and in various portions of Jackson, Cedar, Clinton, and Scott Counties. The Jones County stone is a very light-colored, fine-grained and compact bituminous dolomite. That from Farley is very similar in general appearance, but contains less bituminous matter. In the small blocks received at the Museum the stones appear of good quality, but we have had no opportunity of learning their weathering qualities.

A finely crystalline light-colored limestone of sub Carboniferous age is quite extensively quarried near Burlington, in Des Moines County. According to Professor McGee* this stone, which is practically identical with that of Keokuk, in Lee County, is used chiefly for common masonry, and only occasionally for dressed work. The upper beds are "nearly white in color, fine, compact, homogeneous, and hard, with a choncoidal or splintery fracture, like the so called lithographic limestone of nearly the same geological age. This stone has been used to some extent for ornamental purposes, but contains too many incipient fractures, and is too liable to unexpected disruption to be of special value."

Near Le Grand and Montour, in Tama County, there occurs a magnesian limestone of the same age as that just described, which is fine grained, compact, and generally buff or whitish in color. The coarser portions are extensively used for heavy masonry, while the finer grades, which are often beautifully veined with iron oxides, are used for ornamental work under the name of "Iowa marbles." Some of the stone from this locality is oolitic. Similar stones are extensively quarried at Iowa Falls and at Humboldt and Dakota, in Humboldt County. Lime-

* Report of Tenth Census, p. 261.

stones and dolomites belonging to the Saint Louis epoch of the Sub-carboniferous age are quite extensively quarried in various parts of Lee, Des Moines, Henry, Washington, Van Buren, Jefferson, Keokuk, Wapello, Manhaska, Marion, Story, Hamilton, and Webster Counties. That from near Farmington, Van Buren County, varies from light buff to nearly white in color, is fine grained, and has been quarried for lithographic purposes. It is, however, no longer used, having been found to contain too many dry seams often cemented by crystalline carbonate of lime. At Chequest the limestone takes a fair polish and is known as "Chequest marble."

In the Devonian limestones near Iowa City and Roberts Ferry there frequently occur masses of fossil coral (*Acervularia davidsoni*) which, when cut and polished, form beautiful ornaments and paper-weights, though of small size. They are known popularly as bird's-eye and fish-egg marbles.

One of the most unique marbles in this country is found in the Devonian beds near Charles City. The stone, which is known commercially as "Madrepore marble," consists of a fine grained and compact non crystalline groundmass of a yellowish-brown or drab color, in which are embedded a great variety of fossil forms and shapes, including large strometophora sometimes a foot or fifteen inches in diameter. The stone polishes well and the fossil forms show up in a manner peculiarly beautiful and unique. This marble is represented in the Museum collections by a large polished slab (catalogue No. 38465) as well as by the smaller specimens in the systematic series.

Kentucky.—Although the building stones of this State are entirely unknown in our principal markets and but few of them have more than a strictly local reputation it by no means follows that there is any lack of material or that it is at all inferior in quality. While it is true that no marbles or granites of importance are found, yet there abound limestones of the finest quality and in inexhaustible quantities. The oolitic limestones of this State are without superiors, if indeed they have equals. Through the energy of Prof. J. R. Proctor the Museum has received a full series of these stones, and we are able to speak of their qualities from personal observation. In Todd, Grayson, Meade, Simpson, Christian, and Caldwell Counties oolitic stones occur of very light, almost white, color and excellent quality. The varieties from Litchfield and Princeton are especially worthy of mention. The oolitic character is very pronounced in these stones, and while in some cases the production of a perfect surface is impossible, owing to the breaking away of these minute rounded grains, still in the better qualities the sharp edges and smooth surfaces are as readily acquired as on the celebrated Bedford (Ind.) or other stones of this character. These are superior to the Bedford stone, moreover, in their clear and uniform colors, never being blotched with oil, as is the Bedford stone. Professor Proctor informs us that the stone is quarried with ease, is easily wrought, stands

ure well, and is considered one of the most reliable stones in the State.

Compact fine-grained limestones of a dark drab color, taking a smooth surface, but not suited for marble, are found in the towns of Franklin, Simpson County; Lebanon, Marion County; Russellville, Logan County, and others. A part of the Franklin County stone is fine grained and suitable for lithographic purposes, though inferior to the imported Bavarian stone. Very light colored compact limestones are found also in Simpson, Logan, and Franklin Counties, but we have no information regarding their availability or the extent to which they are quarried.

Maine.—Limestone is an abundant and common rock in this State, especially in the southeastern part, in the counties of Knox and Lincoln, where it is very extensively burnt into quicklime. So far as I am aware none of the stone is utilized for building, as its colors—blue and blue-black, veined with white—are poorly adapted for such purposes. No stone suitable for marble is yet known to occur in the State, though Hitchcock* expresses the opinion that such may yet be found in “the belt of Helderberg limestone, running from Matagamon (east branch Penobscot) River northeasterly.”

Many samples of so-called white marbles have been taken from the limestone formations about Rockland, in Knox County, but, so far as observed by the present writer, they are all too coarsely crystalline or too distinctly granular in structure to be of value.

Michigan.—Limestone or dolomites of a character suitable for building purposes are at present but little quarried in this State, the entire value of the output during the census year being but about \$26,000. A fine-grained fossiliferous dolomite of a drab color is worked at Sibley's Station, in Wayne County, and a very light-colored granular rock, of similar composition, near Raisinville, in Monroe County. Near Alpena light-colored limestones are quarried which are hard, compact, and said to be durable. They are not obtainable anywhere in large quantities nor in blocks of large size, but there are numerous small openings sufficient to supply the local demand. Other localities where stone can be obtained are at Trenton, near Detroit, and upon Macon Creek, both in Monroe County. The stone is apt to contain dry seams and requires care in selecting. These are all of Devonian age.

Minnesota.—The Lower Silurian limestones and dolomites of this State, which are at present the only ones quarried, are, as shown by the Museum collection, nearly all of a light buff, drab, or blue color, fine-grained and compact, though in some cases cellular and semi-crystalline, according to Professor Winchell.†

The stone appears in the bluffs of the Mississippi River and St. Croix Valley, and is quarried at all points where (except Lake City) there is any demand between Stillwater and Winona, along the Mississippi Val-

* Second Annual Rep. Geol. of Maine, 1862, p. 428.

† Rep. Tenth Census, p. 249, and Geol. of Minn., vol.

ley on the Minnesota side, and also at several places farther west, as at Caledonia, in Houston County, Lanesborough and Rushford, in Fillmore County, and at points in Winona County.

At Stillwater the rock is a silicious dolomite of a light buff color. In the ledge, which is about 45 feet thick, it occurs in alternate bands of compact and cellular rock varying from 3 to 6 feet in thickness. The coarser variety is most durable and is used in heavy masonry, as bridges and foundations. The finer variety is used for house trimming, ashlar work, and tombstones.

At Saint Paul the rock is a fine light-bluish semi-crystalline magnesian limestone. It is usually quite regularly stratified, and occurs in beds from 3 to 24 inches in thickness, with joints from 10 to 30 feet apart. Blocks 10 by 5 by 2 feet can be obtained if desired. It is used only locally. At Minneapolis the rock is quite similar, though sometimes slightly fossiliferous or mottled with argillaceous spots. It was formerly used almost exclusively in Minneapolis, but is now being gradually replaced by stone from the neighboring States.

In speaking of these stones Professor Winchell says:*

"In the use of the Trenton limestone quarried at Saint Paul and Minneapolis regard should be had constantly to its laminated structure. The beds quarried now are as they were originally deposited, and as cut for use embrace in every block many layers of from one-half to two inches in thickness. These consist of alternating clayey and calcareous portions, the latter constituting the hard and enduring part of the stone. These layers are not always distinct and continuous over large surfaces, but they blend or shade into each other every few inches. Yet in process of time, under natural weathering, they get separated so as to fall apart, the clayey matter disintegrating first and causing the calcareous structure which sustains the whole to break up into small sheets or fragments. Hence this stone should never be placed on edge, but in the same position it occupied in the quarry. It should never be allowed to occupy projecting or exposed parts of a building. More especially if it be on edge and in a projecting cornice or capital it is the source of weakness to the structure, as well as of danger to all passers, from the dropping of sheets or fragments as the weather, by wet or frost, separates them from each other. Its color is also against its being put in the exposed and ornamental parts of a structure. * * * The color of the Trenton makes it very suitable for foundations and for the ranges below the water-table, but even there it should be well bedded in mortar and protected by the water-table in order to keep out the water."

At Red Wing, in Goodhue County, the stone is quarried only for local building and for burning into quicklime. Blocks as large as can conveniently be handled can be obtained. At Frontenac, in the same county, the stone is of a buff or gray color, medium fine, and quite

* Preliminary Rep. on Building Stone, etc., 1889, p. 33.

cellular. This rock is considered one of the best in the State, and is used for all varieties of building purposes, as well as for bases and tombstones. Blocks 11 by 7 by 5½ feet and weighing 18 tons have been taken out, which is about as large as the quarries will furnish. It is said to work with comparative ease, and to withstand the weather well. Although having been in use longer than any other stone in the State, it has not as yet shown any change whatever from atmospheric influences. Its powers of resistance to pressure vary from 5,000 to 7,000 pounds per square inch.

At Kasota and Mendota, in Le Sueur County, the dolomite is of a buff or rusty pink color, of homogeneous texture, and very strong and durable. It withstands a pressure of 10,000 pounds per square inch without crushing. Blocks 10 by 11 feet by 1 foot in thickness can be obtained. It is quite generally used throughout the State, the pink variety being most admired and bringing the highest price.

At Mankato, in Blue Earth County, the rock is also a dolomite, buff in color, fine, compact, and semi-crystalline, sometimes cellular. Blocks 20 by 10 by 6 feet can be obtained from the quarries.

At Winona the dolomite is quarried for general building purposes, flagging, and burning into lime. It is of a buff color, usually fine and uniform in texture, though sometimes containing cherty lumps, and porous. Blocks of any size that can be handled may be taken from the quarries.

Missouri.—Limestones and dolomites of a nature unfitted for marbles, but of good quality for general building purposes, occur in great abundance in Saint Louis, Cole, Cooper, Pettis, and Jackson Counties in this State. At present, owing to the ready accessibility of a good market, the Saint Louis stone is the most extensively quarried of any of these mentioned. The stone, which is of Carboniferous age, is fine-grained and compact, and of a drab color. It is represented as strong and durable and well adapted for the manufacture of lime. At present it is used largely for foundations. A very fine-grained and compact limestone of a dark drab color occurs near Saverton, in Ralls County, which has been used to some extent for lithographic purposes. Stones from other localities are mostly compact, and of light or dull red. A very light encrinital stone is quarried in the vicinity of Hamilton and Bear Creek, in Marion County.

Nebraska.—Fine-grained, light-colored, compact, or sometimes finely fossiliferous and oolitic limestones, apparently of good quality, have been received at the Museum from near Roca, in this State. Also a light-colored fusulina-bearing stone, closely resembling that of Augusta, Kans., from Glen Rock, Nemaha County, and a fine-grained, soft, light-colored fossiliferous stone from La Platte, in Sarpy County. The writer possesses no information regarding the extent to which they have been worked, if at all.

New York.—With but few exceptions the limestones of this State con-

tain a sufficient percentage of magnesia to merit the name magnesian limestone, though scarcely enough to constitute a true dolomite. Many of the rocks belonging to this group are marbles, and have already been described. www.libtool.com.cn

At Greenport, Columbia County, a stratum of Lower Silurian limestone upward of 60 or 70 feet in thickness is extensively worked for ornamental and building purposes. The quarry proper is said to cover an area of 40 acres, and a face 30 feet high and half a mile in length has been opened. The stone is of medium texture, semi-crystalline, of a water-blue or gray color. The quarries at Glens Falls, on both sides of the Hudson River, furnish beside the black marble already referred to a great amount of dark-colored limestone which is used for tiling, etc., as well as burning into lime. At Willsborough and Crown Point, in Essex County, there are also extensive quarries of blue-black limestone of good quality. In various towns in Montgomery County a gray or blue-gray semi-crystalline limestone is worked for building material. The stone is said to be strong and durable, though care need to be used in its selection. At the Indian reservation in Onondaga County a gray, compact, semi-crystalline limestone, said to possess great strength and durability, was formerly extensively quarried, but the work has of late fallen off somewhat, owing to lack of transportation facilities. A gray, crinoidal stone that takes a fair polish is also found at Onondaga, in the same county.

At Lockport, in Niagara County, a fossil-bearing calcareous dolomite has been quarried for many years for general purposes of construction in New York and Rochester. The stone does not take a good surface and consequently does not polish readily, but some portions make quite showy mantels, owing to the presence of red crinoidal remains. According to Professor Julien* this stone as used in New York City has not proved durable. The fault, however, he regards in part to the manner in which the stone is used, about 40 per cent. of the blocks being set on edge.

North Carolina.—Limestones and dolomites of good quality for building purposes occur in abundance in this State, but are not extensively quarried for lack of a market or transportation facilities. Near New Berne, Craven County, there occurs a very coarse cellular shell stone of Eocene age that has been used for underpinnings and fences, but it is said not to weather well. Material of the same nature, but much finer in texture and more compact, occurs at Rocky Point, in Pender County, and which has been used in the construction of breakwaters and other harbor improvements at Wilmington, in this State. A coarse, dull red dolomite occurs at Warm Springs, in Madison County, and also light blue-gray varieties, but neither are worked, as there is little demand for the material.

* Report of Tenth Census, Vol. x, p. 369.

Ohio.—The limestones and dolomites of this State are almost altogether of a dull, uninteresting color, and though in many cases durable and strong are entirely unfit for any sort of fine building and ornamental work. They are therefore used chiefly for the rough work of foundations, street paving, and flagging, and to a very large extent for making quicklime. In many instances they have been used locally for building purposes, but their qualities are not such as to cause them to be sought from a distance.

At Point Marblehead, in the northern part of the State, dull, light-colored compact dolomites of Carboniferous age have been quarried for making lime and for building purposes for the past fifty years. Many buildings in the vicinity have been constructed from it, and it has also been largely used by the Government for light-houses and other structures along the lake front. Of late years its use for building has very considerably diminished. Near Sandusky, in Erie County, the same formations have been extensively worked, not less than 12 acres in the vicinity having been quarried over to a depth of 8 feet. The stone is of a dull, bluish-gray color, and is used for building, flagging, and making lime; about one hundred and eighty houses in the city have been constructed from it. Near Columbus, in Franklin County, the Devonian limestones are extensively quarried, and the product has in a few instances been used for building purposes. By far the greater part of the product is, however, used as a flux for iron and for making quicklime. A dolomite from the same formations is quarried for rough building and lime burning at and near Marion, in Marion County.

In Allen, Miami, Clarke, Greene, Montgomery, Preble, and several other counties the dolomites and limestones of Upper Silurian age are extensively worked, but so far as the author can learn but a small part of the quarry product is utilized for building. At Springfield the stone is buff in color and somewhat porous, though it is said to be strong and durable.

Near Greenfield, Ross County, and Lexington, Highland County, there are extensive quarries of a bituminous dolomite, which is largely used in Cincinnati for flagging, steps, and in the manufacture of lime. Specimens received at the National Museum from the places show the stone to vary from dark grayish distinctly laminated to fine, compact, and homogeneous of a yellowish or buff color. The buff stone can be cut to a sharp edge, and acquires a good surface, but takes only a dull polish. So far as the author has observed this is one of the finest appearing and best working stones in the State.

The Montgomery County stone is a magnesian limestone, and it is said to have obtained a good reputation. It is not now used as much as formerly, however. The stone quarried in the other localities mentioned present so little diversity of character as to need no special description.

Pennsylvania.—The Lower Silurian formations in Montgomery, Lancaster, and Chester Counties, which furnish the supply of marble already referred to,* furnish also large quantities of gray or bluish-gray stone of the same composition, but, owing to its color and texture, unsuited for any form of ornamental work. It is, however, extensively quarried for general building, for foundations and bridge abutments. Besides, in Montgomery County, limestone is quarried for local use in Easton, Tuckerton, and Reading, Berks County, and in Annville, Lebanon County; also near Harrisburg, Dauphin County; Leaman Place, Lancaster County; York, York County; Bridgeport, Shiremanstown, and Carlisle, Cumberland County. The stone from the Lancaster quarries breaks with an irregular fracture; is "plucky," as the stone cutters say, and is hence hard to work. It is, however, very durable, exposure for many years having no other apparent effect than that of a slight fading of the color.

The York stone is very fine grained, compact, and of a deep blue-black color. It takes a high polish, and but for its uneven texture might make a fine marble. In Wrightsville, in this same county, a white or bluish crystalline granular stone is quarried, which takes a fair polish, and which might perhaps be used for marble.

At Chambersburg, and in other parts of Franklin County the stone is a calcareous dolomite, dark in color, fine grained, and very durable; buildings which have stood for a century showing only a slight fading. It is used locally for rough building, lime burning, and fertilizers.

At various localities near South Mountain, a limestone breccia similar to that of Frederick, Md., occurs, and which perhaps can be made to yield good stone for ornamental work.

Tennessee.—A compact, finely fossiliferous, light pink spotted limestone occurs in the vicinity of Nashville, in this State, and which is quite extensively quarried for use in the near vicinity. The stone is said to be of rather poor quality, but is used on account of its accessibility. Near Chattanooga, in Hamilton County, a magnesian limestone of bluish-black color is quarried for local use. The quarry is said to be very favorably located, and the stone cheap and very durable.

Light pink, finely fossiliferous, semicrystalline limestones occur at Columbia, Maury County; light-colored, similar-textured stones at Carter's Creek; light, almost white, at Morristown; red, compact fossiliferous at Springville; and compact drab and almost black dolomites near Charlotte Pike. A fine grained, compact, and light-colored oolitic stone occurs at Sherwood Station, which cuts to a sharp, smooth edge and seems a most excellent stone. So far as the author is aware none of these are quarried for anything more than local use.

Texas.—Compact, fine-grained Cretaceous (?) limestones of excellent quality occur near San Saba in this State. A portion of these are

* See p. 382.

entirely crystalline and acquire an excellent surface and polish, such as fits them for interior decorative work.

Light-colored, fine-grained limestones also occur in the vicinity of Austin, in Travis County; and dark mottled varieties near Burnet, in Burnet County.

Wisconsin.—The more thickly settled portions of this State are, according to Professor Conover,* underlain by Silurian rocks so disposed that there are but few regions where rock fit for ordinary purposes of construction can not be obtained in quantities sufficient to supply the local demand. Previous to 1880, however, with a single exception, no quarries had been worked for export beyond the State, and but few that had been worked for other than local markets. As a whole the stone belonging to this class in the State are characterized by their light colors, compact textures, and hardness. Many of them will take a good polish and might be used for ornamental work, but that the colors are dull and uninteresting. Such occur and are quarried to a considerable extent at Byron, Fond du Lac, and Eden, in Fond du Lac County, but although the stone seems very durable, its hardness is such that it has not been used for facings or any kind of ornamental work. Coarse drab dolomites are quarried for general building at Ledyard and Kaukauna, in Outagamie County; at Neenah and Oshkosh, Winnebago County, and at Duck Creek Station, in Brown County. In various parts of Waukesha County there occurs a light drab, sometimes almost white, dolomite, which, though a hard stone to cut, has been quite extensively used and with very good effect for general building. At Eden, Oak Centre, and Sylvester, Green County, a similar stone occurs, which also crops out in Calumet County. Here it is of a white mottled color, takes a good polish, and is locally called marble.

Near Racine there occur beds of dolomite, varying from coarse, porous, and irregularly bedded to a fine, compact, and homogeneous rock, eminently adapted for fine building material, though not well suited for ornamental work. The quarries are very extensively worked. Other quarries in the same formation occur at Milwaukee, Cedarburgh, Grafton, Sheboygan, and Manitowoc. The Milwaukee quarries furnish several grades of building material, and of almost any necessary size. These are said to be remarkable for the great depth of excellent building stone which their working has developed.

Numerous other quarries occur in Rock, Dane, and La Crosse Counties, but which can not be mentioned here for lack of space.

* Report of Tenth Census, Vol. x.

E.—THE GRANITES AND GNEISSES.

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(1) COMPOSITION AND ORIGIN.

By the term "granite" is understood a crystalline granular mixture of the minerals quartz, orthoclase, and plagioclase, which, in varying proportions, make up the chief bulk of the rock. Besides these, there is nearly always present one or more of the minerals biotite, muscovite, or hornblende, and more rarely augite, chlorite, tourmaline, graphite, and hematite. By the aid of the microscope may frequently be detected other accessory minerals such as apatite, epidote, zircon, magnetite, menaccannite, and microcline. These last, although of scientific interest, are of little practical importance.

Microscopic study of properly prepared thin sections of granite have shown that there are at least two varieties of feldspar and that they are radically different. The one is orthoclase, which is usually the predominating constituent, while the other is a triclinic variety, usually albite or oligoclase, called for convenience *plagioclase* when the exact variety can not be definitely ascertained. It is easily distinguished from the orthoclase by its beautiful banded structure as seen in polarized light. A third variety, identical in chemical composition with orthoclase, but crystallizing in the triclinic system, is also frequently present. This is microcline. Under the microscope it shows a peculiar basket-work structure, due to the nearly rectangular intersection of its laminae produced by twin formation.

The quartz does not occur in the form of crystals, but rather in that of angular crystalline grains. It appears always fresh and glassy, but on microscopic examination is found to contain numerous inclosures, such as rutile needles and little prisms of apatite. A most interesting fact is the presence of minute cavities within the quartz, usually filled wholly or in part with a liquid, though sometimes empty. This liquid is commonly water containing various salts, as the chloride of sodium or potassium, which at times separates out in the form of minute crystals. Carbonic acid is frequently present, giving rise to a minute bubble like that of a spirit-level, and which moves from side to side of its small chamber as though endowed with life. So minute are these cavities that it has been estimated from one to ten thousand millions could be contained in a single cubic inch of space.*

Granites are massive rocks, occurring most frequently associated with the older and lower rocks of the earth's crust, sometimes interstratified with metamorphic rocks or forming the central portion of mountain chains. They are not in all cases, as was once supposed, the oldest of

* Judd on Volcanoes, p. 64.

rocks, but occur frequently in eruptive masses or bosses, invading rocks of all ages up to late Mesozoic or Tertiary times.*

They are very abundant throughout the Eastern and Northern United States and the Rocky Mountain region.

The average specific gravity of granite is 2.66, which is equal to a weight of 166½ pounds per cubic foot, or practically 2 tons per cubic yard. According to Professor Ansted† granites ordinarily contain about 0.8 per cent. of water, and are capable of absorbing some 0.2 per cent. more. In other words, a cubic yard would in its ordinary state contain 3.5 gallons of water. The crushing strength of granite is quite variable, but usually lies between 15,000 and 20,000 pounds per square inch, as will be seen by reference to the tables. The average chemical composition is as follows:

	Per cent.
Silica	72.00
Alumina	15.07
Iron peroxide	2.22
Magnesia	5.00
Lime	2.00
Potash	4.12
Soda	2.9
Loss by ignition	1.19

(2) VARIETIES OF GRANITE.

In classifying granites the varietal distinction is based upon the prevailing accessory minerals. The more common varieties are muscovite granite, biotite granite, muscovite-biotite granite, hornblende granite and hornblende-biotite granite; more rarely occur augite, epidote, tourmaline, cordierite, and chlorite granites. The variety without any accessory minerals is sometimes called *granitell*. *Protogine* is the name given to granites like those of Mount Blanc, which have talc or chlorite as the characterizing accessory. Pegmatite or graphie granite is a vein rock containing scarcely any mica, but consisting almost altogether of quartz and orthoclase. It owes its peculiar structure to the crystallization of these two ingredients in long parallel and imperfect prisms so that a cross-section shows peculiar triangular and polygonal figures comparable to the letters of the ancient Greek or Phœnician alphabets.

By far the larger proportion of the granites at present quarried in the United States have mica, either muscovite or biotite, as the characterizing accessory, and hence can be spoken of as mica granites. The amount of mica present is of considerable economic importance. It does not polish as easily as do quartz and feldspar, owing to its softness,

* Professor Whitney considers the eruptive granites of the Sierra Nevada to be Jurassic. Zirkel divides the granites described in the reports of the 40th parallel survey into three groups: (1) Those of Jurassic age; (2) those of Paleozoic age; and (3) those of Archaean age. The granites of the Eastern United States, on the other hand, are considered by geologists almost without exception as Archaean.

† Hull, Building and Ornamental Stones, p. 30.

and the presence of a large amount therefore renders the rock difficult to polish, and when polished it does not retain its luster so long as do the other minerals, its surface soon becoming dull by exposure. Its presence in large amounts is therefore deleterious to stones which are intended for exterior polished work. The condition in which the mica occurs is also an important factor. A large amount of it scattered in very fine flakes throughout the mass of the rock influences its value as a polished stone less than does the presence of large and thick crystals scattered through the rock in smaller number. The method of the arrangement of the mica is an important item; if scattered at haphazard, and lying in all directions among the quartz and feldspar crystals, the rock will work nearly as well in one direction as another. If it is scattered through the rock in such a way that its laminæ are arranged in one definite plane, it imparts a stratified appearance to the rock, causing it to split more readily in the direction of this lamination than across it. When this stratified appearance becomes strongly marked the rock is called a gneiss. Since, then, the distinction between granite and gneiss is simply one of structure, and as the two rocks are used to a considerable extent for the same purposes, they will be treated of together in the following pages.

If hornblende is the characterizing accessory, the rocks are usually without distinct lamination, as this mineral commonly exists in a granular form. Hornblende is subject to as wide variations of composition as is mica, but its white and very light colored varieties do not usually occur in our granites. Hornblende cleaves parallel to two planes, which make angles of 124° with each other, and in this respect is distinguished from black mica, which has but one cleavage. Its folia are also inelastic.

Hornblende takes an easier and more durable polish than mica and its presence is preferable on this account. Pyroxene as a characterizing accessory in granite is more common than has ordinarily been supposed. Indeed all rocks which contain pyroxene abundantly have usually been confounded with hornblende granites. The distinction between these two minerals is important from an economic stand-point, as hornblende possesses a much better cleavage than pyroxene, while the pyroxene is much more brittle than the hornblende, and cracks out with greater ease while working. The cracking out of little pieces from the black ingredient of the Quincy granites has been frequently noticed, and is due to the circumstance that this granite is not the hornblende-granite it has usually been supposed to be. Hornblende is very tough, but the Quincy granite contains a peculiar variety of pyroxene which is so brittle that it is difficult to produce a large surface which does not show some little pits, due to the breaking out of a portion of the black grains of pyroxene. Although pyroxene and hornblende may be identical in composition, they are frequently associated together in the same rock; a fact which is very evident when thin sections are examined

with the microscope, though they are indistinguishable to the naked eye. Those granites which contain hornblende also frequently contain mica, but it is noticeable under such circumstances that the mica is always the dark variety, and an example of a granite which contains both hornblende and muscovite is unknown.* Although epidote is a very common constituent of our granites in the form of microscopic crystals, the cases in which it occurs as chief accessory are quite rare. So far as observed it is always of a green color, and when present in any quantity is readily noticeable on this account alone. The pink granite of Dedham, Mass., is the most marked example of epidotic granite now quarried, though in several other cases, as the biotite-epidote gneiss of Lebanon, N. H., the mineral is frequently present in such quantities as to appear in greenish blotches on a polished surface. Tourmaline granites occur only in veins, and, so far as is known to the writer, never in sufficient abundance to warrant the opening of quarries to work them exclusively.

In texture the granites vary from extremely fine and homogeneous rocks to those in which the individual crystals are several inches in length. Porphyritic structure is common, and is produced by the development of larger crystals of orthoclase in the finer groundmass of quartz and feldspar. The color of granites is dependent largely upon the abundance and kind of accessory minerals and the color of the prevailing feldspar. Ordinarily the muscovite granites are very light gray in color, the biotite and hornblende granites light to dark gray, or sometimes almost black on a polished surface, as is the case with the hornblende-biotite granite of Saint George, Me. In the red and pink granites the color is due to the red or pink orthoclase, which is the prevailing constituent.

(3) USES OF GRANITE.

Since the earliest times granite has been used by all civilized nations for monumental and other purposes where great strength or durability was required. But while the enduring properties of the rocks have caused them to be eagerly sought, their great hardness and consequent poor working qualities have caused them to be used in works of the more simple and massive kind, where but little carving and dressing were necessary. In past ages the cheapness of life and labor in great part counter-balanced these difficulties, and hence are found works of most elaborate design executed in this refractory material; works which with the present high valuation set upon labor could never be executed but with the aid of greatly-improved machinery and methods of workmanship. The ancient Egyptians, to whom human life and labor were matters of minor importance, have left a profusion of temples, obelisks, and pyramids, whose surfaces are often carved and polished in the finest and most delicate manner, although constructed of material so obdurate

* Hawes Lith. of New Hampshire.

and unchangeable that in some cases even the marks of the tool remain upon it to the present day. A specimen of red granite now in the Museum, and formerly a portion of one of these obelisks, still shows the original carving made upon it upwards of three thousand years ago.

There is probably no country on the globe in which so large a proportion of its stone buildings are of granitic rock as the United States. This fact is due rather to the ready accessibility of the rock in those portions that were earliest settled than to any very decided preference on the part of the builder. The United States Government has of late shown a decided preference for granite in the construction of its public buildings, and has often had it transported many hundreds of miles, at a cost that never would have been undertaken by private capitalists. One item that tends to increase the cost of our granite, and other stone buildings as well, to a seemingly needless extent is the fact that American tastes seem yet incapable of appreciating any but smoothly-dressed or carved stone in a wall. This fact is, it seems to the writer, greatly to be regretted, since, with the majority of stones, better and more majestic effects can be produced by rock-faced and rubble-work than in any other manner, and at a much less cost.

Probably the most elaborate granite buildings now in the United States are the State, War, and Navy Department Buildings in Washington and the new capitol at Albany, N. Y.

(4) GRANITES OF THE VARIOUS STATES AND TERRITORIES.

California.—It is stated* that the first stone house erected in San Francisco was built of stone brought from China, and at the present day the granites most employed are brought from Scotland and the Eastern United States. However this may be, it is obvious that this condition of affairs need not long continue to exist, since granites of good quality occur in inexhaustible quantity in the near vicinity. As early as 1853 a granite quarry was opened in Sacramento County, and since then others have been opened and systematically worked in Penryn and Rocklin in Placer County. The Penryn works are some 28 miles east from Sacramento on the line of the Central Pacific Railroad. The first quarries were opened in 1864 and are now said to cover some 680 acres at Penryn and Rocklin,† the latter point being some 6 or 8 miles distant from the former in a westerly direction.

The rock varies in color from light to dark gray, one variety, which contains both hornblende and biotite, being almost black on a polished surface. They are as a rule fine grained, and take a good polish. Blocks more than 100 feet long, 50 feet wide, and 10 feet thick have been quarried out and afterwards broken up.‡

The buildings mentioned below have been constructed wholly or in

*Building Stone and Quarry Industry, Report Tenth Census, Vol. x, p. 2.

†The Rocklin stone is rather a quartz diorite than a true granite.

‡Mineral Resources of the United States, 1883, p. 455.

part of these granites: United States Mint, new City Hall, new Stock Exchange, the Real Estate Associates' building, and several private residences, and many monuments; all in San Francisco.

A fine-grained very light gray granite of excellent appearance is found on the line of the California Southern Railroad between Los Angeles and Cucamonga, and is beginning to be used in Los Angeles. In texture it is as fine as the finest Westerly, R. I., or Manchester, Va., stone, and of a uniform light gray color. A coarser stone, carrying abundant hornblende and black mica, is found also at Sawpit Cañon, in the same county. It works readily, but contains too much hornblende, and also too many small crystals of sphene, to be of value for fine monumental work.

Colorado.—Granites are at present but little worked in Colorado, although the State contains great quantities of this material. A coarse red granite has been quarried to some extent from bowlders at Platte Cañon, Jefferson County, but the rock is poor in color and possesses but little tenacity. Fine gray granite of good quality occurs at Georgetown and Lawson, in Clear Creek County, and there are inexhaustible quantities of equally good material all through the mountains, but which are not quarried owing to the cost of transportation. A full series of them is in the Museum collection.

Connecticut.—"Extensive quarries of granite and gneiss are located at various points in this State, especially near Thomaston and Roxbury, in Litchfield County, on Long Island Sound, Fairfield County, near Ansonia, Bradford, and Stony Creek, New Haven County, Haddam, Middlesex County, and near Lyme, Mantic, Groton, and Mason's Island, New London County. The Connecticut granites and gneisses are usually fine-grained and light gray in color, and the appearance is usually so characteristic as to distinguished them from other granites of the Atlantic States."*

The most of these stones are, however, quarried only for local use, and but few find their way into markets outside of the State. A beautiful light gray muscovite-biotite granite is quarried at Thomaston and Reynolds Bridge, which for evenness of grain and clearness of color can not be excelled. The stone from Roxbury is a trifle darker, but though of fine and even grain and acquiring a good polish, is used only for curbings, foundations, and pavings. The Ansonia rock is a very fine-grained muscovite-biotite gneiss, and has been used for general building purposes in New Haven and Bridgeport. The Leetes Island and Stoney Creek rocks are of a pink color, the first mentioned being sometimes very coarsely porphyritic. A turned column of the Leetes Island rock in the Museum shows large pink orthoclase crystals 2 inches or more in length embedded in the finer gray groundmass of the rock. A beautiful and very coarsely crystalline red granite occurs near Lyme, but for some unexplained reason the stone is not in the market. It has

*Report Tenth Census, Vol. x, p. 127.

been used to some extent in Newport, R. I., and some of the material may be seen in the Chaney Memorial Church at this place. Contrary to the general rule in red granites, the feldspars of this rock are not opaque; but quite clear and transparent, and in point of beauty the rock far excels the celebrated Scotch granites from Peterhead. The Haddam, Greenwich, and Bridgeport gneisses are all hornblendic, very dark gray, and split readily in the direction of their lamination; their uses are strictly local.

Delaware.—This State produces scarcely anything in the way of granite rocks. A few quarries of a dark gray gneiss are worked near Wilmington, and are used for general building purposes in this city. One church and several private dwellings have been constructed of this stone, which belongs to the class known as *augite hornblende* gneiss, since it contains both of these minerals in about equal proportions.

Georgia.—Although this State is known to contain inexhaustible quantities of building stones of the finest quality, but little systematic quarrying is done, and none of the rocks have more than a local reputation. A fine grade of muscovite granite, light gray in color, occurs at Stone Mountain, near Atlanta, and also a dark gray hornblendic gneiss. A hornblendic granite resembling that of Quincy, Mass., is said to occur in Oglethorpe County, though the author has never seen any of the material.

Maine.—The large extent of coast-line of the State of Maine, composed of granitic rocks of a kind suitable for building purposes, renders possible the shipment and transportation of the quarried rock at rates much lower than would otherwise be attainable, the quarries being frequently situated so near the water's edge that little, if any, handling is necessary prior to loading upon the vessel. This favorable circumstance, together with the excellent quality of the rock obtainable, led to the early opening of very numerous quarries both on the mainland and the adjacent islands, and hence at the present time are found Maine granites in very general use in nearly every city of importance in the country, even as far west as California, frequently to the almost entire exclusion of perhaps equally good material close at hand.

According to the returns furnished by the special agents in the employ of the building-stone department of the Tenth Census, there were during the census year some eighty-three quarries of various kinds of building stone in the State, situated chiefly either immediately on the coast or within easy reach of tide-water.

Of these eighty-three quarries seventy-four were of granite or gneiss. The different varieties of these stones produced may be classed under the following heads: Biotite granite, biotite-muscovite granite, hornblende granite, hornblende-biotite granite, biotite gneiss, and biotite-muscovite gneiss.

BIOTITE GRANITE.—The great majority of the Maine granites are of this kind. They vary usually from light to dark gray in color, though

pinkish and red varieties are quarried in a few instances. At Red Beach, near Calais, and at Jonesborough there is quarried a pink or reddish rock, very compact and hard, which from a simple examination with the ~~unaided eye is seen to~~ be composed of pink or cream-colored feldspars, smoky quartz, and a few small shreds of mica. An examination of a thin section with the microscope does not greatly increase the number of constituent minerals. The mica, which is usually of a greenish color, is very evenly disseminated throughout the rock and in very small shreds, bearing numerous inclosures of magnetite. A few small apatite crystals are as usual present, but are visible only with a microscope.

The evenness of the grain of these rocks, and the occurrence of the mica only in small amount and in minute flakes are matters of great practical importance, since they allow the production of a more perfect surface and lasting polish than would otherwise be possible. The texture of the rock is much finer than the red Scotch granite, and the color a more delicate pink. They are, in fact, the most beautiful of any of our pink or red granites now in the market, and are used very extensively for monuments, ornamental work, and general building purposes. The largest blocks ever taken out from these quarries was 7 by 7 feet and 2 feet thick. It is said, however, that blocks 30 by 15 by 2½ feet could be obtained if desired. The principal markets of the stone are Boston, Providence, New York City, Baltimore, Philadelphia, Buffalo, Cincinnati, Cleveland, and Columbus, Ohio, Springfield and Chicago, Ill., Milwaukee, Saint Louis, Charleston, S. C., Washington, D. C., and San Francisco, Cal.

At West Sullivan, in Hancock County, a light gray, sometimes slightly pinkish, granite of medium texture is extensively quarried for paving blocks and general building purposes. The stone corresponds closely with that quarried in the town of Franklin. A slightly pinkish granite of coarse texture is also quarried at Somerville, on Mt. Desert Island. This stone was used in the construction of the Brooklyn approaches to the East River bridge and in the arches and foundations of the new bridges in Back Bay Park, Boston. Blocks 150 by 50 by 18 feet have been loosened in the quarry. "The position of these quarries is peculiarly good for shipping, as they lie near the head of Somer Sound, along a narrow and very deep fiord, running several miles inland from the southwest harbor, between the mountains. One of the quarries is situated on the side of a hill and at the water's edge. The sheets of stone are very thick in some cases, one being 18 feet in thickness."

In the vicinity of East Blue Hill, in this same county, are quarried some of the most beautiful gray granites at present in the market. The rock varies from fine, even-grained gray or slightly pinkish to coarsely porphyritic. A foot cube of this granite in the National Museum is composed of a fine even-grained gray groundmass, carrying very many snow-white crystals of orthoclase an inch or more in length. This is

one of the most beautiful gray granites for monumental work with which the author is acquainted. Blocks 90 by 80 by 6 feet have been moved out in some of these quarries. Specimens of this granite tested at the Centennial Exposition at Philadelphia in 1876 showed a crushing strength of 22,000 pounds per square inch. In the quarries the stone lies in sheets from 3 to 10 feet in thickness. The principal markets are Philadelphia, New York, Chicago, Harrisburg, and Washington, D. C.

Two varieties of granite are quarried at Mount Waldo, in the town of Frankfort. Both are light-gray rocks, frequently porphyritic through large white orthoclase crystals. Both varieties are of the same mineral composition, the difference being simply one of texture, one being quite coarse and somewhat porphyritic, while the other is much finer and of more even texture. As would naturally be expected, the finer grade is the better and more durable rock, the coarser variety being more liable to crumble. The mica occurs in large flakes, which the microscope shows to be frequently pierced by small crystals of apatite. A part of the mica is greenish in color and contains a few small grains of epidote. An occasional flake of white mica was noticed in this rock, and there is present the usual sprinkling of magnetite granules, together with an occasional cube of pyrite. Quarries were opened at Mt. Waldo in 1853, and single blocks 80 by 40 by 20 feet have been taken out and afterward cut up. It is estimated that blocks 150 by 50 by 12 feet could be obtained if desired. The rock has been used largely in the building of forts on the coast of Maine, but is also used for all purposes, both ornamental and otherwise, to which granite is usually applied, and has been shipped as far South as Mobile and New Orleans. It is a beautiful stone when polished. The principal quarry is situated on Mt. Waldo, overlooking the Penobscot River, at an elevation of some 320 feet above high tide.

The quarries at Vinalhaven, in Penobscot Bay, are the most extensive of any at present in operation in this country. Quarries were first opened here about 1850, and the present annual product is upwards of 200,000 cubic feet, valued at some \$110,000. Upwards of six hundred men are regularly employed at the works, though the number has at times risen as high as one thousand five hundred. The capabilities of the quarries can be best illustrated by stating that during a visit of the writer to these quarries in the summer of 1883 he was shown the remains of a huge block of granite 300 feet long, 20 feet wide, and varying from 6 to 10 feet in thickness, that had been loosened from the quarry in a single piece and afterward broken up. The largest block ever quarried and dressed was the General Wool monument, now in Troy, N. Y., which measured, when finished, 60 feet in height by $5\frac{1}{2}$ feet square at the base, or only 6 feet 7 inches shorter than the Egyptian obelisk now in Central Park, New York.

In texture the Vinalhaven rock is rather coarse and the general color gray, although the prevailing feldspar is sometimes of a light flesh-

color. Besides biotite, the rock contains small amounts of hornblende and microscopic apatite and zircon crystals.* It takes a good and lasting polish, and is well adapted for all manner of ornamental work and general building purposes. The stone has been used so extensively all over the country, that to cite special cases seems superfluous.

A granite closely resembling that of Vinalhaven is extensively quarried at Hurricane Island, some 3 miles distant, in a southwesterly direction, and is used for similar purposes. The structure of the stone here differs in different parts of the quarry. In one portion it lies in comparatively thin sheets, while in another there occur immense masses of solid rock, extending downward for 50 feet without perceptible jointing. A block of 80 tons has been moved, and a mass 80 by 40 by 25 feet was loosened in the quarry. Natural blocks 500 feet long, 20 feet wide, and 50 feet deep occur.

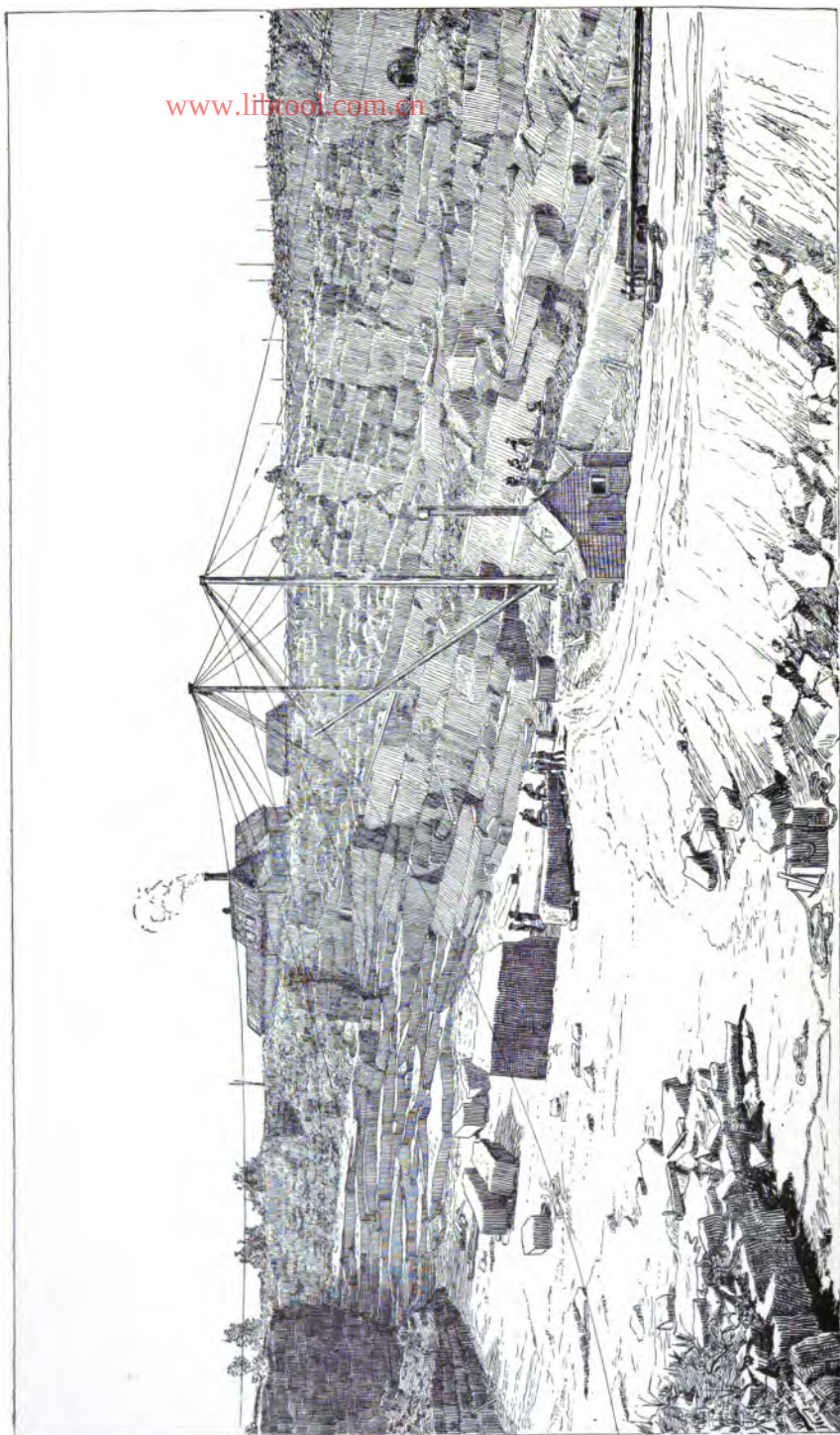
The celebrated quarries on Dix Island, in Knox County, from whence was obtained the granite for the United States Treasury building at Washington, including the monolithic columns, $31\frac{1}{2}$ high by 3 feet in diameter, are at the present writing (1885) abandoned. Nearly the whole island has been quarried over and large bluffs entirely removed. The rock is rich in quartz, and therefore quite hard, but is a good and safe working stone. It has been very extensively used in New York City, Philadelphia, and Washington, D. C.

To give a special description of each and all the quarries of biotite granite to be found upon the coast would extend this work far beyond the prescribed limits. A complete list of them is to be found in the Museum catalogue.

MUSCOVITE BIOTITE GRANITES.—The granite of Augusta and Hallowell has long been justly celebrated for its beauty and fine working qualities. It is a fine, light-gray rock, the uniformity of whose texture is often broken by the presence of large white crystals of microcline, which inclose small, rounded grains of quartz. Biotite and muscovite occur in abundance, and in about equal proportions, but in small flakes, the muscovite appearing as small, silvery-white glistening particles on a broken surface of the rock. Under the microscope three feldspars are readily distinguished—orthoclase in imperfect crystals and irregular grains, an abundance of plagioclase, and microcline in large plates filled with cavities and inclosures of muscovite and quartz. In the thin sections the quartz inclosures are usually circular in outline and are pierced in every direction by minute thread-like crystals of rutile, in polarized light showing up in strong contrast with the beautiful basket-work structure of the inclosing microcline. All the feldspars are quite fresh and pure. A few apatite crystals are present, together with occa-

* In Hitchcock's "Report on the Geology and Natural History of Maine," 1862, p. 265, the Vinalhaven rock is referred to as a "peculiarly fine-grained syenite of good color," etc. In none of the specimens received at the Museum from this locality, however, does hornblende play more than a secondary part, and in the majority of cases does not appear at all. Hence all are classed as biotite-granites.

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GRANITE QUARRY, HALLOWELL, MAINE.
Drawn from a photograph.

sional garnets, which in thin sections are always destitute of crystalline form, appearing as rounded or oval nearly colorless bodies traversed by many irregular lines of fracture. They are quite free from impurities, though occasionally containing inclosures of biotite. As is usual in muscovite-bearing rocks but little magnetite is present; in two cases only grains of pyrite were noticed.

This is one of the best working of the Maine granites, and is used very extensively, not only for building and monuments, but is carved into statues, like marble. The rock is properly a gneiss, but showing no signs of stratification in the hand specimen is classed here as a granite. As illustrative of the great extent of the quarries, it is stated that blocks 200 feet in length, by 40 feet in width and 8 feet in thickness, can be broken out in a single piece if so desired. There is no gap between the sheets, and little or no pyrite to cause discoloration. The sheets, as is usually the case, increase in thickness downward, being about 1 foot thick at the surface and 10 feet thick at the bottom of the present openings, which are from 50 to 60 feet deep. (See Plate VIII.)

This stone is in such demand for statuary and monumental work that an Italian designer who served his apprenticeship in Roman studios is employed constantly by the company. Many of the workmen are also said to be Italians who worked on marble in Italy, but have learned to cut granite since their arrival in Hallowell. Among the prominent structures and monuments constructed, wholly or in part, of this stone, are the new capitol, Albany, N. Y.; Bank of Northern Liberties, Philadelphia; State capitol, Augusta, Me.; Emory Block, Portland, Me.; Odd Fellows' Memorial Hall, Equitable Building, and part of the old Quincy Market, Boston; Ludlow-street jail, the Tribune building, and the old Tombs prison, New York City; the statues of the Pilgrim's Monument at Plymouth, Mass.; soldier's and sailor's monuments at Marblehead, Mass.; Portsmouth, Ohio; Augusta, Boothbay, and Gardiner, Me.; Odd Fellows' monument, Mount Hope, Boston; Washington Artillery monument and Hernandez tomb, New Orleans, etc. The statues on the Pilgrim's Monument are said to be the largest granite figures in existence. The standing figure is 38 feet in height, while the four in sitting posture are each 15 feet in height.

HOENBLENDE GRANITE.—This is rather a rare building-stone in Maine, though extensively quarried in other States. Its production is at present confined to Otter Creek, Mount Desert, where a coarse red rock is quarried, which on a superficial examination somewhat resembles the biotite granites of Calais and Jonesborough, though lacking the cream colored feldspar and consequent speckled appearance characteristic of these rocks. Orthoclase predominates over all other constituents, and is deep-red in color.

This rock is very compact and hard, but works well and takes an excellent surface and polish. It is of finer texture than the Scotch-red granites, and bears a closer resemblance to red granite of the Bay of

Fundry than to any other at present in the collection. If the specimen received at the Museum is a fair sample of the rock at the quarry, it is certainly a most excellent stone, though its otherwise uniform texture is often interrupted by the presence of oval or rounded black patches or knots, caused by segregations of mica, hornblende, and other iron-rich minerals. This is, however, a defect not uncommon in many of the Maine granites.*

Maryland.—The most noted quarries in this State are situated in Baltimore County, near Woodstock. The rock is a biotite granite, varying from light to dark gray in color, and of about medium texture. It is used extensively for general building purposes and for monumental work in Baltimore, Washington, and some of the Western States. At Mount Royal and opposite Ellicott City fine-grained dark-gray gneiss is quite extensively quarried for general building purposes, curbstones, etc. A part of this rock is beautifully porphyritic through large feldspars an inch or more in length.

A dark-gray gneiss, which is the principal stone used in Baltimore for rough work, is quarried in the immediate vicinity of the city.

At Port Deposit, in Cecil County, a gray biotite gneiss is extensively quarried, and is used chiefly for bridge building, docks, harbor improvement, and general building work. It has been used in the construction of Haverford College, Md., St. Dominick's Church, Washington, and several churches in the immediate vicinity. Other locations where good quality of granite is exposed, but not quarried to any extent, are Gwynn's Falls, in Baltimore County, and 3 miles east of Rockville, in Montgomery County.

All of the Maryland granites and gneiss at present quarried have biotite as their chief accessory, are of a gray color and of medium fineness of grain. They appear, however, better adapted for general building than for ornamental work.

Massachusetts.—As Massachusetts was the earliest settled of the New England States it is but natural that here the systematic quarrying of granite should first be undertaken. As already noted,† granite from the boulders on the Quincy Common, and from Chelmsford began to be used in and about Boston as early as 1737, but it was not until the early part of the present century that its use became at all general. Indeed it may be said that it was not until the opening of the quarries at Quincy in 1825 that the granite industry assumed any importance. From this time the use of the stone for general building purposes increased in a marked degree, and the history of granite quarrying in the United States may properly begin with this date.

This early opening of quarries at Quincy was due largely to the demand for stone at Charlestown for building the Bunker Hill monument,

* See On the Black Patches in Maine Granite, Proc. Nat. Mus., 1883, p. 137; also, On the Collection of Maine Building Stone in the National Museum, Proc. Nat. Mus., 1883, p. 165.

† Ante p. 286.

but the attention of capitalists being thereby called to the extent of the granite ledges in this vicinity other works were soon established, and at the present time the two towns of Quincy and West Quincy contain upwards of thirty quarries. Altogether these produce not less than 700,000 cubic feet annually, and give employment to upwards of eight hundred men.

The Quincy granites are as a rule dark blue-gray in color, coarse grained, and hard. A pinkish variety is quarried to a slight extent. They are all hornblende granites, and their general appearance so characteristic that once seen they are always easily recognizable wherever met with. As already mentioned these rocks contain besides hornblende a very brittle variety of pyroxene, which makes the production of a perfect surface somewhat difficult. Nevertheless, they are very extensively used both for rough and finished work. The United States custom-houses at Boston, Mass., Providence, R. I., Mobile, Ala., Savannah, Ga., New Orleans, La., and San Francisco, Cal., are of this stone, as are also the new Masonic Temple and Ridgeway Library building, in Philadelphia. In Boston alone there are one hundred and sixty-two buildings constructed wholly or in part of this material. Its suitability for interior decorative work can not be better shown than by reference to the polished stairways and pilasters in the new city buildings at Philadelphia.

Other very extensive quarries of hornblende-granite are located at Cape Ann, in the town of Gloucester, where it is stated * that quarrying was commenced as early as 1824 by a Mr. Bates, of Quincy. The largest quarries in the State, and, with the exception of those at Vinalhaven, Me., the largest works now in operation in the United States, are situated at this place. Like that of Quincy the rock is hornblendic, though frequently considerable black mica is present.† The texture is coarse and the color greenish, owing to the orthoclase it contains. Some varieties are, however, simply gray. It is a hard, tough rock, eminently durable, and well suited for all manner of general building and ornamental work. The stone has been used in the construction of the post-office and several churches and private buildings in Boston, and the Butler house on Capitol Hill at Washington.

Other hornblendic granites, somewhat similar in appearance, are quarried at Rockport, Peabody, Wyoma, Lynn, and Lynnfild, all of which are represented in the Museum collection. The Rockport stone is the most important of these, and has been quarried since 1830. In color and texture it is indistinguishable from much of the Gloucester stone, but, if anything, is of a more decided greenish hue. In the quarries it is extremely massive, and blocks 100 feet long by 50 feet wide and 16

* History of Gloucester, Cape Ann, by J. J. Babson, p. 577.

† The black mica of the Gloucester and Rockport granites has been shown by Professors Dana and Cooke to be lepidomelane or annite. (Text book of Mineralogy, p. 313).

feet thick have been loosened from the bed in a single piece, while it is estimated a block 200 feet long 50 feet wide and 20 feet thick could be obtained if desired. The principal markets are New York, Boston, New Orleans, and Cuba.

Biotite granites.—Several important quarries of coarse biotite granite are worked in this State, but their product is mostly used in the near vicinity. Light pink varieties admirably adapted for rock-faced work occur at Brockton, Milford, and North Easton. The Milford stone, though not extensively quarried, is particularly effective when used in this manner, as is well illustrated in the new city hall at Albany, N. Y., and also in the new railway station at Auburndale, Mass. At Framingham, Leominster, Fitchburgh, Clinton, Fall River, and Freetown are also quarries of coarse gray but apparently strong and durable granites of this class.

Epidote granite.—This is a rare variety of granite in this country, the quarries at Dedham producing all that is now upon the market. The stone is fine-grained and of a light pink color. Besides epidote, which is visible to the naked eye as small greenish specks, it contains numerous flecks of chlorite, resulting from the alteration of a black mica. The stone works readily and gives very pleasing effects either in polished or rock-face work. It is of this stone that was constructed the new Trinity Church in Boston, and which is considered by good authorities to be, from an architectural standpoint, the finest building in America.

Gneiss.—A fine-grained very light gray, sometimes pinkish, muscovite gneiss of excellent quality has been quarried more or less for the past thirty-five years near the town of Westford. Other quarries of gneiss are at West Andover, Lawrence, Lowell, Ayer, several towns in Worcester County, at Becket, Northfield, and Monson, as will be noted in the tables.

Being in most cases distinctly stratified, these gneisses are not adapted to so wide a range of application as the massive granites, but at the same time the ease with which in many cases they can be quarried makes them particularly valuable for foundations, bridge abutments, curbing, paving, and rock-faced building. At the Monson quarries, for instance, the rock is divided by a series of joints, approximately parallel to the surface of the hill on which the quarries are situated, into immense lenticular sheets from 6 inches to 10 feet in thickness. By taking advantage of these natural facilities a block was split out in 1869 which measured 354 feet in length by 11 feet in width and 4 feet in thickness. An analysis of the Monson stone from the Flynt quarry is given in the tables.

As a general rule it may be stated that while the granites and gneisses of Massachusetts are good and safeworking stones they are coarse and in no way remarkable for their beauty. In the matter of color and texture they bear a striking contrast to the fine and even grained stones of her sister States, Connecticut and Rhode Island,

Minnesota.—According to Professor Winchell more than half the State of Minnesota is underlaid by that general class of rocks—the crystalline—to which granite belongs. In the northern part of the State there are large exposures of very fine light-colored granites, but being beyond the limits of settlements and roads those in the southern and western part, in the country bordering along the Mississippi and Minnesota Rivers, are of more especial interest and importance. These last have been somewhat quarried and the materials can be seen in some of the principal buildings in various parts of the State, as well as in cities beyond the State limits. The first quarry in these rocks in Minnesota was that now owned by Breen & Young, at East Saint Cloud, Sherburne County.

This was opened in 1868, and the stone first taken out was used in the corners, steps, and trimmings of the United States custom-house and post-office in Saint Paul. Three kinds of stone were taken out and used indiscriminately, and all of them may be seen in the building first erected. The variety now more generally used is of a gray color and uniform texture. The crystalline grains are rather fine, so that the texture is close. The color, however, is sometimes disturbed by the appearance of greenish spots of the size of butternuts or even as large as 6 inches in diameter, caused by segregations of a green chlorite. "About one-third of the whole rock is made up of quartz, and two-thirds of the remainder of orthoclase. About one half the remainder is hornblende and the residue is divided between the other minerals, the chlorite predominating." An occasional grain of a triclinic feldspar is present together with magnetite and pyrite in minute crystals.†

"The red granite from East Saint Cloud is not very different from the foregoing, but the feldspar is mainly flesh red and all the grains are coarser." It also has a higher per cent. of silica, a fact that has been discovered practically by the owners, who had given up the general use of it because of it being more costly to work. " * * * In the winter of 1874-5 a block weighing ten tons was taken out of the red-granite quarry, about 3 miles west of Saint Cloud, for a monument base. * * * It was very fine, and greatly resembled the Scotch granite in color, grain, and polish. At the point where this was taken out the granite rises about 20 feet above the general surface and spreads over more than an acre. A similar red granite occurs at Watab (in Benton County), and has furnished several handsome monuments." A light-gray granite also occurs here.*

At Sauk Rapids, in the same county, there is found a fine-grained gray granite closely resembling the gray variety from East Saint Cloud.

* See Geol. and Natural Hist. Survey of Minnesota, Vol. 1, pages 142-148.

† These rocks are designated in Professor Winchell's report above referred to as "Syenites." According to the system of classification now generally adopted, they are rather hornblende or hornblende-biotite granites, as designated by the author in the census report, p. 90. The name *syenite*, as already noted, is applied to a quartzless rock (see pp. 308 and 430).

It has been quite generally used, and is one of the best-known granites in the State:

Missouri.—Although there are inexhaustible quantities of granite in the northern part of Iron and Madison Counties and the southern portion of Saint Francois, there are but few quarries of the material systematically worked.

At Graniteville, Iron County, and in Syenite, Saint Francois County, there occurs a coarse red granite, quite poor in mica, which is now extensively quarried for the Saint Louis and Chicago markets. It is somewhat lighter in color than the well known Scotch granite, but is admirably suited for massive structural purposes, as is well illustrated in the lower stories of the fine business blocks erected during the season of 1886 on Adams street, between Fifth avenue and Franklin, and on the corner of Adams and La Salle streets, in Chicago. The enormous blocks of rock-faced granite and large polished columns of this stone as here displayed* would indicate that this is destined to be one of the leading granites of this portion of the country. It admits of a high lustrous polish and is coming into use for monumental work.

Montana.—There is a plenty of good granite within the limits of the Territory, but for lack of a market scarcely any quarrying is at present carried on.

A cube of a fine-grained light-gray biotite granite was received at the National Museum from Lewis and Clark Counties, but so far as the writer is aware the quarry has never been worked to any extent. A coarse hornblende mica granite of a greenish-gray color and somewhat resembling the celebrated Quincy and Gloucester (Massachusetts) stone forms the country rock in the region of the celebrated silver and copper mines of Butte, and is beginning to be used for purposes of heavy foundation and general building. So far as the writer was able to judge, from the short time he was on the ground, the rock is of excellent quality, but needs to be selected with care, as certain portions, those in proximity to the ore veins, are abundantly charged with pyrite, which oxidizes readily on exposure.

New Hampshire.—Although New Hampshire is popularly known as the "Granite State," in value of total product of the material it ranks but fifth in the list of New England States, being preceded by Maine, Massachusetts, Connecticut, and Rhode Island. However this may be there are but few of our building stone that have a wider reputation than the fine light-gray muscovite-biotite granites from quarries near Concord.

* The window-sills in the first of the above-mentioned buildings are rough blocks of granite, each 3 feet square by 17 feet 4 inches long, and weighing about 10 tons each. The polished columns of the building corner of Adams and La Salle streets are ten in number, each 18 feet high by 4½ feet in diameter, and weighing not far from 18 tons. The largest single block of polished granite yet produced at these works is the Allen monument, in Saint Louis, which is 42 feet in height by 4½ feet square at the base. The weight is about 45 tons.

These rocks have been quarried for many years and very extensively used for all manner of constructive purposes. The following list includes some of the more important buildings and monuments made wholly or in part from this material: Charter Oak Insurance Building, Hartford, Conn.; soldiers' monument, at Manchester, N. H.; monument to the discoverer of anesthetics; the Germania Savings Bank; Equitable Life Insurance; Masonic Temple; Massachusetts State prison, and some seventy-five other buildings in Boston, and Booth's Theater in New York.

According to Professor Hitchcock, the more important quarries are situated on what is known as Rattlesnake Hill, an elevation some 600 feet above the level of the Merrimac River, and which consists almost entirely of granite rocks. Other granites of this class occur and are quarried at Allentown, Sunapee, and Peterborough, and are used for similar purposes, though they are not widely known outside of New England. Gray biotite granites of good quality are quarried at Mason, Fitzwilliam, Rumney, Hanover, Portsmouth, and other towns, as noticed in the tables.

The Peterborough, Mason, and Fitzwilliam are exported to some extent to the neighboring States, but the others mentioned are used in the near vicinity.

The New Hampshire granites are nearly without exception of fine and even grain and well adapted for all kinds of work. The Concord rock is practically identical both in general appearance and mineral composition with that of Hallowell, Maine, already described.

New York.—This State, although rich in marbles, limestones, and sandstones, produces little of general interest in the way of granite rock. A coarse, gray biotite gneiss is quarried at Hastings-upon-Hudson, in Westchester County; a somewhat darker hornblendic gneiss at Cold Spring, in Putnam County; and a coarse red hornblendic granite at Clayton, in Jefferson County.

The gneisses are quarried chiefly for the rough work of foundations in the vicinity. The red granite from Grindstone Island (Clayton post-office) is a beautiful stone and takes a fine polish. The sample forwarded to the National Museum, however, contains particles of iron pyrite, which unfit it for monumental work. The present product of the quarry is made into paving blocks and monuments, principally for Chicago, Ill., and Montreal, Canada, though two beautiful columns of it are to be seen in the new capitol building at Albany, N. Y.

New Jersey.—Aside from a single quarry of greenish-gray gneiss at Dover, Morris County, in this State, no granitic or gneissic rocks are anywhere regularly worked within the State limits. But "Gneissic rocks are found in a few localities in thick beds and so jointed that large and regular blocks can be quarried out at a comparatively small cost. Of the quarries that have been opened and worked to any extent that at Dover alone is kept steadily in operation. It furnishes a large

amount of stone annually for railroad construction along the line of the Delaware, Lackawanna and Western Railroad. The same rock occurs along the New York, Ontario, and Western Railroad from Pompton to Franklin, and at several points its outcrops have been opened for stone. The Sussex and Central Railroad lines also cross the rock. A large quarry was opened a few years ago near Franklin, on the mountain east of the village, but the place, though promising, was soon abandoned. The stone was adapted for heavy work. The transportation appeared to be too expensive for it to compete with stone coming by water routes.*

Pennsylvania.—Although ranking as second in importance in the list of stone-producing States, Pennsylvania furnishes very little in the way of granitic rock, and absolutely nothing in this line of more than local interest. "The southern gneissic district, described in the geological reports of Pennsylvania as ranging from the Delaware River at Trenton to the Susquehanna, south of the State line and lying south of the limestone valley of Montgomery, is the district in which are located nearly all the quarries of gneiss in the State, and those furnishing most of the material are in the vicinity of Philadelphia." The rock, which is for the most part a dark-gray hornblende gneiss, is quarried at Rittenhousetown, Twenty-first ward, and Germantown, Twenty-second ward, and Jenkinstown, in Montgomery County, and is used principally for the rough work of foundations in the near vicinity. In Chester, Delaware County, the gneiss bears mica in place of hornblende and is, as a rule, lighter in color. The quarries are in close proximity to the Delaware River, which affords an easy method of transportation to Philadelphia, the principal market. This stone is also used almost wholly for foundations, though in some cases it has been used as rock-faced work in the fronts of private dwellings, with rather a pleasing effect.

Rhode Island.—The granites of this State are nearly all fine-grained light gray or pink biotite granites, the principal quarries of which are situated some 2 miles east from Westerly, in Washington County. The rock is of fine and even texture and of excellent quality, and is much used for monumental work and general building. Other quarries of biotite granite occur at Smithfield, West Greenwich, Newport, and Niantic. A greenish, fine gray, hornblende gneiss is quarried at Diamond Hill, in Providence County. Aside from the Westerly rock the most of this material is for local market only.

Tennessee.—At the present time scarcely anything in the line of granitic rock is quarried in this State, and owing to the limited areas occupied by granite ledges it is more than doubtful if the granite quarrying ever assumes any great importance. Small outcrops of granite, gneiss, or mica schist occur in the extreme eastern and southern parts of Polk, Monroe, Cocke, Washington, Carter, and Johnson Counties, in the eastern part of the State, but even these are not in all cases suitable for

* Ann. Rep. of State Geologist of New Jersey, 1885, pp. 41-42.

any but the roughest work. The Museum collections contain an extremely coarse greenish epidotic granite, with large red porphyritic crystals of orthoclase, from Bench Mountain, in Cocke County, which might perhaps be worked if there were a market.

South Carolina.—Although no granites from this State are to be found in our principal markets, it by no means follows that there is any deficiency in the supply. The collection now in the Museum shows, on the contrary, that excellent stones of this class occur in various localities.

Near Winnsborough, in Fairfield County, quarries have recently been opened which furnish fine-grained gray biotite granite fully equal to any in the market. The quarries, as we are informed by the owner, Mr. W. Woodward, cover some 70 acres of boulders and two large ledges, one 11 acres in extent and the other 6. The stone works readily and acquires an excellent polish. A pinkish granite also occurs in this same county. Other granites in this State, of which we have seen specimens, but concerning which we have but little accurate information, occur near Columbia, Richland County; and in Newberry, Lexington, Edgefield, and Aiken Counties. The Columbia stone is of a light-gray color, apparently of excellent quality. It was used in the construction of the State house in that city, and is stated to be very durable.*

Texas.—Red granites, both coarse and fine, occur in Burnet County, in this State, though at present neither are quarried to any extent. Both varieties carry biotite as the chief accessory mineral. The coarser variety corresponds closely with the coarse red granite from Platte Cañon, Colo. Their colors are dull and they seem better adapted for rough building than for monumental work.

Utah Territory.—A coarse, light-gray granite occurs in inexhaustible quantities in Little Cottonwood Cañon, not far from Salt Lake City. So far the stone has been quarried only from boulders that have been rolled down the cañon, and the parent ledge remains untouched. This stone has been used in the construction of the new Mormon temple at Salt Lake City.

Vermont.—This State furnishes but little in the way of granitic rocks, from the fact that few of her quarries produce material not found elsewhere in New England, where there are better and cheaper facilities for transportation. Quarries of biotite granite of fine grain and a gray color are, however, worked at Barre, Brunswick, Morgan, Ryegate, and Woodbury. A very light, almost white, muscovite granite is also quarried at Bethel. The most of these rocks are for local use only, though that from Brunswick is said to be carried to some extent into the neighboring cities in New York State.

Wyoming.—"The only building stone which is quarried in Wyoming is at Sherman, the highest point of the Northern Pacific Railroad. At this point—the summit of the Black Hills—the road cuts through a heavy

* South Carolina, Resources, Population, etc., 1883, p. 609.

body of red granite similar to the Scotch, but with much larger crystals." This stone has been used to some extent in San Francisco and Sacramento, but is hard to work, owing to its coarseness and lack of tenacity.*

Virginia.—The granites of this State are, as a rule, fine-grained, biotite-bearing rocks, and of a light-gray color. They correspond in a remarkable degree with the granites of New England, more so than those of any Southern or Western State. The principal quarries, thus far developed are in Chesterfield and Henrico Counties on the James River, and within easy reach of the Richmond market.

The quarry of the Richmond Granite Company, on the Richmond and Alleghany Railroad, near Richmond, produces a massive gray granite used for general building purposes, paving stone, and monumental work, and which is shipped more or less to all the States and cities south of New England and as far west as Nebraska. Much of the material is dressed at the quarry, polishing works being located on the ground.

The Id Dominion Granite Company and the Westham Granite Company, in Chesterfield County, produce a very similar stone, the principal markets of which are in Richmond, Washington, Norfolk, Lynchburgh, and Philadelphia. Other important quarries are in the Tuckahoe district, Henrico County, and Namozine district, Dinwiddie County. Stone from the last-named locality was used in the construction of the post-office and custom house at Petersburg, Va. The most important building yet constructed of the Virginia granites is the State, War, and Navy building in Washington, which is probably the most elaborate granite structure in the country. Near Fredericksburgh is found a fine light gray muscovite-biotite granite closely resembling those of Hallowell, Me., and Concord, N. H., but it is not at present quarried to any extent.

Wisconsin.—The extensive outcrops of granite rock in this State have been scarcely at all worked up to the present time, owing to the lack of transportation facilities. At the present writing the most important quarries are at Montello, Marquette County, and Wausau, Marathon County. The Montello rock is very fine grained, compact, and of a dull pink color. Quarries were first opened here to furnish paving stones for the Chicago market, but the stone has since been used to a considerable extent for general building and monumental work.

According to Prof. T. C. Chamberlain† the great Laurentian area of the northern part of the State is occupied largely by granite and gneiss, among which are some of exceptional excellence. Granite rocks of greater or less excellence crop out along the upper reaches and tributaries of the Menominee, the Peshtigo, the Oconto, the Wolf, the Wisconsin, the Yellow, the Black, the Chippewa, the Flambeau, the Bad, and the Montreal Rivers. These are now being brought within the reach of cheap transportation, and should be utilized to the mutual benefit of those who work and those who use.

* Report Tenth Census, Vol. X, p. 278.

† Geology of Wisconsin, Vol. I, p. 66.

F.—THE PORPHYRIES, PORPHYRITIC FELSITE.

(1) COMPOSITION AND ORIGIN.

Popularly any fine-grained, compact rock, carrying larger crystals scattered throughout its mass is called a porphyry, whatever may be its composition. In the present work the term has been restricted to those acid eruptive rocks of pre-Tertiary origin, consisting of a very compact felsitic base formed of an intimate mixture of quartz and feldspar and in which one or both of these minerals are porphyritically developed. The groundmass is usually too fine to allow a determination of its composition by the unaided eye, and under the microscope is found to possess that peculiar felt-like structure called by lithologists microfelsitic. The porphyritic crystals are usually of a different color from the groundmass in which they are imbedded, and hence produce the striking effect which has made these rocks so famous in all ages and caused them to be used in the finest ornamentations in spite of their hardness.

(2) VARIETIES OF PORPHYRY.

Accordingly as the porphyries vary in mineral composition they are divided into two principal varieties: (1) Quartz porphyry, which consists of the fine-grained groundmass in which quartz alone or quartz and orthoclase are porphyritically developed, and (2) quartz-free or orthoclase porphyry, in which orthoclase alone prevails, no quartz appearing either porphyritically or in the groundmass. This last variety, it will be seen, bears the same relation to the quartz porphyries as does syenite to the granites. Through an entire disappearance of the porphyritic crystals, the rock passes into felsite. The porphyries bear the same accessory minerals (hornblende, mica, etc.), as do the granites, but these are usually in such small particles as to be invisible to the naked eye.

Porphyries, like granites, are of a variety of colors; red, purple, gray, green, brown, and black of a variety of shades are not uncommon, and when, as is so often the case, the porphyritic minerals contrast in color in a marked degree with the groundmass, the effect on a polished surface is very beautiful.

(3) USE OF PORPHYRY.

The porphyries are as a rule intensely hard and tough and completely without rift in any direction. As a consequence they are scarcely at all used in this country, although among the most beautiful and indestructible of our rocks. The celebrated porphyries of Elfdalen, Sweden, are wrought into a variety of objects of art, and with exceedingly beautiful effects. Visitors at the Centennial Exposition in Philadelphia will recall the beautiful large column and inlaid table of this stone that was there displayed.

(4) PORPHYRIES OF THE VARIOUS STATES AND TERRITORIES.

Inexhaustible quantities of porphyries of a variety of colors and great beauty occur at Saugus, Malden, Lynn, and Marblehead, and other localities in eastern Massachusetts, but which have never been utilized to any extent owing to the cost of working. Many of these are of exceptional beauty, presenting colors red as jasper, through all shades of pink, gray, and even black, often beautifully variegated and brecciated in a variety of colors. Flow structures caused by the onward flowing of the rock while in a partially cooled condition often gives rise to a beautiful banding and interweaving of colors impossible to describe, and which must be seen to be appreciated. The striking beauty of this flow structure is sometimes heightened by the presence of angular fragments of variously colored portions of the rock, which, becoming broken from the parent mass, have been imbedded in a matrix of quite different color, as at Hingham, where we have found bright red fragments imbedded in a yellowish paste. The rock acquires a beautiful polish, and the fact that it has not ere this come into more general use is a sad comment upon the taste of our wealthier citizens. Nearly as indestructible as glass, and as beautiful as an agate, and yet almost wholly ignored except for purposes of rough construction.

A large variety of porphyries, varying in color from black to red, occurs also in New Hampshire, particularly near Waterville, some of which would make fine ornamental stones. At Franconia, in the White Mountains, there occurs a porphyry conglomerate formed of fragments of jasper red porphyry closely cemented into a compact rock, which is particularly beautiful. Slabs of this stone in the National Museum can not be excelled for richness of color.

Porphyries are abundant in many other States, but are scarcely at all used. Maine, Pennsylvania, Missouri, Minnesota, and Wisconsin all contain good material, though, as little or no search has been made for the highly ornamental varieties, it is impossible to say what they can produce.

At Green Lake, in the last named State, there occurs a beautiful stone of this class, almost black in color, with white porphyritic feldspars. It has been quarried to some extent near the town of Utty, and polished columns of it may be seen in the German-American Bank building and Union Depot at Saint Paul, Minn. It is greatly to be regretted that no economic method of working so beautiful and durable a material has as yet been discovered.

Near Charlotte, in Mecklenburgh County, N. C., there occurs a very light colored, almost white, quartz porphyry, which is penetrated by long parallel streaks or pencils of a dead black color. These are so arranged that, when cut across, the surface appears studded thickly with roundish and very irregular black points of all sizes up to half an inch. Cut parallel with the direction of the pencils, the surface is streaked

with black lines, which sometimes assume the most beautiful fern-like or dendritic forms imaginable.

The rock is intensely hard, tough, and without definite rift. It can therefore be worked only at great cost, and is not regularly quarried. It has been used only locally for rough purposes, as for curbing, steps, and sills. An analysis of this rock is given in the tables.

G. THE LIPARITES.

(1) ADAPTABILITY FOR CONSTRUCTIVE PURPOSES.

Tertiary and post-Tertiary rocks of any kind are at present very little used for constructive purposes in the United States, owing, in the case of fragmental rocks, to their state of imperfect consolidation and consequent feeble tenacity, and in the case of eruptives to their almost entire absence in those portions of the country that have become permanently settled and where as a consequence there has arisen a demand for a more durable building material than wood. Of the eruptive rocks of this class only the liparites, andesites, and basalts have been at all utilized and these to but a small extent. Their textures are, as a rule, such as to fit them only for the rougher kinds of construction, since, with the exception of the glassy varieties, they will not polish, and their rough appearance unfits them for any kind of interior decorative work.

(2) MINERAL AND CHEMICAL COMPOSITION OF LIPARITE.

Under the head of liparites are classed those acid eruptive rocks consisting chiefly of quartz and sanidin (the glassy variety of orthoclase) which are not older than Tertiary and which may be regarded as the younger equivalents of the granites, quartz porphyries, and felsite pitchstones.

In texture they vary from coarsely granitoid rocks, entirely crystalline throughout, through all intermediate felsitic stages to clear glassy forms. Structurally they vary from fine, compact, even-grained to coarsely porphyritic, amygdaloidal, and sperulitic forms; well marked fluidal structure is common. The prevailing colors are chalky white to dark gray; more rarely greenish, brownish, yellowish, and reddish varieties occur.

The average chemical composition of liparite (quartz-trachyte) as given by Zirkel is silica, 76.36; alumina, 11.97; iron oxides, 2.01; lime, 1.09; magnesia, 0.56; potash, 3.70; soda, 4.53; specific gravity, 2.55.

(3) VARIETIES OF LIPARITES.

According as they are crystalline throughout, felsitic and porphyritic or entirely glassy, liparites are classified as (1) granitic liparites or *neradites*, (2) *rhyolites*, and (3) glassy liparites as *obsidian*, *pumice*, *pearlite*, and *pitchstone*. Of these only the felsitic and porphyritic variety *rhyolite* is now quarried.

(4) LIPARITES OF THE VARIOUS STATES AND TERRITORIES.

Near Mokelumne Hill, in Calaveras County, Cal., rhyolite occurs in several different colors, and has been quarried to some extent for use in the immediate vicinity. It is also abundant in Colorado, New Mexico, Nevada, Utah, and other of the Western States and Territories.

The glassy variety of rhyolite called obsidian is very abundant in certain parts of the West, and though as yet no attempt has been made to utilize the material there would seem no good reason for its not being used in small pieces for the finer kinds of decorative work. The rock, which is a natural glass formed by the rapid cooling of a molten mass, is of various colors, black, red, and greenish, and often beautifully spotted and streaked. From the Yellowstone National Park, Glass Butte, Oregon, and other sources, the Museum has received specimens of red obsidian spotted and streaked with black wavy lines in a way that is highly ornamental. The stone occurs naturally in a badly jointed condition and could be obtained only in pieces of small size. Owing to its glassy fracture also it could be worked only with plain flat surfaces, but as it takes a high glass like polish, it would be very desirable for tops of small stands, paper-weights, and inlaid work.

H.—THE SYENITES, TRACHYTES, AND PHONOLITES.

(1) DEFINITION OF SYENITE.

Under the name of Syenites are here included those rocks consisting essentially of orthoclase with or without one or more of the accessory minerals, mica, hornblende, or augite. They differ from granites only in the absence of quartz, and otherwise present a precisely parallel series. Thus we may have mica syenite (minette), hornblende syenite, augite syenite, etc.*

(2) LOCALITIES OF SYENITE.

At the present time syenites are but little quarried in this country, though there would seem to be no lack of material and of good quality.

In and about Portland, Me., there occur in the glacial drift many boulders of a beautiful syenite, the exact source of which is not known to the author, but which can not be far to the northward. The rock consists mainly of bright lustrous gray orthoclase and coal-black hornblende, with occasionally a little black mica. In texture it is not too

* Formerly it was customary to call by the name syenite a rock consisting of quartz hornblende, and orthoclase, or what is now called a hornblende granite. The name takes its origin from Syene, Egypt, where a rock supposed to answer this description was originally quarried. Investigation has, however, shown that the Syene rock contains more mica than hornblende, and hence at best can not be classed as a true syenite even according to the old definition. According to recent lithologists the Syene rock is a hornblende mica granite, while true syenite, as above stated, is a quartzless rock.

coarse, and the contrast of colors such that one can scarcely imagine a more beautiful stone for rock-faced work. It is very tough, and, to judge from the bowlders, is also very durable, and not at all liable to discoloration on exposure.

Hawes* describes augite syenites as occurring in Jackson, Columbia, and on Little Ascuntney Mountain, in New Hampshire; also hornblende syenites as occurring at Red Hill and Moultonborough, Columbia, Sandwich, Stark, and Albany, in the same State. Dr. Wadsworth† also mentions a syenite as occurring in eastern Massachusetts, where it occupies a large proportion of the coast line between Salem and Manchester. None of these are as yet quarried.

Near Hot Springs, in Arkansas, there is quarried under the name of granite a tough gray rock of variable texture, consisting mainly of hornblende and *elæolite*, and which would therefore be classed as an *elæolite* syenite. Some portions of the rock, as shown by the large block in the Museum collection, are fine-grained and homogeneous, while in others the *elæolite* crystals reach some 2 or 3 inches in length. The appearance of the stone is excellent, but portions of it contain a large amount of pyrite and it needs to be selected with care if designed for exterior or highly ornamental work.

A syenitic rock bearing abundant *elæolite* and frequently *cancrinite* and *sodalite*, and which must, therefore, also be classed as an *elæolite* syenite occurs abundantly in the vicinity of Litchfield, Me., and specimens of the rock have found their way into the building-stone collections of the Museum. An examination of the rock does not, however, impress one particularly in its favor. Its durability is, to say the least, doubtful, and its varying texture and colors rather against it.

(3) THE TRACHYTES AND PHONOLITES.

Under the name of trachytes are comprehended by Rosenbusch those massive Tertiary and post Tertiary rocks consisting essentially of *sanidin* and *hornblende*, *augite* or black mica, and which may be regarded as the younger equivalents of the syenites and quartz free porphyries.

The average chemical composition is silica, 63.55; alumina, 18.0; iron oxide, 6.15; lime, 1.96; magnesia, 0.83; specific gravity, 2.65.

In structure trachytes are rarely granular but usually possess a fine scaly or micro-felsitic groundmass, rendered porphyritic by the development of scattering crystals of *sanidin*, *hornblende*, *augite*, or black mica. The texture is porous and possesses a characteristic roughness to the touch; hence its name from the Greek word *τραχὺς* rough. The prevailing colors are gray, yellowish or reddish.

Trachytes are volcanic rocks occurring in eruptive masses in dikes and in lava flows. They may be divided into *hornblende*, *biotite*, or

* Geol. of New Hampshire, Vol. III, Part IV, p. 205.

† Geol. Mag., May, 1885, p. 207.

augite trachytes, according as either of these accessory minerals predominates.

Phonolites differ from trachytes in carrying one or both of the minerals nepheline or leucite in addition to the other constituents named. They bear the same relations then to the trachytes as do the *elæolite* syenites to the syenites proper.

Neither trachytes nor phonolites are, so far as now known, common rocks in the United States. Zirkel describes numerous trachytes from the areas covered by the Fortieth Parallel survey, and Caswell† describes both trachytes and phonolites from the Black Hills, Dakota. Recent investigations by Wadsworth‡ and Messrs. Hague and Iddings§ show, however, that the supposed trachytes of Zirkel were in large part if not altogether andesites, and it is very probable that similar tests applied to many other cases heretofore described would be productive of similar results. However this may be, the utility of the rocks in America is purely prospective.

Their colors and textures are such that they can never be used for other purposes than rough construction, as is the case with the majority of the younger eruptives.

I.—AUGITE (ENSTATITE, HYPERSTHENE) PLAGIOCLASE ROCKS.

(1) DIABASE.

(Diabase, from the Greek word *διαβασis*, to pass over; so called because the rock passes by imperceptible gradations into diorite.)

The diabases are entirely crystalline granular rocks, composed essentially of plagioclase feldspar and augite, with nearly always magnetite and frequently olivine. Geologically they are pre-Tertiary eruptive rocks, basic in composition, occurring in dikes, intruded sheets, and lava flows. Their mode of occurrence is quite similar to that of basalt, from which they differ chiefly in date of eruption and the amount of alteration they have undergone. In structure they are as a rule massive, but schistose varieties occur and more rarely spherulitic forms. The texture is as a rule fine, compact, and homogeneous, though sometimes porphyritic or amygdaloidal. The colors are somber, varying from greenish through dark gray to nearly black, or sometimes black when freshly quarried, but becoming greenish on drying.||

* Micro. Petrography, fortieth parallel.

† Geol. Black Hills of Dakota.

‡ Proc. Bos. Soc. Nat. Hist., Vol. XXI, 1881, p. 243, and Vol. XXII, 1883, p. 412.

§ Am. Jour. Sci., Vol. XXVII, 1834, p. 453.

|| Mr. J. P. Iddings suggests that the change in color from dark, blue black, and greenish, as noticed in diabase of New Jersey, is due to the drying of the serpentine or chlorite, which results from the alteration of the included olivine. (Am. Jour. Sci., May, 1886, p. 330.)

According to Zirkel, the average chemical composition of diabase is as follows :

	Per cent.
Silica	49.54
Alumina.....	14.05
Iron protoxide	14.27
Lime	8.20
Magnesia	5.28
Potash.....	1.16
Soda.....	3.88
Water	2.29

Average specific gravity, 2.8, equal to a weight of 175 pounds per cubic foot.

In classification two principal varieties of diabase are recognized, the distinction being founded upon the presence or absence of the mineral olivine. We thus have (1) olivine diabase, or diabase with olivine, and (2) diabase proper, or diabase without olivine.

Owing to its lack of definite rift, compact texture, and hardness, diabase can, as a rule, be worked only with difficulty and usually at a cost considerably greater than that of granite. It is therefore not extensively quarried, though of late years it has come into more general use for paving purposes, and still more recently for building and monumental work. The green *antique porphyry* or *Marmor Lacedæmonium viride*, formerly much used for pavements and general inlaid decorative work in Greece and Rome, is, according to Delesse,* a diabase consisting of large greenish crystals of labradorite embedded in a fine compact ground mass of the same feldspar, together with augite and titaniferous iron. The quarries from which the stone was taken are stated by Hull† to be situated between Sparta and Marathon, in Greece. A stone of a similar character and closely resembling it in color and structure is abundant among the drift boulders of eastern Massachusetts, but its exact derivation is unknown.

In the eastern United States the dikes of diabase are frequently associated with deposits of red or brown Triassic sandstone, which are also extensively quarried, as will be noticed further on. Concerning these dikes Professor Dana writes: ‡

"It is remarkable that these fractures (through which the diabase was forced to the surface) should have taken place in great numbers just where the Triassic beds exist, and only sparingly east or west of them; and also that the igneous rock should be essentially the same throughout the thousands of miles from Nova Scotia to North Carolina. The igneous and aqueous rocks (sandstone) are so associated that they necessarily come into the same history. Mount Tom and Mount Holyoke, of Massachusetts, are examples of these trap ridges; also East Rock and West Rock, near New Haven, and the Hanging Hills, near

*Annals de Mines, p. 256.

†Op. cit., p. 73.

‡Manual of Geology, third edition, p. 417.

Meriden, in Connecticut; the Palisades along the Hudson River, in New York; Bergen Hill and other elevations in New Jersey.

"In Nova Scotia trap ridges skirt the whole red-sandstone region and face directly the Bay of Fundy; Cape Blomidon, noted for its zeolitic minerals, lies at its northern extremity on the Bay of Mines.

"In Connecticut the ridges and dikes are extremely numerous, showing a vast amount of igneous action. * * * They commence near Long Island Sound, at New Haven, where they form some bold eminences, and extend through the State and nearly to the northern boundary of Massachusetts. Mounts Holyoke and Tom are in the system. The general course is parallel to that of the Green Mountains.

• "Although the greater part of the dikes is confined to the sandstone regions, there are a few outside, intersecting the crystalline rocks and following the same direction, and part, at least, of the same system.

"Even the little Southbury Triassic region, lying isolated in western Connecticut, has a large number of trap ridges, and such a group of them as occurs nowhere else in New England outside of the Triassic. Their direction and positions in overlapping series are the same as in the Connecticut valley.

"The trap usually forms hills with a bold columnar or front and sloping back. When nearly north and south in direction the bold front is to the westward in the Connecticut Valley, and to the eastward in New Jersey. It has come up through fissures in the sandstone, which varied from a few inches to 300 feet or more in breadth. In many cases it has made its way out by opening the layers of sandstone, and in such cases it stands with a bold front, facing in the direction toward which it thus ascended."

Connecticut.—The extensive diabase outcrops noted above as occurring at East and West Rocks, north of New Haven in this State, are quarried for foundation walls and for paving purposes in the near vicinity. The rock is too dull in color for ornamental work.

Maine.—Diabase is quarried at three localities in this State, Addison, Vinalhaven, and Tenant's Harbor. At Addison the rock occurs in extensive outcrops close by the water's edge. Single blocks 66 by 10 by 20 feet have been moved in the quarries, and natural blocks 90 by 10 by 15 feet occur. The chief defects in the stone are said to be the so-called "knots," which consist of irregular patches of coarse feldspar and dark crystals of hornblende. There are also occasional seams, causing the rock to split unfavorably. The rock is moderately fine-grained, very dark gray, sometimes almost black or spotted black and white on a polished surface and of a fine appearance. It has been used in the walls inclosing the Capitol grounds at Washington, in the construction of a bank at Montreal, and is quite generally used for monuments in Boston, New York, Brooklyn, Washington, Montreal, and Quebec. The Vinalhaven diabase is less extensively worked on account of its hardness. It is of finer grain than the Addison stone and uniformly dark-gray,

nearly black, in color. It is used to some extent for building material and also in cemetery work. The Tenant's Harbor (Saint George, Knox County) stone closely resembles that of Addison, and is used for similar purposes. These are all most excellent stones, and it is a matter for congratulation that they are being so extensively introduced, and, to some extent, replacing the marbles in monumental work. The cost of working is, owing to their compact structure, somewhat greater than that of granite, but the results fully justify the increased outlay. All the above, it should be noted, are known commercially as "black granite."*

Massachusetts.—Diabase is quarried for foundation walls, general constructive purposes, and monumental work at Medford and Somerville in this State. Samples received from these localities are, however, coarser, lighter in color, and much inferior in point of beauty to those just described.

New Jersey.—The extensive outcrops of diabase, or "trap-rock," known as the Palisades of the Hudson River in northeastern New Jersey furnish an inexhaustible supply of this material, and which is at present quite extensively quarried about Guttenberg, Weehawken, West New York, and southward along the Palisades as far as Montgomery avenue in Jersey City.† The rock is used chiefly for paving, and the quarries are small affairs worked by gangs of from two to five men. Two sizes of blocks are prepared. The larger, which are known as specification blocks, are 4 by 8 or 10 inches on the head and 7 to 8 inches deep. The second size, which are called square blocks, are 5 to 6 inches square and 6 or 7 inches deep. The specification blocks bring about \$30 per thousand in the market, and the square only about \$20 per thousand. It is estimated that some 4,000,000 of the specification and 1,000,000 of the square blocks were quarried in 1887, valued at \$140,000.

There are three principal grades of the rock quarried. A fine-grained variety at Mount Pleasant, a rocky hill north of the Pennsylvania Railroad; a light-gray variety at Bergen Cut, south of the railroad;

* It should be remarked that all of these diabases differ radically in structure and composition from any others here mentioned, and deserve a more thorough and careful study than they have yet received. All contain a rhombic pyroxene pleochroic in red, green, and brown colors, and which is evidently hypersthene, while certain sections of the Addison rock show a pyroxenic constituent carrying an abundance of the rhombic inclusions so characteristic of entstatite. Both the Addison and Vinalhaven rocks were in the collection and marked as diabase on my assuming charge, and as such I considered them in my paper on the Maine building stones (Proc. Nat. Mus., Vol. vi, 1883). The Tenant's Harbor rock is presumably the one described as olivine diabase by Wadsworth and Dickerson (Proc. Bos. Soc. Nat. Hist., Mar., 1884, p. 28).

† The Hudson River Palisade rock is called *greenstone* by Mahan (Civil Engineering, p. 3), who states that it is composed of hornblende and common and compact feldspar. This is obviously an error. The rock contains neither hornblende nor "common" (orthoclase) feldspar, but is wholly composed of augite and plagioclase feldspar with a few minute accessories, as magnetite and apatite.

and a dark, almost black, variety at Weehawken and West New York. Other quarries of this rock are worked at Orange Mountain, Snake Hill, Hudson County, and at Morris Hill in Paterson. In the western part of the State the outcrops are not so extensive, but quarries are worked at Rocky Hill, near Titusville, Smith's Hill, and near Lambertville. At Rock Church, 4 miles from Lambertville, the rock is quarried and used for monumental work as well as for general building purposes, being put upon the market under the name of black granite. The rock from the Palisade quarries has also been quite extensively used in and about Jersey City for building purposes. St. Patrick's Cathedral, and the Hudson County Court House, as well as many private buildings, are of this stone, but the effect as a whole is not pleasing, owing to the somber colors of the material. Employed in connection with brick or lighter stone, to give variety and contrast, the effect is admirable.

The finely broken stone is also used very extensively for railroad ballast and road-making. Several of the quarries near Orange Mountain have machines for breaking up the stone for this purpose.*

Pennsylvania.—The principal quarries of diabase in this State are at Collis Station, Lancaster County, and near York Haven, York County. At the latter place the face of the quarry is about 70 feet in height. The rock lies in huge natural blocks sometimes weighing hundreds of tons and having curved outlines giving them a sort of oval shape. Stone from this quarry is used only by the Northern Central Railroad in the construction of bridges, culverts, etc.

At Collins Station diabase is more extensively quarried than at any other locality in the State. The stone is used for all manner of building purposes and monumental work. The foundation of the new Harrisburg post-office and the soldiers' monument in this city are from this material.

In the vicinity of Gettysburgh diabase has been quite extensively quarried from boulders, and has been used for head-stones in the national cemetery at this place.

Virginia.—As in the States to the east and north, the Triassic beds of Virginia are cut by large dikes of "trap" or diabase, and which in some cases are capable of affording excellent material for paving blocks and general building and ornamental work. So far as the author is aware quarries have been opened upon these dikes in but two localities, at Cedar Run, near Catlett's Station on the Virginia Midland Railroad, and near Goose Creek, about 3 miles east of Leesburgh, in Loudoun County. Specimens of these rocks which we have examined represent the coarser varieties of our Mesozoic diabase, are of a dark gray color, very strong, and apparently durable. That from Goose Creek has been found to stand a pressure of 23,000 pounds per square inch, and, as the author has observed, undergoes no change on an exposure of twenty-

* See Ann. Rep. State Geologist of New Jersey 1881, pp. 60-63.

five years other than a slight and in no way objectionable darkening of color. Neither stone has been used as yet for other than paving purposes and bridge abutments, though they are apparently well adapted to all kinds of work for which their color and hardness qualify them.

(2) GABBRO.

The rock gabbro differs from diabase mainly in containing the foliated pyroxene diallage in place of angite. It is not at present quarried to any extent in this country, though for no apparent reason other than that it is difficult to work.

Very extensive outcrops of a dark gray, almost black gabbro of medium fineness of texture occur in the immediate vicinity of Baltimore, Md., but which have been quarried only for purposes of rough construction close at hand. The rock is popularly known as "nigger-head" owing to its hardness, dark color, and its occurrence in rounded boulders on the surface.*

At Rice's Point, near Duluth, Minn., there occurs an inexhaustible supply of a coarse gabbro, which has been studied and described by Professor Winchell.† The feldspar of the rock, which is labradorite, according to the authority quoted, sometimes prevails as at Beaver Bay, in crystals one-half to three-fourths of an inch across, and to the almost entire exclusion of other constituents. In this form the rock varies from lavender blue or bluish gray to light green, and acquires a beautiful surface and polish, and is considered as constituting a valuable material for ornamental slabs and columns. The typical gabbro of the region is of a dark blue-gray color, and "has been employed in a few buildings at Duluth, both in cut trimmings and for rough walls." It has also been used for monuments and for bases, to which it is especially adapted, being cut under the chisel and polished more easily than any of the crystalline rocks that contain quartz. The stone is known popularly as "Duluth granite." The same kind of rock occurs at Taylor's Falls, but is little used, though favorably situated for quarrying and transporting.

A rock closely allied to the gabbros and diabases is the so-called norite, which consists essentially of the minerals hypersthene and a plagioclase feldspar. The only rocks of this nature now regularly quarried are at Keeseville, N. Y., and Vergennes, Vt. The first is known commercially as "Au Sable granite," and the second as "Labradorite granite." Both are coarse-grained, dark-gray rocks, much resembling the darker varieties of the Quincy granites, from which, however, they differ radically in mineral composition. They take a high lustrous polish, frequently show a beautiful bright bluish iridescence, and are

* This is the rock the interesting petrographical features of which have lately been made known by Dr. Williams, of Johns Hopkins University. See Bull. U. S. Geol. Survey, No. 28.

† Geol. of Minn., Vol. I, pp. 148-9.

admirably adapted for polished columns, pilasters, and other decorative work. The lasting power of the norites, when polished, is yet to be ascertained. After an exposure of untold years in the quarry bed the surface has turned white. No data are obtainable for calculating their lasting qualities in the finished structure.

(3) MELAPHYR.

The melaphyrs, as defined by Rosenbusch,* are massive eruptive rocks, consisting of plagioclase, augite, and olivine, with free iron oxides and an amorphous or "porphyry" base. They are thus of the same mineral composition as the basalts and olivine diabases, but differ structurally, and belong in great part to the Carboniferous and older Permian formations. Although very abundant in many parts of the United States, they are scarcely at all quarried owing to their dull colors and poor working qualities.

In the Brighton district of Boston, but a few miles out of the city proper, and in other localities in the vicinity, there occur small outcrops of a greenish or sometimes purplish melaphyr, or "amygdaloid," the lithological nature of which was, I believe, first correctly stated by E. R. Benton† The prevailing color of the rock is greenish, often amygdaloidal, the amygdules being composed often of epidote, thus spotting the surface with greenish-yellow blotches. The rock is greatly altered, only the feldspars of the original constituents remaining now recognizable, while chlorite, quartz, calcite, epidote, and several other minerals occur as secondary products. The rock is nevertheless very firm, compact, and durable, and is being quarried to some extent for rough work. It would seem fitted for a yet wider architectural application.

(4) BASALT.

This rock differs from diabase only in point of geological age, being a product of post-Tertiary eruptions. It is, as a rule, less perfectly crystalline, still retaining portions of its glassy magma, and the surfaces of the flows are often less compact owing to their having been exposed to atmospheric agencies for a shorter period, and consequently having suffered less erosion. Owing in great part to the fact that basalts occur in this country only in the western and more recently settled portions, as do also the andesites and rhyolites, they have been heretofore but little utilized. There would seem, however, no reason for excluding the rock from the list of available building materials in those regions where it occurs in such form as to be accessible. At Petaluma, Bridgeport, and other places around the bay of San Francisco there lie immense sheets of this rock, but which are worked now only for paving materials. Like the andesites and rhyolites the basalts will not polish, and their colors are such as to exclude them from all forms of interior decorative work.

* Mik. Physiog. der Massigen Gesteine, p. 392.

† Proc. Bos. Soc., Vol. xx, p. 416.

K.—AMPHIBOLE PLAGIOCLASE ROCKS (TRAP AND GREEN-STONE IN PART).

(1) DIORITES.

Diorite from the Greek word *διωριζω*, to distinguish.

Diorites are entirely crystalline granular rocks composed essentially of plagioclase and hornblende.

They are pre-Tertiary eruptive rocks occurring mostly in dikes and intrusive sheets and basic in composition, containing only from 50 to 54 per cent. of silica. In structure they are massive. The individual crystals composing the rock are sometimes grouped in globular aggregations forming the so-called *orbicular diorite* or *kugel diorite*. The texture is as a rule compact, fine, and homogeneous, though sometimes porphyritic. The common colors are dark gray or green. According to Zirkel the average composition is:

	Per cent.
Silica	48.50 to 60.88
Alumina	15.72 to 22.12
Protoxide of iron	6.26 to 11.92
Lime	5.47 to 7.99
Magnesia	0.54 to 9.70
Potash	1.05 to 3.79
Soda	2.20 to 5.21
Water	0.60 to 1.90

In classification two principal varieties are recognized, mica diorite or diorite in which black mica is present in excess of the hornblende, and hornblende diorite or diorite proper. The presence of quartz gives rise to the variety quartz diorite. The name tonalite has been applied by Vom Rath to a quartz diorite containing the feldspar andesite and very rich in black mica and which occurs in the southern Alps.

Diorites are commonly known by the names trap and greenstone, as are also the diabases.

These rocks are as a rule exceeding compact and strong, but are scarcely at all used for building purposes owing to their lack of rift and poor working qualities in general. Their somber colors are also a drawback to any form of architectural display. In England diorites are stated by Hauenschild* to be largely used for road materials, while the celebrated *kugel diorite* or *napoleonite* of Corsica has been abundantly utilized through Italy for interior decorative work.

Porphyritic diorites, or porphyrites, may be said to bear the same relation to true diorites as do the quartz porphyries to granites. That is, they consist of a compact felsitic base in which hornblende or feldspar is porphyritically developed. The celebrated red Egyptian porphyry or "Rosso Antico" is a porphyrite as shown by Delesse.† The source of this rock is stated by this authority to be the Dokhan Mountains,

* Katechismus der Baumaterialien, p. 81.

† Bull. Soc. Geol. de France, 1849-50, p. 524.

about 25 miles from the Red Sea and 85 miles from ancient Coptos (now called Kypt). Rocks of this class, though in no way comparable from the standpoint of beauty, have been described by Hawes* as occurring in New Hampshire at Campton Falls, North Lisbon, Dixville, and Dixville Notch; a mica diorite is also described as occurring at Stewartstown. None of these are put to any practical use. A dark gray granitic appearing diorite of variable texture occurs near Reading, Berks County, Pa., which may answer for rough construction. It is not a handsome stone, and is, moreover, hard to work.

The Museum collections contain a cube of a compact light greenish gray diorite, carrying quite an amount of greenish mica and plentifully besprinkled with white porphyritic feldspars from near El Paso, Tex. This cuts to a sharp edge and acquires a good surface and polish. It appears like a good stone for ordinary purposes of construction.

A somewhat similar stone is found near Monarch, Chaffee County, Colorado.

A quartz diorite of a coarse granitic structure is found and quarried at Rocklin, Placer County, Cal. The stone resembles granite in general appearance and works with equal facility.

(2) THE ANDESITES.

Under the name of andesites is included a group of volcanic rocks of Tertiary and post-Tertiary age, and consisting essentially of a triclinic feldspar and hornblende, augite, or black mica.

In structure the andesites are rarely entirely crystalline, but usually present a fine densely microlitic or partly glassy groundmass. According as they vary in composition four principal varieties are recognized: (1) Quartz andesite (Dacite) or andesite in which quartz is a prominent ingredient; (2) hornblende andesite; (3) augite andesite, and (4) mica andesite, each taking its name according as hornblende, augite, or mica is the principal accessory mineral. Hypersthene andesite, or andesite in which the mineral hypersthene is a leading constituent, is also common in many of the Western States and Territories.

The andesites are as yet but little used for structural purposes, and this largely for the same reasons as were given in the chapter on Liparites. Like the rhyolites they will not polish and are in no way suited for decorative work. Although very abundant throughout many of the Western States and Territories they have been quarried in an itinerant way only at Reno and Virginia City, Nev. The rock from the latter source is said to quarry easily and cut well when first taken out, and to harden on exposure. The Reno andesite has been used in the construction of the prison and a few stores at that place.

* Geol. of New Hampshire, Vol. III, Part IV, p. 160.

L.—SCHISTOSE, OR FOLIATED ROCKS.

(1) THE GNEISSES.

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The gneisses, as already noted, have essentially the same composition as do the granites, from which they differ mainly in their foliated or schistose structure. On account of this schistosity the rocks split in such a way as to give parallel flat surfaces, which render the stone servicable in the construction of rough walls and for street curbing. This structure, which is caused mainly by the arrangement of the mica and other minerals in parallel layers, is, however, a drawback to the uniform working of the stones, and hence they are more limited in their application than are the granites. These rocks are frequently called by quarrymen *stratified* or *bastard* granites. The name *gneiss*, it should be stated, is of German origin, and should be pronounced as though spelled *niz*, never as *nees*. For reasons already given the gneisses have been included under the chapter on granites in the present work.

(2) THE SCHISTS.

Mica schist is a rock that consists essentially of quartz and mica. It usually possesses a distinct schistose structure, due to the parallel arrangement of these minerals, as was noted in the gneiss, from which it may be said to differ only in its lack of feldspar. It is a rock which is supposed to have been formed by the deposition and subsequent crystallization of sediments, and consequently the structure of these minerals and their arrangement are markedly stratified. These peculiarities of the schists are not such as to render them favorites for purposes of fine construction. They are, however, in most instances broken out from the ledges with comparative ease, and for rough construction, such as foundations and bridges, as well as for flagging, they are extensively employed.

The mica of the schists may be either muscovite or biotite, or both; in short, the schists may be characterized by one or more of the same accessories as are the granites and gneisses, and we may have just as many varieties. Through a diminution in the amount of mica these rocks pass into quartz schists, and by an increase in the amount of feldspar into gneisses. The relative amounts of quartz and mica in the schists varies almost indefinitely, the percentage of silica, which is largely dependent upon the amount of quartz, varying from 40 to 80 per cent. The finer grained, more compact varieties of mica schist make very fair building material, but the coarser and more schistose varieties are not at all desirable, especially if the mica be biotite and it occurs in great abundance.

In accessory minerals the schists are particularly rich. Some of the more common of these are garnet, feldspar, epidote, cyanite, hornblende,

chlorite, talc, staurolite, magnetite, pyrite, tourmaline, and rutile. Through an increase in the amount of hornblende, chlorite, or talc, the rock passes into hornblende, chlorite, or talc schist.

Owing to their schistose structure and poor working qualities the schists are but little used for architectural purposes, as already noted. One of the most important of these rocks at present worked in this country is the biotite schist near Washington, D. C. This is quite extensively quarried, though in a crude and itinerant manner, both in the District of Columbia and on the opposite side of the Potomac River, in Virginia. The rock is as a rule fine grained and compact, and of a blue-gray color, whence its popular name of "Potomac bluestone." It is at times scarcely at all schistose, and contains a very considerable proportion of feldspar, thus approaching gneiss in composition. Several important structures have been made of this stone, including Georgetown College and one or two churches. It can be worked, however, with great difficulty, and it is only by taking advantage of the natural joint faces that it can be utilized with any degree of economy. Pyrite is very abundant in certain portions of the rock, and shows its utter unreliability by retaining its bright, brassy luster unchanged in some cases for many years, while in others it oxidizes almost immediately.*

In Cape Elizabeth, Maine, near Portland, there occurs a fine-grained talcose schist which is peculiar for the readiness with which it breaks out into jointed blocks of about the right dimensions for building. By taking advantage of this jointing several churches and other buildings in Portland have been erected and present a respectable appearance, though through the oxidation of the included pyrite the walls are stained almost beyond recognition. These joints are as sharp and clean as though cut with a knife, and are usually indistinguishable in the quarry, having been recemented by calcite. A few blows from a hammer on the end of a block will, however, almost always cause joints to open, and often in very unexpected places.

In the town of Bolton, Worcester County, Mass., there occurs a mica schist that has been quarried for many years to furnish flagging materials for Hartford and other New England cities. The rock is fine grained, distinctly schistose, and evenly laminated; it therefore splits out readily into thin plates eminently suited for the purposes to which it is applied.

* It is possible that both ordinary pyrite and the gray variety, marcasite, are present in these rocks, and that it is the latter mineral that so readily oxidizes, while the pyrite remains unchanged.

M.—FRAGMENTAL ROCKS.

(1) SANDSTONES, BRECCIAS, AND CONGLOMERATES.

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(a) COMPOSITION AND ORIGIN.

Sandstones are composed of rounded and angular grains of sand so cemented and compacted as to form a solid rock. The cementing material may be either silica, carbonate of lime, an iron oxide, or clayey matter. Upon the character of this cementing material, more perhaps than upon the character of the grains themselves, is dependent the color of the rock and its adaptability for architectural purposes. If silica alone is present the rock is light colored and frequently so intensely hard that it can be worked only with great difficulty. Such are among the most durable of all rocks, but their light colors and poor working qualities are something of a drawback to their extensive use. The cutting of such stones often subjects the workmen to serious inconvenience on account of the very fine and sharp dust or powder made by the tools, and which is so light as to remain suspended for some time in the air. The hard Potsdam sandstones of New York State have been the subject of complaint on this score. If the cement is composed largely of iron oxides the stone is red or brownish in color and usually not too hard to work readily.* When the cementing material is carbonate of lime the stone is light colored or gray, soft, and easy to work. As a rule such stone do not weather so well as those with either the siliceous or ferruginous cement, owing to the ready solubility of the lime in the water of slightly acidulated rains; the siliceous grains become loosened and the rock disintegrates. The clayey cement is more objectionable than any yet mentioned, since it readily absorbs water and renders the stone more liable to injury by frost. Many sandstones contain little if any cement, but owe their tenacity simply to the pressure to which they were subjected at the time of their consolidation. Such stones are generally of a grayish hue, easy to work, and if the amount of cohesion be sufficiently great, are very durable. The finer varieties of these stones, such as the Euclid "bluestone" and "Berea grits," are utilized in the manufacture of grindstones and whet stones. Since they contain little cementing material they do not become polished when exposed to wear, but crumble slowly away, presenting always fresh, sharp surfaces to be acted upon. In certain of our Potsdam sandstones the siliceous cement is found to have so arranged itself with relation to the grains of sand as to practically convert it into a crystalline rock or quartzite. This has already been referred to in the chapter on microscopic structure.

* Julien states that in the Tertiary sandstones of the Appalachian border the ferruginous cement is largely turgite; in the Triassic and Carboniferous sandstones it is largely limonite, and in the Potsdam sandstones of Lake Champlain and the southern shore of Lake Superior it is largely hematite. (Proc. A. A. A. S., Vol. XXVIII, 1879, p. 408.)

Sandstones are not in all cases composed wholly of quartz grains, but frequently contain a variety of minerals. The brown Triassic sandstones of Connecticut, New Jersey, and Pennsylvania are found, on microscopic and chemical examination, to contain one or more kinds of feldspar and also mica (see Fig. 6, Plate II), having, in fact, nearly the same composition as a granite or gneiss, from which they were doubtless originally derived. According to Dr. P. Schweitzer,* a fine-grained sandstone from the so-called Palisade range in New Jersey contains from 30 to 60 per cent. of the feldspar albite. That quarried at Newark, in the same State, contains, according to his analysis, albite, 50.46 per cent.; quartz, 45.49 per cent.; soluble silica, .30 per cent.; bases soluble in hydrochloric acid, 2.19 per cent., and water, 1.14 per cent. Iron pyrites is a common ingredient of many sandstones. Unless quite abundant the chief danger to be apprehended from the use of such stone is the change of color it is liable to undergo on exposure through its oxidation.

Sandstones are of a great variety of colors; light gray (almost white), gray, buff, drab or blue, light brown, brown, pink, and red are common varieties, and, as already stated, the color is largely due to the iron contained by them. According to Mr. G. Maw† the red and brownish-red colors are due to the presence of iron in the anhydrous sesquioxide state, the yellow color to iron in the hydrous sesquioxide state, and the blue and gray tints to the carbonate or the protoxide of iron. It is also stated that the blue color is sometimes caused by finely-disseminated iron pyrites, and rarely by an iron phosphate.‡ (See page 306.)

Sandstones vary in texture from almost impalpably fine-grained stones to those in which the individual grains are several inches in diameter. These coarser varieties are called *conglomerates*, or, if the grains are angular instead of rounded, *breccias*. Neither of these varieties are at present quarried in this country to any great extent, though in foreign countries calcareous breccias form some of the most beautiful marbles.

All sandstones, when freshly quarried, are found to contain a variable amount of water, which renders them soft and more easily worked, but at the same time peculiarly liable to injury by freezing. So pronounced is this character that many quarries in the northern regions can be worked only in the summer months, as during the cold season the freshly quarried material would freeze, burst, and become entirely ruined. It is customary also for dealers to refuse to assume any risks of injury from freezing to which such stone may be liable after shipment. After the evaporation of this "quarry water," as it is called, the stone is found to be considerably harder, and hence more difficult to work. This hardening process is explained by Newberry and others by the

* American Chemist, July, 1871, p. 23.

† Quar. Jour. Geol. Soc. of London, XXIV, p. 355.

‡ Notes on Building Construction, Part III, p. 35.

theory that the quarry water holds in solution certain of the cementing materials, as has been already noted (p. 339).

(b) VARIETIES OF SANDSTONES.

Many varieties of sandstones are popularly recognized, the distinctions being founded upon their composition, structure, the character of the cementing material, or their working qualities. *Arkose* is a sandstone composed of disintegrated granite. *Ferruginous*, *siliceous*, and *calcareous* sandstones are those in which these substances form the cementing material. *Argillaceous* sandstones contain clay, which can easily be recognized by its odor when breathed upon. *Flagstone* is a sandstone that splits readily into thin sheets suitable for flagging; the same term is applied to other rocks, as the schists and slates, which serve a similar purpose. *Freestones* are so called because they work freely in any direction, their bedding or grain not being strongly enough marked to in any way interfere with this property. *Graywacke* is a compact sandstone composed of rounded grains or fragments of quartz, feldspar, slate, and other minerals, cemented by an argillaceous, calcareous, or feldspathic paste. This term is no longer in general use. *Quartzites* result from the induration of sandstones, a result brought about either by pressure or, more commonly, by the deposition of silica between the granules.

Sandstones occur among rocks of all ages, from the Archæan down to the most recent; none are, however, at present used to any great extent for building purposes in this country that are of later origin than Triassic, or possibly Cretaceous. In the list of natural building materials of the United States sandstone ranks third in importance; the census returns for 1880 showing a product of 24,776,930 cubic feet, valued at \$4,780,391.

(c) SANDSTONES OF THE VARIOUS STATES AND TERRITORIES.

Alabama.—On the line of the Alabama Great Southern Railway, some 60 or 100 miles from Chattanooga, Tenn., there occurs a yellow sandstone that is sufficiently soft when first quarried to be cut with an ax, and which hardens sufficiently on exposure to be very durable in that climate. Samples of this stone received from De Kalb County are of decidedly inferior quality.

Arizona.—There is at present little demand for building stone in this Territory, and consequently but little is known regarding its available material. From Yavapai County, on the line of the Atlantic and Pacific Railroad, we have received a block (No. 35571) of fine grained, compact, light-pink sandstone, that from its warm and pleasing color and easy working qualities would be eagerly sought by Eastern builders were it more accessible. So far as we are informed, it is not at present quarried to any extent.

Arkansas.—Brown massive "freestone" that will make a good building stone is stated by Owen* to occur in Van Buren County.

*Geol. of Arkansas, 1858, p. 75.

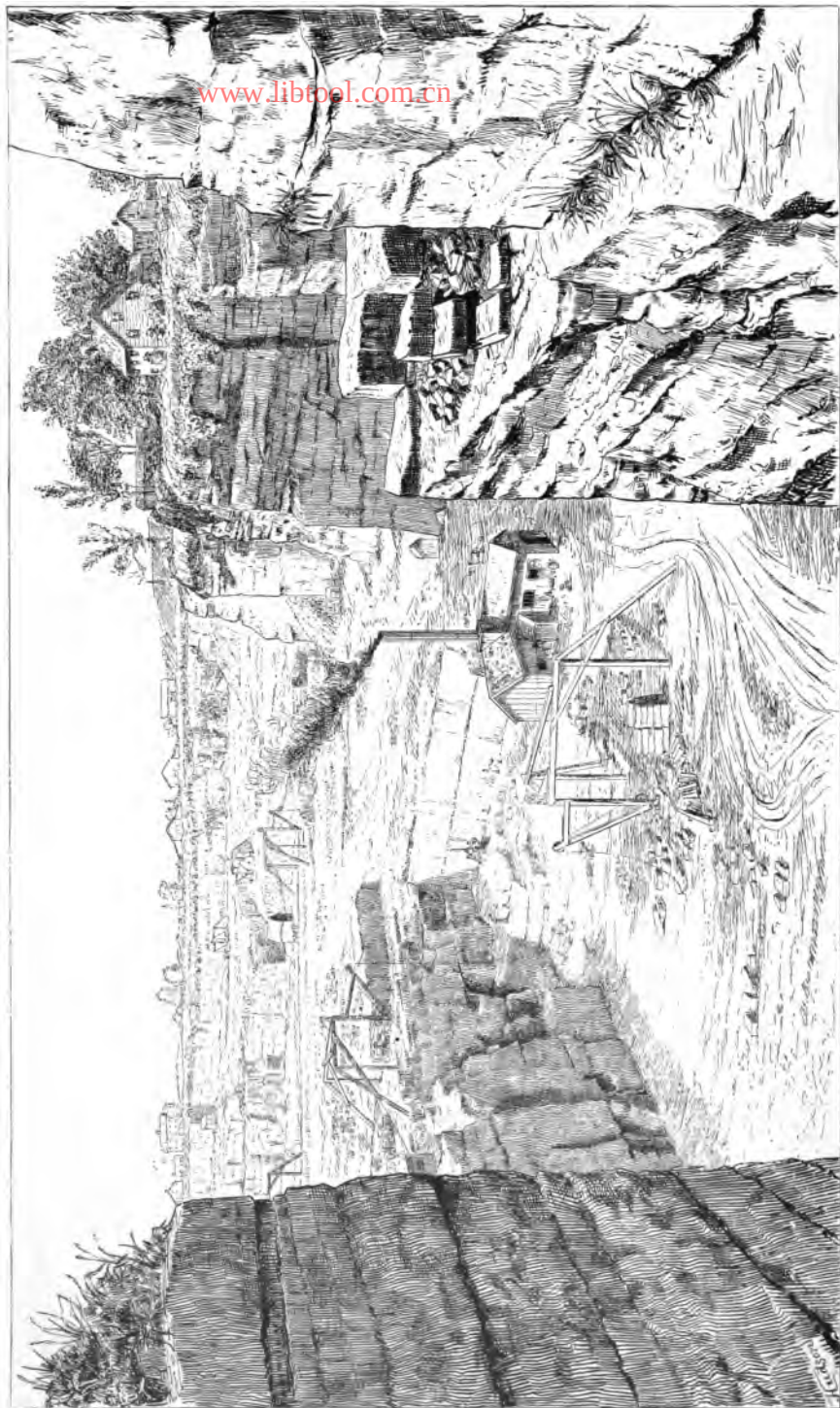
California.—Around the Bay of San Francisco there occur sandstones of a considerable variety of colors which are beginning to come into use to some extent. The prevailing colors here are brownish and gray. On Angel Island, in Marin County, there occurs a fine sandstone of a greenish-gray color, which has been used in the Bank of California building, and others of a lighter shade are found in various parts of Alameda County. A few miles south of San José, Santa Clara County, there are also inexhaustible supplies of light gray and buff stone, but which are at present worked only in a small way. Near Cordelia, Solano County, there occurs a coarse, dark-gray volcanic tuff, that can, perhaps, be utilized for rough construction should occasion demand.

Colorado.—This State contains a variety of sandstones, of good quality, but which, owing to lack of transportation facilities and the thinly settled condition of the country, are as yet in little demand. Near Fort Collins, in Larimer County, a fine light-gray stone occurs which is excellent for flagging and foundations, but contains too much pyrite for fine building purposes. At Coal Creek, in Fremont County, is also a fine grayish or buff stone closely resembling that of Berea, Ohio. As seen by the writer in the stone-yards of Denver, this is a most excellent material, being free from flaws, of good color, and cutting to a sharp edge. It is stated that it occurs in inexhaustible quantities and is obtainable in blocks of large size. At Glencoe, above Golden, in Jefferson County, there occurs a deep salmon-red stone of a beautiful warm and lively hue. It is said to work with considerable difficulty, but is much sought on account of its color. Its principal market is now Chicago, but it is a matter of regret that it can not be introduced into our eastern markets. Near Morrison, in the same county, there occur extensive beds of red and nearly white sandstone. The white is not considered desirable, but the red is much sought for trimming purposes. It is stated to absorb water readily, and hence to be peculiarly liable to damage from frost. The light-colored stone used in the construction of the court-house at Denver was obtained from Cretaceous beds near Cañon City. Trinidad, Las Animas County, also furnishes a good sandstone, which is used in Denver, and another important stone of good quality is brought from Amargo, in Rio Arriba County, across the line in New Mexico.

Connecticut.—As already noted (ante, p. 289) the first quarries of sandstone to be systematically worked in this country were those located in the now well-known Triassic beds at Portland and Middletown in this State. The area of the Triassic deposit in New England as given by Dana* extends from New Haven on Long Island Sound to northern

* Manual of Geology, p. 404. The entire area of the Triassic sandstones in the United States as given by this authority is divided into three parts: (1) the Connecticut area as given above; (2) the Palisade area, commencing along the west side of the Hudson River in the southeast corner of New York, near Piermont, and stretching southwestward, through Pennsylvania, as far as Orange County, Va., about 350 miles long; and (3) the North Carolina area, commencing near the Virginia line and extending through North Carolina over the Deep River region, 120 miles long.

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QUARRIES OF TRIASSIC SANDSTONE, PORTLAND, CONNECTICUT.

Drawn from a photograph.

Massachusetts, having a length of 110 miles and an average width of 20 miles. The stone is at present quarried only at Portland, Middlesex County, East Haven, New Haven County, and Manchester, Hartford County; though ~~small quarries have~~ been worked from time to time to furnish stone for local consumption at East Windsor, Hayden's Station, Suffield, Newington, Farmington, and Forrestville in this same county. The Manchester stone is a beautiful fine-grained reddish variety, and that from East Haven is represented as excellent for rock-faced work. The Portland quarries are, however, by far the most important of any of these, and it is estimated that from their combined areas not less than 4,300,000 cubic feet of material have been taken.

As now worked at this place the quarries descend with absolutely perpendicular walls on three sides for a depth in some cases of upwards of 150 feet, the fourth side being sloping to allow passage for teams or workmen. The stone is of medium fineness of texture, of a uniform reddish-brown color, and lies in nearly horizontal beds varying from a few inches to 20 feet in thickness. Natural blocks 100 by 50 by 20 feet occur, and hence blocks of any desired size can be obtained. In quarrying, channeling machines are used to some extent, though in many cases large blocks are first loosened by means of deep drill holes and heavy charges of powder, and these then split up by wedges. The blocks are roughly trimmed down with picks at the quarry and shipped thus to New York and other large cities to be worked up as occasion demands. Scarcely any of the material is dressed at the quarries. The stone has been used in all our leading cities, particularly in New York, and has even been shipped to San Francisco via Cape Horn. But little quarrying is done in cold weather, as care must be taken against freezing while the stone is full of quarry water, a temperature of 22° F. being sufficient to freeze and burst fine blocks of freshly-quarried material. About a week or ten days of good drying weather is considered sufficient to so season a stone as to place it beyond danger from frost.

Great outcry has from time to time been raised against the Portland stone on account of its disposition to scale or flake off when laid in exposed places. While it is undoubtedly true that it is unfit for carved work in exposed situations, still the author can but feel that the architect and builder are largely responsible for the many ruined fronts caused by this scaling, to be seen in New York and elsewhere. It is the almost invariable custom in building to split the stone with the grain into slabs but a few inches thick and to veneer the walls of buildings with these slabs placed on edge. Let thicker blocks be used and the stone laid on its bed, as nature laid it down in the quarry, and this defect will prove less serious, if it be not entirely remedied. But no stone that is capable of absorbing so large a percentage of water as is much of the Connecticut and other of our Triassic stones, can be more than very moderately durable in the very trying climate of our Northern States.

There is, however, a vast difference in material from the same quarry. I have seen tombstones perfectly sound and legible after an exposure of nearly two hundred years, while others begin to scale in less than ten. The remarks made in the chapter on selection of stone are especially applicable here.

Dakota.—The pink and red quartzite from Sioux Falls in this State is one of the most promising stones of the West. Chemically the stone is almost pure silica, with only enough iron oxide to impart color to it. It is so close grained as to be practically impervious to moisture, so strong as to endure a pressure of 25,000 pounds to the square inch, and will take a polish almost like glass, with which it may favorably compare in durability. In color the stone varies from light pink to jasper red, and it is one of the few stones at present quarried in the United States which is equally well adapted for rough building and for ornamental work, both interior and exterior. Professor Winchell, in reporting upon this stone, states that it bears a heat up to that of redness without cracking or scaling. The writer is informed by Mr. J. H. Drake, of Saint Paul, that the stone will shortly be introduced into the Eastern markets for tiling, decorative work, and general building purposes. The chief drawback to the stone, as may readily be imagined, is its great hardness, which is fully equal to that of pure quartz, or 7 of the scale as given on page 294. It however possesses a remarkably perfect rift and grain, and by especially designed apparatus the company expect to be able to put it upon the market at such prices as shall insure its adoption, and at the same time return a fair profit.

The stone has been used in the construction of the "Queen Bee" flouring mill at Sioux Falls, a structure 100 feet long, 80 feet wide, and 106 feet high, the walls being 5 feet thick at the base and averaging 2 feet 9 inches throughout. It has also been used in the construction of several private residences, and the Dakota penitentiary in this same city, and in the buildings of the deaf-mute school at Keokuk, and those of the Grinnell College at Grinnell, Iowa. It has also been used in polished columns and pilasters in the German-American Bank and Union Depot buildings at Saint Paul, Minnesota.

Idaho.—The Museum has received samples of a rather coarse, very light-colored, sandstone of fair quality from Boise City, in this Territory, but we have no information regarding their availability or the extent of the deposits.

Illinois.—Carboniferous sandstones of light and dark-brown color and good quality are found near Carbondale, in this State. The stone is of medium texture, works readily, and closely resembles some of the Triassic brownstones of Connecticut. The beds are about 14 feet thick and are capable of furnishing blocks of large dimensions. A very fine-grained light bluish-gray laminated stone is quarried in a small way near Xenia, and other sandstones of fair quality occur at Suka, Marion County, Chester, Randolph County, and various points in Perry and Greene Counties.

Indiana.—Very light, almost white, and bluish-grey sandstones, of fine, sharp, and even grain, occur in French Lick Township, Orange County, and in a few localities in Warren and Perry Counties. A part of the Orange County stone is used for whetstones, and is known commercially under the name of "Hindustan oil-stone."

Georgia.—No sandstones are at present quarried in this State, but it is stated that "the Chattooga Mountains contain a considerable variety and of various shades of colors, among which are white, gray, buff, brown, and red. Some of these exist in massive compact beds, while others have a jointed structure that make them easily quarried. The thickness of the entire sandstone series is about 800 feet. Building stone of this character may be had also on Lookout and Sand Mountains, in the Cohutta range."* We have as yet seen none of the above.

Iowa.—This State produces but little of value as building material in the way of sandstones. Coarse, dark brown stones of Carboniferous and Cretaceous ages occur in Muscatine and Cass Counties and have been quarried to some extent, but their qualities are not such as to cause them to be used for other than rough work in the near vicinity.

Kansas.—Good sandstones are stated by Professor Broadhead to occur in several of the counties in the southwestern part of this State, though, so far as we have observed, few if any of these are of such a quality as to acquire other than a local market. A fine, deep blue, gray laminated stone is found at Parsons, and a brownish one at Oswego, in Labette County, also a brownstone at Pawnee, Crawford County, and others of various hues in Bourbon, Neosho, Montgomery, Wilson, Woodson, Greene, and Elk Counties.

Kentucky.—The sandstones of this State, so far as shown by the collections, are all of a light color, fine-grained and rather soft. Light buff and pinkish colors are found in Simpson, Grayson, Todd, Johnson and Breckenridge Counties, some of which are of a beautiful mellow tint. Light-gray stones of apparent good quality, and closely resembling the Berea of Ohio, occur at Blue Lick Mountain, Livingston in Rockcastle County, and in Pineville, Bell County. We are unable to give further information regarding them.

Maryland.—Sandstone of such a nature as to be in demand for other than local uses is quarried in but a single locality in this State. In Montgomery County, near the mouth of Seneca Creek, about 30 miles northwest from the city of Washington, there occurs a considerable deposit of Triassic sandstone which for many years has been quarried more or less to furnish material for the Washington market. The stone is as a rule light reddish-brown in color, of fine and even texture, and well adapted for all manner of building and ornamental work. The writer has examined this stone, both in the quarry and in various buildings, and does not hesitate to pronounce it one of the best of our

* Commonwealth of Georgia, p. 136.

Triassic stones. Clay-holes abound in some portions of the rock, but can be avoided by careful selection. The stone is not at all shaley and shows little, if any, disposition to scale when exposed to the weather. The Smithsonian Institution, erected in 1848-'54 from this stone, shows few defects from weathering alone, and these only in those cases where they might have been avoided by judicious selection. On blocks of this stone in the aqueduct of the Chesapeake and Ohio Canal which have been constantly permeated by water every season for fifty years, the tool-marks are still fresh and no signs of scaling are visible other than are produced by too close contact at the joints. The quarries are conveniently situated near by the canal, where stone can be readily loaded upon boats for the Washington markets, from whence it can be shipped by rail or vessel to all our principal cities.

Massachusetts.—The beds of Triassic sandstone, which furnish in Connecticut the well-known Portland brownstone, are continued up the valley of the Connecticut River to the northern boundary of Massachusetts and furnish in several places valuable deposits of building material. At East Long Meadow, in Hampton County, quarries are worked in this formation which produce a rather finer grained stone than that of Portland and of a bright brick-red color. Like all the Triassic stones it is soft and works readily, and on account of its warmth of color can be used with very pleasing effects in a variety of combinations.

The extensive formation of Primordial conglomerate in Dorchester, Roxbury, Brookline, and other towns south and west of Boston furnishes an inexhaustible supply of durable building material for rough work, but which, owing to its coarseness, is unsuited for ornamental work of any kind. The stone is quite variable in different localities, but may, as a whole, be said to consist of a greenish gray groundmass or paste in which are imbedded rounded pebbles of all sizes up to several inches in diameter of quartz, granite, melaphyre, felsite, and a variety of rocks. This composition renders the smooth dressing of the stone a practical impossibility, and it is used only in the rough state, advantage being taken of the numerous joint faces, which in building are placed outward, thus forming a comparatively smooth wall. The stone thus forms a very durable building material and has been used with good effect in several churches and other buildings in and about Boston.

Michigan.—According to Professor Conover* the beds of Potsdam sandstone occurring with frequent outcrops in the northern part of the Upper Peninsula in this State are likely to furnish the largest quantity and the best quality of building material found within the State limits. The stone quarried from this formation at Marquette is of medium fineness of texture, of a light brownish-red color, often curiously spotted or mottled with gray. These gray spots are generally rounded and vary in size, according to Mr. Batchen, from that of a pea to 12 or 18 inches in diameter. These blotched portions are usually rejected in building,

* Report Tenth Census, 1880, p. 227.

although when used they give striking and not unpleasant effects. The spots are stated by the above-mentioned authority to be equally durable with the rest or colored portion. A similar stone is quarried at L'Anse, in Houghton County. Mr. Bachen states these stones were introduced into the Chicago market about 1870. Their chief defects are flint pebbles, which fly out in process of dressing, and clay holes. Both defects can be avoided by proper selection of the stone. In color the Marquette and L'Anse stone are both richer than the Connecticut or New Jersey brownstones, and apparently would prove more durable, although as yet they have been too little used to establish this point to a certainty. Besides the localities mentioned, these stones occur at various places along the lake shore west of Keweenaw Point, and also near the eastern end of the coast of Lake Superior, along the valley of the Laughing Whitefish River and around it. At this latter locality the stone is very hard, compact, heavily bedded, splitting readily into slabs of any required thickness, and is especially suited for heavy masonry.

Minnesota.—According to Professor Winchell* the red sandstones of Fond du Lac are the most valuable of their kind that the State possesses. They are of the same formation as the New Ulm quartzite described below, but were less hardened at the time of their upheaval. The stone is of medium texture and of a brown or reddish color, closely resembling the Connecticut brownstone, but much harder and firmer. A similar rock comes from Isle Royal and Sault Ste. Marie at the eastern end of Lake Superior. At this latter place it is often mottled with gray or greenish. The stone consists almost wholly of quartz cemented with silica and iron oxides. Its crushing strength is said to vary between 4,000 and 5,000 pounds per square inch.

At New Ulm and in other places in Cottonwood, Watonwan, Rock, and Pipestone Counties there occurs a very hard, compact, red quartzite, which has been used to some extent for building purposes, though its intense hardness is a great drawback, but it is practically indestructible and hence valuable. In Pipestone County the rock occurs associated with the beautiful and interesting red pipestone or catlinite, famous on account of its being used by the Indians for pipes and ornaments.

At this point the rock is jasper red in color and very hard, but is beginning to be used for ashler work, producing very striking effects. I am informed by the quarry owners that the entire bed at Pipestone is some 75 feet in thickness and the stone is quarried entirely by means of bars and wedges, no explosives being necessary. A polished slab of the stone of great beauty was exhibited at the Chicago Exposition in 1886.

In Courtland Township, Nicollett County, the same quartzite occurs of a beautiful deep red, almost purple, color. Samples received at the National Museum were found to work with great difficulty but were very beautiful. The same stone, but of lighter color, occurs at

*Geol. of Minnesota, Vol. I.

Sioux Falls, Dak. At Dresbach, in Winona County, there occurs a fine-grained rather soft-light gray stone which bears a close resemblance to the Berea stone of Ohio. It is quarried to some extent and is regarded by Professor Winchell as promising of future usefulness. We have received also specimens of a fine light-pink sandstone from Pine County, which is stated to occur in heavy beds and to be easy to quarry. It is regarded by Professor Winchell as fully equal to the Cleveland, Ohio, freestone. The sandstone occurring at Jordan, Scott County, is of a light color, and while suitable for general building purposes is not regarded as fitted for first-class structures.

Missouri.—So far as the author has had opportunity of examining, the fine light buff subcarboniferous sandstone quarried within a few miles of the town of Saint Genevieve is the most important sandstone in the State.

The quarry face shows a bed 25 feet in thickness of good uniform rock, and blocks 150 feet long, 20 feet wide, and 10 feet thick are said to be obtainable if desired. The stone weathers well in the climate of Saint Louis, but is stated to discolor by smoke.

Near Miami Station, in Carroll County, a fine gray sandstone is quarried, the better grades of which make good building material; but it must be selected with care, as it frequently contains concretionary masses which weather out on exposure.

The Johnson County sandstone is stated to be of good quality in certain situations. It has been used in several important structures in the State, and stands the test of time without scaling, only becoming stained and darkened with age. It is quite light, weighing only 140 pounds per cubic foot when seasoned, or 145–150 when freshly quarried.

Mississippi.—Sandstones of gray and light buff color occur in Jefferson, Rankin, and Tishomingo Counties, in this State. Samples of these were on exhibition at the exposition at New Orleans in the winter of 1884–'85, and from thence were transferred to the national collection at Washington. As shown by these specimens the stones are fine-grained but rather soft and friable, and in no way remarkable for their beauty. Their durability would depend apparently altogether on climatic influences. The writer has no information regarding the uses to which the stones have been put, if, indeed, they have as yet been used at all.

Montana.—A fine light gray Cretaceous sandstone somewhat resembling the well-known stone of Berea, Ohio, occurs in considerable abundance in Rocky Cañon, Gallatin County, and is coming into general use in Boseman. The writer is informed* that it can be obtained in blocks of large dimensions and that it works readily when first quarried, but hardens on exposure, though, like the Ohio stone, it stains with reddish streaks from oxidation of pyrite. A compact red quartzite from near Salesville, west of the west Gallatin, is also coming into use to some extent. A fine, very light stone of uncertain age is also quarried

* By Dr. A. C. Peale, U. S. Geol. Survey.

near Dillon for use in Butte, Deer Lodge County. So recently has the Territory become settled that there has as yet arisen but little demand for other materials than wood for building. The great scarcity of this article in the most thickly settled portions of the Territory, together with the abundance of easy-working, but in so dry a climate durable, sandstone, will doubtless bring about a radical change within a very few years.

New Jersey.—The largest and most extensively worked quarries of stone of any kind in this State are in the Triassic belt of red or brown sandstone which extends from the New York line in a general south-westerly direction across the State to the Delaware River. The principal quarries are in various towns in Passaic, Essex, Hunterdon, and Mercer Counties. The stone, like that of Connecticut and other Triassic areas described, is a granitic sandstone, cemented by iron oxides, silica, and carbonate of lime; the colors varying from light brownish gray to reddish brown. As shown in the Museum collections, the stone is as a rule of finer texture than that of Connecticut, and less distinctly laminated, consequently scaling less readily when exposed to atmospheric agencies. According to Professor Cook,* this stone has been used from an early date in Bergen, Passaic, and Essex Counties for building purposes and for monuments and gravestones, where it has shown good proof of its durability. It has also been very extensively used in New York and neighboring cities. At the quarries, as is usually the case, the surface stone is found more or less broken up and blocks of small size only can be obtained, but the beds become more solid as they are followed downward. At some of the Belleville quarries blocks containing 1,000 cubic feet have been broken out. In one of these quarries over 2 acres have been excavated to an average depth of 60 feet. Some of the quarries, as at Passaic, produce stone of several varieties of color, as light brown, dark brown, and light gray; the fine-grained dark brown is usually considered the best and is the most sought. In several of the quarries trap-rock (diabase) also occurs.

New Mexico.—From the vicinity of Las Vegas Hot Springs have been received samples of light gray, brown, and pink sandstone, of fine texture and apparently excellent quality. They are not as yet much used, owing simply to lack of demand for stone of any kind. A soft, very light gray volcanic tuff occurs at Santa Fé, which may prove of value for building purposes in a dry climate, or one where the temperature does not often fall below the freezing point.

Nevada.—A coarse, gray, friable stone is quarried at Carson, in this State, but it is unfit for any sort of fine work or foundation, owing to its softness and porosity.

New York.—The principal sandstones now quarried in this State may be divided into three groups, belonging to three distinct geological horizons, each group possessing characteristics peculiar to itself and

*Annual report State Geologists, 1881, p. 43.

so pronounced as to be readily recognized thereby. The first of these belong to the Hamilton period of the Devonian formations, and are fine-grained, compact, dark blue-gray stones, very strong and durable.*

They give a pronounced clayey odor when breathed upon, and have been designated *greywacke* by Professor Julien, though popularly known as "bluestones" for their ordinary color. The second group belongs to the Medina period of the Upper Silurian formations. These stones are largely siliceous, of coarser, more distinctly granular texture than the last, and are of a gray or red color. The third and last group belongs to the Potsdam period of the Cambrian formations. Like the Medina stone, they are largely siliceous, and contain a much larger proportion of siliceous cementing material. These are usually light red or nearly white and intensely hard and refractory.

Discussing each group more in detail, it may be said that the "blue-stone" district is confined to comparatively narrow limits west of the Hudson River, and mainly to Albany, Green, and Ulster Counties. It begins in Schoharie County, passes to the southeast and enters Albany County near Berne, and from there passes around to the south and southwest across Green, Ulster, and Sullivan Counties, and across the west end of Orange County to the Delaware River and into Pike County, Pennsylvania.†

The typical bluestone belongs to the Hamilton period, and is a fine-grained, compact, tough, and eminently durable rock of a deep dark blue-gray color. Owing to the fact that it occurs usually in thin beds and splits out readily in slabs but a few inches thick, it has been used very extensively for flagging, curbs, sills, caps, steps, etc. Its somber color is something of a drawback to its use for general building purposes. As a rule the quarries are shallow affairs, and the work carried on in the crudest possible methods. At Quarryville, Ulster County, the quarries have been worked for upwards of forty years, and vast quantities of the material removed. The quarries lie in lines along three parallel ledges, which have a general northeast and southwest direction, the beds of sandstone overlying each other from west to east, with strata of slate and hard sandstone between them. The quarries in the eastermost ledge extend about a mile in length, 175 feet in width, and have been worked to an average depth of about 12 feet. In the middle ledge the line of quarries extends over an area about $1\frac{1}{2}$ miles in length, 150 to 500 feet in width, and have been quarried to a depth of from 12 to 20

* Microscopic examination has shown the Devonian sandstones of New York to consist chiefly of "angular to subangular grains of quartz and feldspar, with their interstices occupied by smaller grains of magnetite, scales of chlorite, and particularly short fibers of hornblende interlacing the grains of the other constituents. The result is an 'argillaceous sandstone,' flagstone, or greywacke, peculiarly compact and impermeable, which has retained its fresh condition to an extent which could not otherwise have been expected from an aggregate so liable to ready decomposition." A. A. Julien in Proc. A. A. A. S., Vol. xxviii, 1879, p. 372.

† Report of the Tenth Census, Vol. x, 1830, p. 130.

feet. Quite heavy beds occur in some of the quarries, and the joints allow blocks of very large size to be obtained. In the western ledge the quarries are in a line some 1,000 feet long by 150 wide, and are worked to an average depth of about 12 feet. The total thickness of the layers in this region is from 4 to 20 feet, and the stripping from 6 to 17 feet in depth. In working the quarries but little capital is required beyond the value of the necessary tools, they being commonly leased and royalty paid at the rate of one-half cent per square foot of stone quarried. The larger size of blocks have dimensions of about 15 by 8 feet, though some 20 by 15 feet have been taken out. At the time of taking the census in 1880 there were upwards of one hundred and fifty quarries within the bluestone district as given above. All, however, agree so closely with those of Quarryville, that further description seems unnecessary.

The quarry district in the Medina sandstone extends from Brockport, Monroe County, to Lockport, Niagara County. The stone is, as a rule, moderately fine-grained in texture, hard, and of a gray or red color, the red variety being most used for building purposes, while the gray is used in street-paving. The red variety has a bright and pleasing appearance; both red and gray are sometimes used together, with good effect. Most of the stone buildings in Lockport and Buffalo are of the Medina stone. The most important feature of the stone is, however, its adaptability for street-paving, in place of the usual granite or trap blocks. It is said that the sandstone blocks have the advantage of not wearing smooth, as do the granites and traps, while at the same time they are nearly, if not quite, as durable.

The stratum of quarry rock is put at about 30 feet in thickness, the different layers of which vary in thickness from 18 to 30 inches.

Three miles south of the town of Potsdam, in Saint Lawrence County, the Raquette River cuts across the Potsdam formation, and quarries are worked along the banks of the stream. The outcrops at this point are some 2 miles in width from north to south. In the quarry the strata dip to the south at an angle of about 45° , the beds increasing in thickness somewhat from the top downward, until at a depth of 40 feet they are some 2 or 3 feet in thickness. In color the stone is light-reddish or reddish-brown, and though, when first quarried, soft enough to work readily, becomes most intensely hard on seasoning. It is very highly silicious and is, without doubt, one of the most durable of all our sandstones. Owing to its hardness it has been as yet but little used for general building purposes. Columbia College, in New York City, is one of the most important buildings yet constructed from it. At Fort Ann, in the same county, the stone is much lighter in color and composed of almost pure silica, there being an almost entire absence of iron oxides in the cementing material. The stone is, as a consequence, extremely hard, but tough and durable.

North Carolina.—The narrow belt of Triassic sandstone already men-

tioned as passing through this State furnishes fine, compact, light and dark reddish-brown stone of a quality not at all inferior to any of that in the more Northern and Eastern States. Through the energy of the late Professor Kerr the museum has received a very full assortment of these, and we can speak of their qualities from a personal examination.

At Wadesborough, in Anson County, the stone lies in beds from 2 to 10 feet in thickness, which are inclined at an angle of about 25° from the horizontal. It is of fine, even grain, quite massive, and of dark brown and reddish colors. Heretofore it has been used chiefly for railroad work and for steps and general trimming purposes in Charlotte and Wilmington, but is worthy of a wider application. Within the past year steps have been taken to introduce it into the markets of Washington and other of our eastern cities. The chemical composition and crushing strength are given in the tables.

The Sanford stone is of a brown color and is said to lie in the quarries in nearly horizontal strata from 1 to 5 feet in thickness. The stone from near Egypt is quite similar in appearance. Near Durham it becomes in part of a gray color, but otherwise is little different. This stone has been used in Raleigh for upwards of thirty years and shows itself to be strong and durable.

Ohio.—According to Professor Orton* those rocks of the sub-Carboniferous period called by the Ohio Geological Survey the Waverly group, are the most important as to production of building stone in the geological scale of this State. The following section shows the arrangement of this formation:

1. Maxville limestones, in patches.	4. Berea shale.
2. Logan group.	5. Berea grit.
3. Cuyahoga shale.	6. Bedford shale.

Of these, number 1 occurs but seldom. Number 2 consists of fine-grained sandstones overlying and alternating with massive conglomerate in the central and southern part of the State. In thickness about 100 feet. The Waverly conglomerate is a member of this group. Number 3, about 300 feet in thickness, is a blue argillaceous shale in many parts of the State, but in many places contains scattered courses of sandstone of great value. Number 4 is from 10 to 30 feet thick, and number 5 is the Berea grit, the great quarry rock of northern Ohio. This formation is from 10 to 75 feet in thickness, and extends in a belt from Williamsfield, in the southeastern corner of Ashtabula County, westward into Erie County, and thence nearly directly southward in Adams County to the Ohio River. The stratum of sandstone where it is best developed consists of heavy sheets, with often a course at the top of thin, broken layers, called *shell rock*, and of no value for building stone. Number 6 is from 10 to 100 feet in thickness, and furnishes no building stone, excepting in Cuyahoga County, where it yields the well-known "Euclid bluestone."

* Report of the Geological Survey of Ohio, Vol. V, p. 578.

The Berea grit, as quarried for building purposes, may be described as a fine-grained homogeneous sandstone, of a very light buff, gray, or blue-gray color, and very evenly bedded, the individual sheets varying from a few inches to 10 or more feet in thickness. In many places this evenness of bedding is especially remarkable, as in some of the quarries of Trumbull County, where blocks of stone 10 feet square and only $1\frac{1}{2}$ inches thick have been extracted, and with surfaces so smooth and straight that a straight-edge laid upon them would touch at every point. Slabs but 1 or 2 inches in thickness are said to have such strength that they go into general use without question. In one case a strip 150 feet long, 5 feet wide, and but 3 inches thick was reported as raised intact from the quarry bed. The various layers, although closely compacted, are, however, perfectly distinct, adhering to one another "scarcely more than sawn planks in a pile."

Like many of the sandstones of this horizon, the Berea grits contain but little cementing material, the various particles being held together mainly by cohesion induced by the pressure to which they were subjected at the time of their consolidation. They are, therefore, soft, working readily in any direction, and are particularly sought for carving.

This property also renders the stone of especial value for the manufacture of grindstones, since the presence of a cement will nearly always cause a stone to glaze and its cutting power be thereby nearly if not quite destroyed. Unfortunately the Berea stone nearly always contains more or less sulphide of iron (pyrite) and needs to be selected with care. The best varieties will usually become yellowish on long exposure, but this is not in all cases injurious. Indeed, this property of "mellowing with age" is now claimed as one of the good qualities of the stone. When, however, the pyrite occurs in such quantities as to produce by its oxidation unsightly blotches its presence is, of course, objectionable.

The principal quarries of the stone at present writing are situated in the towns of Amherst, Berea, East Cleveland, Ilyria, and Independence in Lorain and Cuyahoga Counties.

At Amherst the quarries are located in a series of ledges which were once the shore cliffs of Lake Erie. The elevated position of the stones is a great advantage, since the light and uniform color seems due to the fact that this elevation produces a free drainage, and the stones have been traversed by atmospheric waters to such a degree that all processes of oxidation which are possible have been very nearly completed. The stone here as elsewhere varies considerably in character and solidity within limited distances. The following section of one of the Amherst quarries is given by Professor Orton :

	Feet.		Feet.
Drift material.....	1 to 3	Grindstone.....	2
Worthless shell-rock.....	6 to 10	Building and grindstone.....	10
Soft rock for grindstones only..	12	Building stone	4 to 7
Building stone.....	3	Building stone or grindstone....	12
Bridge stone	2		

Nearly all the quarries exhibit this diversity of material, although the order of arrangement is not always the same. The colors are light buff and bluish gray, the buff stone occurring above the line of perfect drainage and extending down as far as the 2 feet of bridge stone, forming a total thickness of 27 feet. In most of the Amherst quarries the relative amount of buff stone is greater. Difference in color and texture has given rise to various local names which may be mentioned here. The colors are denominated simply by "blue" and "buff." The regularly and evenly stratified stone is called "Split rock;" that in which the stratification is irregular and marked by fine transverse and wavy lines is called "Spider web," and the homogeneous stone showing little or no stratification is called "Liver rock."

As regards composition the stone contains usually about 95 per cent. of silica with small amounts of lime, magnesia, iron, oxides, alumina, and alkalis. Analysis has shown them to contain from 5.83 to 7.75 per cent. of water when first taken from the quarry, and from 3.39 to 4.28 per cent. when dry. The quarries can be operated only about eight months of the year owing to the injury caused by freezing when the stone is full of its quarry water.

In the town of Berea nearly 40 acres of territory have been quarried over to an average depth of 40 feet. The stratum is 65 to 75 feet in thickness, the individual sheets varying from 2 inches to 10 feet. The stone is as a rule a little darker than the Amherst bluestone. It is used mostly for building purposes, though grindstones and whetstones are also manufactured quite extensively.

Great care must be taken here in selection of material, as the sulphide of iron is often present in such amount as to shortly disfigure the surfaces and even discolor the stone in the courses below.

The well known "Euclid bluestone" is obtained from the Bedford shale formation in Newburgh and Euclid, in Cuyahoga County. The stone differs from the Berea in being of finer and more compact texture, and of a deep blue gray color. Like the Berea stone, however, it unfortunately contains considerable quantities of pyrite, and, as a general thing, is not a safe stone for other than bridge work and foundations or flagging, for which last purpose it is eminently suited. Even when free from pyrite it does not weather in uniform colors, and needs always to be selected with great caution.

In the vicinity of Marietta and Constitution, in Washington County, a fine grained buff and blue gray sandstone, belonging to the Upper Coal measures series, is quite extensively quarried for grindstones and building purposes. Different portions of the stratum furnish stone of all varieties of texture for wet grinding, and the grindstones are shipped to all manufacturing points in the United States. The principal market for the building-stone is in Marietta and various towns along the Ohio River.

At Piketown there is quarried a very pretty, fine grained brown-

stone, soft and easy to work, and apparently fairly durable. It has been used in some of the finest stone fronts in Columbus, in this State.

According to Professor Orton,* however, the stone is brown only on the outcrop, and a few feet from the surface assumes a dark blue-gray color, and loses its value as an ornamental stone, since it contains a large amount of soluble iron protoxide, which produces bad discoloration on exposure. An analysis of this stone is given in the tables.

Oregon.—Two miles south of Oakland, Douglas County, in this State, there occurs an extensive deposit of a fine, dark blue-gray sandstone, which changes to a drab color on exposure. It occurs in layers of 17 to 36 inches in thickness, parted by shaly seams, and is readily quarried by means of wedges. Quarries were opened in 1879, but have not been extensively worked as yet. A fine-grained sandstone, said to be suitable for either building or ornamental work, also occurs about 14 miles from Portland, in Clackamas County. It has been quarried since 1866, and used in some prominent structures in Portland.

Pennsylvania.—The belt of Triassic sandstones passing through southwestern Pennsylvania is described as beginning at the west bank of the Hudson River and extending in a broad belt from the Bay of New York to the base of the first ledges of the Highlands, being bounded on the northwest by this chain and its continuation. To the southwestward it traverses New Jersey, Pennsylvania, Maryland, and, in a somewhat interrupted manner, Virginia and part of North Carolina, its total length being not less than 500 miles, and of a width varying from 10 to 50 miles. The principal quarry in this formation in Pennsylvania is situated on the south side of a hill in Hummelstown, Dauphin County, the stone dipping to the north at an angle of about 40° and the ledge being about 85 feet in thickness. The rock is evenly bedded, the courses varying from 3 to 10 feet in thickness, the joints regular and from 4 to 40 feet apart, so that blocks of any practicable size can, it is said, be obtained. The texture is about medium fineness, and the color a deep bluish brown, slightly purple. The topmost layers are, however, of a reddish brown color, closely resembling the Portland stone. The stone compares very favorably with any of the Triassic stones, its chief defect, so far as the author has observed, being occasional clay holes, which sometimes have an unpleasant way of making their presence known in unexpected and undesirable places. The Hummelstown stone is now in very general use in all our principal Eastern cities.

Stone from the same formation and differing, if at all, only in slight color and texture peculiarities is quarried more or less in other towns along the belt, particularly Goldsborough, Reading, Bridgeport, and several towns in Bucks County.

The Carboniferous sandstones of Pennsylvania are little quarried excepting for local use, although occasionally of good quality. Near

* *Op. cit.*, p. 599.

Pittsburgh and Allegheny, and other towns in Allegheny County, there are many quarries which produce gray stone of medium texture of apparently good quality. They are said, however, to weather unevenly, owing to the presence of calcareous matter, and to be very sensitive to frost when first quarried. In several places in Westmoreland County the stones of this age are of a gray, reddish, or brownish color, fine grained and of good quality. They are used to some extent for building and also for flagging and paving.

The sub-Carboniferous formation, so valuable in Ohio for the building stone they supply, are in this State of little value, or at least up to date have been but little quarried for purposes of construction. At Venango, in Franklin County, a fine-grained, evenly-bedded buff stone, somewhat resembling the buff varieties of the Berea grit, is quarried for sidewalks and buildings in the near vicinity. Other quarries are located at Titusville, and also at Uniontown, Altoona, and Scranton.

Aside from the Triassic stones, the most important sandstones at present quarried in the State are from the Devonian formations. In several towns in Pike, Carbon, Luzerne, Wyoming, Susquehanna, and other counties, stones belonging to this formation, of a fine, compact texture and dark blue-gray color, are quite extensively quarried. So far as can be judged from the material examined, this is one of the most valuable stones in the State for building as well as for flagging purposes. The Wyoming County stone is known to the trade as "Wyoming Valley stone," and is in considerable demand. It agrees very closely in general appearance with much of the New York bluestone already described.

Tennessee.—Fine-grained light pink and coarse buff sandstones occur at Sewanee, in this State, and coarse gray at Parksville. The museum is in possession of no information regarding the extent to which these are used or their weathering properties.

Texas.—So far as is yet known this State produces but little of value in the way of sandstones. In Burnet County there are coarse dark-brown and red Lower Silurian (?) sandstones that may do for purposes of rough construction in the near vicinity. A fine, light buff Carboniferous stone, closely resembling the light-colored Ohio sandstone, occurs also at Mormon Mills, on Hamilton Creek, in this same county. A very light gray distinctly laminated stone occurs at Riverside, in Walker County, but to judge from the sample in the Museum collection it is of very poor quality. A fine-grained light buff stone, studded with fine black points, is found at Ranger, in Eastland County, and several varieties of apparent good quality, ranging in color from light buff to deep ferruginous red, in Parker County. So far as the curator can learn none of these are quarried to any great extent.

Utah.—No sandstones of any kind are now regularly quarried in this Territory, though there is no lack of material. At Red Butte, near Salt Lake City, there occur inexhaustible supplies of Triassic sandstone of

various shades of red or pink color. These have been used to some extent in Salt Lake City.

Virginia.—The belt of Triassic sandstone upon which the quarries of Seneca Creek, in Maryland, are situated extends across the Potomac River in a southwesterly direction as far as the Rapidan River, in Virginia. So far as the curator is aware, but a single attempt has been made to quarry this material. On the line of the Manassas and Virginia Midland Railroad, at a point not far from Manassas, quarries were opened about 1868, and up to the time of the taking of the tenth census some 400,000 cubic feet of material had been moved. As represented in the collection of the National Museum the stone is fine-grained, light reddish brown in color, closely resembling the lighter varieties from Seneca Creek, from which, however, it differs in being softer and a trifle more absorbent. The quarries are represented as being situated near the top of a low eminence, the strata being nearly horizontal, with but a slight dip toward the south. The surface only of the ledge has been quarried and this to a depth of about 20 feet. The beds vary from 1 to 6 feet in thickness and are separated by a greenish shale.

No other sandstones of any importance are at present quarried within the State limits, although formerly the beds of light gray or buff Juro-Cretaceous stone in the vicinity of Aquia Creek were worked to a considerable extent to furnish material for the public buildings in Washington City. It required but a few years, however, to demonstrate the entire unfitness of this material for any sort of exposed work, and the quarrying has therefore been discontinued.

Washington Territory.—On Chuckanut Bay, adjoining Bellingham Bay, in this Territory, is a very large deposit of a blue-gray Carboniferous sandstone that has been quarried to furnish material for the United States custom-house at Portland, Oregon, and for use in other towns on Puget Sound. The quarry is situated on a bluff which is represented as from 50 to 150 feet in height and about a mile in length. The supply of workable material is inexhaustible and it is said blocks 30 feet in length can be obtained without a flaw. The quarries are so situated that vessels of large size can be brought directly to the pier for loading.

Wisconsin.—The sandstones of this State, so far as we have had opportunity of observing, are mostly of a very light color and uninteresting appearance, such as are not likely to ever be in demand for other than local uses. Near Darlington, La Fayette County, there is stated by Professor Conover to occur a large outcrop of Silurian sandstone, of a brown and brick-red color passing into grayish-pink. This is regarded by the above-named authority as the best-appearing stone in that part of the State, though little quarried, owing to the large amount of worthless stone associated with it and the cost of transportation. The Potsdam formations in the region of Lake Superior are regarded as capable of furnishing desirable sandstones, yellowish to deep brown in color.

The chief defect in these is the presence of numerous and large clay holes, necessitating great care in selecting the material. Many exposures, as at Douglas and Bayfield Counties and on the Apostle Island are so situated that the quarried material could be shipped directly upon vessels with but little carting.

West Virginia.—According to Professor Orton this State abounds in building stone, of which, however, but a small percentage is strictly first-class material. With the exception of one or two points on the Baltimore and Ohio Railroad, none is quarried for the general market. Near Rowlesburgh, on the banks of the Cheat River, there occurs a deposit of fine deep blue-gray Devonian sandstone that has been quarried to the depth of 40 feet, over an area of perhaps one-fourth of an acre. The quarry lies at the very foot of the mountains, and the amount of stripping is accordingly very great and continually increasing. The stone resembles very closely the Devonian bluestone of New York, especially that quarried in Chenango County and the lighter varieties of Ulster County. It is said to be highly esteemed and very durable.

According to the same authority the Kanawha River and its tributaries throughout the whole region about Charleston are walled with rock, and quarries are possible everywhere, but not all of the stone is equally good. The engineers employed in the erection of the Government building at Charleston, after thoroughly testing all the prevailing varieties, finally decided upon that from a comparatively thin bed, 6 to 10 feet in thickness, that forms the cap to the Mahoning sandstone formation near Charleston. This rock is light gray, siliceous, somewhat conglomeritic, but strong and eminently durable. Frost seemed to have no effect upon it, and no efflorescence is perceptible upon exposed blocks. Continual vigilance must, however, be exercised in selecting stone, as much of it contains shaly pockets and pyritiferous seams. The bluestone from this same region, which has been largely used in the Government works of improving the Kanawha River, is a strong stone, experiments having shown it to have a crushing strength of about 14,000 pounds per square inch of surface, but much of it is pyritiferous, and great care must be used in selection. This stone has been used in one or two important buildings, and with very bad results, it beginning to discolor and exfoliate within two or three years.

At Grafton, in Taylor County, a light-gray sandstone belonging to this same formation (Carboniferous) has been extensively quarried for railroad work. The quality of the stone is said to be good, and it is strong enough for the heaviest work. The thickness of the stratum here is from 150 to 200 feet, and the amount of stone available is beyond computation, there being literally mountains of it. There are several other localities in this region where sandstone is quarried for local purposes, but which can not be noticed here.

(2) VOLCANIC FRAGMENTAL ROCKS. TUFFS.

(a) DEFINITION, ORIGIN, AND COMPOSITION.

Under the general name of tuff it is customary to include those fine-grained fragmental rocks formed by the consolidation of volcanic detritus, such as ashes, sand, and lapilli, or by the breaking down and reconsolidation of volcanic rocks of various kinds. This consolidation, according to Geikie,* may have taken place either under water or on dry land; in either case they are as a rule distinctly stratified. Those of the tuffs which are formed from Tertiary or post-Tertiary erupted materials are naturally but slightly consolidated, soft and easy to work. It follows, almost as a matter of course, that they will absorb a proportionally large amount of water, and hence be less durable in the exceedingly trying climate of the Eastern and Northern States.

The older tuffs are often so firmly compacted that recourse to the microscope must be had to determine their fragmental nature.

(b) VARIETIES OF TUFFS.

According to the nature of the lava, from the disintegration of which the tuffs are formed, they are designated by special names. *Rhyolite* tuff is composed of disintegrated rhyolite; *trachyte* tuff of disintegrated trachyte, etc.

(c) LOCALITIES AND USES.

These rocks are very abundant throughout our Western States and Territories, but are scarcely at all used for building purposes, owing in part to the newly settled condition of the country in which they occur and in part to their state of incomplete consolidation. They are, however, soft, and easy though rather unsafe working stones, owing to lack of definite rift and grain, often plucky fracture, and the presence of numerous dry seams and clay holes. They are, moreover, light, frequently weighing only from 75 to 100 pounds per cubic foot, though moderately strong. When not exposed to too wide variations of climate they must prove very durable. Although no systematic experiments have as yet been made, appearances indicate that they would prove extremely refractory in case of fire.†

They present a great variety of colors; white, gray, pink, red, lavender, salmon, green, and even black, are common.

With these qualities there seems no reason for their not proving a valuable material in dry climates for all kinds of structural purposes where only the rougher kinds of finish are employed, their textures being almost invariably such that they will not polish.

The light gray and pink rhyolite tuff occurring in Douglass County, Colo., has been used in the construction of the Union Depot, Windsor Hotel, and other buildings in Denver.

* Text-Book of Geology, p. 164.

† Newberry states that the tuffs found near Challis, Idaho, are of "considerable importance as they are extensively used in place of fire-brick for lining lead-smelting furnaces," being very refractory and easily dressed into shape with an old ax.—Trans. N. Y., Acad. Sci., Dec., 1881.

The stone has already been alluded to under the head of sandstones. It may rank as a fairly durable material, but contains clay holes and other imperfections that unfit it for fine work of any kind. The Museum has received other samples of tuffs of various kinds from California, New Mexico, Idaho, and Utah, but they are not at all used at present, and their fitness or unfitness for any sort of building purposes is a problem for the future to decide. From near Phoenix, Ariz., has been received a tuff consisting only of the firmly compacted shreds of volcanic glass or pumice and that is stated to have been used locally to some extent.*

Although so little used in this country, tuffs are very generally employed for building purposes in many foreign localities. They are found abundantly in the volcanic districts of central France, and in the Haute-Loire, where they have been used in the construction of churches and dwelling-houses. The so-called "peperino" of the campagna of Rome and Naples, is a tuff formed by the consolidation of volcanic ashes, and has been used in some of the buildings of these cities. It was also used in the construction of the houses of Herculaneum and Pompeii.†

Rhyolite tuffs are, as I am informed by Signor Aguilera, very largely used for general building in certain parts of Mexico, the climate being such as to render almost any material very durable. There is now a large collection of these stones in the National Museum.

(3) ARGILLACEOUS FRAGMENTAL ROCKS. THE SLATES.

(a) COMPOSITION AND STRUCTURE.

Ordinary clayslate consists of consolidated clay. It is therefore classed as a fragmental rock, although microscopic examination has shown that it frequently contains crystalline matter, and that the rocks pass by insensible gradations into what are called argillitic mica schists. Microscopic examination of slates from Littleton, N. H., by Hawes,‡ showed them to consist of a mixture of quartz and feldspar in fragments as fine as dust. There is also present a "considerable quantity of some amorphous coaly matters," and many little needles of a brightly polarizing substance which is probably mica. The clayslate of Hanover, N. H., was found by the same authority to contain many minute crystals of garnet and staurolite. An examination of some clayslates from the Huronian region of Lake Superior, by Wichmann,§ showed them to consist of a "colorless isotropic groundmass in which the other constituents are apparently imbedded, whilst throughout are found dust-like particles of a deep gray color, which represent the chief constituent, and consist probably of clay substances, the greater part of them probably of kaolin." Besides these constituents there were also a few quartz and feldspar particles, scales of hydrated oxide of iron, flakes

* See Am. Jour. Sci., Sept., 1886, p. 1991.

† Hull: Building and Ornamental Stones, p. 283.

‡ Geol. of New Hampshire, Vol. III, p. 237.

§ Quar. Jour. Geol. Soc., London, xxxv, 1879, p. 158.

of coal, minute tourmalines, and mica fragments. The Maine slates as observed by the author contain quite large flakes of greenish mica, and many quartz and carbonaceous particles. As a rule the dark color of slate seems to be due to these carbonaceous particles, since they are very abundant in the dark varieties, as those of West Bangor, Pa., and almost entirely lacking in the light-greenish varieties, as those of Castleton and Fairhaven, Vt. The red slates of Granville, N. Y., are made up of a groundmass of impalpable red dust in which are imbedded innumerable quartz and feldspar particles all arranged with their longer axes parallel with the cleavage direction of the slate.

Although slate is undoubtedly a sedimentary rock, its remarkable cleavage property is in no way connected with its bedding; as might at first be supposed, but as shown by Sorby,* Daubrée,† and others, is caused by pressure acting in a direction at right angles with this cleavage plane, and which may or may not correspond with that of its bedding.

(b) USES OF SLATE.

Besides for roofing purposes, slates are used for billiard-tables, mantels, floor-tiles, steps, flagging, and in the manufacture of school-slates. For the last-named purpose a soft, even-grained stone is required, and almost the entire supply is at present brought from Pennsylvania and Vermont.

Of late years the business of marbleizing slates for mantels and fireplaces has become an important industry. All kinds of stones can be imitated by this process, but that most commonly seen is the green verd-antique marble and the variegated marbles of Tennessee. Like many counterfeits, however, the work is too perfect in execution, and need deceive none but the most inexperienced.

The following table gives the various sizes of slate made for roofing, and the number that are necessary for a "square," i. e., a space 10 feet square, or containing an area of 100 square feet:‡

Size.	No. of slates to a square.	Size.	No. of slates to a square.	Size.	No. of slates to a square.
<i>Inches.</i>		<i>Inches.</i>		<i>Inches.</i>	
24 by 14.....	98	18 by 9.....	213	10 by 7.....	588
24 13.....	105	18 8.....	230	10 6.....	696
24 12.....	114	18 10.....	222	10 5.....	823
24 11.....	124	18 9.....	246	10 4.....	1,039
24 10.....	138	18 8.....	247	9 8.....	600
22 13.....	116	16 7.....	316	9 7.....	698
22 12.....	126	14 9.....	300	9 6.....	800
22 11.....	138	14 8.....	327	9 5.....	960
22 10.....	151	14 7.....	374	9 4.....	1,200
20 12.....	141	14 6.....	436	8 6.....	960
20 11.....	154	12 8.....	400	8 5.....	1,152
20 10.....	169	12 7.....	457	8 4.....	1,440
20 9.....	188	12 6.....	570	7 5.....	1,440
18 11.....	174	12 5.....	640	7 4.....	1,800
18 10.....	192	10 8.....	514	7 3.....	2,400

* Edinburg Philosoph. Jour., IV, 1853, p. 137.

† Geologie Experimentale, p. 391.

‡ From Rep. D 3, Vol. I, p. 142, Second Geol. Sur., Pennsylvania.

(c) SLATES OF THE VARIOUS STATES AND TERRITORIES.

Georgia.—Slates sufficiently cleavable to be applicable for roofing purposes are stated * to exist in great quantities along or near the line of contact between the Silurian and Metamorphic Groups, near the Cohutta, Silicoa, Pine Log, and Dug Down Mountains in this State. The most noted locality for roofing slates is on the eastern side of Polk County. The outcrops are in steep hills and are apparently of great thickness. They have been worked quite extensively at Rock Mart, though in a crude and itinerant manner, since as early as 1859, the material being shipped chiefly to Atlanta and neighboring towns. Other dark-colored slates are found in Bartow, Gordon, Murray, and Fannin Counties, while buff and light green varieties are found in large quantities in the northwestern portion of Bartow County. None of the above are to be found in the general market, nor have we received samples of the same.

Maine.—According to Dr. Jackson † inexhaustible quantities of slate occur along the banks of the Piscataquis River from Williamsburgh to Foxcroft. Professor Hitchcock ‡ also reports excellent sites for quarries of this material as occurring on the Kennebec River from Patten to Pleasant Ridge. At various times quarries have been opened at different points in these localities, but the principal ones at this time are in the towns of Monson, Blanchard, and Brownville, Piscataquis County. The slates here produced are all of a blue-black color and are reported by Mr. J. E. Wolff as of most excellent quality, being hard, with a fine cleavage surface, not subject to discoloration, and giving forth a clear ringing sound when struck. Although seemingly susceptible of being used for all purposes to which slates are usually applied, they are at present utilized almost altogether for roofing.

Maryland.—The principal quarries of slate in this State are in Harford County, adjoining Pennsylvania. The ridge upon which the quarries are situated extends across the State line into York County, where several other quarries are worked within a radius of about 1 mile. As the Harford and York County stones are practically identical we will reserve a complete description of their qualities until we come to speak of the latter. Other quarries were formerly worked in the town of Ijamsville, in Frederick County. The stone here is of a blue black color and is represented to be of good quality, but for some reason unknown to the writer the quarries are no longer worked.

Massachusetts.—Although, as already noted, slate was one of the stones to be earliest quarried in eastern Massachusetts, the material was of such a nature as to be of little value except for rough construction, and hence the industry has always remained of slight importance. The only quarries now worked from which slate suitable for roofing or other

* Commonwealth of Georgia, p. 137.

† Second Report on Geology of Maine, 1838, p. 116.

‡ Second Ann. Rep. Geol. and Nat. Hist. of Maine, 1862, p. 429.

fine work can be obtained are at Lancaster, in Worcester County. This quarry is stated by Marvin* to have been opened by a Mr. Flagg over a century ago, and the slates were in use as early as 1750 or 1753 (ante, p. 291). Owing to lack of favorable transportation facilities the work was discontinued more than fifty years since, and it was not till 1877 that it was recommenced. The slate though porous is said to hold its color well and to be durable. Another outcrop of slate of good quality is said to occur about 1 mile north of Clinton, in this same county. It is not, however, as yet quarried.

The clay slates occurring in the vicinity of Boston and Cambridge have long been used for road materials, but for purposes of construction only to a slight extent. They are not sufficiently fissile for roofing purposes. The stone is regarded by Professor Shaler as of great value for rough building, as it is durable, easily quarried, and very effective when placed in a wall. The Shepherd Memorial Church in Cambridge is the only building of importance yet constructed of this material.

Minnesota.—At Thompson, Carlton County, where the Saint Paul and Duluth Railroad crosses the Saint Louis River, there occurs, according to Prof. N. H. Winchell† an inexhaustible supply of hard, black, and apparently eminently durable slate suitable for roofing, school-slates, tables, mantels, and all other purposes to which slate is usually applied. Quarries were opened here by the railroad company in 1880, but for some unknown reason were discontinued before any of the stone had been put upon the market. The deposit is regarded as of especial value by Professor Winchell, inasmuch as it is the most western known in the United States, and its close proximity to the railroad renders the transportation of the quarried material a matter of comparative ease.

Michigan.—An extensive deposit of Huronian slates occurs in the northwestern portion of the northern peninsula of this State, principally in the towns of Houghton, Marquette, and Menomonee. But a small portion of the entire formation will furnish material sufficiently fissile, homogeneous, and durable for roofing purposes; nevertheless the supply of good material is so abundant as to be practically inexhaustible. At L'Anse the beds extend down to the lake shore, but are badly shattered, not homogeneous, nor of sufficient durability in this immediate vicinity to be of value. Good roofing slate is, however, found about 15 miles from L'Anse, on the northwestern side of the Huron mountain range, and about 3 miles from Huron Bay, where extensive quarries have been opened. The stone here is susceptible of being split into large, even slabs of any desired thickness, with a fine silky, homogeneous grain, and combines durability and toughness with smoothness. Its color is an agreeable black and very uniform. Several companies have located their quarries along the creek which runs parallel with the strike of the slate, and a tramway about $3\frac{1}{2}$ miles in

* History of Lancaster.

† Preliminary Rep. on the Building Stones, etc., of Minnesota, 1880, p. 17.

length has been built down to the bay, where a dock has been erected for the unloading of vessels and for the convenient shipment of the material.*

New Jersey.—The belt of Silurian slates and shales extending in a northeasterly and southwesterly direction entirely across the northern part of this State includes several quarriable areas, but which have up to the present time been utilized only to a limited extent. Quarries have been worked at La Fayette and Newton, in Sussex County, and also at the Delaware Water Gap in Warren County. The product of these is represented by Professor Cook† as of good quality and suitable not only for roofing material, but also for school slates, tiles, mantels, etc.

New Hampshire.—Professor Hitchcock states‡ that the only formation in this State likely to furnish good roofing slates is the Cambrian range along the Connecticut River. There have been quarries upon this belt in the towns of Littleton, Hanover, and Lebanon, but they have not now been worked for several years. The stone is stated to be not quite equal to that of Maine and Vermont, but certain portions of it might be utilized locally to good advantage, as for tables, platforms, curbs, and flag-stones. In Littleton the band of rocks suitable for working is nearly an eighth of a mile wide and has been opened at two localities. The strata are vertical and the outcrops on a hill where good drainage can be had to a depth of a hundred feet. The stone is soft, apparently durable, and of a dark-blue color, but does not cleave so thin as the slate from Maine. At East Lebanon the valuable part of the slate-bed is 30 feet in width. The stone does not split sufficiently thin for roofing, but can be utilized to good advantage for chimney-pieces, table-tops, and shelves; also for sinks, cisterns, flooring-tiles, etc. The waste material was formerly ground and bolted into slate flour.

New York.—According to Professor Mather§ “The roofing-slate formation of this State ranges through Rensselaer County from 2 miles west of Lebanon Springs to the northeast corner of Hoosic; thence north in Washington County through the towns of White Creek, Jackson, Salem, Hebron, Granville and Hampton; and thence an unknown distance into Vermont.” A range of roofing slate supposed to be the same as that of the Hoosic quarries extends also through the towns of Canaan, Austerlitz, Hillsdale, Copake, Aneram, and Pulver’s Corners, in Columbia County. The most important quarries at present worked are in the towns of Hampton, Middle Granville, Granville, and Salem, in Washington County, and Hoosic, in the northeastern part of Rensselaer County, though there are said to be numerous promising localities in different parts of the range which have never been opened. Professor Mather estimates the quantity of slate suitable for roofing in the range as above given to be “sufficient to supply a nation’s wants for ages.” The same

* Geol. of Michigan, Vol. III, Part I, p. 161.

† Ann. Rep. State Geologist of New Jersey, 1881, p. 66.

‡ Geol. of New Hampshire, Vol. III, p. 81.

§ Nat. Hist. of New York, Geology, 1843, part 1, p. 420.

authority states that these slates, though softer than the imported Welsh slates, are equally good. They are reported by Doctor Fitch* as occurring in a great variety of colors, passing through almost innumerable shades of gray, brown, black, blue, green, yellow, purple, and red. This last variety, I am informed by Professor Smock, is the most highly valued, bringing about three times the price of the black. It is quarried extensively at North Granville, near the Vermont line, and is regarded as the best of its kind produced in this country. According to Doctor Fitch† the bed of red slate, although at present quarried in only one or two towns, "occurs in a nearly continuous line through the whole length of the slate formation from Vermont to New Jersey." But a small part of this, however, is capable of furnishing material of good quality. Many attempts have been made, as I am informed by Professor Smock, to open quarries in the central and western half of Washington County with but indifferent success, those now worked being almost altogether in the northeast corner of the county, near the Vermont line.

Pennsylvania.—The narrow slate belt already noted as occurring in Harford County, Md., crosses the State line into the extreme eastern portion of York County, in Pennsylvania, and thence sweeps around in a gradually narrowing curve to the Susquehanna River, appearing again on its eastern bank, in Fulton Township, Lancaster County, where it finally disappears. It is from this narrow belt, at its greatest dimensions less than a mile wide and scarcely more than six miles long, that has been quarried for many years the justly celebrated blue-black "Peach Bottom slate." The stone is stated to rank very high for strength and durability. It is tough, fine, and smooth in texture, and is stated not to fade on exposure, buildings on which it has been exposed for upwards of seventy-five years still showing it fresh and unchanged. An analysis of this slate is given in the tables. The principal quarries now worked are at Bangor and West Bangor, York County, in Pennsylvania, and at adjacent points just across the line in Maryland.

The Utica and Hudson River slate formation, in which lie the largest and most important quarries of slate at present worked in this country, extends in a belt of from 7 to 12 miles in width throughout the entire northern parts of Northampton and Lehigh Counties, and thence in a gradually though unevenly narrowing band in a general southwesterly direction through Berks, Lebanon, Dauphin, Cumberland, and Franklin Counties, whence it passes into Maryland. But a very small portion of the thus roughly delineated area is of such a nature as to furnish stone for economic purposes. The quarries at present worked, beginning with the northeastern part of Northampton County, are situated at East Bangor, Bangor, Pen Argyl, Chapman's Station, Catasauqua, Allentown, Dale, Lynnsport, and Stinesville.

The geological character of the beds and the details regarding the quarries have been described with considerable detail by Mr. R. H. San-

*Trans. N. Y. Agr. Soc., 1849, p. 830.

†Op. cit., p. 834.

ders,* and which it seems unnecessary to repeat here. The slates produced are all of a blue or blue-black color, and are used for all purposes to which such material is usually applied. In the manufacture of school-slates a softer and finer grade of material is requisite than for most other purposes. These are split from the block in the same manner as roofing-slates, their edges trimmed with a circular saw, and the faces smoothed by a drawing-knife, after which they are rubbed down with a cloth and fine slate dust till the surface is smooth and even. They are then mounted in wooden frames and packed for shipment.

The following statistics of shipments from the Slatington region for the year 1882 will give some idea of the magnitude of the industry:†

Squares of roofing slates, 100,000; cases of school slates, 29,704; cases of blackboards, 1,171; cases of mantels, 71; mantels (pieces) 2,704; cases of hearths, 6; cases of flagging, 173½; flagging (pieces) 16,643; cases of sawed slate, 15; cases of pencil slate, 3; making a total by weight of about 29,920 tons for the year.

South Carolina.—Clay slates are stated‡ to occur in this State in a broad band extending along the edge of the Tertiary formations from Edgefield County, on the southwest, to Chesterfield, on the northeast. The present writer has seen none of this material nor has he any knowledge regarding its adaptability for any form of architectural work.

Texas.—Bluish-black slates of a jointed and thinly stratified structure, resembling the surface slates of New Hampshire and Vermont, and promising of great utility, are stated to occur in Llano and Presidio Counties.§ The writer has seen none of these.

Vermont.—The roofing slates of Vermont are stated by Professor Hitchcock|| to exist in three distinct and nearly parallel belts, occupying the eastern, middle, and western portions of the State. The eastern belt extends from Guilford, one of the most southern towns in the State, to Waterford, and probably as far north as Burke, in Caledonia County, where it is cut off by an immense outcrop of granite. The slate of this belt differs from that of the other divisions in presenting a more laminated appearance, resembling closely a mica schist, the cleavage corresponding closely with the lamination, which varies, if at all, but a trifle from the planes of stratification. The stone is represented as of good color, tough, and durable. Besides for roofing purposes it was used largely for tombstones prior to 1830, when marble began to be used in its place. The first quarry opened in this belt is stated by the above authority to have been that of the New England Slate Company, who commenced operations in 1812. At the present time, so far as the author is aware, no quarries whatever are worked in this belt.

The middle range of slate extends from Lake Memphremagog in a

* Rep. D 3, Second Geol. Surv. of Pennsylvania, Vol. I, 1883. pp. 83-160.

† From Rep. D³, 2d Geol. Surv. Pennsylvania, p. 144-146.

‡ South Carolina, Resources, Population, etc., 1883, p. 133.

§ Second Ann. Rep. Geol. of Texas, 1876, p. 26.

|| Geol. of Vermont, Vol. II, 1861, p. 791.

southerly course as far as Barnard. The slate found in this differs from that of the eastern belt in that it splits more readily into thin sheets, is not so distinctly laminated, and is more uniform in color, "being nearly black and apparently free from the traces of iron oxides." A single quarry is now in operation in this belt, that of the Adams Slate Company, in Northfield, Washington County.

The western and most important of the slate belts of this State extends from a point near the town of Cornwall, on the north, southward through Castleton, Fairhaven, Poultney, Wells, and Pawlet, and passes into the State of New York at Granville. In this slate it is stated "there is a marked difference between the stratification and cleavage planes, the dip of the latter being greater than the former." In color the slates of this region are said to closely resemble those of Wales, being of a dark purple, with blotches of green, while some of the strata are green throughout. In some portions of the formation a red slate occurs, similar to that found across the line in New York State. This variety is not, however, now quarried. This western area furnishes the most fissile and valuable slates of the State, and, as will be seen by reference to the tables, is very extensively worked. The slate is soft and uniform in texture, and can be readily planed or sawn with a steel circular saw, such as is used in sawing lumber. It is well adapted and extensively used, not only for roofing purposes, but for school slates, slate-pencils, blackboards, table-tops, mantels, etc. It is very extensively marbled. It is stated by Professor Hitchcock* that the first quarry opened in this region was that of Hon. Alanson Allan, who began the manufacture of school slates at Fairhaven in 1845.

Virginia.—On Hunt Creek, a tributary of Slate River, in Buckingham County, in this State, there occur extensive deposits of blue-black slate of a quality suitable for a variety of uses, although they are now used almost altogether for roofing purposes. The principal quarries now worked are at or near the towns of Buckingham, New Canton, and Ore Banks. Another belt of slate of the same geological age (Archæan) as that just mentioned is stated to occur near the southeast base of the Blue Ridge, in Amherst and Bates Counties. Very few samples of any of these have as yet come into the Museum collection.

(d) CATLINITE, OR INDIAN PIPE STONE.

Although frequently found in the collections of amateur mineralogists, this substance can not be considered a true mineral, but is rather an indurated clay.† It therefore varies greatly in composition, as it does also in color and degree of induration. The usual color is a deep though dull red, often beautifully flecked with small yellowish dots. This form is soft enough to be readily cut with a knife, but is sufficiently firm and compact to retain the sharpest edges and lines that may be

* *Op. cit.*, p. 796.

† See Analyses, Geol. Minnesota, Vol. I, p. 542.

carved upon it. The material first derived its notoriety from the fact that the Sioux Indians utilized it for the manufacture of their pipes and various other articles, and at the present time these same people living in the vicinity of Flandreau, Dak., derive a considerable income from the manufacture and sale of these articles.

Owing to the fact that the material occurs only in a thin bed underlying the hard and tough red quartzite of the vicinity, it can, with the present facilities for extraction, be obtained in blocks of only very moderate dimensions. Its color is such, however, that in proper combinations it could be used very advantageously in interior decorations. The principal source of the material is near Pipe Stone City, in Pipe Stone County, Minn.*

* See Geol. of Minnesota, Vol. I; also Am. Jour. Sci., 1867, p. 15, and Am. Naturalist, 1868-'69.

PART III.

STONES OF OTHER COUNTRIES.

A.—ALABASTER.

Italy.—Alabaster of the finest quality occurs in several parts of Italy, particularly at Miemo, in Tuscany, Fontibagni, and Castellina, and at Aosta, in Piedmont. The purest and best variety is, however, from Val di Marmolago, near Castellina.* Some of these are very extensively worked, the clouded varieties being made into vases and other objects, while the pure white varieties are made into statuettes. In this form they are sold in considerable quantities in this country, passing under the name of *Florentine marbles*. As prepared for the market these are indistinguishable from true marble by any but an expert, and it is safe to say a large number of people are yearly imposed upon. Should one have reason to suppose that this article is being imposed upon him for true marble he has but to try the object in some obscure part with the thumb-nail. Alabaster is readily scratched or indented in this manner while marble is not affected. Another test is to apply a dilute acid. True marble will dissolve and effervesce briskly, while the alabaster remains unchanged. Besides being softer and hence more liable to injury these alabaster objects are inferior to those of marble in that they are more easily soiled and are difficult to cleanse.

It is stated† that the Italian alabaster is, when first quarried, semi-transparent, and that it is wrought while in this state. It is then rendered white and opaque (like marble) by placing the objects in a vessel of cold water which is then slowly raised to the boiling point. It is then allowed to cool to a temperature of about 70° or 80° Fahr. when the objects are removed and carefully wiped dry. At first they appear little changed by their baptism, but gradually assume the desired color and opacity.

B.—SERPENTINOUS ROCKS. VERDANTIQUE MARBLES.

England.—None of the American serpentinous rocks now known can compare in point of beauty, in variety and elegance of colors, with those of the Lizard district in Cornwall, England. A series of polished blocks

* Hull: Build. and Ornam. Stones, p. 165.

† Appleton's Dict. of Mechanics, Vol. II, p. 387.

of these in the Museum collection show the prevailing colors to be dark olive green with veins, streaks, and blotches of greenish white, chocolate brown, and blood red. The green varieties are often spotted by ill-defined flakes of a "silky brouzitic mineral."

The rock is softer than the serpentine of Harford County, Md., but takes an equally good surface and polish, and works much more readily. It is stated by Hull* to be obtainable in blocks from 7 to 8 feet in length and from 2 to 3 feet in diameter. According to this same authority, the stone is admirably adapted for interior decorations and is now being used for ornamental fonts, pulpits, small shafts, and pilasters, as well as for vases, tazza, and inlaid work.

Considering the remarkable beauty and the variety of colors displayed by this stone, it seems strange that it should not have found its way more extensively into American markets.

The rock is regarded by Bonney† as an altered intruded igneous rock, rich in olivine (Lherzolite).

Italy.—The principal serpentinous rocks of Italy are the opicalcites of Pegli and Pietra Lavezzara, near Genoa, and of Levante, and the true serpentine of Tuscany. The Verde di Pegli is a breccia consisting of deep green fragments of serpentine cemented by light green calcite. The contrast of colors thus produced is said to be very pleasing. The Verde di Genova stone from quarries at Pietra Lavezzara is also a breccia consisting of green, blackish green, brown, or red serpentine fragments with an abundant cement of white or greenish calcite. It has been quarried from time immemorable and is largely used in France where it is known as *Vert de Gênes*. Its selling price at Turin is about 20 cents per cubic foot. The opicalcite of Levante is a breccia like the preceding, the fragment being of a violet or wine red color. It is difficult to work but acquires a good polish. The Italian name for the stone is *rosso* or *Verde di Levante*; though sometimes called *granito di Levante*. The Tuscany serpentine from quarries near Prato is known commercially as *Verde di Prato*. The stone is of a deep green color, carrying crystals or nodules of diallage and is traversed by a net-work of fine lines giving it a brecciated appearance. It contains also veins of noble serpentine of a clear, greenish or whitish color. It is softer than ordinary serpentine and acquires only a dull polish, but works very readily. The dark green varieties are most valued, and having been used in ancient monuments is frequently called the *Nero antico di Prato*‡. This stone is stated by Hull to be subject to rapid decay when exposed to atmospheric influences.

* Building and Ornamental Stones. p. 102.

† Quar. Jour. Geological Society of London, Vol. xxxiii, Part 2, 1877, p. 584.

‡ Delesse, pp. 77-79.

C.—LIMESTONES AND MARBLES.

www.libtool.com (1) AFRICA.

Numidian Marbles.—Within a very few years there have been reopened in Algeria and Tunis the famous quarries of “Numidian” marbles, from whence the ancient Romans are stated to have obtained the celebrated “Giallo Antico” and other stones for the decoration of their houses and temples.

According to Playfair,* the name *Numidian* is incorrect, as the marbles are not found in Numidia proper, but in the provinces of Africa and Mauritania. “Most of the Giallo Antico,” says this authority, “used in Rome was obtained from Simittu Colonia, the modern Chemtou, in the valley of Medjerda, the quarries of which are now being worked by a Belgian company; but the most remarkable and valuable marbles are found near Kleker, in the province of Oran, in Algeria. There, on the top of *Montagne Grise*, exists an elevated plateau, 1,500 acres in extent, forming an uninterrupted mass of the most splendid marbles and breccias which the world contains. Their variety is as extraordinary as their beauty. There is creamy-white, like ivory; rose color, like coral; Giallo Antico. Some are variegated as a peacock’s plumage, and on the west side of the mountain, where there has been a great earth movement, the rock has been broken up and recemented together, forming a variety of breccia of the most extraordinary richness and beauty.”

There are in the Museum collections a series of these,† which range in color through many shades of gray, drab, sienna, yellow, and rose-red, and which are designated in our markets under the names of *jaune*, *antique doré*, *paonazzo rosso*, *jaune chiaro ondate*, *jaune rosé*, *rose clair*, *breche sanguin*, and *jaspé rouge*. All are extremely compact and hard and acquire a surface and polish of wonderful beauty. The United States, at present, produces nothing that can compare with them for interior decorations.

Egyptian onyx or “*Oriental alabaster*.”—This beautiful stone, which, like the onyx marbles of Mexico, is a travertine, occurs, according to Hull,‡ in extensive beds amongst the Tertiary limestones of Blad Recam (marble country) near the ravine of Oned Abdallah, Egypt. The

* Geol. Mag., Dec., 1885, p. 562.

† The gift of Mr. E. Fritsch, of New York, by whom they were imported.

‡ Building and Ornamental Stones, p. 179. There is confusion here among authorities. Hull, as above noted, sets down the Egyptian onyx as from Blad Recam. Delesse (*op. cit.*, p. 155), on the other hand, states that the Egyptian rock comes from Beni-Souef, about 25 leagues south of Cairo on the Nile, and from Syout, still farther south, while the Algerian stone is stated to occur at Ain-Tembalek, near the river Isser, in the province of Oran. As the imported stone is known altogether as *Egyptian onyx*, it seems probable that it comes from either Beni-Souef or Syout. To judge from samples in the Museum collections the Egyptian stone is much superior to that of Algeria.

stone was used by the inhabitants of Rome and Carthage for the interior decorations of their houses, but for over one thousand years the quarries were entirely lost sight of, and it was not until 1849 that they were rediscovered by a French gentleman, M. Delmonte. The stone is of a whitish, yellow, and amber color, and presents the peculiar banded and wavy structure common to stones of this class. It is now shipped in considerable quantities to Paris, where it is utilized in the manufacture of candlesticks, timepieces, and similar articles. It is also imported into this country and is used in the decorative work of soda fountains and for small articles of household furniture.

Nummulitic limestone.—The celebrated nummulitic limestone of Eocene age from Northern Africa, and which was so extensively used by the Egyptians in the construction of their pyramids, is represented in the collections of the National Museum by a 7-inch cube, the gift of Commander Gorringer, U. S. Navy. This particular block was formerly a portion of the steps leading to the obelisk at Alexandria, and was brought away at the same time as the obelisk itself. Hull states that this stone was used in the construction of Baalbec, Aleppo, and some of the cities of the Holy Land. The pyramid of Cheops is of the same material.*

(2) BELGIUM.

This country is stated by Violet† to be exceptionally rich in colored marbles, though white varieties are entirely wanting. They are mostly of a somber or dull color, and, like the marbles of Northern France, belong, according to Delesse,‡ to the Carboniferous and Devonian formations. The principal varieties now quarried for exportation, as represented in the collections of the National Museum, are the black of St. Anne, from Busnie, province of Namur, the blue from Couillet, near Charleroi province of Hainaut, the reds from Cerfontaine and Merlemont, near Philippeville, province of Namur, and the well-known "Belgian black" from quarries in Golzines, and the environs of Dinant, also in the province of Namur.§ All of these are very fine grained and compact, admitting of smooth surfaces and high polish.

The St. Anne marble is of a deep blue-black color with many short and interrupted veins of white; those of Couillet are much lighter in color and with more white; some of the varieties are breccias composed of fragments of compact blue-gray limestone imbedded in a white crystalline matrix. The red marbles of Cerfontaine and Merlemont are known as *rouge griotte*, *rouge griotte fleuré*, *rouge impérial*, and *rouge royal*.

* *Op. cit.*, p. 236.

† Les marbres, p. 44.

‡ Matériaux de construction, p. 194.

§ Violet gives the full list of Belgian marbles as follows: "Le marbre Saint Anne, le rouge royal, le rouge impérial, la griotte de Flandre, la griotte fleurie, le granite belge, le bleu belge, le Florence belge, bizantin belge, bleu antique, le grand antique, le petit antique, et les marbres noirs de Golzines et de Dinant."

All are dull red, of light and dark shades, variously spotted, flecked, and veined with white and gray; none of them are as brilliant in color as the French *griottes*. The variety *rouge royal* is very light, and somewhat resembles certain varieties of the Tennessee marbles, but is inferior. The well-known "Belgian black" is of a deep black color, hard and difficult to work, but takes a high polish, and is considered the best of its kind now in the market.

(3) BERMUDA.

The building stones of Bermuda are altogether calcareous and fragmental. Although popularly known as coral limestones, they contain as a rule fully as large a proportion of shell as of coral fragments. Nearly all the quarried material belongs, according to Professor Rice,* to the drift sand-rock variety, *i. e.*, rocks made up of fragments blown inland from the beach and subsequently cemented by calcareous matter in a crystalline or subcrystalline state. The rock varies in color and texture from chalky white, fine grained, and porous (somewhat like the French Caen stone), to a darker, coarser, but tough and compact form, in which the individual fragments, often of a pink color, are one-fourth of an inch or more in diameter.

According to the authority above quoted the rock is usually very soft and is quarried out in large blocks by means of a peculiar long-handled chisel, and afterward sawn up in sizes and shapes to suit individual cases. The harder varieties, as found at Paynter's Vale and elsewhere are, however, worked like "any ancient limestone or marble."

Most of the houses of Bermuda are stated by Professor Rice to be built of this soft, friable variety, and even the roofs are covered with the same material sawn into thin slabs. When covered with a coating of whitewash the stone is found sufficiently durable for ordinary buildings in that climate, but if exposed to the rigors of a New England winter it would crumble rapidly. The hard rock, such as is found at Paynter's Vale and Ireland Island, "has been used in the construction of the fortifications and other Government works" on the islands. "The quarry of the Royal Engineers, near Elbow Bay, appears to be in beach-rock."

(4) ENGLAND.

Bath oolite.—The well-known Bath stone or Bath oolite is a light, almost white or cream-colored oolitic limestone from quarries in the Jurassic formations which extend from the coast of Dorset, in the south of England, in a northeasterly direction through Somersetshire, Gloucestershire, Oxfordshire, Northamptonshire, to Lincolnshire, to Yorkshire.†

In texture it is distinctly oolitic, soft, and very easy to work. Its

* Geol. of Bermuda, Bull. 25, U. S. Nat. Mus., 1864.

† Hull, Building and Ornamental Stones, p. 210.

durability when exposed in the trying climate of America is a matter of great doubt.

Nevertheless, churches and cathedrals erected in the west of England as long ago as the eleventh, twelfth, and fifteenth centuries, are stated by Hull* to be still in good preservation.

As yet the stone has been but little used in this country, though a movement has been of late on foot for its introduction.

Portland stone.—This stone, which has been in use in England since the middle of the seventeenth century, is a light-colored Jurassic limestone from quarries on the Isle of Portland, near Weymouth. In composition it is a nearly pure carbonate of lime, but its texture is too uneven to recommend it for other than massive structures. It was used in the construction of St. Paul's Cathedral (London), and many churches erected during the reign of Queen Anne.†

(5) FRANCE.

Griotte, or French Red.—This beautiful stone takes its name, according to Violet,‡ from the griotte cherry, owing to its brilliant red color. When, as frequently happens, the uniform redness is broken by small white spots, it is called "birds-eye griotte" (*griotte œil de perdrix*). Some varieties are traversed by white veins, but these are regarded as defects and are avoided in quarrying. The stone is found in several localities in the French Pyrenees, notably in the valley of the Barousse, of the Pique, at the bridge of the Taoulo, and in the environs of Prades. It is used for all manner of interior decorative work in France, and is exported to a very considerable extent to this country. This is by all odds the most brilliant in color of any marble of which the author has knowledge. In the small slabs usually seen in soda-fountains, counters, &c., it appears homogeneous and free from flaws. As displayed in the halls of the capital building at Albany, N. Y., however, it is full of flaws and has been so extensively "filled" as to give the whole surface a gummy appearance, in striking contrast with that of the Tennessee marble with which it is associated. The price in France as given by Violet§ is from 400 to 500 francs per cubic meter, or about \$2.75 to \$3.50 per cubic foot, according to quality.

Another marble of a brilliant scarlet color, blotched with white and known as Languedoc marble or French red, is stated by Violet (*op. cit.*) to occur at various points in the Pyrenees, but in masses of exceptional beauty and compactness at *Montagne Noire* (Black Mountain), where it has been quarried since the sixteenth century. It is obtainable here in blocks of considerable size which bring in the market of Carcassone prices varying from 250 to 350 francs per cubic meter, or, roughly speaking,

Op. cit., p. 209.

† Hull, p. 212.

‡ Les Marbres, &c. Rapports sur L'Exposition Min., 1878, xxviii, p. 15.

§ *Op. cit.*, p. 16.

from \$1.75 to \$2.50 per cubic foot. Other French marbles, though which are but little used in this country, are the rose marble from Caunes, the *vert-moulin*, also called *griotte campan*, the *campan vert*, or the *campan mélangé*. The wrongly so-called Italian griotte is, according to Chateau,* obtained from quarries at La Motte de Félines-d'Hautpoul, department of Herault. Violet states that this name was given it simply that it might command a higher price.

Caen stone.—This is one of the most noted limestones of modern history. It is a soft, fine-grained stone, very light colored, and admirably adapted for carved work, but so absorbent as to be entirely unfitted for outdoor work in such a climate as that of the United States. Egleston† states that in the climate of New York City the stone does not endure longer than ten years unless protected by paint.

The stone takes its name from Caen, in Normandy, where the principal quarries are situated. It was probably introduced into Great Britain soon after the Norman conquest, where it was largely used in cathedrals and other buildings down to the middle of the fifteenth century. The cathedral of Canterbury and Westminster Abbey are of this stone.‡

Brocatelle.—This is a very beautiful marble and much used for mantels and other interior decorations. The body of the stone is very fine and compact, and of a light yellow color, traversed by irregular veins and blotches of dull red. It is further variegated by patches or nodules of white crystalline calcite. It takes an excellent polish and requires less filling than many marbles. Its source is stated by Violet§ to be Jura, in southern France. The stone is difficult of extraction and brings a high price.

The name brocatelle is stated by Newberry|| to signify a coarse kind of brocade used for tapestry.

(6) GERMANY AND AUSTRIA.

The two principal marbles now imported from this country are known commercially as *Formosa* and *Bougard*. Both are very beautiful stones, ranking among the finest now in general use. The first named is dark gray and white mottled and blotched with red; it is slightly fossiliferous. The Bougard has about the same colors, but is lighter and the tints are more obscure.

Lumachelle marble.—This is a fossiliferous limestone in which the shells still retain their nacre, or pearly lining, and which when polished gives off in spots a brilliant iridescent luster with rainbow tints; the finer varieties being seemingly set with opals. It is a beautiful stone for

* *Op. cit.*, p. 443.

† Cause and prevention of the decay of building stone, p. 27.

‡ Hull, p. 230.

§ *Op. cit.*, p. 33.

|| Rep. of Judges, p. 148.

inlaid work and elaborate ornamentation, but is usually found only in small slabs. A variety quite commonly seen in mineral cabinets is of a dark grayish-brown color and with occasional brilliantly iridescent spots and streaks like those of the fine opal. It is brought from Bleiberg and Hall in the Tyrol in Austria.

(7) ITALY.

The quarries of the Apennines in northern Italy, near Carrara, Massa, and Serravezza, furnish marbles of a great variety of colors of the finest qualities and in apparently inexhaustible quantities. To give a full description of these quarries and their various products would be to transcend the limits of this work. I shall therefore confine myself to a brief description of only those stones which are imported to any extent into this country.

White statuary marble.—This is a fine-grained saccharoidal pure white stone, without specks or flaws. On a polished surface it has a peculiar soft, almost waxy, appearance, entirely different from the dead whiteness of the Vermont statuary marbles, to which it is considered greatly superior. It is brought principally from the Poggio. Silvestro and Betogli quarries, that from the first named locality being considered the best. The price of the stone in Italy varies from 15 to 40 liras per cubic foot in blocks of sufficient size for an ordinary statue 5 feet in height.

Ordinary white or black marble.—This is usually white in color, though sometimes faintly bluish and veined. It is largely imported into this country, and used for monumental work. The variety from the Canal Bianco quarries is white, with faint bluish lines; that from Gioja quarries is fine-grained, and uniformly white and somewhat translucent, sometimes resembling gypsum on a polished surface. The variety from the Ravaccione quarries is faintly water-blue, while that from the Tautiscritti quarries is of similar color, but traversed by fine, dark-bluish veins. These stones sell for from 4 to 10 liras per cubic foot in blocks containing 20 cubic feet each.

The veined marbles from the Vara and Gioja quarries are of a white color, but often blotched with darker hues, and traversed by a coarse irregular net-work of faintly bluish lines. The Bardiglio marbles of the ordinary type from the Para and Gioja quarries are of a water-blue color, blotched irregularly with white, and far inferior in point of beauty to the justly-famed *Bardiglio veined* marbles from the Seravezza quarries. These are of a light-blue color, traversed by an irregular net-work of fine dark-blue lines, intersecting one another at acute angles. This stone is used very extensively in soda-water fountains, counters, and for panellings.

The *Red Mixed* marble from quarries at Levante is also much sought, but works with difficulty and requires much filling. It is properly a breccia, composed of irregular whitish and red fragments embedded in

a reddish paste. It does not take a high polish, nor are its colors brilliant. The so-called *Parmazo* marbles, from the Miseglia, Pescina, and Bacca del Frobbi quarries, are all white or whitish, and traversed by a very coarse net-work of black or blue-black veins.

The Yellow or Siena marbles are, next to the white statuary, probably the most sought and widely-known of Italian marbles. Like the majority of foreign colored marbles, they are exceedingly fine-grained and compact in texture, and take a high lustrous polish. The prevailing color is bright yellow, though often blotched with slight purplish or violet shades. When these darker veins or blotches prevail to a considerable extent the stone is called *Brocatelle*. The most beautiful variety of the Siena marble is obtained, according to Delesse, from Monte Arenti, in Montagnola. It is of a uniform yellow color, but blocks of large size can be obtained only rarely, and these often bring a price as high as \$6 per cubic foot. The *Brocatelle* variety from the same locality is worth only about two-thirds this sum.

The Portor or Black and Gold marble.—This is, according to Delesse, a black silicious limestone, traversed by yellowish, reddish, or brown veins of carbonate of iron. It is brought chiefly from the Isle of Palmaria, in the Gulf of Spezia, and from Porto Venere. A small amount is also produced at Carrara and Serravezza. Blocks of this stone in the National Museum show a good surface and high polish. It is a beautiful stone, and the name black and gold well describes it. The Portor marble, from the Monte d'Arma quarries, is a breccia of fragments of black limestone with a yellowish cement. This is inclined to break away in the process of dressing, thus rendering the production of a perfect surface impossible without much filling.

Black marble.—A fair variety of this material is brought from the Colonnata quarries. The stone is not so dark as the Belgian black, nor does it admit of so high a polish.

Breccia marble.—The breccia marbles from Gragnana and Serravezza I have never seen in use in this country, though they are stated to be imported to a slight extent. The first-named consists of small bluish-white fragments cemented closely by a chalk-red cement, while the second variety has both white and red fragments similarly cemented.

The Yellow marbles of Verona and Gragnana are entirely different in appearance from those of Siena, being rather of a brownish hue, and taking only a dull polish. They are compact rocks, excellently adapted for decorative work. The so-called red marble from the Castel Poggio quarries is rather a chocolate color, dull in polish, but pleasing to the eye.

Ruin marble.—This is a very compact yellowish or drab limestone, the beds of which appear to have been fractured in every conceivable direction by geological agencies, after which the resultant fragments have become recemented by a calcareous or ferruginous cement. The rock is therefore really a breccia, although the proportional amount of

compares. A peculiar stone from this same locality is white with streaks and blotches of a blood-red color. It is more peculiar than beautiful. The marbles of Pero Pinheiro are of mottled white and pink—almost red—color, fine grained and compact. They are said to have been extensively used in Lisbon, where they have proved very durable. Other marbles that perhaps need especial mention are the breccias from Serra da Arrabida and Chodes, Saragossa Province. The first named is composed of rounded and angular pebbles of a gray, drab, black, and red color, embedded in a dull red paste. In a general way it resembles the breccia from Montgomery County, Md., but has less beauty. The Chodes stone is composed of very angular fragments, of a black color, in a reddish-brown paste. The proportion of paste to the fragments is very large and much filling is necessary in polishing. Fine, compact marbles of dull reddish hues, often veined with drab, occur in Pannella province. Others that may be mentioned are the red and yellow mottled marbles of Murcia province, the black of Alicante province, and the black white-veined breccias of Madrid. A fine translucent alabaster is also included in the collections from Saragossa province.

A very full series of these stones was exhibited at the Centennial Exposition at Philadelphia in 1876, and from there was transferred to the National Museum.

D.—GRANITIC ROCKS.

(1) EGYPT.

Granite of Syene.—The now well-known red granite, formerly called syenite, from near Syene, Egypt, and from which was constructed the numerous obelisks of the Egyptians, is represented in the Museum collections by a block some 10 inches long by 5 inches broad, and which was presented by the late Commander H. H. Goringe. The block was at one time a portion of one of these obelisks, as it was found during the excavations preparatory to the removal of the obelisk now in Central Park, New York, from Alexandria. The rock, which is very coarse, is of a general reddish color and is composed of large crystals of red and whitish feldspars intermixed with clear, glassy quartz and coal-black mica and hornblende. Some of the red feldspars are very large, exceeding an inch in length. The original source of the granite is stated to have been Upper Egypt, where it occupies large tracts between the first cataract of the Nile and the town of Assonan, the ancient Syene. It was quarried by the Egyptians as far back as one thousand three hundred years before the Christian era and has been fashioned into obelisks, sarcophagi, and colossal statues innumerable.* The block in

* See Hull, *op. cit.*, p. 51; also Goringe's "The Egyptian Obelisk," N. Y., 1882, or Jour. Geol. Soc. of London, Vol. VII, 1850-'51, p. 9.

the Museum collections still shows the ancient carving supposed to have been made upon it upwards of three thousand years ago.

A fragment of a blue-gray hornblendic granite was also received from Alexandria with that described above. Its original source is not known.

(2) BRITISH PROVINCES OF NORTH AMERICA.

New Brunswick.—In the vicinity of St. George, Kings County, occurs an inexhaustible supply of a red hornblendic intrusive granite, which is beginning to be extensively worked, and which has been introduced into the markets of the United States, where it is known as "Bay of Fundy granite." In texture the rock is medium coarse, very like that of Calais and Jonesborough, Me., from which, however, it differs in depth of color and in bearing hornblende in place of mica. It is tough and compact, takes a brilliant polish, and is apparently durable. An urn of this material in the National Museum is one of the most beautiful granite objects in the entire collection. The quarries now worked are situated about $2\frac{1}{2}$ miles from the town of St. George, where the rock occurs in rugged hills, and of varying shades of color from deep red to cream color or gray, the latter colors occurring in occasional large patches, 20 to 40 feet across, and of indefinite length. The quarries are opened along the hillside, where the rock is very conveniently jointed for getting out large blocks.*

Nova Scotia.—Gray mica-bearing granites of apparently excellent quality, and varying in texture from medium fine and homogeneous to coarsely porphyritic are quarried at Shelburne, and at Purcell's Cove, in Halifax County. These are exported to some extent into the United States. Two 12-inch cubes are in the collection of the National Museum.

(3) SCOTLAND.

The granites brought into this country from Scotland are the coarse red from Peterhead, and the gray from Aberdeen. Both are excellent stones and are used very largely for monumental work, door-posts, and pillars in all our cities and towns. In point of beauty they are inferior to many of our native granites, but their well-established reputation will probably cause their being used for many years to come. The Peterhead granite is stated† to weigh 165.9 pounds per cubic foot, and to be composed of quartz, orthoclase, albite, and black mica. The Aberdeen granite has the same composition, excepting that its triclinic feldspar is oligoclase in place of albite, and there is sometimes present a little white mica. It is of this latter stone that the city of Aberdeen is largely built. A coarse gray granite with large, well-defined porphyritic crystals of pink orthoclase is also imported from Shap, in northern England. None of these stones have any exact counterpart among the granites of this country. Six small turned and polished columns of these are in the National Museum.

* Rep. of G. F. Mathew, Geol. Surv. of Canada, 1876-'77, pp. 345-349.

† Building Construction, p. 20.

E.—QUARTZ PORPHYRIES.

Russia.—From the Isle of Hoghland, in the Gulf of Finland, the Museum has received a variety of quartz porphyries. These have mostly a dull red, very compact base, and carry large, nearly white, pinkish or reddish feldspars and glassy quartz in great profusion. The rocks acquire a good surface and polish, but are intensely hard. Other porphyritic and compact rocks, variously called diorites, keratites, and porphyries, were received from the district of Katharinenburg, in the Urals, as noted in the accompanying catalogue of the collections.

F.—SANDSTONES.

(1) BRITISH PROVINCES OF NORTH AMERICA.

Ontario.—On Vert Island, Nipigon Bay, in the northern part of Lake Superior, there occurs an extensive deposit of sandstone of Potsdam age, in which quarries have been opened within a few years, and the product of which has already found its way into the principal markets of Canada and the Lake cities of the United States. The stone is of fine and even grain, not distinctly laminated, hard, and of a bright reddish-brown color. It is said to occur in inexhaustible quantities, and that blocks as large as can be handled can be readily obtained.

An 18-inch cube from this locality in the collections of the National Museum shows it to be one of the most attractive appearing of our red sandstones. It cuts to a sharp and firm edge, and every appearance would indicate it to be very durable, though possibly liable to fade slightly on exposure. I am informed that its hardness is such that it can not be sawn with sand in the usual manner, but must be cut either with diamond-toothed circular saws or by means of chilled iron globules.

A thin section of the stone submitted to microscopic examination shows it to consist of closely compacted grains of quartz and feldspar, and an occasional shred of mica interspersed with iron oxides, which serve as a cement and give color to the stone. The feldspars are often kaolinized and there is an occasional grain of calcite.

New Brunswick and Nova Scotia.—Sandstones, varying in color from red to yellow and light gray with an olive-green tint, are very abundant among the Lower Carboniferous rocks of Albert and Westmoreland Counties in the province of New Brunswick. They are, as a rule, soft enough to be readily cut when first quarried, but harden on exposure.* So far as the author is aware the only one of these varieties extensively used in the United States is the olive-green from Dorchester, Hopewell, and neighboring localities near Shepody Bay, at the head of

* Dawson, *Acadian Geology*, p. 248.

the Bay of Fundy. The stone is of fine and even grain, works readily, and has been used both in carved and plain work with excellent effect in New York and neighboring cities. The author has had no opportunity of investigating personally the weathering properties of the stone. By some it is claimed as very durable, while by others it is regarded as unfit for finely-carved work exposed to the atmosphere. It is probable that sufficient time has not elapsed since its introduction to fully show its qualities, either good or bad. Sandstones of quite similar appearance and of the same geological age are quarried in various parts of Nova Scotia, particularly at Saw Mill Brook, near the head of Pictou Harbor. These are exported to some extent to this country.*

Owing to the fact that the Nova Scotia stone was the earliest introduced into our market, it has become confounded with that of New Brunswick, which it closely resembles, and it is customary to speak of all stone from this region as "Nova Scotia stone." As noted by Julien, however, full 95 per cent. of the imported material is, in reality, from Westmoreland and Albert Counties, New Brunswick.

(2) SCOTLAND.

So far as I am aware, the only Scotch sandstones regularly brought to the United States are the Corsehill stone, from near Annan, in Dumfriesshire; the Ballochmyle stone, from Forfarshire, and a third variety from Gatelaw Bridge, about 30 miles from Ballochmyle, in Dumfriesshire.

Of these the Corsehill stone is of greatest importance. Samples in the Museum collections are of a fine and even grain, distinctly laminated, and of a bright red color. The stone is stated by the agents to have been first introduced into this country about 1879, since which it has been quite extensively used for trimmings and general building. It is regarded by Julien† as a durable stone and well adapted for ashlar work, for carving, and for columns. The strength and chemical composition of this stone are given in the tables.

The other varieties mentioned are of the same general appearance as the Corsehill stone, and are used for the same purposes.

As these stones are brought chiefly as ballast by vessels sailing from Carlisle, England, they are known commercially as "Carlisle stone," regardless of their true source.‡

There are in the Museum collections samples of other Scotch sandstones from quarries in Morayshire. Nairn, Caithness, Sutherland, and Ross. These are all of a light color and seemingly possess no qualities to warrant their use in preference to materials obtainable nearer home.

*Dawson, *Acadian Geology*, p. 345.

†Rep. Tenth Census, Vol. X, p. 318.

‡Julien, *loc. cit.*

G.—SLATES.

www.libtool.com.cn (1) CANADA.

Slates of excellent quality, smooth, homogeneous, and strong, and of green, red, purple, and blue-black colors, occur in Richmond County, in the province of Quebec. These are now being quarried and are to be found in the principal markets of the United States. The leading quarries as given by Newberry* are those of the New Rockland Slate Company, the Melbourne Slate Company, the Rankin Hill Slate Company, and the Danville School Slate Company.† Of these the writer has seen and examined only material from the New Rockland quarries, a large slab of which is in the National Museum. It is apparently of excellent quality.

(2) GREAT BRITAIN.

The finest roofing slates of Great Britain are stated by Hull‡ to be derived from the Cambrian and Lower Silurian formations of North Wales. The Cambrian slates are stated to be generally of a green and purple color, while those of the Silurian formations vary from pale gray to nearly black. The stone splits with wonderful facility into very thin sheets, and the quarries are especially favorably situated both for working and for shipment. Material from these sources has been sent to every quarter of the globe, and has been more extensively used for roofing than any other slate now quarried.§

* Report of Judges, p. 164.

† Further details regarding the slate areas of Canada are given in *Geology of Canada*, 1863, pp. 830, 831.

‡ *Op. cit.*, p. 292.

§ For a detailed account of the Welsh slates and the methods of quarrying see *Davies Slate and Slate Quarrying*, Crosby, Lockwood & Co., London.

PART IV.

APPENDIX A.

THE QUALITIES OF BUILDING STONE AS SHOWN BY THEIR CRUSHING STRENGTH, WEIGHT, RATIO OF ABSORPTION, AND CHEMICAL COMPOSITION.

(1) GENERAL REMARKS.

The present methods of testing building stone are at best extremely unsatisfactory and the results obtained unreliable. In the majority of cases, indeed, no attempt is made to ascertain the resistance of the material to the action of fire, frost, or the general effects of weathering. This is due in part (1) to a lack of knowledge of methods by which such tests can be made, (2) to a lack of appreciation of the necessity of such tests, (3) to a desire on the part of quarriers to get the stone immediately upon the market without the delay necessitated by a long series of experiments, (4) to the expenses attendant upon such experiments, and (5) in altogether too many cases to a desire on the part of interested parties to sell the stone regardless of its qualities. Even the tests that are now applied are in many cases practically valueless, owing to a lack of definiteness in stating results, or our inability with our present knowledge to interpret them properly. Take for instance the chemical analysis of a sand stone as ordinarily given. This shows the presence of certain percentages of iron oxides, alumina, lime, and silica, but we have no means of knowing in just what conditions these substances exist; whether the iron occurs as a hydrous or anhydrous oxide, is confined wholly to the cementing material, or is a constituent of the various minerals composing the stone itself. The same may be said regarding at least a part of the silica, alumina, and lime. These difficulties may be in part avoided if the analysis is supplemented by a microscopic examination, whereby is ascertained the mineralogical nature of the stone, its structure, and the freedom from decomposition of its constituent parts. And indeed as a rule it may be said that while the analysis of any stone is of interest in a general way, it fails completely to give more than an approximate idea of its value for constructive purposes. Any analysis should always be preceded by a microscopic examination, and if the results of such examination should show it to be essential this should be followed by a pulverization and me-

chanical separation of the mineral constituents, which may in their turn be in part or wholly subjected to analysis.

Strength and ratio of absorption.—The test of compressive strength is at the present time the principal test to which a stone is put to ascertain its adaptability to any particular kind of structural application. The value of the results are, it seems to the author, greatly overestimated. It is a rule among builders never to place a stone where it will be subject to more than one-tenth the pressure it has shown itself capable of bearing by actual experiment. Even under these circumstances there is scarcely a stone in the market that would not be found when freshly quarried strong enough for all ordinary purposes of construction. The problem is not what will a selected and carefully prepared sample of the stone bear to-day, but what will it bear after many seasons' exposure to heat and frost? For all ordinary purposes of construction the excess of strength of any stone over 15,000 pounds per square inch is of little value excepting so far as it denotes density, and hence greater resistance to atmospheric influences.

The size of the cubes tested and the methods used in their preparation are matters that need consideration in making comparisons of results in any series of experiments. General Gillmore found* that within certain limits "the compressive resistance of cubes per square inch of surface under pressure increases in the ratio of the cube roots of the sides of the respective cubes, expressed in inches." Thus a series of cubes varying in size from one-fourth inch to 4 inches square were found to give results varying from 4,992 pounds to 11,720 pounds per square inch of surface. It naturally follows that ambitious dealers desiring any stone to show great power of resistance would select the larger sized cubes to be experimented upon. That the method of preparing a cube to be experimented upon is of moment will become apparent when we consider that in the process of dressing a small sample by hammer and chisel it becomes filled to a greater or less extent with small fractures and hence will break under less strain than though carefully sawn out and ground down to a smooth and even surface.†

* Report on compressive strength, etc., of building stone, Ann. Rep. Chief of Engineers, 1875.

† The author ventures to submit the following scheme for testing stone in addition to the chemical methods already alluded to. It aims to accomplish in the course of a few weeks results such as would be brought about by natural weathering in perhaps as many years.

Let six samples of the stone, all from the same bed and so far as can be determined all exactly alike, be selected and dressed by sawing and grinding (never by hammer and chisel) to a uniform size, say 2-inch cubes. From not less than three of these let the ratio of absorption be ascertained by weighing, immersing in water for not less than twenty-four hours, and reweighing. Take two of the cubes and ascertain their crushing strength when dry; two more and in like manner ascertain their crushing strength when saturated with water, say after twenty-four hours' immersion though a longer time would be preferable. Take the two remaining cubes and,

The specific gravity or density of stone having been considered by many as sufficiently indicative of their strength to be authoritative, the series of tests given below were made by Dr. Böhme. The results obtained seem to show that while with limestones this might be true, with sandstones such tests could not be relied upon. A moment's reflection will be sufficient to show us the cause of this, since the strength of any stone, which is but an aggregate of minerals, is necessarily dependent not upon the hardness, density, or toughness of the individual minerals themselves, but upon the tenacity with which they adhere to one another. (See *ante* p. 306.)

(a) *Limestone with a specific gravity of 2.68.*

	Five wet samples.	Five dry samples.
Lowest strength	7, 154. 16	7, 267. 95
Highest strength	9, 984. 54	10, 581. 91

(b) *Limestone with a specific gravity of 2.70.*

	Eleven wet samples.	Eleven dry samples.
Lowest strength	8, 050. 22	8, 050. 22
Highest strength	10, 738. 36	12, 515. 80

(c) *Limestone with a specific gravity of 2.71.*

	Six wet samples.	Six dry samples.
Lowest strength	7, 196. 83	7, 879. 54
Highest strength	12, 316. 72	13, 668. 60

after careful weighing, saturate them with water, and subject them to freezing and thawing by artificial temperatures; weighing them again, at the conclusion of the experiments, to learn the loss of material, if any. After the freezing tests are concluded the same cubes should, in their saturated condition, be submitted to crushing tests. By a comparison of the results thus arrived at it is believed a better knowledge of the durability of any stone could be obtained than would be possible in any other way than by the actual exposure of the stone for a period of many years. Where stones are to be subjected to the action of the acid gases of cities or liable to be subjected to high temperatures from burning buildings, artificial atmospheric and fire tests can readily be applied after the plan adopted by Professor Winchell (Geol. of Minn., final rep., Vol. 1). The actual cost of such a series of experiments need not necessarily be great after the apparatus has once been established. Had such a series been inaugurated by the National Government years ago, we might have been spared the infliction of the painted walls of the White House and Capitol.

(d) *Limestone with a specific gravity of 2.72.*

	Five wet samples.	Five dry samples.
Lowest strength	9,073.27	9,600.50
Highest strength	15,033.71	14,934.15

(e) *Sandstone with a specific gravity of 2.54.*

	Wet samples.	Dry samples.
No. 1	12,487.40	13,668.60
No. 2	15,488.80	14,607.02

(f) *Sandstone with a specific gravity of 2.56.*

	Wet samples.	Dry samples.
No. 1	10,169.44	9,700.10
No. 2	18,518.24	18,902.37

(g) *Sandstone with a specific gravity of 2.59.*

	Wet samples.	Dry samples.
No. 1	8,932.04	9,700.10
No. 2	11,051.27	11,349.56
No. 3	17,224.45	16,754.40

See Am. Arch., November 4, 1882.

(2) MODULUS OF ELASTICITY.

By the term *modulus of elasticity* is understood the amount of force in pounds requisite to stretch a bar of any material 1 inch square to twice its original length, provided the rate of stretch could continue uniform throughout the trial without the breaking of the material. The *modulus of rupture* is the force requisite to break a similar bar 1 inch square resting upon supports 1 inch apart, the load being applied in the middle.

So far as the writer has been able to learn, but few tests of this nature have been made upon stone. The following are from the report of Mr. T. H. Johnson.*

* Rep. State Geol. of Indiana, 1881, p. 45.

It will be noticed that there is a strong discrepancy in favor of sawn over tool-dressed stone.

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Kind of stone.	Modulus of rupture.	Modulus of elasticity.	Crushing strength.
Oolite limestones, Indiana, tool dressed*	1,477	2,679,475	7,857
Oolite limestones, Indiana, sawn†	2,338	4,889,480	12,675
Granite, Hallowell, Me., tool dressed‡	1,754‡	2,511,800	.....
Sandstones, Ohio, sawn§	479	398,234	.....
Compact limestones, Indiana, sawn || .....	2,825	6,300,000	16,312

* Average of twelve determinations.

† Average of four determinations.

‡ Average of two determinations.

§ Average of five determinations.

|| Average of four determinations.

(3) TABLE SHOWING THE SPECIFIC GRAVITY, STRENGTH PER SQUARE INCH, WEIGHT PER CUBIC FOOT, AND RATIO OF ABSORPTION OF STONES OF VARIOUS KINDS.

Kind of stone.	Locality.	Size of cube.	Position.	Strength per square inch.	Specific gravity.	Weight per cubic foot.	Ratio of absorption.	Remarks.	Authority.
Biotite granite (?)	Niantic, Conn.	<i>Inches.</i> 2	Bed.	<i>Pounds.</i> 9,550	2.600	<i>Pounds.</i> 162.5	$\frac{7}{12}$	Burst suddenly; pores supposed filled with red pigment.	Gillmore
Do.	do	2	Bed	9,450	2.580	161.2	$\frac{1}{12}$	Burst suddenly.	Do.
Gneiss.	Sachemshead, Conn.	2	{ Edge Bed.	{ 15,937 14,600	2.620	163.7	$\frac{1}{12}$	do.	Do.
Hornblende biotite gneiss.	Greenwich, Conn.	2	11,500	2.835	177.2			Average of two determinations; broke suddenly without cracking.	Do.
Biotite granite.	New London, Conn.	2	12,500	2.660	166.25			Broke suddenly without cracking.	Do.
Do.	do	2	14,175	2.660	166.25			do.	Do.
Do.	Millstone Point, Conn.	2	17,468	2.706	168.7			Average of two determinations; broke suddenly without cracking.	Do.
Do.	Mystic River, Conn.	2	Bed	18,125	2.630	164.4		do.	Do.
Do.	do	2	{ Edge Bed.	{ 22,250 15,000	2.630	164.4		Broke suddenly without cracking.	Do.
Do.	Stony Creek, Conn.	2	{ Edge Bed.	{ 16,750 15,750	2.645	165.4	$\frac{1}{12}$	Burst suddenly.	Do.
Do.	do	2	15,750	2.645	165.4		$\frac{1}{12}$	do.	Do.
Granite.	Milford, Conn.	$\left\{ \begin{array}{l} 5.93 \times 5.97 \\ 5.93 \times 5.97 \\ 5.93 \times 5.93 \end{array} \right\}$	$\left\{ \begin{array}{l} \\ \\ \end{array} \right\}$	22,610					Watertown Arsenal Mass.
Do.	do	$\left\{ \begin{array}{l} 5.93 \times 5.97 \\ 5.93 \times 5.93 \end{array} \right\}$	$\left\{ \begin{array}{l} \\ \end{array} \right\}$	22,600					Do.
Biotite granite	Vinalhaven, Me.	2		13,381	2.660	166.3		Average of two determinations; broke suddenly without cracking.	Gillmore.
Do.	do	2		14,950	2.720	170		Average of two determinations; broke suddenly without cracking.	Do.
Do.	do	2	Bed	16,031	2.630	164.4		Finely marked; bluish.	Do.
Do.	do	2	Bed	18,000	2.630	164.4		Average of six determinations; boldly marked; resembling fine breccia.	Do.
Do.	do	2	Bed	15,698	2.608	163		do.	Do.
Do.	do	2		14,875	2.631	164.1		Burst suddenly.	Do.
Do.	For Island (Vinalhaven), Me.	2		18,000	2.620	163.7		Average of two determinations; boldly marked; resembling fine breccia.	Do.
Do.	Dyer's Island, Me.	2	Bed					do.	Do.
Do.	City Point, Me.	2	Bed	15,046	2.650	165.6		Burst suddenly.	Do.
Do.	Dix Island, Me.	2		15,000	2.635	164.5		Average of two determinations; broke suddenly without cracking.	Do.
Do.	Jonesboro, Me.	2		13,164	2.750	171.9		do.	Do.
Do.	Springhead, Me.	2		15,500	2.750	171.9		Average of two determinations; broke suddenly without cracking.	Richarda. Gillmore.

Do.	Hewitt's Island, Me	2	14, 718	2, 634	161.6	do	Do.
Do.	Hurricane Island, Me.	2	14, 425	2, 670	166.9	Burst suddenly	Do.
Do.	do	2	14, 937	2, 670	166.9	Split off considerably before bursting	Do.
Do.	Huron Island, Mich	2	11, 000	2, 630	164.4	Streaked a week for absorption	Do.
Do.	do	2	18, 125	2, 660	166.2		Do.
Do.	do	2	20, 050	2, 660	166.2		Do.
Do.	do	2	14, 425	2, 632	163.7		Do.
Hornblende granite.	East Saint Cloud, Minn.	2	28, 000	2, 632	163.2	Trace.	Do.
Do.	do	2	26, 250	2, 609	163.2		Do.
Do.	Saint Cloud, Minn	2	16, 000	2, 609	163.1		Do.
Do.	do	2	18, 500	2, 609	163.1		Do.
Do.	East Saint Cloud, Minn.	2	28, 000	2, 609	163.1		Do.
Do.	do	2	26, 250	2, 609	163.1		Do.
Do.	Watab, Minn	2	25, 750	2, 659	168.4		Do.
Do.	do	2	25, 000	2, 606	162.8		Do.
Do.	Sauk Rapids, Minn.	2	23, 750	2, 683	167.7		Do.
Do.	do	2	21, 500	2, 603	162.7		Do.
Do.	Beaver Bay, Minn	2	25, 000	2, 603	162.7		Do.
Do.	do	2	26, 500	2, 603	162.7		Do.
Do.	Port Deposit, Md	2	25, 750	2, 720	170	Coarse; strongly dashed with black.	Do.
Do.	do	2	19, 750	2, 720	170	Average of two determinations	Do.
Hornblende granite.	Cape Ann, Mass	2	13, 100			Broke suddenly without cracking	Do.
Do.	do	2	15, 750			do	Do.
Do.	do	2	12, 423				Do.
Do.	Rockport, Mass.	2	16, 300	2, 610	163.2		Do.
Do.	Quincy, Mass.	2	19, 750	2, 660	166.2	Cracked before bursting	Do.
Do.	do	2	17, 750	2, 695	168.7	do	Do.
Do.	Fall River, Mass.	2	14, 750	2, 635	165	Burst suddenly, first split vertically.	Do.
Biotite granite.	do	2	15, 937				Do.
Granite.	Monson, Mass	2	9, 250				Do.
Do.	do	2	15, 390				Do.
Do.	do	2	12, 720				Do.
Biotite granite.	Keene, N. H	2	10, 375	2, 656	166	Used in inside of new capital, Albany, N. Y.	Gillmore.
Do.	do	2	12, 875	2, 656	166	Cracked before bursting	Do.
Biotite gneiss.	Tarrytown, N. Y	2	18, 250	2, 655	162.2	Broke suddenly without cracking	Do.
Do.	Morrisania, N. Y	2	15, 800	2, 720	170	Cracked before bursting	Do.
Biotite granite.	Staten Island, N. Y	2	23, 250	2, 861	178.8		Do.
Granite.	North River, N. Y	2	12, 250	2, 580	161.3		Do.
Do.	do	2	13, 370				Do.
Gneiss.	Madison avenue, N. Y	2	11, 250	2, 920	182.5		Do.
Do.	do	2	12, 500	2, 920	182.5		Do.
Granite.	Chaumont Bay, N. Y	2	18, 770	2, 65	165.4	Soaked a week for absorption	Do.
Biotite granite.	Westerly, R. I	2	14, 687	2, 670	166.9	Broke suddenly without cracking	Do.
Do.	do	2	17, 184				Do.
Do.	do	2	14, 937	2, 670	166.9	Broke suddenly without cracking	Do.

Watertown Arsenal,
Mass.

Gillmore.

Richards.
Gillmore.

(3) TABLE SHOWING THE SPECIFIC GRAVITY, STRENGTH PER SQUARE INCH, ETC.—Continued.

Kind of stone.	Locality.	Size of cube.	Position.	Strength per square inch.	Specific gravity.	Weight per cubic foot.	Ratio of absorption.	Remarks.	Authority.
Biotite granite.....	Westerly, R. I.....	Inches. 2	.....	Pounds. 17,500	2.646	163.6	.....	Average of two determinations.....	Gillmore
Do.....	Richmond, Va.....	2	{ Bed {	14,100 } 13,875 }	2.630	164.4	3½	Broke suddenly without cracking.....	Do.
Do.....	do.....	2	Bed.....	19,104	2.727	170.5	.....	Average of three determinations; broke suddenly without cracking.	Do.
Hornblende granite.....	Bay of Fundy, New Brunswick.	2	Bed.....	11,916	2.600	162.5	.....	Average of two determinations.....	Do.
Diabase.....	New Haven, Conn.....	2	{ Edge {	7,750 } 9,500 }	2.600	162.5	3½	{ Waxy looking, having a resinous } { luster; burst suddenly. }	Do.
Gabbro.....	Duluth, Minn.....	2	Edge.....	17,187	.....	.....	.....	.....	Do.
Do.....	do.....	2	{ Bed {	17,631 } 27,250 }	2.800	175.1	3½	Average of four determinations.....	Do.
Gabbro f.....	do.....	2	{ Edge {	28,250 } 28,250 }	2.802	175.1	.....	.....	Do.
Diabase.....	Taylor's Falls, Minn.....	2	{ Bed {	28,250 } 28,250 }	3.000	187.5	(*)	.....	Do.
Labradorite (massive).....	Beaver Bay, Minn.....	2	{ Edge {	20,750 } 20,750 }	2.704	169	3½	.....	Do.
Diabase.....	Near Duluth, Minn.....	2	{ Edge {	28,250 } 28,250 }	3.005	187.8	3½	.....	Do.
Do.....	Jersey City Heights, N. J.....	2	{ Edge {	28,250 } 21,500 }	3.03	189.5	.....	Very dark color; average of two determinations.	Do.
Do.....	Pompton, N. J.....	2	Bed.....	24,040	.....	.....	.....	Average of three tests, taken from near the surface.	Do.
Do.....	Goose Creek, Loudoun County, Va.....	1	.....	23,000	.....	.....	.....	.....	U. S. Ordnance Department.
Limestone [marble].....	Joliet, Ill.....	2	Bed.....	5,812 14,775	2.56	160	½	Average of three trials; burst without cracking.	Gillmore.
Dolomite.....	Quincy, Ill.....	2	Bed.....	9,687	2.570	160.6	3½	Crushed with loud explosion.....	Do.
Do.....	do.....	2	Edge.....	9,787	2.610	156.9	½	do.....	Do.
Dolomite.....	Lemont, Ill.....	2	Bed.....	12,000	2.645	163.3	½	Burst without cracking.....	Do.
Do.....	Putnamville, Ind.....	2	Edge.....	14,000	2.645	163.3	½	do.....	Do.
Limestone.....	do.....	2	.....	11,750	.....	166.36	3½	.....	Geology of Indiana, 1846, p. 98.
Do.....	Greensburgh, Ind.....	.....	.....	16,875	.....	169.98	3½	.....	Geology of Indiana, 1878, p. 90.
Do.....	Near Saint Paul, Ind.....	.....	.....	16,000	.....	168.09	3½	.....	Geology of Indiana, 1878, p. 91.
Do.....	Harrison County, Ind.....	.....	.....	10,250	.....	149.59	¾	.....	Geology of Indiana, 1878, p. 98.
Do.....	Mount Vernon, Ind.....	.....	.....	15,750	.....	165.43	3½	.....	Geology of Indiana, 1878, p. 89.

Do.	Bloomington, Ind.	13, 750	137. 24	ft	Geology of Indiana, 1878, p. 95.
Limestone (oolitic)	Spencer, Ind.	7, 500	140	ft	Geology of Indiana, 1878, pp. 96, 97.
Do.	do	8, 750	145. 16	ft	Do.
Do.	Kiltsville, Ind.	13, 500	142. 33	ft	Do.
Do.	do	12, 628	152. 39	ft	Do.
Do.	Bedford, Ind.	6, 500	162. 39	ft	Do.
Do.	do	10, 125	162. 39	ft	Do.
Do.	do	6, 750	140. 3	ft	Do.
Do.	do	8, 625	144. 28	ft	Do.
Limestone?	Salmon, Ind.	16, 250	2. 67	ft	Gillmore.
Do.	Bardonia, Ky.	15, 000	2. 67	ft	Used for Louisville and Portland Canal.
Do.	do	22, 880	166. 9	ft	do.
Dolomite. [Marble]	Lee, Mass.	23, 900			{ Saturated maximum load of testing-machine without apparent injury.
Do.	do	21, 700			Flaked off along one edge.
Do.	do	20, 504			Crushed suddenly with report.
Do.	do	22, 370			Burst into fragments suddenly.
Dolomite. [Marble]	do	22, 820			{ Effect of loading, slight flaking of one face of block; did not break.
Limestone?	Marquette, Mich.	7, 850	2. 34	ft	{ Sustained maximum load of testing-machine without perceptible injury.
Do.	do	7, 285	2. 24	ft	Average of two trials.
Do.	Lime Island, Mich.	19, 475	2. 54	ft	Burst without cracking.
Do.	do	11, 250	2. 421	ft	Average of three trials; burst without cracking.
Dolomite	Frontenac, Minn.	12, 500	151. 3	ft	Do.
Do.	Stillwater, Minn.	25, 000	2. 762	ft	Do.
Do.	Winona, Minn.	16, 250	2. 450	ft	Do.
Do.	do	23, 000	2. 595	ft	Do.
Dolomitic limestone	Red Wing, Minn.	10, 750	2. 567	ft	Do.
Do.	Stillwater, Minn.	12, 750	160. 4	ft	Do.
Do.	Kasota, Minn.	18, 500	2. 519	ft	Do.
Do.	do	9, 500	157. 4	ft	Do.
Do.	Mantorville, Minn.	10, 000	2. 310	ft	Do.

* Scarcely appreciable.

(3) TABLE SHOWING THE SPECIFIC GRAVITY, STRENGTH PER SQUARE INCH, ETC.—Continued.

Kind of stone.	Locality.	Size of cube.	Position.	Strength per square inch.	Specific gravity.	Weight per cubic foot.	Ratio of absorption.	Remarks.	Authority.
Limestone†	Billingsville, Mo.	Inches.	Bed.	Pounds.	2.32	Pounds.	145	Burst without cracking	Gillmore.
Do.	do	2	Edge	6,650	2.32	145	145	do	Do.
Do.	Canton, Mo.	2	Bed	7,250	2.34	146	146	Average of four trials	Do.
Magnesian limestone	Glen's Falls, N. Y.	2	Bed	11,475	2.700	168.8	168.8	Burst without cracking	Do.
Do.	do	2	Edge	10,750	2.700	168.8	168.8	do	Do.
Do.	Lake Champlain, N. Y.	2	Bed	25,000	2.75	171.9	171.9	do	Do.
Do.	do	2	Edge	21,500	2.75	171.9	171.9	do	Do.
Do.	Canaoharie, N. Y.	2	Bed	20,700	2.685	169.8	169.8	do	Do.
Do.	do	2	Edge	19,250	2.685	169.8	169.8	do	Do.
Limestone†	Kingsdon, N. Y.	2	Bed	13,900	2.69	168.2	168.2	do	Do.
Do.	do	2	Edge	11,050	2.635	164.7	164.7	do	Do.
Do.	Garrison's Station, N. Y.	2	Bed	18,500	2.635	164.7	164.7	do	Do.
Do.	do	2	Edge	18,275	2.61	163.6	163.6	Average of three trials	Do.
Do.	Williamsville, N. Y.	2	Bed	18,092	2.64	165	165	Burst without cracking	Do.
Do.	do	2	Edge	12,375	2.64	165	165	do	Do.
Dolomite. [Marble]	Tuckahoe, N. Y.	2	Bed	13,076	2.837	177.6	177.6	Average of four trials; burst without cracking	Do.
Bituminous dolomite.	Marblehead, Ohio	2	Bed	11,517	2.43	152	152	Average of three trials	Do.
Limestone. [Marble]	Montgomery County, Pa.	6.55× 6.05× 6.02	Bed	13,700					Watertown Arsenal, Mass.
Do.	do	6.50× 6.05× 6.03	End	10,120					Do.
Do.	do	6.04× 6.00× 6.01	End	9,590				{ Probable reduction in strength from uneven bearing.	Do.
Do.	do	6.60× 6.01× 6.0	Bed	10,940					Do.
Do.	do	6.4× 6.35× 6.02	Bed	11,470				{ Failed immediately after first signs of rapid yielding.	Do.
Do.	do	6.00× 6.40× 6.02	End	10,420				No signs of failure till block burst.	Do.
Limestone	Conahohocken, Pa.	5.94× 5.90× 5.92	End	14,090				Block split up along stratification	Do.

Do.	do	5 92X 5 85X 5 82X 5 80X 5 81X 5 81X	16, 240			{ Failed immediately after first signs of weakness.	Do.
Limestone. [Marble]	— Vermont.		13, 400				Gillmore.
Do.	Dorset, Vermont.		8, 670		2, 683	Crushed with slight explosion.	Do.
Do.	do		7, 612		2, 635	do	Do.
Limestone f.	Door County, Wis.		26, 225		2, 800	Crushed with quiet explosion.	Do.
Do.	do		13, 700		5, 800	Crushed with slight explosion; sand cracks.	Do.
Do.	Big Sturgeon Bay, Wis.		21, 500		2, 78	A remarkably solid, stable stone.	Do.
Do.	do		10, 887		2, 75	Burst without cracking.	Do.
Limestone (Tertiary)	Caen, France		3, 550		1, 900	Average of two trials; burst without cracking.	Do.
Do.	Italy		12, 156		2, 600	Burst without cracking.	Do.
Limestone. [Marble]	Middletown, Conn.		6, 950		2, 360		Do.
Sandstone	Portland, Conn.		5, 536				Do.
Do.	East Long Meadow, Mass.		4, 945				Gillmore.
Do.	Marquette, Mich.		8, 812				Do.
Do.	do		6, 185		2, 235	Average of two trials	Do.
Do.	do		5, 550		2, 285	Average of three trials.	Do.
Do.	do		6, 323		2, 186	Average of two trials	Do.
Do.	do		5, 240		2, 165		Do.
Do.	Hinckley, Minn.		19, 000		2, 529		Do.
Do.	do		17, 500				Do.
Do.	Near Fort Snelling, Minn.		14, 250		2, 221		Do.
Do.	Dresbach, Minn.		20, 000				Do.
Do.	Jordan, Minn.		6, 500		1, 880		Do.
Do.	do		3, 750				Do.
Do.	Fond du Lac, Minn.		3, 750		1, 825		Do.
Do.	Jordan, Minn.		3, 000				Do.
Do.	do		8, 750		2, 245		Do.
Do.	do		5, 750				Do.
Do.	do		4, 750		1, 901		Do.
Do.	Dakota, Minn.		4, 750		1, 872		Do.
Do.	Taylor's Falls, Minn.		3, 000				Do.
Do.	do		5, 500		1, 876		Do.
Do.	Kesota, Minn.		10, 700		2, 630	Calcareous sandstone	Do.
Do.	do		11, 675		2, 630		Do.
Do.	Frontenac, Minn.		6, 250		2, 325		Do.
Do.	do		7, 775		2, 325		Do.
Quartzite	Pipe Stone, Minn.		27, 750		2, 729		Do.
Sandstone	Warrensburg, Mo.		27, 000				Do.
Do.	Bellville, N. J.		4, 968		2, 140		Do.
Do.	do		11, 700				Do.
Do.	do		10, 250		2, 250	Broke suddenly	Do.
Do.	Little Falls, N. Y.		9, 850				Do.
Do.	do		9, 150		2, 250		Do.

(3) TABLE SHOWING THE SPECIFIC GRAVITY, STRENGTH PER SQUARE INCH, ETC.—Continued.

Kind of stone.	Locality.	Size of cube.	Position.	Strength per square inch.	Specific gravity.	Weight per cubic foot.	Ratio of absorption.	Remarks.	Authority.
Sandstone	Haverstraw, N. Y.	Inches. 2	Bed...	Pounds. 4,350 9,000- 13,000	2.130	Pounds. 133.1	5		Gillmore.
Do.	Hudson River, N. Y.	2	{ Bed... Edge...	{ 13,000- 11,425					Probosc.
Do.	Albion, N. Y.	2	Bed...	13,500	2.420	151.2	5		Gillmore.
Do.	Haverstraw, N. Y.	2	Edge...	11,350	2.420	151.2	5		Do.
Do.	Medina, N. Y.	2	Edge...	4,025	3.130	133.1	5		Do.
Do.	do	2	Bed...	17,250	2.410	150.6	5	Lilac in color.	Do.
Do.	do	2	Edge...	14,812	2.390	149.3	5	More purple than last.	Do.
Do.	do	2	Bed...	17,725	2.420	151.1	5		Do.
Do.	Wadesborough, N. C.	{ 1.08x 1.97x 2	{ }	{ 8,000 }				{ Cracked at 32,000 pounds; crushed at 44,675 pounds.	
Do.	do	1x1.97	...	8,000					Gillmore.
Do.	Vermilion, Ohio	2	Bed...	9,850	2.160	135.2	5	Average of five trials.	Do.
Do.	do	2	Edge...	7,840	2.157	134.8	5		Do.
Do.	Seneca, Ohio	2	Bed...	9,687	2.390	149.3	5		Do.
Do.	do	2	Edge...	10,500	2.390	149.3	5		Do.
Do.	Cleveland, Ohio.	2	Bed...	6,800	2.240	140	5		Do.
Do.	do	2	Edge...	7,910	2.240	140	5		Do.
Do.	Marblehead, Ohio.	2	Bed...	7,937	2.310	144.4	5	Rather a chalky limestone	Do.
Do.	do	2	Edge...	6,850	2.310	144.4	5	do	Do.
Do.	Massillon, Ohio.	2	Bed...	7,737	2.110	131.8	5	Average of two trials	Do.
Do.	North Amherst, Ohio.	2	Edge...	5,450	2.140	133.7	5		Do.
Do.	do	2	Bed...	6,212	2.175	135.8	5	Average of two trials	Do.
Do.	Berea, (t) Ohio	{ 6.03x 6.52x 6.03	{ }	{ 6,510 }					{ Watertown Arsenal, Mass.
Do.	Berea, Ohio.	2	Bed...	10,250	2.110	131.9	5	Very friable, like sugar.	Gillmore.
Do.	do	2	Bed...	8,222	2.145	134	5	Average of four trials.	Do.
Do.	Hummelstown, Pa.	{ 6.45x 6.40x 6.04	{ }	{ 12,810 }					{ Watertown Arsenal, Mass.
Do.	do	{ 6.45x 6.50x 6.02	{ }	{ 13,610 }				Burst suddenly	Do.
Do.	Bass Island, Wis.	2	Bed...	4,850	2.040	127.5	5	Average of two trials	Gillmore.
Do.	do	2	Edge...	4,287	2.040	127.5	5		Do.
Do.	Fond du Lac, Wis.	2	Bed...	6,237	2.230	138.8	5	Average of two trials	Do.
Do.	do	2	Edge...	5,110	2.220	138.8	5		Do.

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Do.....	Dorchester, New Brun-	3	Bed.....	9,381			Do.....
Do.....	wick.	2	Edge.....	6,050			Do.....
Do.....	do.....	2	Bed.....	12,000			Do.....
Do.....	Edinburgh (Craigleith),				141.3	.....	Do.....
Do.....	Scotland.				2,260	.....	
Do.....	do.....	3	Edge.....	11,250	141.3	.....	
Do.....	Annan, Scotland.	6		7,825	141.3	.....	
Do.....	Verte Island, Lake Supe-	2		11,842	.....	.....	
	rior.						

(4) TABLES SHOWING THE CHEMICAL COMPOSITION OF STONES OF VARIOUS KINDS.

Serpentine rocks.	Silica.	Magnesia.	Chromic oxide.	Nicolous oxide.	Ferrous oxide.	Manganous oxide.	Alumina.	Water.	Magnetic iron.	Authority.
Serpentine, near Dublin, Harford County, Md.....	40.06	39.02	0.20	0.71	3.43	0.09	1.37	12.10	3.02	F. A. Genth.
Precious serpentine, Easton, Pa.....	41.55	40.15			Ferric oxide 8.90			13.70		Mineralogy of Pennsylvania, preliminary report, 1874, p. 115.
Serpentine var. Williamsite, Lancaster County, Pa..	45.02	37.75					3.35	13.01		Mineralogy of Pennsylvania, preliminary report, 1874, p. 115 (Brud.).
Serpentine (verdantique marble) Roxbury, Vt.....	42.60	35.50			8.30	CaCO ₃ .60		13.00		Geology of Vermont, Vol. II, p. 778.
Serpentine (verdantique marble) Cavendish, Vt.....	43.39	39.55			5.32			11.79		Do.

Limestones and dolomites other than marbles.	Carbonate of lime.	Carbonate of magnesia.	Oxides of iron.		Oxide of alumina.	Silica and insoluble residue.	Water and loss.	Sulphuric acid.	Chlorides of alkalis.	Authority.
			Ferric.	Ferrous.						
Limestone, Nauvoo, Ill.....	82.48					12.50	2.92			Prof. A. D. Conover.
Dolomite, Lemoist, Ill.....	45.80				7.00	15.90	6.90	0.38		Geology of Indiana, 1878, p. 92.
Do.....	42.97	34.30		2.07		21.36		Potash. 0.21	Soda. 0.23	Geology of Minnesota, Vol. I.
Limestone (oolitic), Belford, Ind.....	96.60	0.13				0.50	0.96	0.31	0.40	Geology of Indiana, 1878, p. 95.
Limestone (oolitic), Spencer, Ind.....	96.80	0.11				0.70	0.92	0.20	0.32	Do.
Limestone, Bloomington, Ind.....	95.54	0.19				0.65	1.57	0.40	0.55	Do.
Limestone, North Vernon, Ind.....	89.40	0.85				1.75	2.66	1.21	Trace	Do.
Limestone, Harrison County, Ind. (Stocklager's quarry).	98.10	None			2.20	0.31	0.62	0.25	0.40	Geology of Indiana, 1878, p. 95.
Limestone, Flat Rock Creek, near Saint Paul, Ind.....	82.71	3.00			0.14	5.10	1.00	0.80	0.50	Geology of Indiana, 1878, p. 91.
Limestone, Greenbury, Ind.....	74.20	4.93			3.70	5.90	0.85	0.90	1.60	Geology of Indiana, 1878, p. 90.
Siliceous limestone, Putnamville, Ind.....	63.76	0.33			1.70	27.50	1.86	2.60	0.75	Geology of Indiana, 1878, p. 93.
Magnesian limestone, Anamosa, Iowa.....	57.32	41.21		0.23		0.72	0.31			Geology of Iowa, Vol. II, pp. 346, 347.
Magnesian limestone, Le Claire, Iowa.....	54.23	41.70		0.74		3.33				Do.

Magnesian limestone, Le Grand, Iowa.....	75.42	20.06	1.08	1.71	0.59	Do.	Geology of Minnesota, Vol. 1.
Magnesian limestone, Stone City, Iowa.....	57.86	37.29	1.29	0.98		Carbonate of iron 2.02	
Limestone (lithographic), Solenhofen, Bavaria.....	94.24	0.21					Gmelin, Chateau, Vol. 1, p. 285.
Limestone (oolitic), Bath, England.....	97.52	2.50	1.20		1.78		Wheatstone & Daniels, Hull, p. 210.
Limestone (oolitic), Portland, England.....	95.16	1.20	0.50	1.20	1.94		
Limestone (Caen), Aubigny, France.....	97.69			1.70			
Dolomitic limestone, Minneapolis, Minn. (Weeks & Heiser's quarry).....	54.533	36.002	0.30	3.16	0.375		Geology of Minnesota, Vol. 1.
Dolomitic limestone, Minneapolis, Minn. (Foley & Herbert's quarry).....	41.890	24.550	4.03			Petash. Soda. 1.22 1.12	Do.
Dolomitic limestone, Minneapolis, Minn. (Eastman's quarry).....	75.482	6.810	1.70		1.60		Do.
Argillaceous limestone, Saint Paul, Minn. (A. Raus's quarry).....	78.18	6.420	1.63	2.67		Organic matter. 0.80	Do.
Dolomitic limestone, Kasota, Minn. (Breckenridge Bros.' quarry).....	47.904	35.227	1.49				Do.
Dolomitic limestone, Kasota, Minn.....	49.16	37.53	1.09			Petash. Soda. 0.02 0.50	Do.
Dolomitic limestone, Clinton Falls, Minn.....	57.68	15.90	1.94				Do.
Dolomitic limestone, Central Point, Minn.....	33.00	13.540	0.33	4.92			Do.
Dolomitic limestone, Lanesboro, Minn. (Mill Co.'s quarry).....	49.66	42.06	0.37	0.33			Do.
Dolomitic limestone, Red Wing, Minn. (Sweeney's quarry).....	50.68	33.61	0.55	0.37			Do.
Dolomitic limestone, Lanesboro, Minn. (Mill Co.'s quarry).....	62.14	28.49	1.05				Do.
Dolomitic limestone, Stillwater, Minn. (Hersey & Co.'s quarry).....	50.22	37.39	0.78	0.64			Do.
Do.....	53.50	40.21	1.11				Do.
Dolomitic limestone, Mantorville, Minn. (Hooke's quarry).....	50.20	38.96	1.77				Do.
Dolomite, Winona, Minn.....	51.23	41.33	0.96				Do.
Dolomite, Frontenac, Minn.....	54.78	42.53	0.36	0.31			Do.
Limestone, Fountain, Minn.....	86.107	9.470	1.39				Do.
Limestone, Point Pleasant, Ohio.....	79.39	0.91	7.00			0.44	Geology of Ohio, Vol. 1, p. 374.

(4) TABLES SHOWING THE CHEMICAL COMPOSITION OF STONES OF VARIOUS KINDS—Continued.

Limestones and dolomites other than marbles.	Carbonate of lime.	Carbonate of magnesia.	Oxides of iron.		Oxide of alumina.	Silica and insoluble residue.	Water and loss.	Sulphuric acid.	Chlorides of alkalies.	Authority.
			Ferrio.	Ferrens.						
Limestone, Dayton, Ohio	92.40	1.10		0.58		1.70	1.08	Soluble silica. 0.90		Geology of Ohio, Report of Progress, 1889, p. 152.
Limestone, Xenia, Ohio	84.50	11.16		2.60		2.20				Geology of Ohio, Vol. II, part I, p. 669.
Magnesian limestone, Marblehead, Ohio.	83.20	15.83				0.15	0.80		Organic matter. 0.02	J. L. Cassell.
Argillaceous dolomite, Yellow Springs, Ohio	51.10	41.12		1.40		5.40				Geology of Ohio, Vol. II, part I, p. 672.
Dolomite, Greenfield, Ohio.	53.67	42.42	1.30			2.44				Geology of Ohio, Report of Progress, 1870, p. 237.
Dolomite, Springfield, Ohio	54.70	44.93		0.20		0.10				Geology of Ohio, Vol. I, part I, p. 474.

(4) TABLES SHOWING THE CHEMICAL COMPOSITION OF STONES OF VARIOUS KINDS—Continued.

Limestones and dolomites, marbles.	Carbonate of lime.	Carbonate of magnesia.	Oxides, iron and aluminum.	Insoluble residue.	Carbonate of manganese.	Carbonate of iron.	Loss.	Authority.
Limestone (white), Talladega County, Ala.	95.25	0.62	1.15	62.95	.....	.....	.....	Geology of Alabama, Report of Progress for 1874, p. 124.
Limestone (blue), Talladega County, Ala.	94.40	0.41	0.75	64.65	.....	.....	.....	Do.
Dolomite (white), Lee, Mass.	94.621	43.933	0.365	.....	.....	.....	.610	Joseph Henry, Smith Report.
Dolomite (white), Pleasantville, N. Y.	94.62	45.04	0.23	.....	.....	.....	.....	C. F. Chandler.
Limestone (pink), Nantahala River, North Carolina.	94.51	2.12	.....	62.56	0.21	0.60	.....	F. A. Geith, Geology of North Carolina, Vol. I, 1875, p. 138.
Limestone (white), Valley River, North Carolina.	97.86	1.29	.....	60.44	0.18	0.23	.....	Do.
Dolomite (white), Valley River, North Carolina.	54.10	44.44	.....	64.32	0.52	0.62	.....	Do.
Limestone, Knoxville, Tenn.	98.43	0.30	.31	.38	Sulphur.	Organic matter.	.150	Geology of Vermont, Vol. II, p. 768.
Limestone (white statuary), Brandon, Vt.	99.51	.....	.....	.29	.014	.....	.20	Do.
Limestone (magnesian), Isle La Motte, Vt.	97.94	4.56	2.60	4.88	Min. trace	.....	.10	Geology of Vermont, Vol. II, p. 775.
Dolomite, Plymouth, Vt.	93.90	44.7	.....	1.3	.....	.....	.....	Do.
Dolomite, Colchester, Mallett Bay, Vt.	93.31	42.23	12.25	10.30	.....	.....	.....	Geology of Vermont, Vol. II, p. 774.
Limestone (white), Rutland, Vt.	97.73	.....	.50	1.68	.....	.....	.....	Geology of Vermont, Vol. I, p. 307.
Limestone (greenish), Rutland, Vt.	95.45	.....	.....	14.55	.....	.....	.....	Do.
Limestone, Sudbury, Vt.	99.79	.....	.30	.....	.....	.....	.....	Do.
Limestone (white), West Rutland, Vt.	98.09	.....	.....	.57	.....	.....	.....	Geology of Vermont, Vol. II, p. 691.
Limestone (dove colored), Swanton, Vt.	94.66	.23	1.09	2.39	.....	.....	1.63	Written quoted by Chateau, Vol. I, p. 294.
Limestone (white), Carrara, Italy.	99.236	0.264	.....	.....	.....	.....	.....	P. M. Kasefeld, quoted in Sil. Jour., Vol. XV, 1883, p. 434.
Do.	98.785	0.900	1.032	0.16	.....	.....	0.096	

e Siliceous matter.

b Quartz and siliceous.

(4) TABLES SHOWING THE CHEMICAL COMPOSITION OF STONES OF VARIOUS KINDS—Continued.

Granitea.	Silica.	Alumina.	Iron oxides.	Manganese oxide.	Lime.	Magnesia.	Potash.	Soda.	Loss.	Sulphur and copper.	Authority.
Granite, Monson, Mass. (light)	73.47	15.07	1.15	.....	4.43	.12	0.38	5.59	.....	Trace...	J. M. Ordway.
Granite, Monson, Mass. (dark)	69.85	13.83	2.00	.....	5.94	.....	2.78	.....	.....	.....	Do.
Hornblende granite, East Saint Cloud, Minn.	65.12	16.96	4.69	.....	4.77	1.99	2.18	3.07	.....	.....	N. H. Winchell, Geology of Minnesota, Vol. I.
Hornblende granite, Sauk Rapids, Minn.	64.13	12.82	21.01	.....	6.90	1.96	1.22	3.21	.....	.....	Do.
Hornblende granite, Beaver Bay, Minn.	71.81	12.63	3.93	.....	2.26	0.56	1.92	2.51	.....	.....	Do.
Hornblende granite, East Saint Cloud, Minn.	74.43	12.63	3.93	.....	1.28	0.25	2.33	1.54	.....	.....	Do.
Do.	74.72	12.30	3.19	.....	1.51	0.25	2.26	1.91	.....	.....	Do.
Hornblende granite, Watab, Minn.	62.66	12.29	4.67	.....	5.84	3.06	1.63	2.44	.....	.....	Do.
Do.	73.12	11.14	2.58	.....	5.82	Trace	4.43	3.33	.....	.....	Do.
Biotite granite, Raleigh, N. C.	69.28	17.44	2.30	0.16	2.80	0.27	2.76	3.64	.....	.....	Geology of North Carolina, Vol. I, 1873.
Hornblende biotite granite, Utah	71.78	14.75	1.94	1.09	2.36	0.71	4.89	3.12	0.52	.....	Geological Exploration Fortieth Parallel, Vol. II, p. 366.
QUARTZ PORPHYRIES.											
Quartz porphyry, Waterville, N. H.	63.63	17.42	5.91	0.22	2.86	.....	5.54	4.52	0.15	.....	Geology of New Hampshire, Vol. III.
Quartz porphyry "leopardite," Mecklenburg, N. C.	75.92	14.47	0.83	0.09	1.02	.....	4.01	4.96	0.64	.....	American Journal of Science, March, 1862, p. 199.

(4) TABLES SHOWING THE CHEMICAL COMPOSITION OF STONES OF VARIOUS KINDS—Continued.

Diabase.	Silica.	Oxides of iron.		Alumina.	Oxide of manganese.	Mag. nesia.	Soda.	Potash.	Lime.	Phos. phoric acid.	Ignition and loss.	Authority.
		Ferrie.	Ferrous.									
Diabase, West Rock, New Haven, Conn.	51.73	3.59	8.25	14.20	0.44	7.63	2.14	0.39	10.70	0.14	0.63	Hawes, American Journal of Science, Vol. IV, 3ed., 1875, p. 186, 187.
Diabase, Mount Holyoke, Mass.	52.63	1.95	9.79	14.14	0.44	6.38	2.56	0.87	9.38	.....	1.60	Do.
Diabase, Duluth, Minn.	59.43	17.63	.....	23.83	.....	2.46	2.06	0.34	4.79	.....	.....	Geology of Minnesota, Vol. I, p. 193.
Gabbro, Duluth, Minn.	48.51	19.34	.....	13.79	.....	4.81	1.87	0.19	8.34	.....	.....	Do.
Diabase, Taylor's Falls, Minn.	35.83	.....	48.45	.....	.....	3.12	1.66	0.22	9.35	.....	.....	Do.
Massive Labradorite, Beaver Bay, Minn.	48.32	.....	35.95	.....	.....	0.25	2.88	0.19	12.65	.....	.....	Do.
Diabase, Jersey City, N. J.	53.13	1.08	9.10	13.74	0.43	8.55	2.30	1.03	9.47	.....	0.90	Hawes, American Journal of Science, Vol. IV, 1875, p. 187.
Diabase, Williamson's Point Pa.	50.79	11.28	TiO ₂ , 0.70	14.19	0.43	7.88	1.89	0.95	9.75	0.15	1.95	F. A. Genth, Rep. E. & E., 2d Geology of Pennsylvania, p. 275

(4) TABLES SHOWING THE CHEMICAL COMPOSITION OF STONES OF VARIOUS KINDS—Continued.

Sandstones and quartzites.	Silica.	Alumina.	Iron oxides.	Manganese oxide.	Lime.	Magnesia.	Potash.	Soda.	Loss.	Authority.
Sandstone, Portland, Conn.	88.94	13.15	2.48	6.70	3.09	Trace	3.30	5.43	1.01	F. W. Taylor.
Sandstone, Stoney Point, Mich.	84.57	5.90	6.48	.....	.....	Trace	Undet.	.....	1.92	F. W. Clark, Bull. U. S. Geological Survey, No. 27.
Quartzite, Pipestone, Minn.	84.52	12.33	2.12	.....	.31	Trace	0.11	0.34	2.31	Geology of Minnesota, Vol. I.
Sandstone, Hinckley, Minn.	93.69	1.06	.....	.....	.43	0.01	Trace	0.17	.....	N. H. Winchell, Geology of Minnesota, Vol. I.
Sandstone, near Fort Snelling, Minn.	97.67	1.31	0.55	.....	.41	0.21	0.02	0.15	.....	Do.
Sandstone, Dresbach, Minn.	81.47	5.90	.....	.....	1.90	0.50	4.20	0.39	.....	Do.
Sandstone, Jordan, Minn.	81.19	16.44	.....	.....	.56	0.40	3.60	0.66	.....	Do.
Sandstone, Fond du Lac, Minn.	78.24	10.88	3.88	.....	.95	1.60	1.67	0.06	.....	Do.
Sandstone, Jordan, Minn.	33.41	5.77	1.79	.....	35.87	Mg ² CO ₃ { 18.94 } Magnesia { 0.30 }	0.12	0.29	.....	Do.
Sandstone, Dakota, Minn.	81.55	10.90	1.41	.....	1.15	Magnesia { 0.30 }	1.76	1.03	.....	Do.
Sandstone, Wadesborough, N. C.	69.28	13.84	.....	.....	.....	.02	.....	6.43	1.69	Do.
Sandstone, Berea, Ohio.	44.40	7.49	3.87	.....	.74	2.11	0.24	0.56	.....	Professor Wormley, Geology of Ohio.
Waverly sandstone, Ohio.	91.00	5.20	1.47	.....	Trace	0.28	.....	.....	1.80	T. M. Chastard, Bull. U. S. Geological Survey, No. 27.
Sandstone, Cleveland, Ohio.	91.67	6.92	Trace	.....	0.38	0.34	.....	.....	1.17	Professor Wormley.
Waverly sandstone, Picketon, Ohio.	73.99	3.56	13.44	.....	Trace	0.46	.....	.....	3.30	Do.
Sandstone, Siskowit Bay, Wisconsin.	90.86	4.76	1.58	.....	.15	0.59	1.06	0.45	.56	W. Wallace.
Sandstone, Annan, Scotland.	95.24	.56	1.28	.....	1.40	1.23	Trace	.....	.....	J. R. Chilton.
Sandstone, Dorchester, New Brunswick.	82.53	7.67	3.55	1.43	1.83	Trace	Trace	.....	3.61	

(4) TABLES SHOWING THE CHEMICAL COMPOSITION OF STONES OF VARIOUS KINDS—Continued.

Argillites. Clay slates.	Silicic acid.	Titanic acid.	Sulphuric acid.	Alumina.	Ferrous and ferric oxide.	Manganese oxide.	Cobalt oxide.	Lime.	Magnesia.	Soda.	Potash.	Carbon.	Water.	Iron silicate.	Authority.
Slate, Delta, York County, Pa.	55.88	1.27	0.022	21.849	9.034	0.586	Trace	0.155	1.405	0.488	3.640	1.974	3.385	0.051	J. S. McCreath.
Slate	60.50	.....	.....	12.70	7.83	.....	.....	1.12	2.20	2.20	3.18	.....	2.30	.....	Professor Hull.
Slate, Llangynog, North Wales.	60.159	.....	.....	24.200	{ 1.815 } { 5.837 }	.....	.....	4.278		.....		.....	3.720	.....	D. H. Richards.
Slate, Llanberis.	66.45	0.68	.....	12.38	{ 1.71 } { 1.71 }	.91	.....	2.86	6.28	0.90	0.05	1.20	4.03	.....	Royal School of Mines.
Slate, Nantlle.	49	.....	.....	22	14.00	.....	.....	4	8	.....	.....	.....	.....	.....	Kirwan.
Slate, Bondorf.	62.50	.....	.....	16.88	8.43	.....	.....	0.24	2.26	.....	3.31	0.92	4.03	.....	Dr. Bischoff.

1 Carbonic acid.

2 Estimated as argillaceous matter.

3 Contained also 1.22 per cent. of carbonate of lime and 0.12 per cent. of oxide of copper.

4 Tabled as "Carbon and loss."

APPENDIX B.

PRICES AND COST OF CUTTING.

The prices of stone and the cost of cutting vary with the price of labor and the conditions of the market, hence exact figures can not be given. Those given below are quoted from reliable sources, and will doubtless be found as near correct as possible in a work of this kind. The prices are for the rough stone and at the quarry, ordinary size.

Kinds.	Price per cubic foot.	Cost of dressing per square foot.					Remarks.
		Sawn.	Rubbed.	Pointed.	Ax-hammered.	Bush-hammered or chiseled.	
Granites:							
Common.....	\$0.35 to \$0.75	-----	-----	\$0.25 to \$0.40	\$0.25 to \$0.50	\$0.40 to \$0.75	
Monumental.....	.75 to 1.50	-----	-----	.25 to .40	.25 to .50	.40 to .75	
Marbles:							
Statuary.....	7.00 to 9.00	\$0.40	\$0.90	.25	.50	.75	
Common.....	1.50 to 2.50	.40	.90	.25	.50	.75	
Decorative.....	2.00 to 4.00	.40	.90	.25	.50	.75	
Monumental.....	4.00 to 5.00	.40	.90	.25	.50	.75	
Tennessee.....	.75 to 3.00	.40	.90	.25	.50	.75	
Sandstones:							
Brown Triassic	1.00 to 2.00	-----	-----	.10 to .15	.30	-----	Extra prices for blocks above 25 cubic feet.
Berea.....	1.00	-----	-----	-----	-----	-----	
N. Y. bluestone	.03 to .10	-----	-----	.15	-----	.25	Per square foot and 2 to 3 inches thick; flagging.
Do.....	.10 to .20	-----	-----	-----	-----	-----	Per square foot and 4 to 8 inches thick; platforms, etc.
Medina.....	.60	-----	-----	-----	-----	-----	Building stone.
Limestones	.50 to .75	-----	-----	-----	-----	-----	
Serpentine, Pennsylvania.	.20 to .40	-----	-----	.10	.15	.15	
Slates.....	2.00 to 3.50	-----	-----	-----	-----	-----	Per square = 100 square feet.

Price-list of Italian marbles.

Quality.	Kind of stone.	Quarry.	Price per cubic foot.	Remarks.
	www.libtool.com.cn		<i>Lira.*</i>	
First	Statuary	Poggio Silvestro..	85 to 40	Prices reckoned on blocks of sufficient size for an ordinary statue 5 foot in height.
Second	do	do	15 to 18	
First	do	Bettogli	80 to 35	
Second	do	do	12 to 15	Prices reckoned on blocks containing not less than 20 cubic feet.
First	White or black marble	Canal Bianco	10	
Do	do	Gioja	9.50	
Second	do	Ravaccione	6 to 6.50	
Third	do	Tanti Scritti	4 to 4.25	
First	White veined	Vara	10.50	
Second	do	Gioja	7	
First	Bardiglio	Para	8.50	
Second	do	Gioja	6.50	
First	Bardiglio, veined	Serravezza	8.75	
Second	do	do	7.25	
First	Portor, black and gold	Spezia	10.50	
Do	Red mixed	Levanto	10.50	
Do	Farmazo	Miseglia	12	
	do	Pescina	12	
	do	Bocca del Frobbl	12	Prices of all of these depend upon the sizes of the pieces and the beauty of the veining.
	Yellow	Sienna	18 to 20	
	Portor	Monte d'Arma	11	
	Black	Colonnata	10.50	
	Breccia	Gragnana	Exceptional.	
	Yellow	do	do	
	Green (serpentine)	Garfagnana	do	
	do	Genoa	do	
	Breccia	Serravezza	do	
	Yellow	Verona	do	
	Red	Castel Poggio	7	

*A lira equals 19.3 cents American money.

NOTE.—For this list of quarries and prices we are indebted to Hon. William P. Rice, United State consul at Leghorn, Italy.

APPENDIX C.

IMPORTS AND EXPORTS OF STONE.*

Marbles imported and entered for consumption in the United States for the years 1867 to 1883, inclusive.

Fiscal years ending June 30—	Sawed, dressed, etc., not over 2 inches thick.	Sawed, dressed, etc., over 2 and not over 3 inches thick.	Sawed, dressed, etc., over 3 and not over 4 inches thick.	Sawed, dressed, etc., over 4 and not over 5 inches thick.	Sawed, dressed, etc., over 5 and not over 6 inches thick.	Veined, and all other in block, etc.	White, statuary, brocatella, etc.	Not otherwise specified.	Total.
1867.....						\$192,514	\$2,540	\$51,978	\$247,032
1868.....						309,750	4,403	85,783	399,936
1869.....						359,881	3,898	101,809	465,088
1870.....						332,839	3,713	142,785	479,337
1871.....	\$5,973	\$168	\$77	\$44	\$28	400,158	1,134	118,016	525,508
1872.....	3,499	1,081	452		318	475,718	4,017	54,539	539,624
1873.....	3,124	21				390,071	4,148	69,991	473,955
1874.....	1,837					474,680	2,863	51,699	531,079
1875.....	1,456	427	96			527,028	1,623	72,389	603,019
1876.....	595	126	204	87		529,126	1,151	60,596	591,885
1877.....	2,124					349,590	1,404	77,293	430,411
1878.....	198	11	8			376,936	592	43,915	421,600
1879.....	184					329,155	427	54,857	384,623
1880.....						531,908	7,239	62,715	601,862
1881.....	839					470,047	1,468	82,046	553,900
1882.....	655					486,331	3,582	84,577	575,145
1883.....	619					633,096	2,011	71,905	607,631

In 1884 the classification was as follows :

	Value.
Marble, in block, rough or squared, of all kinds.....	\$511,287
Veined marble, sawed, dressed, or otherwise, including marble slabs and marble paving tiles	12,941
All manufactures of, not specially enumerated.....	67,829
Total	592,057

* The tables here given relative to the imports and exports of various kinds of stone are taken bodily from Williams's Mineral Resources of the United States, 1883-'84.

Building stone (exclusive of marble), paving stone, and stone ballast imported and entered for consumption in the United States, 1867 to 1884, inclusive.

Fiscal years ending June 30—	Building stone, dressed.	Building stone rough.		Sand-stone.	Slate, chimney pieces, mantels, etc.	Roofing slate.	Lime-stone.	Paving stones.	Ballast.	Total value.
		Quantity.	Value.							
		<i>Long tons.</i>								
1867.....					\$37,510	\$85,204				(?)
1868.....	\$59,081				16,045	118,776		\$5,718		(?)
1869.....	61,408		\$8,237	\$4,171	19,602	85,364		467	\$3,987	(?)
1870.....	150,619			3,101	19,879	107,521		2,034	10,518	(?)
1871.....	145,759	1,455	16,982	3,660	21,381	117,484			34,703	(?)
1872.....	162,614	10,723	39,515	7,680	25,925	107,192	\$2,459	5,529	11,303	\$362,217
1873.....	218,236	20,226	73,889	6,160	26,643	91,503	1,486	3,788	17,143	438,848
1874.....	238,680	19,658	81,645	8,534	27,519	80,519	1,639	7,246	21,882	467,664
1875.....	275,633	15,748	67,357	10,986	42,022	16,342	2,023	2,017	9,025	425,405
1876.....	316,404	8,199	34,124	7,174	44,266	2,051	1,938	1,005	9,350	416,312
1877.....	201,034	7,584	25,571	5,492	34,479	4	1,705	485	6,272	275,042
1878.....	153,693	10,197	37,878	7,136	39,935	275	2,614	1,950	6,989	250,470
1879.....	125,493	6,845	24,531	13,956	46,260	620	1,456	2,943	2,365	217,624
1880.....	75,501	11,035	43,997	10,220	51,165	72	2,560	2,383	7,572	193,470
1881.....	76,741	15,867	65,950	15,115	46,862	2	1,990	3,799	5,401	215,860
1882.....	104,296	16,778	75,369		45,774	154	2,710	16,599	8,792	253,694
1883.....	127,476	14,324	64,767		44,375	2,813	1,841	2,620	5,745	249,646
1884.....	122,463	12,198	50,860		34,640	16,099	143	2,576	2,551	229,332

Marble and stone of domestic production exported from the United States.

Fiscal year ending September 30 until 1842 and June 30 since.	Rough.	Manu-factured.	Total.	Fiscal year ending June 30—	Rough.	Manu-factured.	Total.
1826.....		\$13,303	\$13,303	1856.....		\$162,376	\$162,376
1827.....		3,505	3,505	1857.....		111,403	111,403
1828.....		3,122	3,122	1858.....		138,590	138,590
1829.....		2,647	2,647	1859.....		112,214	112,214
1830.....		4,655	4,655	1860.....		176,239	176,239
1831.....		3,588	3,588	1861.....		185,267	185,267
1832.....		3,455	3,455	1862.....		195,442	195,442
1833.....		5,087	5,087	1863.....		138,428	138,428
1834.....		7,359	7,359	1864.....	\$57,715	144,647	202,362
1835.....		8,687	8,687	1865.....	74,261	183,782	258,043
1836.....		4,414	4,414	1866.....	89,703	112,830	202,533
1837.....		5,374	5,374	1867.....	53,983	138,558	192,541
1838.....		5,199	5,199	1868.....	60,390	105,046	165,445
1839.....		7,661	7,661	1869.....	62,266	87,135	149,401
1840.....		35,794	35,794	1870.....	42,227	138,046	180,273
1841.....		33,546	33,546	1871.....	135,672	137,613	273,285
1842.....		18,921	18,921	1872.....	156,976	165,311	322,287
1843 (nine months).....		8,545	8,545	1873.....	96,735	189,795	286,530
1844.....		19,135	19,135	1874.....	126,669	168,977	295,646
1845.....		17,626	17,626	1875.....	125,968	254,356	380,324
1846.....		14,234	14,234	1876.....	95,480	236,255	331,735
1847.....		11,220	11,220	1877.....	131,716	917,937	1,049,653
1848.....		22,466	22,466	1878.....	142,661	597,356	740,017
1849.....		20,282	20,282	1879.....	143,457	430,848	574,305
1850.....		34,510	34,510	1880.....	199,055	453,912	652,963
1851.....		41,449	41,449	1881.....	220,362	409,433	629,795
1852.....		57,240	57,240	1882.....	180,774	433,656	614,430
1853.....		47,628	47,628	1883.....	152,182	389,371	541,553
1854.....		88,327	88,327	1884.....	188,245	415,015	603,260
1855.....		168,546	168,546				

Marble and stone, and manufactures of marble and stone, of foreign production exported from the United States, 1872 to 1884, inclusive.

Fiscal year ending June 30—	Value.	Fiscal year ending June 30—	Value.	Fiscal year ending June 30—	Value.
1872	\$1,929	1877	\$8,475	1881	\$709
1873	4,571	1878	3,448	1882	4,848
1874	1,928	1879	6,364	1883	490
1875	3,428	1880	6,816	1884	8,420
1876	13,371				

Summarizing the foregoing statistics the movement during the fiscal years 1882, 1883, and 1884 may be stated thus :

Balance of trade in marble and stone.

Fiscal year ending June 30—	Imports.	Exports.			Excess of imports over exports.
		Of domestic productions.	Re-exports of foreign productions.	Total exports.	
1882	\$828,839	\$614,430	\$4,844	\$619,278	\$209,561
1883	1,475,658	541,553	490	542,043	933,615
1884	821,389	603,260	8,420	611,680	209,709

In addition to the domestic exports tabulated there are occasional insignificant exports of roofing slate, amounting in 1871 to \$1,256, and in 1881 to \$1,018.

APPENDIX D.

LIST OF SOME OF THE MORE IMPORTANT STONE STRUCTURES OF THE UNITED STATES.

Locality.	Structure.	Material.	Date of erection.
Akron, Ohio	Memorial Chapel	Sandstone, Marietta, Ohio	
Albany, N. Y.	State Capitol	Granite, Hallowell, Me. (in great part).	1863-'82
	City Hall	Granite, Millford, Mass	
	United States court and post-office building.	Granite, Maine	1884
Augusta, Me	State Capitol	Granite, Hallowell, Me	1829-'32
	Asylum for the Insane	do	1837-'40
	United States Arsenal	do	1828
Atlanta, Ga	United States post-office and court-house.	Granite, Vt.	1880
Baltimore, Md	Eutaw Place Baptist Church	White marble (dolomite), Texas and Cockeysville, Md.	
	Brown Memorial Presbyterian Church.	do	
	Franklin Street Presbyterian Church.	do	
	City Hall	do	
	Peabody Institute	do	
	First Presbyterian Church	Sandstone, New Brunswick, N. J.	
	City Prison	Gneiss, Jones's Falls, Md.	
	Catholic Cathedral	Gneiss, Ellicott City, Md.	1806
Bangor, Me	Post-office and custom-house	Granite, Frankfort, Me.	1855
Boston, Mass	King's Chapel	Granite (boulders)	1749-'54
	United States custom-house	Granite, Quincy, Mass.	1837-'48
	United States court-house	do	1830-'31
	Masonic Temple	do	1828-'29
	St. Paul's Church	do	1820
	Merchants' Exchange	do	1842
	Mount Vernon Church	do	
	Unitarian Church, Jamaica Plains.	do	
	Bowdoin Square Baptist Church	do	
	Bunker Hill Monument	do	1825-'42
	United States post-office	Granite, Cape Ann, Mass.	1869-'82
	Boston Water-Works	do	
	St. Vincent de Paul Church	do	
	Herald Building	Granite, Concord, N. H.	
	Transcript Building	do	
	Advertiser Building	do	
	Massachusetts General Hospital	Granite, Westford, Mass.	1818-'21
	Massachusetts General Hospital (addition).	do	1846
	Equitable Insurance Company's building.	Granite, Hallowell, Me	
	Odd Fellows' Memorial Hall (in part).	do	
	Parker House, on School street	Marble, Rutland, Vt	1854
	St. Cloud Hotel	do	
	Hotel Dartmouth	do	
	Hotel Vendome (old part)	Marble, Italy	
	New York Mutual Life Insurance Company's building.	Marble (dolomite), Tuckahoe, N. Y.	
	Hotel Vendome (new part)	do	
	Hotel Pelham	Red sandstone, Portland, Conn., and New Jersey.	
	Second Unitarian Church	Red sandstone, Newark, N. J.	
	Arlington Street Church	Red sandstone, Belleville and Little Falls, N. J.	
	Young Men's Christian Union, Boylston street.	Red sandstone, Bay View, New Brunswick.	
	Young Men's Christian Union	Sandstone, Amherst, Ohio	

LIST OF SOME OF THE MORE IMPORTANT STONE STRUCTURES OF THE UNITED STATES—Continued.

Locality.	Structure.	Material.	Date of erection.
Boston, Mass.	Harvard College Building, Arch street.	Sandstone, Amherst, Ohio .....	.....
	First Church, Marlborough and Berkeley streets.	Conglomerate, Roxbury, Mass. ....	.....
	Brattle Square Church	do. ....	.....
	Central Congregational Church	do. ....	.....
	Emanuel Church, Newbury street	do. ....	.....
	New Old South Church	do. ....	.....
	Second Universalist Church	do. ....	.....
	Tremont Street Methodist Episcopal Church	do. ....	.....
	Cathedral of the Holy Cross	do. ....	.....
	St. James (Episcopal) Church	do. ....	.....
	St. Peter's Church (Dorchester)	do. ....	.....
	Trinity Church	Granite, Dedham, Mass. ....	.....
Brooklyn, N. Y.	Academy of Design, Montague street.	Brown sandstone, Portland, Conn. ....	.....
Cambridge, Mass.	Soldiers' Monument	Granite, Mason, N. H. ....	.....
Chicago, Ill.	Court-house	Dolomite, Lemont, Ill. ....	.....
	do.	Granite, Fox Island, Me. ....	.....
	Custom-house and post-office building.	Oolitic limestone, Bedford, Ind.	1880
	Chamber of Commerce	Brown sandstone, Freestone, Ohio. ....	.....
	Palmer House	Granite, Fox Island and Hallowell, Me. ....	.....
	Grand Pacific Hotel	Sandstone, Amherst, Ohio .....	.....
	St. Paul Universalist Church	do. ....	.....
	Union League Club house	Dolomite, Lemont, Ill. ....	.....
	Central Music Hall	Brown sandstone, Springfield, Mass. ....	.....
Columbia, S. C.	State House	Dolomite, Lemont, Ill. ....	.....
	Post-office and court-house	Granite, near Columbia, S. C. ....	.....
Denver, Colo.	Windsor Hotel	Granite, Winnsborough, S. C. ....	.....
	Union Depot	Rhyolite-tuff, Douglas County, Colo. ....	.....
	Union Pacific Freight Depot	do. ....	.....
	Rio Grande Depot	do. ....	.....
Hoboken, N. J.	Stevens's Institute	do. ....	.....
Jersey City, N. J.	Court-house	Diabase, Jersey City, N. J. ....	.....
	St. Patrick's Cathedral	do. ....	.....
Malden, Mass.	Converse Memorial Library	do. ....	.....
Middletown, Conn.	Wesleyan University buildings	Sandstone, East Long Meadow, Mass. ....	.....
Minneapolis, Minn.	Washburne Flouring Mills	Brown sandstone, Portland, Conn. ....	.....
	University of Minnesota	Magnesian limestone, Minneapolis, Minn. ....	.....
	Universalist Church	do. ....	.....
	City hall	do.	1873-'85
	Westminster Presbyterian Church	do. ....	.....
Mobile, Ala.	Custom-House	Brown sandstone, Fond du Lac, Minn.	1881-'83
Nashville, Tenn.	do.	Granite, Quincy, Mass.	1858
	State capitol	Oolitic limestone, Bowling Green, Ky.	1882
	Custom-house and post-office building.	Limestone near Nashville, Tenn. ....	.....
Newark, N. J.	County court-house	Sandstone, Little Falls, N. J.	1859
	Custom-house	do. ....	.....
New Orleans, La.	Monument to General Robert E. Lee.	Granite, Quincy, Mass.	1872
	Columbia College	Granite, Georgia .....	.....
New York City	Trinity Church, Broadway and Wall street.	Gray marble, Knoxville, Tenn. ....	.....
	Lenox Library, Fifth avenue and Seventieth street.	Red sandstone, Potsdam, N. Y. ....	.....
	Hospital, Sailors' Snug Harbor, Staten Island.	Brown sandstone, Little Falls, N. J. ....	.....
	Ludlow street jail	Limestone, Lockport, N. Y. ....	.....
	Halls of justice or "Tombs"	Granite, Spruce Head, Me. ....	.....
	Seventh Regiment armory	do. ....	.....
	Metropolitan Museum of Art	Granite, Round Pond, Me. ....	.....
	New York post-office	Granite, Mt. Desert, Me. ....	.....
	Court-house in City Hall Park	Granite, Dix Island, Me.	1883
	Astor House	do. ....	.....
	Reformed Church, La Fayette Place.	Granite, Quincy, Mass. ....	.....
	Egyptian obelisk in Central Park	do. ....	.....
		Hornblende granite, Egypt .....	.....

LIST OF SOME OF THE MORE IMPORTANT STONE STRUCTURES OF THE UNITED STATES—Continued.

Locality.	www.libtool.com.cn Structure.	Material,	Date of erection.
New York City	St. Patrick's Cathedral (in part) .. Old city hall, east, south, and west fronts. Treasury building, Wall street .. St. Patrick's Cathedral (in part) .. Stock Exchange	Dolomite (marble), Lee, Mass. Dolomite (marble), West Stockbridge, Mass. do .....	..... ..... .....
	St. Patrick's Cathedral (in part) .. Union Dime Savings Bank	Dolomite (marble), Tuckahoe, N. Y. do .....	..... .....
	Fortifications, Fort Richmond	"Snowflake" marble (dolomite), Pleasantville, N. Y. ....	.....
	Fortifications, Fort Lafayette	Marble (dolomite), Pleasantville, N. Y. ....	.....
	Fortifications at Willets Point	Granite, Dix Island, Me. ....	.....
	Fortifications at Governor's Island ..	Brown sandstone, New Jersey .....	.....
	Fortifications at Bedloe's Island ..	Granite, Spruce Head, Me. ....	.....
	Fortifications at Ellis Island	do .....	.....
	Fortifications, Fort Schuyler, Throgg's Neck ..	Gneiss .....	.....
	Fortifications, Fort Wadsworth, Staten Island ..	Granite, Maine .....	.....
	Fortifications, Fort Hamilton	do .....	.....
	Fortifications, Fort Diamond	do .....	.....
New York City and Brooklyn.	New York and Brooklyn bridge. }	Granite, Frankfort, Me.; Concord, N. H.; Spruce Head, Me.; Cape Ann, Mass.; Hurricane Island, Me.; Westerly, R. I.; East Bluehill, Me.; Stony Creek, Conn.; Mt. Desert Island, Me.; Chancesburgh, N. J. ....	.....
Philadelphia, Pa.	Girard Bank	Limestone, Rondout, N. Y.; Kingston, N. Y.; Isle La Motte, Lake Champlain; Willsborough Point, Lake Champlain; near Catskill, N. Y. ....	.....
	United States custom-house	Limestone (marble), Montgomery County, Pa.	1798
	United States mint	do	1819
	United States Naval Asylum	do	1829
	Merchants' Exchange	do	1830
	Girard College	do	1832
	Philadelphia National Bank	do	1833
	First National Bank	Granite, Quincy, Mass.	1850-'60
	New Masonic Temple	do	1865
		Granite, Fox Island, Me.; Cape Ann, Mass.	1872
	New Post-Office	Granite, Dix Island, Me.; Richmond, Va.	1885
	St. Mark's Protestant Episcopal Church ..	Sandstone, Portland, Conn.	1849
	Bank of Commerce	do	1850
	Bank of North America	do	1850
	Holy Trinity Episcopal Church ..	do	1857
	Fifth Baptist Church	do	1863
	New city buildings	Dolomite (marble), Lee, Mass. ....	.....
	University of Pennsylvania	Serpentine, Chester County, Pa.	1871
	Memorial Baptist Church	do	1874
	Holy Communion Church	do	1875
	Academy of Natural Sciences	do	1876
	Young Men's Christian Association ..	Sandstone, Ohio	1868
Portland, Me	Fort's Preble, Scammel, and Gorges ..	Granite, Mount Waldo, Biddeford, and Spruce Head, Me. ....	.....
	Post-office	Crystalline limestone (marble), Vermont ..	1872
	Custom-house	Granite, Hallowell, Me., Concord, N. H.	1872
Providence, R. I.	City hall	Granite, Hurricane Island, Me.; Westerly, R. I., and Concord, N. H. ....	.....
	Soldiers' and sailors' monument ..	Granite, Westerly, R. I. ....	.....
	Post-office and custom-house	Granite, Quincy, Mass.	1858
	Roger Williams's monument	Granite, Westerly, R. I. ....	.....
	New Catholic cathedral	Sandstone, Portland, Conn. ....	.....
	Grace Church	Sandstone, Little Falls, N. J. ....	.....
	First Congregational Church	Granite, Smithfield, R. I. ....	.....

LIST OF SOME OF THE MORE IMPORTANT STONE STRUCTURES OF THE UNITED STATES—Continued.

Locality.	Structure.	Material.	Date of erection.
Saint Paul, Minn.....	Catholic cathedral	Magnesian limestone, Saint Paul, Minn. ....	.....
	Unitarian church.	do .....	.....
	St. Paul's Episcopal church	Magnesian limestone, Kasota, Minn.	1873-'74
	United States custom-house and post-office.	do	1872
	Adams school	do .....	.....
	Franklin school	do .....	.....
	County jail	do .....	.....
Salt Lake City, Utah.	Assembly house	Granite, Little Cottonwood Cañon, Utah. ....	.....
San Francisco, Cal. . .	New Mormon Temple	do .....	.....
	Bank of California	Blue sandstone, Angel Island, San Francisco Bay.	1865
	United States mint	Sandstone, New Castle Island, Gulf of Georgia, British Columbia.	1874
Savannah, Ga.	Presbyterian church	Granite, Quincy, Mass .....	.....
	Custom-house	do	1852
Trenton, N. J.	State capitol	Sandstone, Trenton, N. J. ....	.....
	State prison	do .....	.....
Washington, D. C. . .	Executive Mansion	Sandstone, Acquia Creek .....	.....
	Treasury Building, old portion.	do	1836-'41
	Treasury Building, new portion.	Granite, Dix Island, Maine	1855
	Patent Office Building, old portion.	Sandstone, Acquia Creek, Va	1837-'42
	Patent Office Building, extension.	Dolomite (marble), Cockeysville, Md.	1849-'64
	Chapel in Oak Hill Cemetery....	Mica schist, near Washington ..	.....
	Georgetown College (new building.)	do .....	.....
	Cabin John's Bridge, parapets and coping.	Sandstone, Seneca Creek, Md.	1848-'55
	Washington Monument, exterior, in part.	Dolomite (marble), Lee, Mass.	1848-'84
	Washington Monument, exterior.	Dolomite (marble), Cockeysville, Md. ....	.....
	Washington Monument, interior.	Mica schist, near Washington; granite, Massachusetts and Maine. ....	.....
	General Post-Office, old portion ..	Dolomite (marble), West Chester, N. Y.	1839
	General Post-Office, extension	Dolomite (marble), Cockeysville, Md.	1855
	United States Capitol, old portion.	Sandstone, Acquia Creek	1793
	United States Capitol, extension.	Dolomite (marble), Lee, Mass.	1851-'65
	United States Capitol, extension, columns.	Dolomite (marble), Cockeysville, Md. ....	.....
	Smithsonian Institution	Sandstone, Seneca Creek, Md	1847-'56
	St. Dominick's Church	Gneiss, Port Deposit, Md .....	.....
	Corcoran Art Gallery (in part) ...	Sandstone, Belleville, N. J .....	.....
	State, War, and Navy Building. {	Basement and sub-basement granite, Maine; superstructure granite, near Richmond, Va.	1871-'86
	Butler house, Capitol Hill.	Granite, Cape Ann, Mass .....	.....

APPENDIX E.

BIBLIOGRAPHY OF WORKS ON BUILDING STONE.

The following list includes all the principal works on the subject of building stone which have come under the writer's notice. It does not include isolated and special papers which have appeared from time to time in various journals and periodicals, or State geological reports. Such, when containing matter of sufficient importance, have been mentioned in the text and reference given in the foot-notes. The list is arranged alphabetically by authors.

- BLUM, Dr. J. REINHARD. *Lithurgik oder Mineralien und Felsarten nach ihrer Anwendung in ökonomischer, artistischer und technischer Hinsicht systematisch abgehandelt.* Stuttgart, 1840.
- BÖHME, Dr. *Die Festigkeit der Baumaterialien. Resultate der Untersuchungen in der Station zur Prüfung der Festigkeit von Bausteinen an der königlichen Gewerbe-Akademie zu Berlin, etc.* Berlin, 1876.
- BURGOYNE, Sir JOHN. *Rudimentary Treatise on the Blasting and Quarrying of Stone.* London: J. Wesle, 1852.
- BURNHAM, S. M. *History and Uses of Limestone and Marbles. Illustrated with colored plates.* Boston: S. E. Cassino & Co., 1883.
- CHATEAU, THÉODORE. *Technologie du Bâtiment ou Étude Complète des Matériaux de toute Espèce employés dans les constructions, etc.* 2. éd. Paris, 1880.
- DAVIES, D. C. *Slate and Slate Quarrying.* London: Crosby, Lockwood & Co., 1878.
- DELESSE, A. *Matériaux de Construction de l'Exposition Universelle de 1875.* Paris, 1856.
- DOBSON, EDWARD. *Masonry and Stone-cutting.* Weale's Rudimentary series. London: Crosby, Lockwood & Co., 1873.
- GERSTENBERGK, HEINRICH VON. *Katechismus der Baumaterialkunde, etc.* Berlin, 1868.
- GOTTGETREU, RUDOLPH. *Physische und Chemische Beschaffenheit der Baumaterialien.* 2 vols. Berlin, 1880-'81. Verlag von Julius Springer.
- GRUEBER, BERNHARD. *Die Baumaterialien-Lehre.* Berlin, 1863. Verlag von Ernst & Korn.
- GWILT, JOSEPH. *An Encyclopedia of Architecture.* London, 1851.
- HALL, Prof. JAMES. *Report on Building Stones.*
- HARTMANN, Dr. CARL. *Vollständiges Handbuch der Steinarbeiten, etc.* Weimar, 1862.
- HAUENSCHILD, HANS. *Katechismus der Baumaterialien.* Wien: Lehmann & Wentzel, 1879.
- HULL, EDWARD. *A Treatise on the Building and Ornamental Stones of Great Britain and Foreign Countries.* London: Macmillan & Co., 1872.
- KERSTEN, E. *Die Baumaterialienkunde, etc.* Leipzig (not dated). Verlag von Eduard Hahnel.

- KÖLLSCH, CARL. Die Baumaterialienkunde für ausführende Bautechniker und für Studierende der Bauwissenschaft. Schwetschke & Sohn. Bruhn, 1861.
- MALÉCOT, LÉON. Matériaux de Construction employés en Belgique. Bruxelles & Liège, 1866.
- NEWBERRY, J. S. Building and Ornamental Stones. Report of Judges, Group 1, U. S. Internat. Ex., 1876, Vol. III. Washington, 1880.
- Notes on Building Construction. Part III. Materials (South Kensington Educational Series). London, Oxford, and Cambridge, 1879.
- SCHLEGEL, CARL FRIEDRICH. Die Lehre von den Baumaterialien und den Arbeiten der Maurer. Leipzig: Verlag von Heinrich Matthes, 1857.
- SCHMIDT, OTTO. Die Baumaterialien. Berlin, 1881. Verlag von Theodor Hofmann.
- Report on the Building Stones of the United States, and Statistics of the Quarry Industry for 1880. Vol. X. Report of the Tenth Census of the United States. Washington: Government Printing Office, 1884.
- THURSTON, R. H. Materials of Construction. New York: Wiley & Sons, 1885.
- VIOLET, ADOLPH. Les Marbres et les Machines à travailler le marbre. (Rapports sur l'Exposition de 1878, XXVIII.) Paris, 1879.
- VISSE, J. E. Die Baumaterialien. Handbuch für Architekten, etc. Emden, 1861.
- WEBBER, MARTIN. Das Schleifen, Poliren, Färben und künstlerische Verzieren des Marmors. Weimar, 1878. Bernhard Friedrich Voigt.
- WENCK, DR. JULIUS. Die Lehre von den Baumaterialien, etc. Berlin, 1863.

APPENDIX F.

GLOSSARY OF TERMS.

- Æolian rocks.** Fragmental rocks composed of wind-drifted materials. The "drift sand rock," the common building stone of Bermuda, is a good example.
- Argillaceous.** Containing clayey matter.
- Ashlar masonry.** Cut stone laid in continuous courses.
- Bardiglio.** This is a favorite Italian marble obtained on Montalto, on the southern borders of Tuscany. It is a gray or bluish color, traversed by dark veins. In some specimens the veining assumes the appearance of flowers, when it is known as Bardiglio fiorito. The name is now commonly applied to any marble having this color and veining.
- Bastard granite.** A somewhat indefinite name given by quarrymen to gneissic or schistose rocks, resembling granites in a general way, but differing in structure. The name is frequently applied by quarrymen to any vein or dike rock occurring in a granite quarry.
- Bird's-eye-marble.** A term used in Iowa to designate a fossil coral (*Acervularia davidsonia*), and used for making small ornaments.
- Bituminous.** Containing bitumen.
- Breast.** The face or wall of a quarry is sometimes called by this name.
- Breccias.** Fragmental stones, the individual particles of which are large and angular in form.
- Bluestone.** In Maryland a gray gneiss; in Ohio a gray sandstone; in the District of Columbia a mica schist; in New York a blue-gray sandstone; in Pennsylvania a blue-gray sandstone. A popular term; not sufficiently definite to be of value.
- Butt.** The butt of a slate quarry is where the overlying rock comes in contact with an inclined stratum of slate rock.
- Calcareous.** Containing lime.
- Cavernous.** Containing irregular cavities or pores, due in most cases to the removal of some mineral, or in limestones of a fossil.
- Cellular or vesicular.** Containing cells or vesicles. This structure is very common in recent eruptive rocks, especially the glassy forms. Sometimes the stone contains so many cells that it will float on water, as is the case with common pumice. These cells are in many cases subsequently filled with other minerals, and the rock is then called amygdaloidal. The Brighton melaphyr is the best example of amygdaloidal structure found in our building stones.
- Choncooidal fracture.** When the surfaces of a chip broken off by a hammer are curved like a bivalve mollusk the stone is said to have a choncooidal fracture. Compact stones, like lithographic limestones, obsidians, and flints, usually break in this manner.
- Clayholes.** Cavities in stones which are usually filled with fine sand or clayey material often of a lighter color than the stone itself and so loosely coherent as to fall away immediately or to weather out on exposure. They are especially prevalent in many of our Triassic sandstones, and, besides being unsightly, are elements of weakness and should always be avoided.

- Concretionary.** Made of concretions, or rounded particles formed by the collecting of mineral matter around some center so as to form a rounded mass composed of concentric layers like the coatings of an onion. When the concretions are small, like the roe of a fish, the structure is called *oölitic*, or if large as a pea, *pisolitic*. The best examples of this structure in our building stones are the oölitic limestones of Bedford, Ind., and other places. A rare structure in crystalline rocks.
- Conglomerates.** Fragmental stones composed of large, rounded fragments.
- Coquina.** The Spanish name for a shell limestone which occurs abundantly in Florida, composed simply of a mass of shells connected together.
- Coral limestone.** A rock composed of fragments of corals.
- Crystalline.** Consisting wholly of crystals or crystalline particles, *not fragmental*. Rocks which like granite or crystalline limestone are made up wholly of crystalline grains are called *crystalline-granular* or *granular-crystalline* rocks. The terms *micro-crystalline* and *crypto-crystalline* are often applied to rocks in which the individual particles are too small to be readily distinguished by the unaided eye. Such rocks are sometimes called *compact*, a term which is also applied to fragmental rocks of similar texture.
- Curb.** A flat piece of stone placed vertically, bounding the street edges of sidewalks, etc.
- Diabase.** An eruptive rock composed essentially of a plagioclase feldspar and augite.
- Dikes** (or *dykes*). Masses of volcanic rock which have been forced up from below in a molten condition to fill fractures or fissures in the earth's crust. Such are also called trap-rocks. The diabases and a variety of eruptive rocks frequently occur in the form of dikes.
- Diorite.** An eruptive rock composed essentially of a plagioclase, feldspar, and hornblende.
- Dip.** The slope or pitch of the strata, or the angle which the layers make with the plane of the horizon.
- Dolomite.** A stone composed of mixed calcium and magnesium carbonates.
- A "Dry."** A natural seam usually invisible when the rock is freshly quarried, but which is brought out on exposure to weather or sometimes during the process or cutting. A very serious defect in many stones.
- Escarpment.** A nearly vertical natural face of rock or ledge.
- Feldspathic.** Containing feldspar.
- Ferruginous.** Containing iron oxides.
- Fibrous.** Having a structure as though made up of bundles of distinct fibers. This structure is not found in any building stone, but is common in some forms of gypsum and of calcite, which are used for making small ornaments.
- Flagstone.** Any kind of a stone which separates naturally into thin tabular plates suitable for pavements and curbing. Especially applicable to sandstones and schists.
- Flint.** Quartz in any kind of rock is commonly known to quarrymen as flint. True flint is amorphous silica, occurring in nodular form in chalk beds.
- Foliated or schistose.** Terms applied to rocks which, like gneiss and schist, have their constituents arranged in more or less definite nearly parallel planes.
- Fragmental or clastic.** Terms which are applied to rocks composed of fragments, like ordinary sandstone. When the fragments are the size of a pea or larger, and rounded in form, the structure is called *conglomerated*, or if the particles are angular, *brecciated*.
- Freestone.** This is a term which has been applied to stones that work freely in any direction. Especially applied to sandstones and limestones. A term of no special value, as it is too indefinite.
- Gneiss.** A rock of the composition of granite but in which the ingredients are arranged in more or less parallel layers.
- Gneissoid.** Like gneiss.
- Grain.** The direction in a rock at right angles with the rift.

Granite. A rock consisting of quartz, orthoclase, and mica or other accessory minerals. In the stone-cutter's nomenclature no distinction is made between the varieties; all stones which are hard, granular, and crystallized are called granite.

Granitoid. Thoroughly crystalline and massive, like granite.

Granular. A term applied to rocks composed of distinct grains, whether fragmental and water worn or crystalline.

Greenstone or grüstein. A term formerly used to designate certain basic eruptive rocks occurring in the form of dikes. Through mistaken notions regarding their true nature and from a general similarity in their appearance the name was made to include a variety of compact, dark-greenish or nearly black rocks, which microscopic examination has shown to be principally diabase and diorite.

Grit. Any sharp, gritty sandstone or schist used as a whetstone or hone.

Grub-saw. A saw made from a notched blade of thin iron, and provided with a wooden back. Used with sand for sawing stone by hand-power. (See Plate v.)

Guys. Ropes or chains used to prevent anything from swinging or moving about.

Hackly fracture. A term applied when the surfaces of a fracture are rough and jagged.

Joints. Divisional planes which divide the rock in the quarry into natural blocks. There are usually two or three nearly parallel series called by quarrymen end joints, back joints, and bottom joints, according to their position. (See section F.)

Ledge. Any natural solid body of rock.

Lewis hole. The Lewis* hole consists of a series of two or more holes drilled as closely together as possible, and then connected by knocking out the thin partition between them, forming thus one wide hole, having its greatest diameter in a plane with the desired rift. Blasts from such holes are wedge-like in their action, and by means of them larger and better-shaped blocks can be taken out than would otherwise be possible. This style of hole is said† to have been devised by a Mr. Joseph Richards, of Quincy, though at about what date we are not informed. This same gentleman was also the inventor of the bush hammer, which, however, when first patented, about 1831, consisted of a solid piece, instead of several pieces bolted together as now.

Limestone. Under this term almost all the calcareous quarried rocks, whether fragmental or crystalline, are classified.

Liver rock. This term is applied to that variety of the Ohio sandstone which breaks or cuts as readily in one direction as in another. In other words, the working of the stone is not affected by stratification.

Lyonnaise marble. A local term applied to marbles which are composed of a mixture of red and white colors, as those of Mallet's Bay, Vt.

Marble. Any limestone or dolomite capable of being polished and suited for ornamental work.

Massive; unstratified. Having, no definite arrangement in layers or strata, but the various ingredients being thoroughly commingled, as in granite and diabase.

Nigger head. (1) The black concretionary nodules found in granite;

(2) Any hard, dark, colored rock weathering out into rounded nodules or boulders;

(3) Slaty rock associated with sandstone. A quarryman's term.

Oolite. A stone composed of small globules resembling the roe of a fish.

Ophicalcite. A mixture of serpentine and limestone.

* This word is spelled by some Louis.

† Potter's History of Quincy, Mass.

Orbitoides limestone. A fossiliferous limestone abundant in the upper Eocene formation in the Southern States.

Perch. In Philadelphia, 22 cubic feet are called a perch. A perch of masonry contains $24\frac{1}{2}$ cubic feet, $16\frac{1}{2} \times 1\frac{1}{2} \times 1$. It is usually taken at 25 cubic feet. The term is falling into disuse.

Plucky. A term often used by stone-cutters to designate stones which under the chisel break away in irregularly conchoidal chips, and which are therefore difficult to trim to a line or to bring to a perfect surface. Common in compact and impure limestones.

Porphyry. Any stone composed of an extremely fine groundmass in which larger crystals are developed.

Porphyritic. When a rock consists of a compact or fine and evenly crystalline groundmass, throughout which are scattered larger crystals, usually of feldspar, the structure is said to be porphyritic. This structure is quite common in granite, but is not particularly noticeable, owing to the slight contrast in color between the larger crystals and the finer groundmass. It is most noticeable in such rocks as the felsites, in which, as is the case with some of the "porphyries" of eastern Massachusetts, the groundmass is exceedingly dense and compact and of a black or red color, while the large feldspar crystals are white and stand out in very marked contrast. This structure is so striking in appearance that rocks possessing it in any marked degree are popularly called porphyries whatever may be their mineral composition. The term porphyry is said to have been originally applied to certain kinds of igneous rocks of a reddish or purple color, such as the celebrated red porphyry or "roseo antico" of Egypt. The word is now used by the best authorities almost wholly in its adjective sense, since any rock may possess this structure whatever its origin or composition may be.*

Putty powder, or polishing putty, is a fine whitish powder, consisting in the commercial form of about equal parts oxide of tin and lead. Used in polishing stone and glass.

Quarry. Any opening in a ledge for taking out stone.

Quarry water. All rocks when first taken from the quarry contain more or less water, which evaporates on exposure, leaving the stone considerably harder. In sandstones this quarry water is considered by Newberry to be a solution of silica (Rep. of Judges, Group 1, p. 127). Its composition probably varies greatly in different classes of rocks. (See p. 339.)

Rhyolite. A post-Tertiary volcanic rock of the composition of granite.

Rift. The direction in a rock parallel to the lamination or foliation, and along which it splits with greatest ease.

Rubberstone. A sharp-gritted Ohio or Indiana sandstone used for sharpening shoe-knives; also called a shoe-stone.

Rubble masonry. Rough, unsquared stones laid in irregular courses.

Saccharoidal. Having a grain and structure like that of loaf sugar. Common in crystalline limestone.

Salt veins. A term applied by the quarrymen to the coarse granite veins from 2 inches to 2 or more feet thick, and which are found intersecting granites and older crystalline rocks.

Scab. A local term used in certain sandstone quarries in Iowa. The stone is very massive and is broken from the quarry in irregular lumps by blasting. These lumps are then trimmed down to a shape approximately rectangular by means of heavy picks. This process is denominated *scabbing*.

Sap. The term originated from imagined analogy between the decomposed layer and the sap wood of trees. A term applied to the stained and worthless portions of the stone extending inward from the point.

* Hull, Building and Ornamental Stones, p. 75.

Sculp. To sculp slates is to break up the large blocks into long slabs, suitable to split.

Segregated. A term applied to the veins and nodular masses of finer or coarser texture that have formed in granite and other crystalline rocks; as for example, the black patches in granite.

Serpentine. A rock composed of hydrous magnesia silicate.

Shell limestone. Rock composed of consolidated shells.

Siliceous. Containing silica.

Spalls. This is a term which is used quite generally by stone-cutters to denote the chips and other waste material cut from a block in process of dressing.

Spider-web. A term applied to the wavy lines in the Ohio sandstones, and which are caused by stains of iron oxide. Frequently seen in sawed stones, especially where the lamination is slightly oblique or irregular. It is very like the grain of wood which shows in a planed board.

Split rock. This term applies to those rocks possessing tabular structure, or which cleave easily in the lines of lamination, and are consequently applicable to the preparation of flagging and for curbstones.

Stalactitic marble. This is a marble which is formed by the deposit of lime carbonates from waters percolating into cavities or caves.

Strata. Layers or beds of rock of the same kind lying one upon another.

Stratified; bedded. Composed of layers or beds lying parallel to one another, as is so frequently seen in sandstone and limestone. When the strata are fine and leaf-like the structure is called laminated or shaly.

Streaked. Having some of the mineral constituents so arranged as to give the rock a striped or streaked appearance. In the eruptive rocks this structure is often produced by the flowing of the mass in a partially cooled condition. It is best seen in obsidian, rhyolite, and quartz porphyries.

Stock. The useful rock taken from a quarry.

Strike. The direction in strata at right angles to the dip, or the course of a horizontal line on the surface of inclined beds.

Syenite. A granular massive rock with the structure of a granite, but containing no quartz.

Trachyte. A post-Tertiary volcanic rock of the composition of syenite.

Trap or trap-rock. (See Dikes and Greenstone.) The name applies to the manner in which a rock occurs, and is not itself a name of specific value.

Travertine. A calcareous rock deposited by water from solution, and which was used as a building stone in Rome. (See text.)

Verde antique. Antique green. A rock composed of a mixture of serpentine and limestone.

Vitreous or glassy. These terms are applied to rocks that have a structure like glass, as obsidian. Rocks of this type are at present little used for any kind of work.

APPENDIX G.

CATALOGUE OF THE COLLECTION OF BUILDING AND ORNAMENTAL STONES IN THE U. S. NATIONAL MUSEUM.

I. UNITED STATES AND TERRITORIES.

ALABAMA.

Limestone. Fine; dark drab. Calera, Shelby County. Calera Lime Works. Centennial, 1876. 17481.

- Fossiliferous; semi-crystalline; very light drab. Near Florence, Lauderdale County. Douglass quarries. Maj. W. R. King, U. S. Army. 27328.
- Fossiliferous; semi-crystalline; light drab. Near Florence, Lauderdale County. Harkin's quarry. Maj. W. R. King, U. S. Army. 27327.
- Coarse; porous; light buff. Turk's Cave. U. S. Geological Survey, 1884. 35782.
- Oolitic; fine; light colored. Near Dickson, Colbert County. Quarries of T. L. Fossick & Co. Tenth Census, 1880; 2 specimens. 26759.
- Fine; light brown; fossiliferous. Near Tuscumbia, Colbert County. Bowser's quarry. Maj. W. R. King, U. S. Army. 27325.
- Oolitic; semi-crystalline; drab. Trinity, Lawrence County. Trinity quarry. Maj. W. R. King, U. S. Army. 27329.
- Fossiliferous; semi-crystalline; light colored. Near Leighton, Lawrence County. Walker's quarry. Maj. W. R. King, U. S. Army. 27326.

Limestone [marble]. White; crystalline. About 4 by 4 by 2 inches. Talladega County. Centennial, 1876. 17482.

- Pure white; crystalline. $5\frac{1}{2}$ by 4 by 1 inches. Talladega, Talladega County. A. W. Bowie's quarry. Tenth Census, 1880. 27314.

Sandstone. Dark yellow; coarse; porous. De Kalb County. Collinsville quarry. Tenth Census. 25918.

- Gray; fine and compact; with pyrite. Near Greensport, St. Clair County. Gibson's quarry. Tenth Census. 27330.

ARIZONA.

Limestone. Fine; light buff. Near Albuquerque, Yavapai County. John S. F. Batchen, 1884. 35745.

Sandstone. Deep pink; fine and compact. Yavapai County. Chino quarry. John S. F. Batchen. 35571.

- Light colored; fine grained. Yavapai County. Cañon Diablo quarry. John S. F. Batchen. 35744.

ARKANSAS.

Elæolite syenite. Very coarse. Large block, 5 feet square by 12 inches thick; one face polished, and with carved inscription, "Specimen from the Diamond Jo Granite Co., Hot Springs, Arkansas." Hot Springs. Diamond Jo quarry. John S. F. Batchen, 1883. 28599.

- Elæolite syenite.** Fine; greenish gray. Hot Springs. Diamond Jo quarry. John S. F. Batchen, 1883. 27519.
- Limestone.** Oolitic; fine; dark drab. Blansett, Scott County. Tenth Census, 1880. 26643.
- **Quartzite;** light colored; fine and compact. Bald Knob, White County. Bald Knob quarry. Tenth Census. 26524.

CALIFORNIA.

- Steatite**[soapstone]. Fine; compact; blue gray. A. P. Blake. 25014.
- Marble.** White; yellow veined. $5\frac{1}{2}$ by $5\frac{1}{2}$ by $\frac{1}{2}$ inches. Kern County. Tenth Census, 1880. 25469.
- Limestone** [marble]. White; green mottled. Two small slabs. Near Auburn, Placer County. Robert E. C. Stearns, 1883. 27352.
- White, and white with dark veins; crystalline. Two specimens. Indian Diggings, El Dorado County. Tenth Census, 1880. 25454.
- Magnesian limestone** [marble]. Dark gray; compact. Colfax, Placer County. Colfax quarry. Tenth Census, 1880. 25636.
- Stalagmite** [marble]. Pinkish. 4 by $3\frac{1}{2}$ by 1 inches. Mrs. J. L. Wilkins, 1882. 27301.
- Travertine** [marble]. Massive; white; translucent. Three small pieces. Popularly called California onyx. San Luis Obispo. Chas. E. Hall & Co., 1884. 36758.
- White; translucent. About $3\frac{1}{2}$ inches. San Luis Obispo. John Dimond, New York, 1884. 36759.
- Massive; white; translucent. Two specimens. Near San Luis Obispo, San Luis Obispo County. San Luis Obispo quarry. Tenth Census, 1880. 25571.
- Light green. 11 by 5 by 1 inches. Sacramento River, near Crescent Falls, near Berryvale, Siskiyou County. J. S. Diller, 1884. 36886.
- Emerald green; fine and compact. About 3 by 3 by $1\frac{1}{2}$ inches. Falls of Sacramento River, Siskiyou County. Chas. H. Townsend, 1884. 35746.
- Reddish brown. 10 by 5 by 1 inches. Suisun City, Solano County. Centennial, 1876. 25255.
- Brown. About 10 by $7\frac{1}{2}$ by 1 inches. Suisun City, Solano County. Centennial, 1876. 25256.
- Brown; mottled. About $7\frac{1}{2}$ by 5 by $\frac{1}{2}$ inches. Suisun City, Solano County. Centennial, 1876. 16054.
- Brown and amber yellow. 5 pieces irregular shaped. Suisun City, Solano County. B. K. Emerson, 1886. 38445.
- Biotite granite.** Medium; light gray. Rocklin, Placer County. G. Griffith's quarry. Tenth Census, 1880. 25539.
- Hornblende biotite granite.** Coarse; gray. Penryn, Placer County. G. Griffith's quarry. Tenth Census, 1880. 25542.
- Hornblende granite** (?). Medium; very dark gray, nearly black. Penryn, Placer County. G. Griffith's quarry. Tenth Census, 1880. 25554.
- The abundance of plagioclase feldspar and small amount of orthoclase in this rock place it intermediate between true granite and quartz diorite.
- Basalt.** Compact; dark gray. Bridgeport, Solano County. Used only for street pavement. Thomason's quarry. Tenth Census, 1880. 25663.
- Compact; dark gray. Near Petaluma, Sonoma County. Used only for street pavement. Quarry of J. Cadden Bros. and others. Tenth Census, 1880. 25664.

Sandstone. Coarse; light brown. Near Alameda, Alameda County. Tenth Census. 25569.

— Fine; gray. Angel Island, Marin County. Angel Island quarry. Tenth Census. 25570.

— Fine; gray. Livermore, Alameda County. Livermore quarry. Tenth Census. 25665.

— Brown. Haywards, Alameda County. Excelsior quarry. Tenth Census. 25801.

— Coarse; very light buff. Near San José, Santa Clara County. Goodrich quarry. Tenth Census. 25797.

— Coarse; very light buff. Near San José, Santa Clara County. Goodrich quarry. Tenth Census. 25798.

— Coarse; very light gray. Near San José, Santa Clara County. Goodrich quarry. Tenth Census. 25799.

Andesite tuff. Coarse; gray. Near Cordelia, Solano County. Thomason's quarry. Tenth Census, 1880. 25800.

COLORADO.

Limestone. Fine; black. Pitkin, Gunnison County. Sunnyside quarry. J. S. F. Batchen, 1884. 35990.

— Fine; dark, mottled. Pitkin, Gunnison County. J. S. F. Batchen, 1884. 36011.

— Coarse; pink. Morrison, Jefferson County. Morrison quarry. J. S. F. Batchen, 1884. 35995.

— Semi-crystalline; dull; pink mottled. Near Morrison, Jefferson County. Morrison quarry. J. S. F. Batchen, 1884. 35996.

Biotite granite. Medium; gray; indistinctly porphyritic. Lawson, Clear Creek County. Quarry of Commet and Ivers. J. S. F. Batchen, 1884. 35980.

— Medium; gray. Georgetown, Clear Creek County. J. S. F. Batchen, 1884. 35987.

— Coarse; light red. Platte Cañon, Jefferson and Douglas Counties. Government quarries. Tenth Census, 1880. 25784.

Muscovite gneiss. Medium; light gray. Lawson, Clear Creek County. Quarry of Commet and Ivers. J. S. F. Batchen, 1884. 35981.

Diorite. Fine; light greenish gray. Monarch, Chaffee County. H. H. Church's quarry. J. S. F. Batchen, 1884. 36004.

Sandstone. Light drab, laminated with blue gray. Fort Collins, Larimer County. Fort Collins quarry. Tenth Census. 25783.

— Fine; light colored. Fort Collins, Larimer County. Fort Collins quarry. Tenth Census. 25787.

— Light colored; fine and compact. Near Fort Collins, Larimer County. E. B. Yout's quarry. Tenth Census. 27005.

— Fine; light red. Near Fort Collins, Larimer County. La Porte quarry. Tenth Census. 27023.

— Nearly quartzite; light pink; fine and compact. Longwort, Larimer County. Longwort quarry. John S. F. Batchen. 35997.

— Light red; laminated. Greeley, Larimer County. John S. F. Batchen. 36001.

— Nearly quartzite; light colored; fine and compact. Buckhorn, Larimer County. C. J. McWhorter's quarry. John S. F. Batchen. 36839.

— Fine; light colored. Coal Creek, Fremont County. Coal Creek quarry. Tenth Census. 25789.

— Fine; light colored. Arkansas River, Fremont County. Brandford quarry. Tenth Census. 25891.

- Sandstone.** Fine; olive-tinted. Near Cañon City, Fremont County. Quarry of Blodety & Nutts. Tenth Census, 25785.
- Fine; light colored. Near Cañon City, Fremont County. Quarry of Frank & Lutz. John S. F. Batchen, 1884. 35983.
- Triassic; light red; micaceous. Sec. 3, T. 4, R. 70 W., Jefferson County. Welch quarry. Tenth Census. 26858.
- Triassic; fine; light brown. Golden, Jefferson County. Centennial, 1876. 27124.
- Light gray; fine; micaceous. Trinidad, Las Animas County. Trinidad quarry. Tenth Census. 25788.
- Quartzite.** Nearly white; very fine and compact. Pitkin, Gunnison County. Quarry of Huck & Co. John S. F. Batchen, 1884. 36838.
- Rhyolite tuff.** Light pink. Used for general building in Denver. Douglas, Douglas County. Colorado Manufacturing Company. Tenth Census, 1880. 27360.
- Light colored; fine; vesicular. Used for general building in Denver. Near Castle Rock, Douglas County. G. F. Girardot's quarry. Tenth Census, 1880. 26786.

CONNECTICUT.

- Dolomite [marble].** White and bluish; crystalline. Two specimens. East Canaan, Litchfield County. E. P. Allen's quarry. Tenth Census, 1880. 26435.
- White; crystalline. East Canaan, Litchfield County. A. Maxwell's quarry. Centennial, 1876. 17544.
- White; crystalline. East Canaan, Litchfield County. Centennial, 1876. 17545.
- White; crystalline. East Canaan, Litchfield County. Centennial, 1876. 17546.
- White, dark mottled; crystalline. East Canaan, Litchfield County. Centennial, 1876. 17561.
- White; crystalline. About 12 by 12 by 8 inches. East Canaan, Litchfield County. Centennial, 1876. 17562.
- White; crystalline. Falls Village, Litchfield County. Mathby's quarry. Tenth Census, 1880. 26169.
- Biotite granite.** Fine; very light gray. West Norfolk, Litchfield County. Centennial, 1876. 17535.
- Fine; gray. West Norfolk, Litchfield County. Centennial, 1876. 17537.
- Fine; gray. West Norfolk, Litchfield County. Centennial, 1876. 17538.
- Fine; gray. West Norfolk, Litchfield County. Centennial, 1876. 17558.
- Fine; gray. West Norfolk, Litchfield County. Quarry of Snow & Wooster. Tenth Census, 1880. 26416.
- Coarse; porphyritic; pink and gray mottled. Foot cube. Leete's Island, New Haven County. Centennial, 1876. 25262.
- Medium; pink. 6 inch cube. Leete's Island, New Haven County. Centennial, 1876. 25577.
- Medium; pink. 6-inch cube. Leete's Island, New Haven County. J. Beattie's quarry. Tenth Census, 1880. 25456.
- Fine; light pinkish gray. Foot cube. Leete's Island, New Haven County. Centennial, 1876. 17530.
- Coarse; pinkish gray. Foot cube. Leete's Island, New Haven County. Centennial, 1876. 17525.
- Medium; gray. Foot cube. Branford, New Haven County. Centennial, 1876. 17532.

Biotite granite. Coarse; pink. Foot cube. Stony Creek, New Haven County. Centennial, 1876. 17521.

— Coarse; pink. East bank of Stony Creek, New Haven County. J. Robbin's quarry. Tenth Census, 1880. 25947.

— Fine; gray. Grotton, opposite New London, New London County. Quarry of Merritt, Gray & Co. Tenth Census, 1880. 25485.

— Very coarse; red. Lyme Station, New London County. Quarry of C. J. McCurdy & E. E. Salisbury. Tenth Census, 1880. 26079.

— Fine; gray. Foot cube. Millstone Point, New London County. Centennial, 1876. 17527.

— Fine; light gray. Foot cube. Mystic Bridge, New London County. Centennial, 1876. 17520.

— Fine; gray. Waterford, New London County. Quarry of J. B. Palmer & Co. Tenth Census, 1880. 25425.

— Medium; gray. Foot cube. Norwalk, Fairfield County. Umpewang quarry. Centennial, 1876. 17522.

— Medium; gray. Branchville, Fairfield County. Umpewang quarry. Tenth Census, 1880. 26337.

— Fine; gray. Millstone Point, Niantic, New London County. Centennial, 1876. 17540.

— Fine; light gray. Foot cube. Thomaston, Litchfield County. Centennial, 1876. 17529.

Muscovite biotite granite. Fine; light gray. Foot cube. Thomaston, Litchfield County. Centennial, 1876. 17528.

— Fine; light gray. Foot cube. Reynolds Bridge, Litchfield County. Centennial, 1876. 17524.

Biotite muscovite granite. Fine; light gray. Near Thomaston Station, Litchfield County. Plymouth Granite Company. Tenth Census, 1880. 26298.

Biotite muscovite gneiss. Fine; light gray. Roxbury, Litchfield County. E. Mower's quarry. Tenth Census, 1880. 26624.

Muscovite biotite gneiss. Fine; light gray. Foot cube. Roxbury Station, Litchfield County. Centennial, 1876. 17531.

— Fine; light gray. Foot cube. Ansonia, New Haven County. Centennial, 1876. 17523.

— Fine; light gray. Ansonia, New Haven County. Quarry of Spring & Willcox. Tenth Census, 1880. 26195.

Biotite gneiss. Medium; gray. East Canaan, Litchfield County. Centennial, 1876. 17564.

— Fine; gray. Near Branford, New Haven County. C. D. Allen's quarry. Tenth Census, 1880. 25618.

— Fine; dark gray; porphyritic. Foot cube. Milford, New Haven County. Centennial, 1876. 17533.

— Coarse; light gray. Near Lyme Station, New London County. Quarry of Luce & Hoskins. Tenth Census, 1880. 25451.

— Medium; gray. Sterling, Windham County. J. W. Boswell's quarry. Tenth Census, 1880. 26388.

— Coarse; gray. Sterling, near Hartford, Windham County. Quarry of Oneco Ledge Company. Tenth Census, 1880. 25484.

— Coarse; pinkish gray. East Killingly, Windham County. J. Oatley's quarry. Tenth Census, 1880. 26299.

Biotite gneiss. Coarse; gray. Stafford Springs, Tolland County. Truesdell quarry. Tenth Census, 1880. 26277.

— Fine; gray. East Glastonbury, Hartford County. C. Hentz's quarry. Tenth Census, 1880. 26415.

Hornblende biotite gneiss. Fine; dark gray. Middletown, Middlesex County. Centennial, 1876. 17541.

— Fine; dark gray. Haddam, Middlesex County. I. Arnold's quarry. Tenth Census, 1880. 26327.

— Medium; dark gray. Greenwich, Fairfield County. T. Ritch's quarry. Tenth Census, 1880. 26338.

— Medium; dark gray. Greenwich, Fairfield County. William Rich's quarry. Tenth Census, 1880. 26339.

— Coarse; dark gray. North Bridgeport, Fairfield County. W. Beer's quarry. Tenth Census, 1880. 26649.

Granite. Turned column of coarse pink porphyritic granite. 16 inches high and 6 inches in diameter. Leete's Island, New Haven County. Centennial, 1876. 17566.

Diabase. Mesozoic; fine and compact; dark gray; nearly black on a polished surface. Used chiefly for street pavements. West Rock, New Haven County. C. W. Blakeslee's quarry. Tenth Census, 1880. 25912.

Sandstone. Triassic; brown; medium. 12-inch cube. Portland, Middlesex County. Shaler & Hall Quarry Company. Centennial, 1876. 17534.

— Triassic; coarse; brown. Portland, Middlesex County. 17536.

— Triassic; medium; brown. Portland, Middlesex County. Middlesex quarry. Centennial, 1876. 17557.

— Triassic; medium; brown. Portland, Middlesex County. Middlesex Quarry Company. Tenth Census. 25424.

— Triassic; fine; brown. Portland, Middlesex County. Quarry of Shaler & Hall. Tenth Census. 25483.

— Triassic; fine; brown. Portland, Middlesex County. Quarry of Brainard & Co. Tenth Census. 26077.

— Triassic; medium; red. Manchester, Hartford County. C. O. Wolcott's quarry. Tenth Census. 26129.

— Triassic; fine; red. Manchester, Hartford County. C. O. Wolcott's quarry. Tenth Census. 26429.

— Triassic; coarse; reddish gray. East Haven, New Haven County. Robert Redfield. Tenth Census. 26453.

DAKOTA.

Quartzite. Potsdam; reddish brown; fine and compact; used for general building, tiling, and ornamental work. Sioux Falls, Minnehaha County. Tenth Census. 26662.

— Potsdam; light red; fine and compact; used for general building, tiling, and ornamental work. Sioux Falls, Minnehaha County. J. L. Phelps's quarry. Tenth Census. 26663.

DELAWARE.

Augite hornblende gneiss. Fine; dark gray. Near Wilmington, New Castle County. P. P. Tyre's quarry. Tenth Census, 1880. 25401.

Dolomite [marble]. Lower Silurian; white; crystalline. Hockessin, New Castle County. Jackson Lime and Marble Company. Tenth Census, 1880. 25402.

DISTRICT OF COLUMBIA.

Steatite [soapstone]. Fine; compact; light blue gray. On land of W. W. Evans, north of Woodley Lane road, Washington. Dr. William S. McIlhenney, 1886. 38510.

FLORIDA.

Limestone. Oolitic; porous and friable; nearly white. Key West. New Orleans Exposition, 1885. 37631.

— Coarse shell rock ("coquina"); light colored. Suwannee River. John S. F. Batchen, 1884. 35898.

Sandstone. Phosphatic; light colored; coarsely cellular. Near Hawthorne, Alachua County. C. A. Simmons's quarry. Tenth Census. 25208.

— Phosphatic; nearly white; coarsely vesicular. Suwannee River. John S. F. Batchen, 1884. 35899.

GEORGIA.

Limestone [marble]. Lower Silurian; pink; coarse; crystalline. Tate, Pickens County. Georgia Marble Company, 1886. 38367.

— Lower Silurian; white with dark blotches; coarse; crystalline. Two specimens. Tate, Pickens County. Georgia Marble Company, 1886. 38368.

— Lower Silurian; pure white; coarse; crystalline. Turned column, 6 inches long, 1 inch diameter. Tate, Pickens County. Georgia Marble Company, 1886. 38370.

— Lower Silurian; white and dark mottled; coarse; crystalline. Tate, Pickens County. Georgia Marble Company, 1886. 38369.

Dolomite [marble]. Purplish gray; fine and compact. Near Chattanooga, Catoosa County. Chickamauga quarry. Tenth Census, 1880. 25916.

Muscovite granite. Fine; light gray. Stone Mountain Station, on Georgia Railroad, De Kalb County. Stone Mountain quarry. Tenth Census, 1880. 25905.

Hornblende biotite gneiss. Fine; dark gray. Atlanta, Fulton County. P. Lynch's quarry. Tenth Census, 1880. 25892.

Gneiss [with pagodite]. Light green. A gneissoid rock containing green pagodite. Pagodite is a soft hydrous rock, from which the Chinese sometimes carve miniature pagodas; hence its name. $3\frac{1}{4}$ by 4 by 2 inches. Near Washington, Wilkes County. Prof. C. N. Shepard, 1880. 26818.

IDAHO.

Sandstone. Coarse; light colored. Near Boise City, Ada County. Penitentiary quarry. Tenth Census. 26660.

— Coarse; light colored. Near Boise City, Ada County. Penitentiary quarry. Tenth Census. 26661.

ILLINOIS.

Limestone. Sub-Carboniferous; semi-crystalline; dark gray. Two specimens. Shetlerville, Hardin County. G. A. Craiger's quarry. Tenth Census, 1880. 26393.

— Sub-Carboniferous; finely fossiliferous; brown. Near Chester, Randolph County. J. Hern's quarry. Tenth Census, 1880. 25744.

— Sub-Carboniferous; semi-crystalline; dark gray. Chester, Randolph County. J. Hern's quarry. Tenth Census, 1880. 25685.

— Sub-Carboniferous; semi-crystalline; light gray. Near Chester, Randolph County. Quarry of Southern Illinois Penitentiary. Tenth Census, 1880. 25686.

Limestone. Sub-Carboniferous; fossiliferous; light colored. Near Columbia, Monroe County. Quarry of P. Friedrich & Son. Tenth Census, 1880. 27194.

— Compact; fossiliferous; yellow. Quincy, Adams County. Centennial, 1876. 17510.

— Upper Silurian; compact; very light colored. 15-inch cube. Lemont, Cook County. Singer & Talcott Stone Company. J. S. F. Batchen, 1883. 27512.

— Compact; light colored; oolitic. Near Jonesborough, Union County. C. G. Flaugh's quarry. Tenth Census, 1880. 26726.

— Light colored; oolitic. Near Jonesborough, Union County. Fullenweiler's quarry. Tenth Census, 1880. 26727.

— Light colored; oolitic. Near Jonesborough, Union County. Dougherty's quarry. Tenth Census, 1880. 26728.

— Light colored; oolitic. Near Jonesborough, Union County. Willard's quarry. Tenth Census, 1880. 26729.

— Compact; fossiliferous; very light colored. Rockport, Pike County. Marblehead Lime Company. J. S. F. Batchen, 1883. 27506.

— Semi-crystalline; light colored. Kinderhook, Pike County. Marblehead Lime Company. J. S. F. Batchen, 1883. 27507.

— Compact; light gray. Near Inka, Marion County. Middleton quarry. Tenth Census, 1880. 25999.

— Compact; light gray. Two specimens. Belknap, Johnson County. J. Bell's quarry. Tenth Census, 1880. 27197.

— Compact; light colored. Sagetown, Henderson County. J. S. F. Batchen, 1882. 27199.

Siliceous magnesian limestone. Sub-Carboniferous; compact; dark drab. Near Breese, Clinton County. J. Taylor's quarry. Tenth Census, 1880. 25661.

Magnesian limestone. Fossiliferous; light colored; crystalline. Near Quincy, Adams County. O. A. Turner's quarry. Tenth Census, 1880. 27078.

Dolomite. Silurian; compact; light colored. Joliet, Will County. W. Warner's quarry. Tenth Census, 1880. 26532.

— Upper Silurian; porous; light gray. Kankakee, Kankakee County. Kankakee Stone Company. Tenth Census, 1880. 26851.

— Compact; light colored. North of Joliet, Will County. W. Krommeyer's quarry. Tenth Census, 1880. 26535.

— Compact; very light drab. Near Joliet, Will County. I. Nobes's quarry. Tenth Census, 1880. 26536.

— Compact; very light drab. Near Joliet, Will County. I. Nobes's quarry. Tenth Census, 1880. 26537.

— Compact; light colored. North of Joliet, Will County. Quarry of Bruce & Co. Tenth Census, 1880. 26538.

— Upper Silurian; compact; light colored. Near Joliet, Will County. Joliet Stone Company. Tenth Census, 1880. 26533.

— Upper Silurian; compact; light colored. Joliet, Will County. Joliet Stone Company. Tenth Census, 1880. 26534.

— Upper Silurian; compact; light colored. Near Joliet, Will County. Quarry of Sanger & Moody. Tenth Census, 1880. 26543.

— Upper Silurian; compact; light colored. North of Joliet, Will County. Quarry of Bruce & Co. Tenth Census, 1880. 26539.

— Upper Silurian; compact; light colored. Joliet, Will County. Quarry of Davidson Brothers. Tenth Census 1880. 26540.

- Dolomite.** Upper Silurian; compact; light colored. Joliet, Will County. C. Warner's quarry. Tenth Census, 1880. 26541.
- Upper Silurian; compact; light colored. Near Lemont, Cook County. Excelsior Stone Company. Tenth Census, 1880. 26542.
- Upper Silurian; compact; light colored. Near Lemont, Cook County. Singer & Talcott Stone Company. Tenth Census, 1880. 26527.
- Upper Silurian; compact; light colored. Lemont, Cook County. Chicago & Lemont Stone Company. Tenth Census, 1880. 26528.
- Upper Silurian; compact; light colored. Near Lemont, Cook County. Chicago & Lemont Stone Company. Tenth Census, 1880. 26529.
- Upper Silurian; compact; light colored. Near Lemont, Cook County. Illinois Stone Company. Tenth Census, 1880. 26530.
- Upper Silurian; compact; light colored. Near Lemont, Cook County. Singer & Talcott Stone Company. Tenth Census, 1880. 26526.
- Upper Silurian; fine; compact; light colored. Lemont, Cook County. Quarry of Boyer & Corneau. J. S. F. Batchen, 1882. 27191.
- Upper Silurian; compact; light colored. Near Lemont, Cook County. Earnshaw & Bodenschatz's quarry. Tenth Census, 1880. 26531.
- Upper Silurian; compact; light colored. Sag Bridge, Cook County. Enterprise Stone Company. J. S. F. Batchen, 1883. 27348.
- Upper Silurian; compact; light colored. Sag Bridge, Cook County. J. S. F. Batchen, 1883. 27505.
- Upper Silurian; nearly black from bituminous matter. 18-inch cube. Chicago, Cook County. Quarry of H. Rice & Son. J. S. F. Batchen, 1883. 27533.
- Upper Silurian; cellular; dark drab. Chicago, Cook County. Quarry of Stearns & Co. J. S. F. Batchen, 1883. 27823.
- Upper Silurian; compact; light colored. Chicago, Cook County. Ledlie & Corse, 1884. 29642.
- Upper Silurian; compact; light colored. Chicago, Cook County. Quarry of H. Rice & Son. J. S. F. Batchen, 1883. 27501.
- Upper Silurian; light colored; very fine and compact. Aurora, Kane County. A. Berthold's quarry. Tenth Census, 1880. 26959.
- Upper Silurian; light colored; very fine and compact. Aurora, Kane County. A. Berthold's quarry. Tenth Census, 1880. 26960.
- Bituminous dolomite.** Upper Silurian; coarse; cellular; stained nearly black by bituminous matter. Near Chicago, Cook County. Artesian Well quarry. J. S. F. Batchen, 1884. 35500.
- Calcareous dolomite.** Sub-Carboniferous; compact; fossiliferous; dark gray. Saline, Grantfork P. O., Madison County. S. Bardill's quarry. Tenth Census, 1880. 27190.
- Sandstone.** Sub-Carboniferous; fine; light colored. Near Chester, Randolph County. John Hern's quarry. Tenth Census, 1880. 25832.
- Carboniferous; fine; light brown. Near Pinkneyville, Perry County. John Day's quarry. Tenth Census, 1880. 27188.
- Light pink; fine and compact. Two specimens. Near Dongola, Union County. F. Neibauer. Tenth Census, 1880. 27195.
- Carboniferous; fine; light gray. Near Xenia, Clay County. William Haag's quarry. Tenth Census. 25646.
- Sub-Carboniferous; fine; yellowish brown. Near Chester, Randolph County. Quarry of Southern Illinois Penitentiary. Tenth Census. 25687.

Sandstone. Fine; brown. Two specimens, light and dark. Near Carbondale, Jackson County. Rawle's quarry. John S. F. Batchen. 28502.

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Limestone. Niagara; compact; yellow and drab. Wabash, Wabash County. Quarry of Bridges & Scott. Tenth Census, 1880. 25601.

— Niagara; compact; dark drab. North Vernon, Jennings County. Quarry of P. Conklin & Co. Tenth Census, 1880. 25589.

— Sub-Carboniferous; compact; drab; finely fossiliferous. Oakalla, Putnam County. Centennial, 1876. 25347.

— Sub-Carboniferous; compact; light colored. Two specimens. Near Greencastle, Putnam County. W. Steeg's quarry. Tenth Census, 1880. 25879.

— Sub-Carboniferous; compact; drab. Spencer, Owen County. B. Schweitzer's quarry. Tenth Census, 1880. 25749.

— Sub-Carboniferous; semi-crystalline; gray. Avoca, Lawrence County. Quarry of Thomlinson & Reid. J. S. F. Batchen, 1882. 27196.

— Sub-Carboniferous; oolitic; light colored. Bedford, Lawrence County. Quarry of Thomlinson & Reid. J. S. F. Batchen, 1883. 27502.

— Sub-Carboniferous; oolitic; light colored. Bedford, Lawrence County. Quarry of Thomlinson & Reid. J. S. F. Batchen, 1883. 27511.

— Sub-Carboniferous; oolitic; dark gray. Bedford, Lawrence County. Hoosier Stone Company. General B. F. Scribner, 1885. 37422.

— Sub-Carboniferous; oolitic; dark gray. Bedford, Lawrence County. Centennial, 1876. 25032.

— Sub-Carboniferous; oolitic; light colored. Near Bedford, Lawrence County. Quarry of Voris, Rodgers & Co. Tenth Census, 1880. 25693.

— Sub-Carboniferous; oolitic; light colored. Near Bedford, Lawrence County. Chicago and Bedford Stone Company. Tenth Census, 1880. 25694.

— Sub-Carboniferous; oolitic; light colored. Bedford, Lawrence County. Centennial, 1876. 25034.

— Sub-Carboniferous; compact; drab. Salem, Washington County. Centennial, 1876. 25036.

— Sub-Carboniferous; oolitic; light colored. Near Salem, Washington County. E. Zink's quarry. Tenth Census, 1880. 25662.

— Upper Silurian; coarsely fossiliferous; dark gray. Vernon, Jennings County. Centennial, 1876. 25033.

— Compact; light, with dark blotches. Evansville, Vanderburgh County. Centennial, 1876. 25204.

— Compact; light, with dark spots. Evansville, Vanderburgh County. Centennial, 1876. 25031.

— Drab, dark spotted; coarsely fossiliferous. Evansville, Vanderburgh County. Centennial, 1876. 26029.

— Light colored; oolitic; very fine grained and compact. Dressed block 26 by 14 by 13 inches. Face with carved inscription, as follows: "From Harrison County, 3 miles south of Corydon, and exists in inexhaustible quantities." Centennial Commission, 1876. 25219.

— Light colored; oolitic. Cube 25 inches in diameter, elaborately carved; face with words Hoosier Stone Co., Bedford, Indiana; right side with carved fruits, flowers, and lion's head; left side with female head, surrounded by wreath of oak and other leaves. Gift of Hoosier Stone Company, 1886. 38961.

Bituminous limestone. Sub-Carboniferous; oolitic; light colored. Ellettsville, Monroe County. Centennial, 1876. 25348.

— Sub-Carboniferous; oolitic; light colored. Near Ellettsville, Monroe County. J. Matthews & Sons' quarry. Tenth Census, 1880. 25741.

— Sub-Carboniferous; light colored; finely fossiliferous. Stinesville, Monroe County. W. H. McHenry's quarry. Tenth Census, 1880. 25748.

— Sub-Carboniferous; oolitic; light colored. Near Spencer, Owen County. Quarry of Howard & Denig. Tenth Census, 1880. 25750.

— Sub-Carboniferous; oolitic; light colored. Near Fort Ritner, Lawrence County. E. B. Dixon's quarry. Tenth Census, 1880. 25683.

Bituminous magnesian limestone. Devonian; compact; dark drab. Kokomo, Howard County. G. W. Defenbaugh's quarry. Tenth Census, 1880. 25635.

Lithographic limestone. Sub-Carboniferous; compact; drab. Spencer, Owen County. Centennial, 1876. 25370.

— Sub-Carboniferous; drab. 10½ by 7½ by 2½ inches. Silverville, Lawrence County. Centennial, 1876. 25030.

Magnesian limestone. Sub-Carboniferous; oolitic; light colored. Near Bedford, Lawrence County. Quarry of N. C. Hinsdale & Co. Tenth Census, 1880. 27075.

— Niagara; compact; light drab. Near Oakdale, Jennings County. Hicks & Hone's quarry. Tenth Census, 1880. 25590.

— Niagara; compact; light drab. Near Osgood, Ripley County. Quarry of Ashman & Glasgow. Tenth Census, 1880. 25596.

Siliceous limestone. Sub-Carboniferous; compact; drab. Near Putnamville, Putnam County. James Lee's quarry. Tenth Census, 1880. 25880.

Dolomite. Upper Silurian; compact; brown. Decatur, Adams County. B. P. Rice's quarry. Tenth Census, 1880. 25619.

— Upper Silurian; compact; drab. Bluffton, Wells County. Quarry of Knapp & Gardner. Tenth Census, 1880. 25620.

— Niagara; compact; yellowish. Wabash, Wabash County. Quarry of Moelling & Paul. Tenth Census, 1880. 25602.

— Niagara; compact; light drab. Near Logansport, Cass County. A. Gleitz's quarry. Tenth Census, 1880. 27080.

— Niagara; compact; drab. Marion, Grant County. S. Faakboner's quarry. Tenth Census, 1880. 27002.

— Niagara; compact; light drab. Montpelier, Blackford County. W. Twiball's quarry. Tenth Census, 1880. 25621.

— Niagara; compact; dark mottled. Eaton, Delaware County. G. W. Carter's quarry. Tenth Census, 1880. 25634.

— Niagara; compact; drab. Anderson, Madison County. W. Crim's quarry. Tenth Census, 1880. 26988.

— Niagara; compact; drab. Near Laurel, Franklin County. M. E. Secrest's quarry. Tenth Census, 1880. 25470.

— Niagara; compact; light drab. Near Greensburgh, Decatur County. Greensburgh Limestone Company. Tenth Census, 1880. 25541.

— Upper Silurian; compact; light colored. Greensburgh, Decatur County. Centennial, 1876. 25037.

— Niagara; compact; light colored. Saint Paul, Decatur County. J. L. Scanlan's quarry. Tenth Census, 1880. 25540.

— Niagara; compact; light colored. Near New Point, Decatur County. New Point quarry. Tenth Census, 1880. 25557.

Ferruginous dolomite. Niagara; compact; yellow and mottled. Two specimens. Longwood, Fayette County. W. Ball's quarry. Tenth Census, 1880. 25448.

Sandstone. Sub-Carboniferous; fine; very light colored. Paoli, Orange County. Centennial, 1876. 25035.

— Sub-Carboniferous; fine; very light colored. French Lick Township, Orange County. T. W. Braxton's quarry. Tenth Census. 26266.

— Sub-Carboniferous; very light gray; fine and compact. Used for oils-tones. French Lick Township, Orange County. Quarry of T. W. Braxton & Sons. Tenth Census. 26944.

— Sub-Carboniferous; very light gray; compact; finely laminated. French Lick Township, Orange County. W. F. Osborn's quarry. Tenth Census. 26050.

— Carboniferous; fine; very light colored. Williamsport, Warren County. B. F. Gregory's estate. Tenth Census. 25591.

— Carboniferous; gray; medium. Attica, Fountain County. S. Bernhart's quarry. Tenth Census. 25597.

— Carboniferous; fine; light reddish brown. Near Canneltion, Perry County. A. Hallabach's quarry. Tenth Census. 26208.

INDIAN TERRITORY.

Limestone. Nearly white; crystalline. Portion of memorial stone in Washington Monument. Cherokee Nation. Dennis O'Leary, 1885. 37628.

IOWA.

Gypsum. Coarse; gray. Fort Dodge, Webster County. Quarries of Cardiff Plaster Mills Company. Tenth Census, 1880. 26804.

Magnesian limestone [marble]. Devonian; compact; non-crystalline; argillaceous; with many fossil shells and large corals; prevailing colors drab, gray, and brownish. Three specimens. One large slab 2 by 4 feet by 1½ inches thick; one small slab 6 inches square by ½ inch thick and one 4-inch cube. Charles City, Floyd County. Charles City Marble Company. J. S. Trigg, 1886. 38465.

Dolomite. Lower Silurian; porous; light colored. Lansing, Allamakee County. J. Nelson's quarry. Tenth Census, 1880. 26217.

— Lower Silurian; coarse; vesicular. Lansing, Allamakee County. Haney's quarry. R. Hufschmidt, 1881. 26682.

— Lower Silurian; fine; light colored. South Lansing, Allamakee County. J. Nelson's quarry. R. Hufschmidt, 1881. 26683.

— Lower Silurian; compact; brown. Dubuque, Dubuque County. W. Rebman's quarry. Tenth Census, 1880. 25894.

— Lower Silurian; coarse; buff. Dubuque, Dubuque County. F. W. Kringle's quarry. Tenth Census, 1880. 25868.

— Lower Silurian; compact; buff. Dubuque, Dubuque County. Quarry of Speer and Lee. Tenth Census, 1880. 25870.

— Upper Silurian; drab; mottled. Near Manchester, Delaware County. Quarry of C. A. & S. A. Davis. Tenth Census, 1880. 25899.

— Upper Silurian; fine; light colored. Near Farley, Dubuque County. Quarry of C. E. De Rome & Co. Tenth Census, 1880. 25897.

— Upper Silurian; fine; light colored. Two specimens. Near Farley, Dubuque County. B. N. Arquette's quarry. Tenth Census, 1880. 25893.

Upper Silurian; fine; buff. Near Monticello, Jones County. J. S. Fuller's quarry. Tenth Census, 1880. 25895.

Dolomite. Devonian; fine; light buff and drab; coarsely fossiliferous. Two specimens. Near Osage Station, Mitchell County. Armstrong's quarry. Tenth Census, 1880. 26122.

- Devonian; dark; compact. Near Mason City, Cerro Gordo County. J. L. Parker's quarry. Tenth Census, 1880. 26065.
- Devonian; fine; buff and coarse drab. Two specimens. Near Bristow, Butler County. E. Frick's quarry. Tenth Census, 1880. 26088.
- Devonian; fine; compact. Cedar Falls, Black Hawk County. E. Carpenter's quarry. Tenth Census, 1880. 25900.
- Devonian; fine; yellowish brown. Two specimens. Near Laporte City, Black Hawk County. G. A. Knowles's quarry. Tenth Census, 1880. 26764.
- Sub-Carboniferous; compact; drab. Near Dakota Station, Humboldt County. Quarry of Miner & Howell. Tenth Census, 1880. 26067.
- Sub-Carboniferous; fine; compact. Humboldt, Humboldt County. A. B. Snyder's quarry. Tenth Census, 1880. 26062.
- Sub-Carboniferous; compact, with red blotches. Humboldt, Humboldt County. C. A. Labeer's quarry. Tenth Census, 1880. 26063.
- Sub-Carboniferous; light brown. Near Iowa Falls, Hardin County. G. W. Chapman's quarry. Tenth Census, 1880. 25986.
- Sub-Carboniferous; compact; brown. Near Iowa Falls, Hardin County. L. L. Kelly's quarry. Tenth Census, 1880. 26705.
- Sub-Carboniferous; fine; buff. Quarry, Marshall County. Le Grand Quarry Company. Tenth Census, 1880. 25479.
- Sub-Carboniferous; fine; light brown. Near Ames, Story County. P. R. Craig's quarry. Tenth Census, 1880. 25498.
- Sub-Carboniferous; fine; drab. Near Ames Station, Story County. R. Coe's quarry. Tenth Census, 1880. 25466.
- Sub-Carboniferous; light gray; quartz-bearing. Keokuk, Lee County. P. Tigue's quarry. Tenth Census, 1880. 25369.
- Sub-Carboniferous; finely vesicular. Near Franklin, Lee County. C. Graner's quarry. Tenth Census, 1880. 25368.
- Niagara; drab; mottled. Delhi, Delaware County. F. B. Doolittle's quarry. Tenth Census, 1880. 25701.

Siliceous dolomite. Lower Silurian; coarse; variegated. Lansing, Allamakee County. City of Lansing Quarries. Tenth Census, 1880. 26803.

- Upper Silurian; buff; porous. Near Postville, Allamakee County. E. H. William's quarry. Tenth Census, 1880. 26215.
- Devonian; compact. Near Waterloo, Black Hawk County. W. Lane's quarry. Tenth Census, 1880. 25933.
- Niagara; buff; dendritic. Near Delhi, Delaware County. J. H. Peter's quarry. Tenth Census, 1880. 25702.

Ferruginous dolomite. Upper Silurian; coarse and fine; buff. Two specimens. Near Sabula, Jackson County. E. A. Wood's quarry. Tenth Census, 1880. 25865.

- Upper Silurian; buff. Near Maquoketa, Jackson County. A. Connel's quarry. Tenth Census, 1880. 25830.
- Upper Silurian; coarse; yellow. Clinton, Scott County. T. Purcell's quarry. Tenth Census, 1880. 25829.
- Upper Silurian; fine; light buff. Near Le Claire, Scott County. E. Thelemann's quarry. Tenth Census, 1880. 25826.

Ferruginous dolomite. Upper Silurian; coarse, yellow; and fine, light buff. Two specimens. Near Dixon Station, Clinton County. J. D. Binford's quarry. Tenth Census, 1880. 25828.

Bituminous dolomite. Upper Silurian; compact; very light colored. Stone City, Jones County. H. Dearborn's quarry. Tenth Census, 1880. 25901.

— Upper Silurian; compact; very light colored. Two specimens. Stone City, Jones County. Quarry of James & Rowen. Tenth Census, 1880. 25902.

— Upper Silurian; compact; very light colored. Stone City, Jones County. J. A. Green's quarry. Tenth Census, 1880. 25931.

— Upper Silurian; fine; light colored. Near Anamosa, Jones County. Quarry of Iowa State Penitentiary. Tenth Census, 1880. 25565.

— Upper Silurian; fine; light buff. Near Olin, Jones County. A. Rummel's quarry. Tenth Census, 1880. 25705.

— Upper Silurian; coarse; porous. Hale, Jones County. O. Horton's quarry. Tenth Census, 1880. 25703.

— Upper Silurian; fine; very light buff. Near Mount Vernon, Johnson County. J. P. McCune's quarry. Tenth Census, 1880. 25572.

— Upper Silurian; buff; porous. Near Dixon Station, Clinton County. J. D. Binford's quarry. Tenth Census, 1880. 26213.

— Upper Silurian; fine; light buff. Le Claire, Scott County. J. Gamble's quarry. Tenth Census, 1880. 25827.

Calcareous dolomite. Sub-Carboniferous; fine; light colored. Quarry, Marshall County. Le Grand Quarry Company. Tenth Census, 1880. 25478.

— Devonian; drab; compact; crinoidal. Buffalo, Scott County. C. Metzger's quarry. Tenth Census, 1880. 25711.

— Carboniferous; light colored; fossiliferous. Near Winterset, Madison County. Quarry of W. H. Lewis. Tenth Census, 1880. 27160.

Bituminous limestone and dolomite. Devonian; fine; drab. Two specimens. Near Garrison, Benton County. Quarry of Kokbrick & Frazer. Tenth Census, 1880. 25951.

Bituminous limestone. Devonian; fine; light colored. Near Vinton, Benton County. Quarry of S. Anngst. Tenth Census, 1880. 25950.

— Sub-Carboniferous; light colored; oolitic. Near Durham Station, Marion County. C. C. Collins's quarry. Tenth Census, 1880. 26214.

Magnesian limestone. Lower Silurian; drab; dark mottled. Decorah, Winne-
shiek County. T. Dwyer's quarry. Tenth Census, 1880. 26133.

— Sub-Carboniferous; oolitic; light colored. Near Le Grand, Tama County. Le Grand Quarry Company. Tenth Census, 1880. 25477.

— Carboniferous; compact; drab. Fort Dodge, Webster County. J. Linebon's quarry. Tenth Census, 1880. 25987.

— Devonian; drab. Near Charles City, Floyd County. J. S. Trigg's quarry. Tenth Census, 1880. 26390.

— Devonian; dark; compact. Near Mason City, Cerro Gordo County. Quarry of A. T. Lien & Bro. Tenth Census, 1880. 26066.

— Compact; light colored. Two specimens. Waverly, Bremer County. G. R. Dean's quarry. Tenth Census, 1880. 26076.

Limestone. Devonian; fine; light colored. Near Mason City, Cerro Gordo County. Quarry of Poyflier & Son. Tenth Census, 1880. 26064.

— Devonian; fine and coarse. Two specimens. Near Marble Rock, Floyd County. Quarry of Boone & Bros. Tenth Census, 1880. 26392.

- Limestone.** Devonian; buff; fossiliferous. Two specimens. Near Independence, Buchanan County. J. Forrester's quarry. Tenth Census, 1880. 25932.
- Devonian; brown; cellular. Iowa City, Johnson County. L. O. Hoffman's quarry. Tenth Census, 1880. 25409.
- Devonian; light colored; finely fossiliferous. Near Iowa City, Johnson County. D. A. Schaeffer's quarry. Tenth Census, 1880. 25410.
- Devonian; drab. Two specimens. Davenport, Scott County. W. L. Cook's quarry. Tenth Census, 1880. 25866.
- Devonian; coarsely fossiliferous. Near Davenport, Scott County. Heinrich Schmiedt's quarry. Tenth Census, 1880. 25867.
- Devonian; fine; drab. Davenport, Scott County. A. C. Fulton's quarry. Tenth Census, 1880. 26216.
- Upper Silurian; fine; light colored. Two specimens. Near Tipton, Cedar County. Quarry of Shearer & Gray. Tenth Census, 1880. 25575.
- Sub-Carboniferous; coarse brown and fine, light colored. Two specimens. Near Iowa Falls, Hardin County. L. L. Kelly's quarry. Tenth Census, 1880. 26684.
- Sub-Carboniferous; light colored; oolitic. Conrad, Grundy County. W. T. Creceline's quarry. Tenth Census, 1880. 26391.
- Sub-Carboniferous; oolitic; light colored and reddish. Two specimens. Near Montour, Tama County. Quarry of Ruggles & Stevens. Tenth Census, 1880. 25476.
- Sub-Carboniferous; finely fossiliferous. Quarry, Marshall County. Le Grand Quarry Company. Tenth Census, 1880. 25480.
- Sub-Carboniferous; buff and light gray; semi-crystalline. Two specimens. Near Washington, Washington County. Quarry of Minnick & Donovan. Tenth Census, 1880. 25623.
- Sub-Carboniferous; compact; light colored. Near Sigourney Station, Keokuk County. William S. Booten's quarry. Tenth Census, 1880. 25624.
- Sub-Carboniferous; compact; light colored. Sigourney, Keokuk County. R. Pilkington's quarry. Tenth Census, 1880. 25625.
- Sub-Carboniferous; light colored and drab. Two specimens. Near Givin, Mahaska County. F. Castle's quarry. Tenth Census, 1880. 25648.
- Sub-Carboniferous; fine; light colored. Near Pella, Marion County. F. C. Mathe's quarry. Tenth Census, 1880. 25896.
- Sub-Carboniferous; compact; drab. Near Ottumwa, Wapello County. B. W. Jeffries's quarry. Tenth Census, 1880. 25443.
- Sub-Carboniferous; compact; drab; oolitic. Near Ottumwa, Wapello County. J. Kelly's quarry. Tenth Census, 1880. 25445.
- Sub-Carboniferous; light drab; oolitic and drab; fossil-bearing. Two specimens. Dudley Station, Wapello County. Quarry of Beckwith & Winters. Tenth Census, 1880. 25411.
- Sub-Carboniferous; gray; micaceous. Two specimens. Near Fairfield, Jefferson County. S. Stieber's quarry. Tenth Census, 1880. 25622.
- Sub-Carboniferous; fine; drab. Near Mount Pleasant, Henry County. P. O'Connor's quarry. Tenth Census, 1880. 25339.
- Sub-Carboniferous; fine; very light gray and drab. Two specimens. Near Mount Pleasant, Henry County. J. Rukgaber's quarry. Tenth Census, 1880. 25340.
- Sub-Carboniferous; fine; light colored. Burlington, Des Moines County. "Star" quarry. Tenth Census, 1880. 26493.

- Limestone** Sub-Carboniferous; light colored; semi-crystalline. Two specimens. Burlington, Des Moines County. Tenth Census, 1880. 25329.
- Sub-Carboniferous; light colored; oolitic. Burlington, Des Moines County. South Hill quarries. Tenth Census, 1880. 26490.
- Sub-Carboniferous; coarse; buff. Burlington, Des Moines County. South Hill quarries. Tenth Census, 1880. 26491.
- Sub-Carboniferous; fine; compact. Near Franklin, Lee County. C. Graner's quarry. Tenth Census, 1880. 25368.
- Sub-Carboniferous; light colored and gray. Two specimens. Bentonsport, Van Buren County. G. W. Jack's quarry. Tenth Census, 1880. 25442.
- Sub-Carboniferous; fine; drab. Two specimens. Near Keosauqua, Van Buren County. J. Creasy's quarry. Tenth Census, 1880. 26218.
- Carboniferous; fine; fossil-bearing. Two specimens. Stennett, Montgomery County. W. Stennett's quarry. Tenth Census, 1880. 25413.
- Carboniferous; coarse; light buff. Bedford, Taylor County. H. W. Greenlee's quarry. Tenth Census, 1880. 25893.
- Carboniferous; light drab; fossiliferous. Bedford, Taylor County. Quarry of H. W. Green & Co. Tenth Census, 1880. 26802.
- Carboniferous; light colored; finely fossiliferous. Near Earlham, Madison County. Quarry of Laird & Royce. Tenth Census, 1880. 25461.
- Carboniferous; light colored and drab; fossiliferous. Two specimens. Near Tracy Station, Marion County. Quarry of Regan Bros. & McGorrich. Tenth Census, 1880. 25464.
- Carboniferous; light colored; finely fossiliferous. Near Winterset, Madison County. Quarry of H. W. Lewis. Tenth Census, 1880. 25475.
- Carboniferous; light colored; fossil-bearing. Near Winterset, Madison County. G. W. Hettyler's quarry. Tenth Census, 1880. 27184.
- Carboniferous; compact; drab. Near Earlham, Madison County. Quarry of Robertson & Willoughby. Tenth Census, 1880. 25462.
- Carboniferous; light colored; fossiliferous. Near Earlham, Madison County. Tenth Census, 1880. 25463.
- Carboniferous; light and dark drab. Two specimens. Near Macedonia, Pottawattamie County. S. Dye's quarry. Tenth Census, 1880. 25446.
- Siliceous limestone.** Devonian; dark mottled. Iowa City, Johnson County. E. Crowley's quarry. Tenth Census, 1880. 25408.
- Sub-Carboniferous; gray; porous. Near Knoxville, Marion County. Garrison quarry. Tenth Census, 1880. 25675.
- Carboniferous; light colored; fossiliferous. Near Corning, Adams County. Quarry of Law & Oak. Tenth Census, 1880. 25412.
- Sandstone.** Carboniferous; coarse; dark brown. Near Muscatine, Muscatine County. A. M. Hare's quarry. Tenth Census. 25593.
- Fine; very light colored. Davenport, Scott County. Goettsch's quarry. Tenth Census. 25745.
- Ferruginous sandstone.** Cretaceous; coarse; dark brown. Lewis, Cass County. J. Woodward's quarry. Tenth Census. 25447.

KANSAS.

- Limestone.** Permian; light colored; porous; fossiliferous. Marysville, Marshall County. Quarry of Erl & Patterson. Tenth Census, 1880. 25419.
- Permian; coarse; porous; light colored. Two specimens. Blue Rapids, Marshall County. Blue Rapids quarry. Tenth Census, 1880. 25438.

- Limestone.** Permian; coarsely porous; fusulina; light colored. Near Frankfort, Marshall County. Joseph Wilson's quarry. Tenth Census, 1880. 25397.
- Permian; light colored; fusulina. Beattie, Marshall County. Tenth Census, 1880. 25420.
- Permian; compact; coarsely porous, with many fossil fusulina. Two specimens. Bigelow, Marshall County. H. F. Gallagher's quarry. Tenth Census, 1880. 25437.
- Permian; light colored; compact; finely fossiliferous. Near Manhattan, Riley County. Quarry of Ulrich Brothers. Tenth Census, 1880. 26502.
- Permian; coarse; porous; fusulina. Near Manhattan, Riley County. Quarry of Ulrich Brothers. Tenth Census, 1880. 26503.
- Permian; light colored; fine; cellular. Near Dunlap, Morris County. Quarry of Wolff, Pickens & Co. Tenth Census, 1880. 26091.
- Permian; light colored; compact; finely fossiliferous. Near Cottonwood Station, Chase County. Quarry of L. W. Lewis. Tenth Census, 1880. 26090.
- Permian; light colored; compact; fusulina. Near Cottonwood Station, Chase County. Quarry of Lantry & Burr. Tenth Census, 1880. 26098.
- Permian; light colored; fossiliferous; cellular. Near Douglass, Butler County. Tenth Census, 1880. 26364.
- Permian; light colored; soft; porous; fossiliferous. Near Douglass, Butler County. W. Dickensheet's quarry. Tenth Census, 1880. 26365.
- Permian; drab; fine and compact. Two specimens. Near Rock Township, Butler County. Smith's quarry. Tenth Census, 1880. 26363.
- Permian; fine; light colored; fossiliferous. Near El Dorado, Butler County. Polwin's quarry. Tenth Census, 1880. 26356.
- Permian; light colored; fine and compact. Near El Dorado, Butler County. Poor Farm quarry. Tenth Census, 1880. 26357.
- Permian(?) ; light colored; porous. Near El Dorado, Butler County. Van Dorner's quarry. Tenth Census, 1880. 26361.
- Permian; light colored; compact and coarsely porous. Two specimens. Near El Dorado, Butler County. Sharper's quarry. Tenth Census, 1880. 26362.
- Permian; light colored; soft; porous; fossiliferous. Near Augusta, Butler County. J. C. Haines's quarry. Tenth Census, 1880. 26130.
- Permian; light colored; soft; porous; fossiliferous. Near Augusta, Butler County. Barker's quarry. Tenth Census, 1880. 26367.
- Permian; light colored; soft; porous; fossiliferous. Near Augusta, Butler County. Ward's quarry. Tenth Census, 1880. 26368.
- Permian; light colored; fusulina. Near Augusta, Butler County. Aldrich's quarry. Tenth Census, 1880. 26369.
- Permian; fine grained; light colored. Near Winfield, Cowley County. Quarry of Hodges, Moore & Co. Tenth Census, 1880. 26577.
- Permian; gray; fusulina. Near Grenola, Elk County. Railroad quarry. Tenth Census, 1880. 26574.
- Cretaceous; white; chalky; used in the manufacture of whiting. Kirwin, Phillips County. Kirwin quarry. Tenth Census, 1880. 25455.
- White; chalky; used in the manufacture of whiting. Wa Keeney, Trego County. Railroad quarry. Tenth Census, 1880. 26499.
- White; chalky. On Smoky River, Trego County. Tenth Census, 1880. 26500.
- Light; fine and porous. Bull's City, Osborne County. Tenth Census, 1880. 25474.

Limestone. Light colored; soft and earthy. Junction City, Davis County. Centennial, 1876. 25048.

- Dark; coarse; fossiliferous. Oswego, Labette County. Hoy's quarry. Tenth Census, 1880. 25790.
- Fine; light buff. Beloit, Mitchell County. Tenth Census, 1880. 25441.
- Buff; coarsely porous. Near Greeley, Anderson County. Greeley quarry. Tenth Census, 1880. 26099.
- Light colored; porous; fossiliferous. Near Armstrong, Wyandotte County. T. F. Sullivan's quarry. Tenth Census, 1880. 25396.
- Buff; fine and compact. Near Wilson, Ellsworth County. Railroad quarry. Tenth Census, 1880. 26481.
- Fine; light buff. Near El Dorado, Butler County. Tenth Census, 1880. 26358.
- Carboniferous; dark; compact; finely fossiliferous. Near Atchison, Atchison County. Quarry of Reddington & Co. Tenth Census, 1880. 25375.
- Carboniferous; light colored; finely fossiliferous. Two specimens. Near Lane, Franklin County. Quarry of Hanway Brothers. Tenth Census, 1880. 25796.

Limestone [marble.] Drab, dark spotted; very compact and close grained. $4\frac{1}{2}$ by $2\frac{1}{2}$ by 1 inches. Leavenworth, Leavenworth County. United States General Land Office, 1882. 27282.

- Dark brown, nearly black, with white fossils. $3\frac{1}{2}$ by $3\frac{1}{2}$ by 1 inches. Bourbon County. United States General Land Office, 1883. 27283.

Magnesian limestone. Carboniferous; dark; fossiliferous. Fort Scott, Bourbon County. W. L. Wilkinson's quarry. Tenth Census, 1880. 25680.

- Buff; fine and compact. Leavenworth, Leavenworth County. Tenth Census, 1880. 25460.
- Permian; light colored; finely fossiliferous. Near Cottonwood Station, Chase County. Quarry of Tweeddale & Parker. Tenth Census, 1880. 26097.
- Permian; light colored; finely fossiliferous. Florence, Marion County. A. F. Horner's quarry. Tenth Census, 1880. 26093.

Dolomite. Coarse; porous; fossiliferous. Near Salina, Saline County. Tenth Census, 1880. 26501.

- Permian; fine grained; light colored. Near Marion Centre, Marion County. Quarry of Groat & Bros. Tenth Census, 1880. 26092.
- Permian; fine; light buff. Near Marion Centre, Marion County. Orner Gee's quarry. Tenth Census, 1880. 26094.
- Permian; light colored; fine grained. Near Marysville, Marshall County. White's quarry. Tenth Census, 1880. 25418.
- Carboniferous; compact; fossiliferous. Two specimens. Near Topeka, Shawnee County. Quarry of Mulvane & Higginbotham. Tenth Census, 1880. 26572.

Siliceous dolomite. Permian; fine; light colored; porous. Richland Township, Butler County. Tenth Census, 1880. 26366.

Bituminous dolomite. Permian; fine; light colored. Near Winfield, Cowley County. C. Schmidt's quarry. Tenth Census, 1880. 26573.

Sandstone. Carboniferous; fine; gray. Near Fort Scott, Bourbon County. Quarry of Gilfillan Bros. 25681.

- Fine; brown. Near Oswego, Labette County. Bailey's quarry. Tenth Census. 25791.

Sandstone. Fine; light colored. Near Parsons, Neosho County. Quarry of Jones & Hayes. Tenth Census. 25792.

— Fine; gray. Near Parsons, Neosho County. Emory's quarry. Tenth Census. 25793.

— Fine; light buff. Near Chanute, Neosho County. "Railroad" quarry. Tenth Census. 26580.

— Carboniferous; dark gray; medium. Near Pawnee, Crawford County. Pawnee, Flagstone County. Tenth Census. Two specimens. 25794.

— Fine; light buff. Neodesha, Wilson County. "Neodesha" quarry. Tenth Census. 26575.

— Dark buff; medium. Larned, Pawnee County. N. J. Krusen's quarry. Tenth Census. 26576.

KENTUCKY.

Limestone. Light drab; finely fossiliferous; compact. Louisville, Jefferson County. City of Louisville quarry. Tenth Census, 1880. 26311.

— Drab; fine and compact. Anchorage, Jefferson County. Quarry of Reilly Bros. J. S. F. Batchen, 1883. 26106.

— Drab; compact and somewhat oolitic. Near Franklin, Simpson County. Paris quarry. J. R. Procter, 1884. 36888.

— Drab; fine and compact. Pilot Knob, Simpson County. J. R. Procter, 1884. 36897.

— Drab; compact. Near Frankfort, Franklin County. Mrs. Pettis's quarry. J. R. Procter, 1884. 36908.

— Drab; finely fossiliferous. Greensburgh, Green County. Garrard Lyle's quarry. J. R. Procter, 1884. 36902.

— Dark drab; compact. Russellville, Logan County. J. R. Procter, 1884. 36915.

— Dark drab; fine and compact. Simpson County. J. R. Procter, 1884. 36893.

— Light colored; finely fossiliferous; cellular. Near Bowling Green, Warren County. Belknap & Dumesnil Stone Company. Tenth Census, 1880. 26285.

— Light colored; oolitic. Princeton, Caldwell County. S. McElfatrick's quarry. J. R. Procter, 1884. 36946.

— Light colored; fossiliferous. Bloomfield, Nelson County. J. R. Procter, 1884. 36916.

— Light colored; oolitic, with fossils. Russellville, Logan County. Quarry of Burgher & Ryan. J. R. Procter, 1884. 36949.

— Light colored; very fine and compact. Near Franklin, Simpson County. J. R. Procter, 1884. 36889.

— Light colored; semi-crystalline. Near Frankfort, Franklin County. Major Williams's quarry. J. R. Procter, 1884. 36911.

— Light colored; finely fossiliferous. Near Frankfort, Franklin County. Mr. Quire's quarry. J. R. Procter, 1884. 36912.

— Light colored; coarsely fossiliferous. About 5 by 4 by 1½ inches. Near Bedford, Trimble County. S. Barnes's farm. J. R. Procter, 1884. 36969.

— Light gray; finely fossiliferous; compact. Near Frankfort, Franklin County. Buttermann's quarry. J. R. Procter, 1884. 36913.

— Light colored; oolitic. Near Trenton, Todd County. J. R. Procter, 1884. 36948.

— Dark; compact. Livingstone, Rockcastle County. Rockcastle quarry. J. R. Procter, 1884. 36921.

— Fine; light gray. Lincoln County. J. R. Procter, 1884. 36931.

Limestone. Sub-Carboniferous; light colored; oolitic. Princeton, Caldwell County. J. R. Procter, 1884. 36940.

— Sub-Carboniferous; fine; drab. Princeton, Caldwell County. J. R. Procter, 1884. 36941. www.libtool.com.cn

— Sub-Carboniferous; light colored; oolitic. Near Princeton, Caldwell County. Garrett's quarry. J. R. Procter, 1884. 36943.

— Gray; semi-crystalline; fossiliferous. Princeton, Caldwell County. S. McElfatrick's quarry. J. R. Procter, 1884. 36944.

— Sub-Carboniferous; very light drab; oolitic. Princeton, Caldwell County. S. McElfatrick's quarry. J. R. Procter, 1884. 36945.

— Corniferous; fine; dark gray. Stewart's Mill, Clark County. J. R. Procter, 1884. 36906.

— Corniferous; drab; compact. Lebanon, Marion County. J. R. Procter, 1884. 36910.

— Lower Silurian; dark gray; coarsely fossiliferous. Bloomfield, Nelson County. J. R. Procter, 1884. 36914.

— Sub-Carboniferous; drab; fine and compact. Dennis, Logan County. J. R. Procter, 1884. 36918.

— Sub-Carboniferous; light colored; oolitic. Pilot Knob, Simpson County. J. R. Procter, 1884. 36887.

— Very light brown; fine and compact. Simpson County. J. R. Procter, 1884. 36892.

— Sub-Carboniferous; light colored; oolitic. Near Garrett, Meade County. J. R. Procter, 1884. 36960.

— Sub-Carboniferous; dark mottled; semi-crystalline. Grahampton, Meade County. 36961.

— Sub-Carboniferous; dark gray; finely fossiliferous; compact. Green County. J. R. Procter, 1884. 36903.

— Fine; drab; compact. Pineville, Bell County. J. R. Procter, 1884. 36924.

— Dark mottled; semi-crystalline; compact. Near Litchfield, Grayson County. J. Cabbage's quarry. J. R. Procter, 1884. 36954.

— Sub-Carboniferous; light colored; oolitic. Near Litchfield, Grayson County. Joe Butler's quarry. J. R. Procter, 1884. 36955.

— Dark gray; semi-crystalline. Litchfield, Grayson County. J. R. Procter, 1884. 36957.

— Lower Silurian; gray; coarsely fossiliferous. Taylorsville, Spencer County. J. R. Procter, 1884. 36909.

— Sub-Carboniferous; light colored; oolitic. Hopkinsville, Christian County. J. R. Procter, 1884. 36900.

— Gray; coarsely fossiliferous. Springfield, Washington County. J. R. Procter, 1884. 36934.

Magnesian limestone. Coarse; dark mottled. Lulbegrude Creek, Clark County. J. R. Procter, 1884. 36907.

— Upper Silurian; yellowish; compact. Nelson County. J. R. Procter, 1884. 36904.

— Upper Silurian; fine; light gray. Near Lagrange, Oldham County. Anita Springs quarry. J. R. Procter, 1884. 36932.

Bituminous limestone. Dark; compact; fossiliferous. Lebanon, Marion County. J. R. Procter, 1884. 36919.

— Dark drab; fine and compact. Simpson County. J. R. Procter, 1884. 36895.

- Bituminous limestone.** Dark; compact. Pineville, Bell County. J. R. Procter, 1884. 36923.
- Dolomite.** Upper Silurian; drab; compact. Bardstown, Nelson County. J. R. Procter, 1884. 36917.
- Corniferous; drab, mottled; semi-crystalline. Lincoln County. Lincoln Sand Company. J. R. Procter, 1884. 36930.
- Sandstone.** Fine; light colored. Pilot Knob, Simpson County. J. R. Procter. 36891.
- Fine; light yellowish. Pilot Knob, Simpson County. J. R. Procter. 36896
- Calcareous; fine; very light gray. Taylor County. Land of George Lee. J. R. Procter, 1884. 36899.
- Fine; very light gray. Livingstone, Rockcastle County. J. R. Procter. 36920.
- Fine; light gray, with dark stains. Near Pineville, Bell County. Land of A. J. Arker. J. R. Procter. 36925.
- Fine; light blue-gray. Near Pineville, Bell County. Land of R. M. Moss. J. R. Procter. 36926.
- Fine; light colored. Near Pineville, Bell County. Land of R. M. Moss. J. R. Procter. 36927.
- Sub-Carboniferous; fine; very light gray. Blue Lick Mountain, Madison County. Land of William Adams. J. R. Procter. 36928.
- Carboniferous; very light brown; medium. Johnson County. J. R. Procter. 36936.
- Carboniferous; very light brown; medium. Johnson County. J. R. Procter. 36937.
- Fine; light pinkish. Kirkmansville, Todd County. Quarry of R. F. Boss. J. R. Procter. 36942.
- Fine; very light blue-gray. Whitley County. J. R. Procter. 36950.
- Fine; light colored. Whitley County. J. R. Procter. 36951.
- Fine; light pinkish. Grayson Springs, Grayson County. J. R. Procter. 36952.
- Fine; light colored. Grayson Springs, Grayson County. J. R. Procter. 36953.
- Sub-Carboniferous; fine; nearly white. Near Marion, Crittenden County. J. R. Procter. 36958.
- Sub-Carboniferous; fine; buff. Near Cloverport, Breckinridge County. J. R. Procter. 36964.
- Sub-Carboniferous; fine; light brown. Near Cloverport, Breckinridge County. J. R. Procter. 36966.
- Sub-Carboniferous; fine; light colored. Near Cloverport, Breckinridge County. J. R. Procter. 36967.

LOUISIANA.

- Sandstone.** Fine; light colored. 37579.
- Quartzite.** Dark drab and white, mottled; very fine and compact. Two specimens. 37602.

MAINE.

- Serpentine.** Compact; dark green, nearly black; takes but a dull polish. Deer Isle, Hancock County. George H. Holden, 1884. 36019.
- Biotite granite.** Coarse; gray. Biddeford, York County. C. H. Bragdon's quarry. Tenth Census, 1880. 26297.
- Coarse; gray. Biddeford, York County. J. M. Andrew's quarry. Tenth Census, 1880. 26316.

Biotite granite. Coarse; gray. Biddeford, York County. Quarry of C. H. & A. Goodwin. Tenth Census, 1880. 26317.

— Broken column; pink. 7½ by 14 inches. Near Red Beach, Washington County. Maine Red Granite Company. Tenth Census, 1880. 26765.

— Coarse; pink; used for ornamental work and monuments. Near Red Beach, Washington County. Maine Red Granite Company. Tenth Census, 1880. 25684.

— Coarse; pink; used as above. Jonesborough, Washington County. Bodwell Granite Company. Tenth Census, 1880. 25872.

— Coarse; pink; used very largely for monumental work. Jonesborough, Washington County. Colonel Clark. 25002.

— Medium; gray. Two specimens. 6-inch cube. Waldo County. Tenth Census, 1880. 25029.

— Coarse; gray; used for general building. Frankfort, Waldo County. Mount Waldo Granite Works. Tenth Census, 1880. 27035.

— Gray; coarsely porphyritic. Frankfort, Waldo County. Mount Waldo Granite Works. Tenth Census, 1880. 27036.

— Fine; gray. Swanville, Waldo County. Oak Hill Granite Company. Tenth Census, 1880. 26485.

— Coarse; dark gray. Canaan, Somerset County. S. L. Fowler's quarry. Tenth Census, 1880. 26296.

— Fine; dark gray. Round Pond, Lincoln County. Quarry of Brown, McAllister & Co. Tenth Census, 1880. 26242.

— Fine; dark gray. 6 by 6 by 4 inches. Round Pond, Lincoln County. Quarry of Brown, McAllister & Co. Tenth Census, 1880. 26974.

— Fine; gray. Vinal Haven, Knox County. J. S. Black's quarry. Tenth Census, 1880. 26165.

— Fine; gray. Vinal Haven, Knox County. Duscham Hill quarry. Bodwell Granite Company. Tenth Census, 1880. 26166.

— Coarse; gray, slightly pinkish. Vinal Haven, Knox County. Harbor quarry. Bodwell Granite Company. Tenth Census, 1880. 26153.

The Vinal Haven granites are used for all manner of building and monumental work.

— Coarse; gray. Hurricane Island, Knox County. D. Tilson's quarry. Tenth Census, 1880. 26180.

— Coarse; gray, slightly pinkish. 6-inch cube. Rockland, Knox County. George's River Granite Company. 25067.

— Coarse; gray; used in the construction of the United States Treasury building at Washington. Dix Island, Knox County. Dix's Island Granite Company. Tenth Census, 1880. 26182.

— Fine; dark gray. South Thomaston, Knox County. Quarry of M. T. Jameson & Co. Tenth Census, 1880. 26181.

— Fine; granite. Vinal Haven, Knox County. East Boston quarry. Bodwell Granite Company. Tenth Census, 1880. 26154.

— Fine; light gray. Saint George, Knox County. Long Cove Granite Company. Tenth Census, 1880. 26177.

— Coarse; gray. Near Saint George, Knox County. Atlantic Granite Company. Tenth Census, 1880. 26178.

— Fine; dark gray. Near Saint George, Knox County. Clark's Island Granite Company. Tenth Census, 1880. 26212.

- Biotite granite.** Coarse; gray. Spruce Head Island, Knox County. Bodwell Granite Company. Tenth Census, 1880. 26179.
- Coarse; gray, slightly pinkish. Fox Island, Knox County. Harbor quarry. Colonel Clark. 25009.
- Fine; dark gray. Fox Island, Knox County. East Boston quarry. Colonel Clark. 25020.
- Medium; dark gray. Bryant's Pond, Oxford County. Grand Trunk Railway. Tenth Census, 1880. 26269.
- Medium; gray. Bryant's Pond, Oxford County. J. S. F. Batchen, 1883. 28647.
- Coarse; gray. Bryant's Pond, Oxford County. Grand Trunk Railway. Tenth Census, 1880. 26270.
- Coarse; gray. Near Wayne, Kennebec County. J. F. Gordon's quarry. Tenth Census, 1880. 26507.
- Coarse; light gray. Franklin, Hancock County. Quarry of Blaisdell Bros. Tenth Census, 1880. 26073.
- Medium; gray pink spotted. Somesville, Mount Desert, Hancock County. C. J. Hall's quarry. Tenth Census, 1880. 26124.
- Medium; gray-pink spotted. Somesville, Hancock County. Quarry of Whitney & Allen. Tenth Census, 1880. 26125.
- Coarse; light pink. Somesville, Mount Desert, Hancock County. C. J. Hall's quarry. Tenth Census, 1880. 26152.
- Coarse; light pink. Near Somesville, Hancock County. C. J. Hall's quarry. Tenth Census, 1880. 27179.
- Coarse; gray. Deer Isle, Hancock County. Quarry of Goss & Goss. Tenth Census, 1880. 26155.
- Coarse; gray. East Blue Hill, Hancock County. Chase & Hall's quarry. Tenth Census, 1880. 26139.
- Gray; porphyritic. East Blue Hill, Hancock County. Collins Granite Company. Tenth Census, 1880. 26146.
- Coarse; gray. East Blue Hill, Hancock County. G. W. Collins & Co. Tenth Census, 1880. 26132.
- Light gray; coarsely porphyritic. Foot cube. East Blue Hill, Hancock County. Centennial, 1876. 17470.
- Medium; gray. West Sullivan, Hancock County. J. H. Stinson's quarry. Tenth Census, 1880. 26049.
- Fine; light gray. Brunswick, Cumberland County. H. Cripp's quarry. Tenth Census, 1880. 26420.
- Fine; gray. Near Pownal, Cumberland County. T. Reed's quarry. Tenth Census, 1880. 27070.
- Biotite muscovite granite.** Fine; very light gray. Waldoborough, Lincoln County. Quarry of Day & Otis. Tenth Census, 1880. 26326.
- Biotite gneiss.** Medium; gray. Jefferson, Lincoln County. J. P. Glidden's quarry. Tenth Census, 1880. 26276.
- Medium; gray. Near Chesterville, Franklin County. J. H. Plummer's quarry. Tenth Census, 1880. 26371.
- Medium; dark gray. Near Turner, Androscoggin County. C. H. Barrell's quarry. Tenth Census, 1880. 26508.
- Muscovite biotite gneiss.** Fine light gray. Lincolnville, Waldo County. Beach Grove Granite Company. Tenth Census, 1880. 26241.

Muscovite biotite gneiss. Fine; gray. Jefferson, Lincoln County. J. P. Glidden's quarry. Tenth Census, 1880. 26486.

Muscovite biotite granite. Fine; very light gray. Near Hallowell, Kennebec County. Hallowell Granite Company. Tenth Census, 1880. 26335.

— Fine; very light gray. Near Hallowell, Kennebec County. Hallowell Granite Company. Tenth Census, 1880. 26336.

— Fine; light gray. North Jay, Franklin County. Maine Central Railroad Company. Tenth Census, 1880. 26385.

Hornblende biotite granite. Coarse; gray. Lincoln, Penobscot County. Jewell Granite Company. Tenth Census, 1880. 27084.

— Fine; very dark gray, nearly black. Saint George, Knox County. Long Cove Granite Company. Tenth Census, 1880. 26176.

Hornblende granite. Coarse; red; very tough and hard. Otter Creek, Hancock County. Otter Creek quarry. Tenth Census, 1880. 27178.

Talcose schist. Fine; compact; dark gray. Knightsville, Cumberland County. P. C. Manning, 1883. 28117.

Elæolite syenite.* Coarse; light gray, yellow spotted. Near Litchfield, Kennebec County. Tenth Census, 1880.

Olivine diabase. Devonian (?); medium; dark gray, nearly black on a polished surface; used for monumental work. Addison Point, Washington County. Col. Edward Clark, 1881. 25022.

— Devonian; medium; dark gray, spotted black and white on a polished surface; known commercially as black granite, and is used largely for monumental work. Six miles southeast of Addison Point, Washington County. Pleasant River Black Granite Company. Tenth Census, 1880. 25925.

Diabase. Devonian (?); medium; dark gray, spotted black and white on a polished surface; known commercially as black granite, and is largely used for monumental work. Addison, Washington County. H. B. Nash's quarry. Tenth Census, 1880. 26072.

— Fine and compact; very dark gray, black on a polished surface; used chiefly for monumental work. Vinal Haven, Knox County. Bodwell Granite Company. Tenth Census, 1880. 26167.

Slate. Blue-black. Monson, Piscataquis County. Quarries of Monson Pond Slate Company. Tenth Census, 1880. 25651.

— Blue-black. Brownville, Piscataquis County. Quarry of Adams H. Merrill. Tenth Census, 1880. 25652.

— Blue-black. Monson, Piscataquis County. Quarries of Dirigo Slate Company. 25819.

MARYLAND.

Steatite [soapstone]. Coarse; rust spotted. Bethesda, Montgomery County. C. W. Lansdale. 25016.

— Fine and compact; dark blue-gray. On Liberty road, about 15 miles from Baltimore. Quarries of Baltimore and North Branch Soapstone Company. Tenth Census, 1880. 26628.

Serpentine. Light and dark green, streaked and mottled; fine grained and compact; takes a high polish. Five specimens; one 12½ by 4½ by ½ inches, polished on both sides; one 5 by 3½ by 1½ inches; and three 4 inch cubes. Dublin, Harford County. Quarries of Green Serpentine Marble Company. E. Mortimer Bye, 1881. 26173.

* The elæolite syenite is not used for building purposes, and is of doubtful utility.

Serpentine. Dark green; very fine and compact; takes a high polish. Deer Creek, Harford County. Deer Creek quarries. Tenth Census, 1880. 26868.

— Light and dark green, mottled; fine and compact; takes a high polish. 6 by 6 by 3 inches. Broad Creek, Harford County. Centennial, 1876. 17514.

— Compact; dark green; takes a high polish. 6-inch cube. Broad Creek, Harford County. Centennial, 1876. 17517.

— Dark green; fine and compact; takes only a dull polish. Near Baltimore. G. A. Leakin, 1883. 27682.

Biotite gneiss. Coarse; gray. Port Deposit, Cecil County. Quarry of McClenahan & Bro. Tenth Census, 1880. 25359.

— Light gray; fine and medium. Two specimens. Near Baltimore City, Baltimore County. J. Harris's quarry. Tenth Census, 1880. 25576.

— Coarse; dark gray. Opposite Ellicott City, Baltimore County. C. J. Werner's quarry. Tenth Census, 1880. 25358.

— Fine; light and dark gray. Two specimens. Jones Falls road, Mount Royal, Baltimore County. J. Curley's quarry. Tenth Census, 1880. 26930.

Biotite granite. Medium; gray. Near Woodstock, Baltimore County. W. F. Weller's quarry. Tenth Census, 1880. 25361.

— Medium; gray. Near Woodstock, Baltimore County. Fox Rock quarry. Tenth Census, 1880. 25360.

— Coarse; gray. Granite, Baltimore County. Quarry of Gill & McMahon. Tenth Census, 1880. 25403.

— Fine; gray. Gwynn's Falls, Baltimore County. Old Winan estate. Tenth Census, 1880. 26867.

— Fine; light gray. Montrose, Montgomery County. H. P. Dwyer's quarry. Tenth Census, 1880. 26947.

Dolomite [marble]. Lower Silurian; white; crystalline. Texas, Baltimore County. A block from the top stone of the Washington Monument. Barney Mooney, 1884. 36050.

— Lower Silurian; white; crystalline. Cockeysville, Baltimore County. Beaver Dam Marble Company. Tenth Census. 27062.

— Lower Silurian; white; crystalline. Cockeysville, Baltimore County. Colonel Clark, 1881. 25206.

— Lower Silurian; white; crystalline. Cockeysville, Baltimore County. Tenth Census, 1880. 25015.

— Lower Silurian; white; crystalline. Cockeysville, Baltimore County. Tenth Census, 1880. 25003.

Magnesian limestone [marble]. White, with purple stripes; crystalline. New Windsor, Carroll County. William N. Chew's quarry. Tenth Census. 26931.

— Light blue-gray; crystalline. Near New Windsor, Carroll County. A. A. Roop's quarry. Tenth Census, 1880. 26807.

— Gray; laminated. Keedysville, Washington County. John Snear's quarry. Tenth Census, 1880. 26205.

— White; crystalline. Union Bridge, Frederick County. D. Rinehardt's quarry. Tenth Census, 1880. 26829.

— Union Bridge, Frederick County. D. Rinehardt's quarry. Tenth Census, 1880. 26830.

Conglomerate breccia [marble]. Triassic; red, variegated. Frederick County. Slab 20 by 30 by 1½ inches. Used in the interior decorations of the Capitol at Washington, D. C. Col. Edward Clark, 1881. 28744.

- Conglomerate breccia [marble].** Triassic; coarse; red, variegated. Near Frederick, Frederick County. Gertzendanner's quarry. Tenth Census, 1880. 26797.
- Siliceous limestone.** Fine black. Liberty Pike, Frederick County. Hoke's quarry. Tenth Census, 1880. 25996.
- Magnesian limestone.** Lower Silurian; fine; dark. Hagerstown, Washington County. T. G. Jones's quarry. Tenth Census, 1880. 26055.
- Biotite epidote gneiss.** Fine; light red. Ilchester, Howard County. Tenth Census, 1880. 26856.
- Hornblende gneiss.** Fine; very dark gray, nearly black. Ilchester, Howard County. Tenth Census, 1880. 26855.
- Sandstone.** Fine; light drab. Seneca, Montgomery County. Tenth Census. 25013.
- Fine; light red; used for building purposes in Washington, D. C. Seneca, Montgomery County. Tenth Census. 25016.
- Nearly white; medium. Frederick County. J. L. Belt's quarry. Tenth Census, 1880. 25678.
- Devonian; coarse; yellow. Cumberland, Allegany County. Shriver's quarry. Tenth Census. 26839.
- Devonian; coarse; yellow. Cumberland, Allegany County. Green Street quarry. Tenth Census. 26840.
- Lower Silurian; coarse; light colored. Cumberland, Allegany County. William Lippold's quarry. 26841.
- Slate.** Blue-black. Slab 6½ inches square. Harford County. Quarries of Harford Peach Bottom Slate Company. Tenth Census, 1880. 25364.
- Blue-black. Slab 6½ inches square. Harford County. Quarries of Harford Peach Bottom Slate Company. Tenth Census, 1880. 25365.
- Blue-black. Slab 6 inches square. Harford County. Quarry of J. W. Jones & Co. Tenth Census, 1880. 25366.
- Blue-black. Slab 6 inches square. Harford County. Quarry of T. W. Jones. Tenth Census. 25367.
- Blue-black. Harford County. Quarries of Harford Peach Bottom Slate Company. Tenth Census, 1880. 26411.
- Blue-black. Harford County. Quarries of Harford Peach Bottom Slate Company. Tenth Census, 1880. 26410.
- Purple. 4 by 4 by 2 inches. Ijamsville, Frederick County. Quarries of Maryland Slate Company. Tenth Census, 1880. 26932.
- Blue-black. Slab 8 inches square. Harford County. Quarry of W. E. Williams & Co. Tenth Census, 1880. 25362.
- Blue-black. Slab 8 inches square. Harford County. Quarry of W. C. Roberts & Co. Tenth Census, 1880. 25363.
- Bracket of carved slate.** 10 by 8 inches. Harford County. Quarries of Harford Peach Bottom Slate Company. Tenth Census, 1880. 26412.

MASSACHUSETTS.

- Steatite [soapstone].** Coarse; dark gray. Two miles southeast of Dana, Worcester County. Quarry of Kimball, Osgood & Co. Tenth Census, 1880. 26439.
- Serpentine.** Compact; very dark green, nearly black; takes but a dull polish. 6-inch cube. Essex County. 25026.
- Compact; very light green; takes a dull polish. Newburyport, Essex County. Centennial, 1876. 26010.
- Deep green, nearly black; fine and compact; takes but a dull polish. Lynnfield, Essex County. Quarries of Lynnfield Soapstone Company. Tenth Census, 1880. 26554.

Dolomite [marble]. Lower Silurian; pure white; crystalline. Lee, Berkshire County. Tenth Census, 1880. 25012.

— Lower Silurian; white; crystalline. Lee, Berkshire County. Quarry of F. S. Gross. Tenth Census, 1880. 26070.

Magnesian limestone. Lower Silurian; gray; coarse; crystalline. Pittsfield, Berkshire County. Tenth Census. 26057.

Magnesian limestone [marble]. Lower Silurian; white; coarsely crystalline. Lee, Berkshire County. Tenth Census, 1880. 27004.

— Lower Silurian; white; crystalline. Egremont, Berkshire County. Centennial, 1876. 17426.

— Lower Silurian; gray; fine and compact. Stockbridge, Berkshire County. Tenth Census, 1880. 26069.

— Lower Silurian; white; coarsely crystalline. Sheffield, Berkshire County. Quarry of Briggs & Co. Tenth Census, 1880. 26081.

Limestone [marble]. Lower Silurian; white; crystalline. Aiford, Berkshire County. Centennial, 1876. 17437.

— Lower Silurian; white; clouded. Alford, Berkshire County. H. S. Fitch's quarry. Tenth Census, 1880. 26082.

Hornblende granite. Coarse; dark gray. Two specimens. Quincy, Norfolk County. Quarry of C. H. Hardwick & Co. Tenth Census, 1880. 25609.

— Coarse; dark gray. Quincy, Norfolk County. Quarry of Wendell & Co. Tenth Census, 1880. 25610.

— Coarse; pinkish gray. Quincy, Norfolk County. Quarry of Wendell & Co. Tenth Census, 1880. 25611.

— Coarse; dark gray. Quincy, Norfolk County. Quarry of Field & Wild. Tenth Census, 1880. 25616.

— Medium; light gray. 6-inch cube. Quincy, Norfolk County. Centennial, 1876. 17430.

— Coarse; dark gray. 6-inch cube. Quincy, Norfolk County. Centennial, 1876. 17432.

— Coarse; dark gray. 6-inch cube. Quincy, Norfolk County. Centennial, 1876. 17433.

— Coarse; dark gray. Quincy, Norfolk County. Quarry of Barker & Sons. Tenth Census, 1880. 25606.

— Coarse; dark gray. Two specimens. Quincy, Norfolk County. Quarry of C. H. Hardwick & Co. Tenth Census, 1880. 25608.

— Coarse; dark gray. Quincy, Norfolk County. Quarry of McKenzie & Patterson. Tenth Census, 1880. 26973.

— Coarse; light pinkish gray. Quincy, Norfolk County. Centennial, 1876. 26002.

— Coarse; dark red. Quincy, Norfolk County. Quarry of H. Barker & Son. G. P. Merrill. 28554.

— Coarse; dark pinkish gray. Polished slab 35 by 35 by 3 inches. Quincy, Norfolk County. Quarry of H. Barker & Sons. Tenth Census, 1880. 26938.

— Coarse; dark gray. 6-inch cube. Quincy, Norfolk County. Centennial, 1876. 17449.

— Coarse; dark gray. Two specimens. Quincy, Norfolk County. Quarry of McKenzie & Patterson. Tenth Census, 1880. 25607.

— Coarse; dark gray. 6-inch cube. Quincy, Norfolk County. Centennial, 1876. 17435.

— Coarse; dark gray. Quincy, Norfolk County. Centennial, 1876. 17436.

Hornblende granite. Coarse; dark gray. 6-inch cube. Quincy, Norfolk County. Centennial, 1876. 17423.

— Coarse; gray. 6-inch cube. Quincy, Norfolk County. Centennial, 1876. 17425. www.libtool.com.cn

— Coarse; dark gray. 6-inch cube. Quincy, Norfolk County. Centennial, 1876. 17427.

— Coarse; dark gray. Quincy, Norfolk County. Centennial, 1876. 17429.

— Coarse; gray. West Quincy, Norfolk County. Quarry of F. J. Fuller & Co. Tenth Census, 1880. 25604.

— Coarse; dark gray. West Quincy, Norfolk County. Quarry of O. T. Rogers & Co. Tenth Census, 1880. 25605.

— Coarse; dark gray. West Quincy, Norfolk County. C. Wilson's quarry. Tenth Census, 1880. 25617.

Epidote granite. Fine; light pink, green spotted. Dedham, Norfolk County. Bullard's quarry. Tenth Census, 1880. 26386.

— Fine; light pink, green spotted. Dedham, Norfolk County. J. Delaney's quarry. Tenth Census, 1880. 26387.

Biotite granite. Coarse; light gray, slightly pinkish. Randolph, Norfolk County. Quarry of S. B. Corliiss. Tenth Census, 1880. 25594.

Muscovite gneiss. Fine; gray. Westford, Middlesex County. Quarry of B. Palmer & Sons. Tenth Census, 1880. 26456.

— Gray; finely porphyritic. Westford, Middlesex County. S. Fletcher's quarry. Tenth Census, 1880. 26457.

— Fine; light gray. Westford, Middlesex County. A. Fletcher's quarry. Tenth Census, 1880. 26458.

— Fine; gray. Westford, Middlesex County. W. Reed's quarry. Tenth Census, 1880. 26460.

— Fine; gray. Westford, Middlesex County. D. Reed's quarry. Tenth Census, 1880. 26461.

— Fine; gray. Westford, Middlesex County. D. Reed's quarry. Tenth Census, 1880. 26462.

— Coarse; gray. West Andover, Essex County. J. Maddox's quarry. Tenth Census, 1880. 26595.

— Coarse; light gray. Lawrence, Essex County. J. Moulton's quarry. Tenth Census, 1880. 26547.

— Medium; light gray. Charlton, Worcester County. Quarry of Lamson & Woodbury. Tenth Census, 1880. 25929.

— Fine; light gray. Monson, Hampden County. Quarry of W. N. Flint & Co. Tenth Census, 1880. 25911.

Muscovite biotite gneiss. Fine; light gray. Westford, Middlesex County. Quarry of Swett & Smith. Tenth Census, 1880. 26459.

Biotite gneiss. Fine; gray; slightly pinkish. Westford, Middlesex County. W. Reed's quarry. Tenth Census, 1880. 25544.

— Coarse; dark gray. Lowell, Middlesex County. S. L. Ward's quarry. Tenth Census, 1880. 26071.

— Coarse; light gray. 6-inch cube. Douglass, Worcester County. Centennial, 1876. 17431.

— Coarse; gray. Northbridge, Worcester County. Quarry of S. J. Fowler, jr. Tenth Census, 1880. 26194.

Biotite gneiss. Fine; dark gray. Monson, Hampden County. Quarry of W. N. Flint & Co., Mass. Tenth Census, 1880. 25910.

— Fine; light gray. Northfield, Franklin County. Quarry of Bassett & Lyons. Tenth Census, 1880. 25944.

Biotite granite. Coarse; light pink. Framingham, Middlesex County. J. G. Cloyse's quarry. Tenth Census, 1880. 26425.

— Coarse; light pinkish gray. Framingham, Middlesex County. J. G. Cloyse's quarry. Tenth Census, 1880. 26426.

— Coarse; gray. Framingham, Middlesex County. J. G. Cloyse's quarry. Tenth Census. 26428.

— Coarse; pinkish gray, with green blotches. North Easton, Bristol County. M. Gilbert's quarry. Tenth Census, 1880. 26918.

— Coarse; pink. North Easton, Bristol County. Quarry of Ames & Son. Tenth Census, 1880. 26821.

— Coarse; light gray. Freetown, Bristol County. Fall River Granite Company. Tenth Census, 1880. 25578.

— Coarse; light pink. Near Milford, Worcester County. Quarry of Norcross Brothers. Tenth Census, 1880. 26767.

— Coarse; light pink. Used in the construction of the new city hall at Albany, N. Y. Milford, Worcester County. J. S. Sherman's quarry. Tenth Census, 1880. 26648.

— Medium; light gray with greenish blotches. Near Milford, Worcester County. Boston and Albany Railroad Company. Tenth Census, 1880. 26505.

— Fine; dark gray. Leominster, Worcester County. S. L. Kittridge's quarry. Tenth Census, 1880. 26400.

— Fine; dark gray. Clinton, Worcester County. L. M. Allen's quarry. Tenth Census, 1880. 26399.

— Coarse; light pink. Brockton, Plymouth County. W. T. Cleaveland's quarry. Tenth Census, 1880. 25579.

Hornblende biotite (annite) granite. Coarse; light gray; slightly greenish. Gloucester, Essex County. S. P. Andrews's quarry. Tenth Census, 1880. 25500.

Hornblende granite. Coarse; gray; slightly pinkish. Gloucester, Essex County. Centennial, 1876. 25287.

— Coarse; gray. Gloucester, Essex County. Trumbull Granite Company. Tenth Census, 1880. 25501.

— Coarse; light greenish gray. Used in the construction of the Butler house on Capitol Hill, Washington, D. C. Gloucester, Essex County. Cape Ann Granite Company. Tenth Census, 1880. 26545.

— Coarse; gray. Gloucester, Essex County. Cape Ann Granite Company. Tenth Census, 1880. 26544.

— Coarse; gray. Two specimens. Gloucester, Essex County. Quarry of Barker Brothers. Tenth Census, 1880. 26553.

— Coarse; greenish gray. Gloucester, Essex County. Lanesville Granite Company. Tenth Census, 1880. 26955.

— Coarse; light greenish gray. Wyoma, Essex County. J. R. Jordan's quarry. Tenth Census, 1880. 26637.

— Coarse; greenish gray. Wyoma, Essex County. J. D. Wilson's quarry. Tenth Census, 1880. 26638.

— Coarse; dark gray. Rockport, Essex County. Lanesville Granite Company. Tenth Census, 1880. 26953.

— Coarse; gray. Rockport, Essex County. Rockport Granite Company. Tenth Census, 1880. 26923.

Hornblende granite. Coarse; gray. Rockport, Essex County. Pigeon Hill Granite Company. Tenth Census, 1880. 26546.

— Coarse; greenish. Peabody, Essex County. Quarry of Putnam & Linneham. Tenth Census, 1880. 25757.

Muscovite biotite granite. Coarse; light gray. Worcester, Worcester County. G. D. Webb's quarry. Tenth Census, 1880. 26440.

Biotite muscovite granite. Coarse; light gray. Fitchburg, Worcester County. S. P. Litchfield's quarry. Tenth Census, 1880. 25862.

— Medium; light gray. 6-inch cube. Fitchburg, Worcester County. Centennial, 1876. 17438.

— Fine; dark gray. Becket, Berkshire County. Chester Granite Company. Tenth Census, 1880. 26107.

— Fine; gray. Becket, Berkshire County. Quarry of McClellan & Goodwin. Tenth Census, 1880. 26108.

Granite. Coarse; light pinkish, with green blotches. Wood's Holl, Barnstable County. U. S. Fish Commission. 26885.

Quartz porphyry. Dark red, with pink spots; fine and compact. Slab 4 by 6 inches. Hingham, Plymouth County. George P. Merrill, 1884. 35943.

This is a most beautiful and durable stone, but is at present scarcely at all used on account of its hardness.

Diabase. Coarse; dark gray. Used for pavements and the rough work of foundations. Medford, Middlesex County. Medford quarry. Tenth Census, 1880. 26422.

— Coarse; dark gray. Used for pavements and the rough work of foundations. Medford, Middlesex County. Medford quarry. Tenth Census, 1880. 26424.

— Coarse; light gray, with pink spots. Used for pavements, building, and monumental work. Somerville, Middlesex County. E. Fitzgerald's quarry. Tenth Census, 1880. 26549.

— Coarse; light gray, with pink spots. Used for pavements, building, and monumental work. Somerville, Middlesex County. E. Fitzgerald's quarry. Tenth Census, 1880. 26550.

— Mesozoic; dark greenish gray; fine and compact. Used chiefly for street pavements. East Long Meadow, Hampden County. Centennial, 1876. 17446.

Melaphyr. Compact; amygdaloidal; dark green, with rounded and oval spots of light green and white. Used for foundations and rough construction. Brighton, Suffolk County. Quarry of S. W. Brown, jr. Tenth Census. 26552.

Sandstone. Triassic; fine; brown. Used extensively for general building and trimming purposes. East Long Meadow, Hampden County. Centennial, 1876. 17440.

— Triassic; fine; brown. Used as above. East Long Meadow, Hampden County. Centennial, 1876. 17443.

— Triassic; fine; brown. East Long Meadow, Hampden County. Centennial, 1876. 17444.

— Triassic; fine; light brown. Long Meadow, Hampden County. Centennial, 1876. 17445.

Conglomerate. Coarse; greenish; very compact. Used for general building purposes. Dorchester, Suffolk County. Owen Nason's quarry. Tenth Census, 1880. 26746.

MICHIGAN.

Limestone. Devonian; drab; fossiliferous. Sibley's Station, Wayne County. F. Sibley's quarry. Tenth Census, 1880. 26206.

Limestone. Devonian; gray. Near Raisinville, Monroe County. Fritz Rath's quarry. Tenth Census, 1880. 26207.

Granite. Fine; light red. Near Vulcan, Menominee County. F. L. Lasier's quarry. Tenth Census, 1880. 27343.

Biotite gneiss. Coarse; gray. Near Vulcan, Menominee County. F. L. Lasier's quarry. Tenth Census, 1880. 27345.

Sandstone. Potsdam; light brown gray spotted; medium. Marquette, Marquette County. Centennial 1876. 18927.

— Potsdam; fine; reddish brown. Marquette, Marquette County. Watson & Palmer's quarry. John S. F. Batchen. 27510.

— Potsdam; dark brown; medium. Marquette, Marquette County. Quarry of Wolf, Jacobs & Co. John S. F. Batchen. 28501.

— Potsdam; fine; brown and reddish brown. Two specimens. Near L'Anse, Houghton County. L'Anse Brownstone Company. John S. F. Batchen. 27356.

— Potsdam; brown with gray bands; medium. L'Anse, Houghton County. L'Anse Brownstone Company. John S. F. Batchen. 27528.

— Potsdam. Brown with gray spots; medium. Near L'Anse, Houghton County. L'Anse Brownstone Company. John S. F. Batchen. 27522.

— Sub-Carboniferous; fine; light yellowish brown. Stoney Point, Jackson County. Michigan Stone Company. John S. F. Batchen. 28500.

— Potsdam; fine; red. Portage entry, Baraga County. Portage Entry quarry. John S. F. Batchen. 28655.

— Potsdam; fine; reddish brown. Isle Royale, Lake Superior. John S. F. Batchen. 34992.

Quartzite. Light-colored; fine and compact. Two specimens, 18 by 9 by 7 inches and 4 inch cube. Near Vulcan, Menominee County. F. L. Lasier's quarry. Tenth Census, 1880. 27344.

Slate. Blue black. Slab 8 inches square. Huron Bay. Centennial 1876. 26036.

— Blue black. Arvon, Baraga County. Clinton quarry. J. S. F. Batchen, 1883. 27342.

MINNESOTA.

Dolomite. Lower Silurian; coarse; drab; vesicular. Stillwater, Washington County. Quarry of Hersey, Staples & Hall. Tenth Census, 1880. 26644.

— Lower Silurian; light buff; fine; compact. Stillwater, Washington County. Quarry of Hersey, Staples & Hall. Tenth Census, 1880. 26646.

— Lower Silurian; light-colored; finely vesicular. Two specimens. Frontenac, Goodhue County. Quarry of Postevin & Co. Tenth Census, 1880. 26755.

— Lower Silurian; light-colored; vesicular. Red Wing, Goodhue County. G. A. Carlson's quarry. Tenth Census, 1880. 26754.

— Lower Silurian; light-colored; coarse; vesicular. Red Wing, Goodhue County. R. L. Berghind's quarry. Tenth Census, 1880. 26725.

— Lower Silurian; fine; reddish. Kasota, Le Sueur County. Quarry of Breen, Young & Co. Tenth Census, 1880. 25965.

— Lower Silurian; fine; light buff. Kasota, Le Sueur County. J. W. Babcock's quarry. Tenth Census, 1880. 25904.

— Lower Silurian; coarse; buff. Two specimens. Mankato, Blue Earth County. O. R. Mather's quarry. Tenth Census, 1880. 25821.

— Lower Silurian; drab; compact. Winona, Winona County. C. M. Porter's quarry. Tenth Census, 1880. 26732.

Siliceous dolomite. Lower Silurian; light drab; vesicular. Stillwater, Washington County. Quarry of Hersey, Staples & Hall. Tenth Census, 1880. 26645.

— Lower Silurian; gray; fossiliferous. Minneapolis, Hennepin County. Quarry of Foley & Herbert. Tenth Census, 1880. 25825.

— Lower Silurian; gray; finely fossiliferous; compact. Clinton Falls, Steele County. Quarry of Lindersmith & Son. Tenth Census, 1880. 26758.

— Lower Silurian; light-colored; cellular. Mantorville, Dodge County. Quarry of Hook, Mantor & Dorg. Tenth Census, 1880. 26689.

Magnesian limestone. Lower Silurian; gray; fossiliferous. Saint Paul, Ramsey County. Quarry of Breen & Young. Tenth Census, 1880. 26288.

— Lower Silurian; gray; fossiliferous. Minneapolis, Hennepin County. A. Dahl's quarry. Tenth Census, 1880. 25871.

— Lower Silurian; very light drab; fine; compact; dedritic. Red Wing, Goodhue County. W. W. Sweeney's quarry. Tenth Census, 1880. 26724.

Siliceous magnesian limestone. Lower Silurian; gray; fossiliferous. Saint Paul, Ramsey County. W. Dawson's quarry. Tenth Census, 1880. 26743.

— Lower Silurian; drab; coarsely fossiliferous. Minneapolis, Hennepin County. Jas. Baxter's quarry. Tenth Census, 1880. 25831.

Limestone. Lower Silurian; gray; fossiliferous. Two specimens. Minneapolis, Hennepin County. W. W. Eastman's quarry. Tenth Census, 1880. 25824.

— Lower Silurian; gray; finely fossiliferous; compact. Cañon City, Rice County. Philip Cromer's quarry. Tenth Census, 1880. 26757.

— Lower Silurian; pinkish. Near Kasota, Le Sueur County. J. S. F. Batchen, 1884. 34994.

Calcareous dolomite. Lower Silurian; gray; finely fossiliferous; compact. Cañon City, Rice County. Philip Cromer's quarry. Tenth Census, 1880. 26756.

Hornblende granite. Coarse; dull red. East Saint Cloud, Sherburne County. Quarry of Breen & Young. Tenth Census, 1880. 26289.

— Coarse; gray. East Saint Cloud, Sherburne County. Quarry of Breen & Young. Tenth Census, 1880. 26290.

— Medium; gray. East Saint Cloud, Sherburne County. Quarry of Breen & Young. Tenth Census, 1880. 25964.

— Medium; gray. Sauk Rapids, Benton County. G. S. Reader's quarry. Tenth Census, 1880. 25743.

Granite. Coarse; red. Four miles below Beaver Bay, Lake County. Tenth Census, 1880. 26518.

— Medium; dull red. Beaver Bay, Lake County. Quarry of Wieland Bros. Tenth Census, 1880. 26633.

Hornblende mica granite. Coarse; gray. Watab, Benton County. Quarry of Saulpaugh & Bros. Tenth Census, 1880. 25822.

— Coarse; dull red. Watab, Benton County. Centennial, 1876. 26000.

— Coarse; red. 14 by 11 by 9. Watab, Benton County. H. D. Gurney, 1885. 37605.

— Coarse; dull red. Watab, Benton County. Quarry of Saulpaugh & Bros. Tenth Census, 1880. 25823.

Quartz porphyry. Reddish brown. Baptism River, Lake County. Tenth Census, 1880. 26629.

— Dark reddish brown. Duluth, Saint Louis County. Tenth Census, 1880. 26438.

Diabase. Nearly black; very fine and compact. Duluth, Saint Louis County. Tenth Census, 1880. 26442.

Diabase. Nearly black; very fine and compact. Used for foundations and rough construction. Near Duluth, Saint Louis County. United States Government Survey. Tenth Census, 1880. 26567.

— Nearly black; fine and compact. Two Harbor Bay, Lake Superior, Lake County. Tenth Census, 1880. 26634.

Gabbro. Coarse; dark gray. Used for house trimmings and general building. Duluth, Saint Louis County. Tenth Census, 1880. 26443.

This stone is commercially known as *Duluth granite*.

Massive labradorite. Coarse; compact; light greenish. Three miles East of Beaver Bay, Lake County. Tenth Census, 1880. 26571.

Olivine diabase. Lower Silurian; nearly black; fine and compact. Used for foundations and rough construction. Taylor's Falls, Chisago County. Tenth Census, 1880. 26591.

Sandstone. Lower Silurian; fine; brown with light spots. Fond du Lac, Saint Louis County. J. G. McDonald's quarry. Tenth Census, 1880. Two specimens. 26446.

— Lower Silurian; fine; brown with light spots. Fond du Lac, Saint Louis County. M. Boyles quarry. Tenth Census. 26447.

— Lower Silurian; fine; very light colored. Hinckley, Pine County. Saint Paul and Duluth Railroad. Tenth Census. 26636.

— Lower Silurian; fine and friable; light-colored with ferruginous blotches. Jordan, Scott County. Phillip Kipp's quarry. Tenth Census. 26686.

— Lower Silurian; fine, friable; very light buff with ferruginous blotches. Jordan, Scott County. Phillip Kipp's quarry. Tenth Census. 26687.

— Lower Silurian; light-colored; fine and friable. Dakota, Winona County. Quarry of Brown & Hartley. Tenth Census. 26723.

— Lower Silurian; gray; fine and friable. Dresbach, Winona County. Quarry of J. F. Fostevin, jr. 26827.

— Purplish brown; medium. Luverne, Rock County. John S. F. Batchen. 27407.

— Lower Silurian; fine; yellow. Mendota, Dakota County. Quarry of Steele & McIntyre. Tenth Census. 26772.

Quartzite. Potsdam; maroon; fine and compact. Courtland, Nicollet County. Fritz Meyerding's quarry. Tenth Census. 26688.

Slate. Greenish. 4 by 4 by 1 inches. Near Knife Falls, Carlton County. Saint Paul and Duluth Railroad. Tenth Census, 1880. 26488.

MISSISSIPPI.

Limestone. Gray; finely fossiliferous; compact. Tishomingo County, 1885. 37580.

Sandstone. Very light yellow; fine; cellular. Tishomingo County. 37581.

— Light colored; soft and friable. Tishomingo County. 37599.

— Light colored; medium. Foot cube. Stonington, Jefferson County. 37820.

Sandstone, argillaceous. Fine; yellow. Rankin County. 37598.

MISSOURI.

Magnesian limestone [marble]. Red; white spotted. Slab 7 by 5 by 1 inches. Iron County. Centennial, 1876. 27123.

— Dull red; variegated. Sec. 36, T. 33, R. 52, Madison County. Cedar Creek quarry. Tenth Census, 1880. 26607.

Limestone. Sub-Carboniferous; drab; fine and compact. Saint Louis. Quarry of Schranka & Veith. Tenth Census, 1880. 26701.

- Limestone.** Sub-Carboniferous; drab; finely fossiliferous. Saint Louis. Quarry of Bambrick & Morihan. Tenth Census, 1880. 26713.
- Sub Carboniferous; light gray; fine and compact. Saint Louis. John McKenna's quarry. Tenth Census, 1880. 26714.
- Sub-Carboniferous; drab; fine and compact. Near Saint Louis, Saint Louis County. George Redemeyer's quarry. Tenth Census, 1880. 26716.
- Sub-Carboniferous; drab; fine; compact; semi-crystalline. Near Saint Louis, Saint Louis County. George Redemeyer's quarry. Tenth Census, 1880. 26717.
- Sub-Carboniferous; drab; fine-grained; compact; fossiliferous. Saint Louis, Saint Louis County. Diederich Scharinghaus's quarry. Tenth Census, 1880. 26718.
- Sub-Carboniferous; light colored; fine-grained; compact. Saint Louis. J. O'Meara's quarry. Tenth Census, 1880. 26722.
- Light colored; semi-crystalline; fossiliferous. Near Glencoe, Saint Louis County. Glencoe Lime Company. Tenth Census, 1880. 26303.
- Sub-Carboniferous; light colored; semi-crystalline; fossiliferous. Near Glencoe, Saint Louis County. Oliver's quarry. Tenth Census, 1880. 26304.
- Coarse; buff; fossiliferous. Glencoe Branch, Saint Louis County. Oliver's quarry. Tenth Census, 1880. 26773.
- Sub-Carboniferous; light colored; finely fossiliferous. Barrett's Station, Saint Louis County. J. Bambrick's quarry. J. S. F. Batchen, 1884. 35698.
- Sub-Carboniferous; dark; fine and compact. Boonville, Cooper County. Russell's quarry. Tenth Census, 1880. 25679.
- Gray; finely fossiliferous. Carthage, Jasper County. Lime quarry. Tenth Census, 1880. 26564.
- Carboniferous; dark buff mottled; fossil-bearing. Kansas City, Jackson County. James Dowling's quarry. Tenth Census, 1880. 25393.
- Light colored; fine-grained; compact. Carthage, Jasper County. Railroad Bridge quarry. Tenth Census, 1880. 26565.
- Sub-Carboniferous; light gray; fossiliferous. Springfield, Greene County. Leftwick's quarry. Tenth Census, 1880. 26561.
- Sub-Carboniferous; light gray; fossiliferous. Springfield, Greene County. J. S. Phelps's quarry. Tenth Census, 1880. 26563.
- Dark; compact; fossiliferous. Neosho, Newton County. Ratliffe quarry. Tenth Census, 1880. 26657.
- Nearly white; crystalline; fossiliferous. Hannibal, Marion County. "City" quarry. Tenth Census, 1880. 26219.
- Nearly white; crystalline; fossiliferous. Bear Creek, Marion County. Hannibal, Lime County. Tenth Census, 1880. 26224.
- Potsdam; pinkish; fine and compact; takes a good polish. Near Ironton, Iron County. Rasnick's quarry. Tenth Census, 1880. 26342.
- Drab; compact; fossil-bearing. Near New London, Ralls County. Brachears's quarry. Tenth Census, 1880. 26227.
- Carboniferous; light colored; fine-grained. Pleasant Hill, Cass County. Parker's quarry. Tenth Census, 1880. 26810.
- Carboniferous; drab; fine-grained; compact. Pleasant Hill, Cass County. Parker's quarry. Tenth Census, 1880. 26811.
- Carboniferous; dark drab; fossiliferous. Near Pleasant Hill, Cass County. Cooley's quarry. Tenth Census, 1880. 26813.

Limestone. Light brown; compact; finely fossiliferous. Near Amazonia, Andrew County. Zimmerman's quarry. Tenth Census, 1880. 25600.

— Drab; fine and compact. Saint Joseph, Buchanan County. Burnes's quarry. Tenth Census, 1880. 26247.

— Gray; compact; fossiliferous. Paris, Monroe County. Robinson's quarry. Tenth Census, 1880. 26225.

— Lower Silurian; nearly white; compact; crystalline. Two specimens. Cape Girardeau, Cape Girardeau County. M. Dettlinger's quarry. Tenth Census, 1880. 26328.

Dolomite. Sub-Carboniferous; light colored; fine-grained. Saint Louis. Gottlieb Eyermann's quarry. Tenth Census, 1880. 26715.

— Sub-Carboniferous; drab; fine and compact. Saint Louis, Saint Louis County. D. Cavenagh's quarry. Tenth Census, 1880. 26721.

— Sub-Carboniferous; drab; fine and compact. City of Saint Louis, Saint Louis County. Quarry of A. O. Englemann & Co. Tenth Census, 1880. 26700.

— Lower Silurian; light colored; coarsely vesicular. Jefferson City, Cole County. H. W. Holkmeyer's quarry. Tenth Census, 1880. 25656.

— Sub-Carboniferous; bluish, drab, and buff; fine-grained; compact. Two specimens. Near Boonville, Cooper County. Stagner's quarry. Tenth Census, 1880. 25658.

— Sub-Carboniferous; yellowish brown; compact; finely fossiliferous. Sedalia, Pettis County. Richard Anderson's quarry. Tenth Census, 1880. 25653.

— Carboniferous; light colored; fine; dendritic. Sec. 2, T. 42, R. 21, Henry County. Quarry on Grand River. Tenth Census, 1880. 25695.

— Buff; fine-grained. Near Ironton, Iron County. Grayson's quarry. Tenth Census, 1880. 26322.

— Light drab; granular. Canton, Lewis County. Canton Stone Company. Tenth Census, 1880. 26361.

— Very light drab; fine and compact. Dutzow, Warren County. J. H. Schweissguth's quarry. Tenth Census, 1880. 26935.

Siliceous dolomite. Lower Silurian; light colored; fine-grained; compact. Jefferson City, Cole County. H. W. Holkmeyer's quarry. Tenth Census, 1880. 25655.

— Sub-Carboniferous; drab; fine-grained; compact. Near Sedalia, Pettis County. Balmer's quarry. Tenth Census, 1880. 25654.

— Light colored; rust-spotted; fine and compact. Jones's Station, Ralls County. Jones's quarry. Tenth Census, 1880. 26221.

— Silurian; light drab; mottled; fine-grained; compact. Near Bowling Green, Pike County. McElroy's quarry. Tenth Census, 1880. Two specimens. 26226.

— Niagara; light colored; fine; compact. Near Bowling Green, Pike County. Jacob Speer's quarry. Tenth Census, 1880. 26228.

— Carboniferous; drab; fine-grained. Near Pleasant Hill, Cass County. Powell's quarry. Tenth Census, 1880. 26812.

— Light colored; fine compact. Near Marshfield, Webster County. Mark Hubble's quarry. Tenth Census, 1880. 26655.

— Light colored; fine and compact. Stoutland, Camden County. From cut on railroad. Tenth Census, 1880. 26659.

— Light drab; fine-grained and compact. Near Hermann, Gasconade County. Quarry of J. C. Grass. Tenth Census, 1880. 25958.

Siliceous dolomite. Light colored; fine-grained; compact. Near De Soto, Jefferson County. Donnelly's quarry. Tenth Census, 1880. 26314.

— Dark spotted; coarse; vesicular. Near Osage, Osage County. Osage quarry. Tenth Census, 1880. 25657.

Magnesian limestone. Sub-Carboniferous; dark, with large light spots; fine-grained. Sedalia, Pettis County. Richard Anderson's quarry. Tenth Census, 1880. 25653.

— Carboniferous; light colored; coarsely oolitic. Near Kansas City, Jackson County. J. Bauman's quarry. Tenth Census, 1880. 25394.

— Dark spotted; fine and compact. Neosho, Newton County. Karnes's quarry. Tenth Census, 1880. 26658.

— Buff; compact; fossiliferous. Hannibal, Marion County. City quarry. Tenth Census, 1880. 26220.

— Potsdam; red with white spots; fine and compact; takes a good polish. Near Fredericktown, Madison County. Tenth Census, 1880. 26403.

Argillaceous limestone. Carboniferous; light colored and blue; fine and compact. Two specimens. Near Clinton, Henry County. C. B. Jordan's quarry. Tenth Census, 1880. 25696.

Lithographic limestone. Sub-Carboniferous; drab; fine-grained; compact. Saver-ton, Ralls County. Eureka Quarry Company. J. S. F. Batchen, 1883. 28498.

Ferruginous limestone. Drab; compact; finely fossiliferous. Near Forest City, Holt County. John Pollack's quarry. Tenth Census, 1880. 25559.

Granite. Coarse; light red. Six-inch cube. Granitesville, Iron County. W. Warren's quarry. Centennial, 1876. 25025.

— Coarse; red. Iron Township, Iron County. Centennial, 1876. 17498.

— Coarse; light red. Three and a half miles south of Iron Mountain, Iron County. Berman's quarry. Tenth Census, 1880. 26321.

— Coarse; pinkish gray. Silver Mountain, Madison County. Einstein's quarry. Tenth Census, 1880. 26594.

Biotite granite. Coarse; light red. Granitesville, Iron County. Syenite Granite Company. F. W. Mott, 1883. 27455.

— Coarse; reddish gray. Syenite, Saint François County. Syenite Granite Company. F. W. Mott, 1883. 27456.

NOTE.—The Missouri granites, as a rule, contain only traces of hornblende or mica.

Hornblende granite. Medium; gray. Six-inch cube. Knob Lick, Saint François County. Centennial, 1876. 25068.

— Medium; gray. Six-inch cube. Knob Lick, Saint François County. 25066.

Olivine diabase. Medium; dark gray. West foot of Tom Luck Mountain, Iron County. Ferguson's quarry. Tenth Census, 1880. 26333.

Calcareous sandstone. Carboniferous; light gray; medium. Warrensburgh, Johnson County. Quarry of Pickle & Bro. Tenth Census. 26936.

— Carboniferous; gray; medium. Near Warrensburgh, Johnson County. Quarry of Pickle & Bros. 25390.

— Bright red; micaceous. Two specimens. Rockville, Bates County. Quarry of Henry Brown & Co. Tenth Census. 26862.

— Carboniferous; fine; gray. Near Miami Station, Carroll County. White Rock Quarry Company. Tenth Census. 26306.

— Fine; light colored. Near Meadville, Linn County. J. Fruin's quarry. Tenth Census. 26 22.

Sandstone. Fine; very light brown. Rockville, Bates County. Tenth Census. 25688.

- Gray; rust-spotted; micaceous. Near Butler, Bates County. Currv's quarry. 25742.
- Carboniferous; fine; light gray. Clinton, Henry County. Tenth Census. 25697.
- Carboniferous; fine; very light brown. Clinton, Henry County. Tenth Census. 25698.
- Carboniferous; fine; very light buff. Clinton, Henry County. George Hapgood's quarry. Centennial, 1876. 27105.
- Brown; porous and friable. Higginsville, La Fayette County. Peter Brand's quarry. Tenth Census. 26286.
- Light colored; porous and friable. Near Brownsville, Pettis County. Collins's quarry. Tenth Census. 26287.
- Brown; rust-spotted; porous and friable. Keytesville, Chariton County. Bartz quarry. Tenth Census. 26305.
- Coarse; yellow. Near Lamar, Barton County. Jesse Bollinger's quarry. Tenth Census. 26562.
- Sub-Carboniferous; fine; very light buff. Near Saint Genevieve County. Benjamin Richardson's quarry. Tenth Census. 26685.
- Fine; light colored. Bluff on Arrow Rock road, Howard County. R. T. Kingsbury's quarry. Tenth Census. 26223.
- Light colored; nearly white. Jones Station, Ralls County. Jones's quarry. Tenth Census. 26229.
- Fine; light colored; rust-spotted. Nevada, Vernon County. City of Nevada quarry. Tenth Census. 25699.

Quartzite. Fine; gray. West Foot of Tom Luck Mountain, Iron County. Fergusson's quarry. Tenth Census, 1880. 26333.

MONTANA.

- Limestone [marble].** White, dark spotted; crystalline. Lewis and Clarke County. Centennial, 1876. 27038.
- Dolomite (?) [marble].** Dark blue-gray, with veins of dull yellow; fine; compact. Helena, Lewis and Clarke County. Centennial, 1876. 27089.
- Gray; brecciated. Helena, Lewis and Clarke County. Centennial, 1876. 27090.
- Hornblende mica granite.** Medium; light gray. Lewis and Clarke County. George McBurney, 1882. 27087.
- Coarse; greenish gray. Butte, Deer Lodge County. George P. Merrill, 1886. 38565.

NEBRASKA.

- Limestone, argillaceous.** Permian; light colored; fine and compact. Roca, Lancaster County. Quarry of Keys & Bullock. Tenth Census, 1880. 27204.
- Limestone.** Permian; light colored; finely fossiliferous. Roca, Lancaster County. Quarry of Keys & Bullock. Tenth Census, 1880. 27202.
- Permian; light colored; compact; finely fossiliferous. Roca, Lancaster County. Quarry of Keys & Bullock. Tenth Census, 1880. 27203.
- Permian; light colored; fusulina. Syracuse, Otoe County. Tenth Census, 1880. 27321.

- Limestone.** Permian(?); light colored; fusulina. Near Glen Rock, Nemaha County Quarry of Keys & Bullock. Tenth Census, 1880. 27201.
- Permian; light colored; fusulina. La Platte, Sarpy County. William A Guire's quarry. Tenth Census, 1880. 27322.

NEVADA.

- Quartz porphyry.** Very dark red with pink porphyritic feldspars. 3 by 3 by 14 inches. Near Great Bend of Carson River. J. C. Russell, U. S. Geol. Survey. 35304.
- Hornblende andesite.** Coarse; gray. Used for purposes of rough construction. Three miles east of Virginia City, Storey County. J. Barrett's quarry. Tenth Census, 1880. 25746.
- Coarse; porphyritic; light brown spotted with white. Used as above. Three miles east of Virginia City, Storey County. J. Barrett's quarry. Tenth Census, 1880. 25747.
- Medium; light gray. Used as above. Two miles west of Reno, Washoe County. Fulton's quarry. Tenth Census, 1880. 25708.
- Sandstone.** Coarse; gray. Carson City, Ormsby County. Carson quarry. Tenth Census. 25709.

NEW HAMPSHIRE.

- Steatite [soapstone].** Coarse; compact; dark gray. Franconia. Centennial, 1876. 10774.
- Biotite muscovite granite.** Fine; gray. Concord, Merrimack County. Quarry of Fuller & Pressey. Tenth Census, 1880. 25225.
- Fine; gray. Concord, Merrimack County. Quarry of Hadley & Hoyt. Tenth Census, 1880. 25226.
- Medium; gray. Concord, Merrimack County. Quarry of Donagan & Davis. Tenth Census, 1880. 26946.
- Medium; light gray. Concord, Merrimack County. A. Hollis's quarry. Tenth Census, 1880. 27031.
- Fine; gray. Concord, Merrimack County. M. H. Johnson's quarry. Tenth Census, 1880. 26945.
- Fine; gray. Concord, Merrimack County. Centennial, 1876. 17486.
- Fine; light gray. Concord, Merrimack County. Concord Granite Company. Tenth Census, 1880. 25859.
- Fine; light gray. Concord, Merrimack County. Granite Railway Company. Tenth Census, 1880. 25649.
- Fine; gray. Concord, Merrimack County. F. Hodgman's quarry. Tenth Census, 1880. 25223.
- Fine; light gray. Foot cube. Concord, Merrimack County. Centennial, 1876. 25043.
- Medium; gray. West Concord, Merrimack County. Quarry of Crowley & Quinn. Tenth Census, 1880. 25766.
- Fine; light gray. West Concord, Merrimack County. Quarry of Putney & Nutting. Tenth Census, 1880. 25222.
- Fine; light gray. West Concord, Merrimack County. G. A. Bosworth's quarry. Tenth Census, 1880. 25224.
- Medium; light gray. Allenstown, Merrimack County. C. A. Bailey's quarry. Tenth Census, 1880. 25874.
- Fine; light gray. Fitzwilliam, Cheshire County. D. H. Reed's quarry. Tenth Census, 1880. 26120.

- Biotite muscovite granite.** Fine; light gray. Fitzwilliam, Cheshire County. J. E. Fisher's quarry. Tenth Census, 1880. 25273.
- Medium; gray; indistinctly porphyritic. Fitzwilliam, Cheshire County. M. Wilson's quarry. Tenth Census, 1880. 26119.
- Fine; gray. Marlborough, Cheshire County. Centennial, 1876. 17485.
- Fine; light gray. Marlborough, Cheshire County. Tenth Census, 1880. 25238.
- Fine; gray. Troy, Cheshire County. Centennial, 1876. 17487.
- Fine; light gray. Troy, Cheshire County. Tenth Census, 1880. 25428.
- Fine; light gray. Troy, Cheshire County. L. Whitmore's quarry. Tenth Census, 1880. 25429.
- Coarse; light pink. Manchester, Hillsborough County. W. S. Locke's quarry. Tenth Census, 1880. 26168.
- Medium; gray. Rumney, Grafton County. G. D. Kenaston's quarry. Tenth Census, 1880. 26174.
- Fine; light gray. Sunapee, Sullivan County. C. E. Boyce's quarry. Tenth Census, 1880. 26421.
- Fine; light gray. Farmington, Strafford County. Richardson's quarry. Tenth Census, 1880. 26864.
- Biotite granite.** Fine; light and dark gray. Two specimens. Fitzwilliam Depot, Cheshire County. R. L. Augier's quarry. Tenth Census, 1880. 25405.
- Fine; dark gray. Fitzwilliam, Cheshire County. Centennial, 1876. 17488.
- Fine; gray. Fitzwilliam, Cheshire County. E. Blodgett's quarry. Tenth Census, 1880. 25835.
- Fine; gray. Manchester, Hillsborough County. Quarry of A. Bodwell & Son. Tenth Census, 1880. 25860.
- Fine; light gray. Manchester, Hillsborough County. H. Willey's quarry. Centennial, 1876. 25221.
- Fine; light gray. Manchester, Hillsborough County. Amoskeag County quarry. Centennial, 1876. 25220.
- Medium; light gray. Mason, Hillsborough County. J. Maxwell's quarry. Tenth Census, 1880. 25235.
- Fine; light gray. Mason, Hillsborough County. W. Braman's quarry. Tenth Census, 1880. 25236.
- Medium; gray. 6-inch cube. Mason, Hillsborough County. Centennial, 1876. 17424.
- Medium; light gray. Mason, Hillsborough County. A. McDonald's quarry. Tenth Census, 1880. 25486.
- Fine; light gray. Milford, Hillsborough County. G. F. Parker's quarry. Tenth Census, 1880. 27082.
- Medium; light gray. Milford, Hillsborough County. N. Merrill's quarry. Tenth Census, 1880. 25234.
- Fine; gray. Milford, Hillsborough County. K. Carlton's quarry. Tenth Census, 1880. 25230.
- Medium; light gray. Milford, Hillsborough County. T. King's quarry. Tenth Census, 1880. 25232.
- Fine; gray. Milford, Hillsborough County. E. Hutchinson's quarry. Tenth Census, 1880. 25233.
- Fine; light gray. Enfield, Grafton County. Quarry of P. H. Freets & Son. 25765.

- Biotite granite.** Coarse; light gray. Enfield, Grafton County. D. L. Tilton's quarry. Tenth Census, 1880. 25489.
- Medium; gray. Plymouth, Grafton County. Blair's quarry. Tenth Census, 1880. 25861. www.libtool.com.cn
- Coarse; gray. Durham, Stafford County. J. S. Abbott's quarry. Tenth Census, 1880. 26246.
- Medium; pinkish gray. Raymond, Rockingham County. Quarry of A. F. Keyes. Tenth Census, 1880. 26175.
- Muscovite biotite gneiss.** Fine; light gray, with garnets. Roxbury, Cheshire County. Keene Granite Company. Tenth Census, 1880. 26158.
- Fine; very light gray. Roxbury, Cheshire County. Quarry of Nourse & Dean. Tenth Census, 1880. 26159.
- Fine; gray. Peterborough, Hillsborough County. Peterborough Granite Works. Tenth Census, 1880. 25229.
- Medium; gray. Fitzwilliam, Cheshire County. A. Haydep's quarry. Tenth Census, 1880. 26127.
- Biotite epidote gneiss.** Coarse; pink, green-spotted. Lebanon, Grafton County. C. Freeman's quarry. Tenth Census, 1880. 25487.
- Coarse; light pink with green spots. Lebanon, Grafton County. Quarry of P. H. Freets & Son. Tenth Census, 1880. 25764.
- Biotite gneiss.** Medium; dark gray. Sunapee, Sullivan County. C. E. Boyce's quarry. Tenth Census, 1880. 26422.
- Porphyry conglomerate [quartz porphyry].** Jasper-red; hard and compact. Two specimens. One 4-inch cube. One polished slab about 13½ by 11 by 2 inches. Franconia, Grafton County. Tenth Census, 1880. 25523.

NEW JERSEY.

- Serpentine [ophiolite].** Blue-gray, with green spots. Near Montville, Morris County. J. J. Gordon's quarry. Tenth Census, 1880. 26588.
- Limestone [marble].** Pink and white; coarsely crystalline; with large crystals of pyroxene). Near Danville, Warren County. Rose Crystal Marble Company. Tenth Census, 1880. 26679.
- Dolomite.** Lower Silurian; dark blue-gray; crystalline; fine; compact. Newton, Sussex County. Newton quarries. Tenth Census, 1880. 26943.
- Gneiss.** Medium; greenish gray. Bloomingdale, Passaic County. M. J. Ryerson's quarry. Tenth Census, 1880. 26844.
- Medium; greenish gray. Dover, Morris County. Delaware, Lackawanna and Western Railroad Company. Tenth Census, 1880. 27051.
- Biotite gneiss.** Coarse; pink. Near Charlot teburgh, Passaic County. M. J. Ryerson's quarry. Tenth Census, 1880. 26845.
- Hornblende granite (?)** Coarse; gray. Near Morristown, Morris County. Tenth Census, 1880. 26956.
- Diabase.** Mesozoic dark-gray; fine and compact. Used for street pavements and general building. Jersey City, Hudson County. J. Kelton's quarry. Tenth Census, 1880. 26198.
- Mesozoic; dark gray; fine and compact. Used mostly for street pavements. Weehawken, Hudson County. M. Moore's quarry. Tenth Census, 1880. 26199.
- Mesozoic; medium; gray. West New York, Hudson County. Used chiefly for street pavements and road ballast. D. Heft's quarry. Tenth Census, 1880. 26200.

Diabase. Mesozoic; fine; dark gray. Lambertville, Hunterdon County. Used as above. G. Bancroft's quarry. Tenth Census, 1880. 26771.

— Mesozoic; medium; gray. Rock Church, Hunterdon County. Used as above. J. H. Murphy's quarry. Tenth Census, 1880. 26971.

— Mesozoic; very fine; dark gray. Rocky Hill, Somerset County. Used as above. J. R. Howell's quarry. Tenth Census, 1880. 26843.

Sandstone. Triassic; fine; brown. Two specimens. Belleville, Essex County. J. B. I. Robinson's quarry. Tenth Census. 26251.

— Triassic; medium; brown. Belleville, Essex County. Quarry of William J. Joyce. Tenth Census. 26256.

— Triassic; fine; brown. Two specimens. Belleville, Essex County. Quarry of William J. Joyce. Tenth Census. 26257.

— Triassic; fine; brown. Belleville, Essex County. Quarry of A. Philip & Son. Tenth Census. 26258.

— Triassic; fine; brown. Belleville, Essex County. Quarry of A. Philip & Son. Tenth Census. 26259.

— Triassic; fine; brown. Belleville, Essex County. Quarry of A. Philip & Son. Tenth Census. 26260.

— Triassic; medium; brown. Belleville, Essex County. J. B. I. Robinson's Quarry. Tenth Census. 26252.

— Triassic; medium; brown. Newark, Essex County. Newark Quarry Company. Tenth Census. 26253.

— Triassic; fine; brown. Newark, Essex County. Newark Quarry Company. Tenth Census. 26254.

— Triassic; fine; brown. Newark, Essex County. Quarry of Kocher Brothers. Tenth Census. 26255.

— Triassic; coarse; brown. Orange Mountain, Essex County. Quarry of James Bell & Co. Tenth Census. 26740.

— Triassic; fine; brown. Avondale, Essex County. Belleville Stone Company. Tenth Census. 26694.

— Triassic; fine; brown. Pleasant Valley, West Orange, Essex County. F. W. Shrump's quarry. Tenth Census. 26737.

— Triassic; fine; very light brown. Pleasant Valley, West Orange, Essex County. F. W. Shrump's quarry. Tenth Census, 1880. 26738.

— Triassic; fine; brown. Paterson, Passaic County. William P. Hartley's quarry. Tenth Census. 26586.

— Triassic; fine; brown. Little Falls, Passaic County. Quarry of J. C. & R. Stanley. Tenth Census. 26613.

— Triassic; fine; brown. Little Falls, Passaic County. Quarry of J. C. & R. Stanley. Tenth Census. 26614.

— Triassic; fine; light brown. Little Falls, Passaic County. Quarry of J. C. & R. Stanley. Tenth Census. 26615.

— Triassic; fine; gray. Little Falls, Passaic County. Quarry of J. C. & R. Stanley. Tenth Census. 26616.

— Triassic; fine; French gray. Martinville, Somerset County. Quarry of William E. Bartle & Bro. Tenth Census. 26739.

— Triassic; fine; dark blue-gray. Milford, Hunterdon County. Smith Clark's quarry. Tenth Census. 26768.

— Triassic; coarse; light colored. Stockton, Hunterdon County. Peter Best's quarry. Tenth Census. 26769.

- Sandstone.** Triassic; coarse; light colored. Stockton, Hunterdon County. J. Sillery's quarry. Tenth Census. 26770.
- Triassic; medium; light brown. Greensburgh, Mercer County. Quarry of L. Clark & Bro. Tenth Census. 26799.
- Triassic; medium; light brown. Greensburgh, Mercer County. Greensburgh Granite and Freestone Company. Tenth Census. 26800.
- Triassic; medium; brown. Greensburgh, Mercer County. Quarry of Chas. Keeler & Son. Tenth Census. 26801.
- Triassic; blue-black; fine and compact. Near Woodsville, Mercer County. Quarry of J. L. Boroughs & Son. Tenth Census. 26823.
- Triassic; light blue-gray; fine; very compact. Princeton, Mercer County. Thos. Jewell's quarry. Tenth Census. 26842.
- Lower Silurian; dark blue-gray; very fine and compact. Quarryville, Sussex County. Thos. J. Carr's quarry. Tenth Census. 27071.
- Lower Silurian; dark blue-gray; fine and compact. Quarryville, Sussex County. Thomas J. Carr's quarry. Tenth Census. 27072.
- Greenish; coarse; compact. Near Danville, Warren County. E. Bulgin's quarry. Tenth Census, 1880. 26587.
- Conglomerate.** Dark reddish-brown and white mottled; coarse; very compact and hard. Boonton, Morris County. Tenth Census, 1880. 27052.
- Coarse; ferruginous. Near May's Landing, Atlantic County. Tenth Census, 1880. 26846.
- Dark reddish-brown and white mottled; coarse; very compact and hard. Near Morristown, Morris County. Tenth Census, 1880. 26957.
- Slate.** Black. Princeton, Mercer County. Quarry of S. Margerum. Tenth Census, 1880. 26763.

NEW MEXICO.

- Gypsum.** White; dark spotted. Bernalillo(?), Bernalillo County. J. S. F. Batchen, 1883. 28586.
- Pumice.** Coarse; red. Used to some extent for purposes of rough construction. From quarries 3 miles south of Santa Fé, Santa Fé County. Santa Fé quarry. Tenth Census, 1880. 26234.
- Rhyolite tuff.** Light colored; soft and porous. Santa Fé, Santa Fé County. Tenth Census, 1880. 26233.
- Sandstone.** Coarse; light colored. Near Santa Fé, Santa Fé County. Santa Fé quarry. Tenth Census, 1880. 26231.
- Coarse; light reddish-brown. Santa Fé, Santa Fé County. Santa Fé quarry. Tenth Census, 1880. 26232.
- Fine; reddish brown. Near Las Vegas Hot Springs, San Miguel County. John S. F. Batchen, 1883. 28580.
- Fine; light red and white striped. Near Las Vegas Hot Springs, San Miguel County. John S. F. Batchen, 1883. 28582.
- Very light gray; fine and compact. Near Las Vegas Hot Springs, San Miguel County. John S. F. Batchen, 1883. 28583.
- Fine; light reddish-brown. Near Las Vegas Hot Springs, San Miguel County. John S. F. Batchen, 1883. 28584.
- Dull red; friable. Near Albuquerque, Valencia County. El Rita quarry. John S. F. Batchen, 1884. 35570.

NEW YORK.

- Ophiolite** [*verdantique marble*]. Coarsely granular; green and white speckled, takes a high polish; commercially known as ophite marble. Port Henry, Essex County. Quarries of Burlington Manufacturing Company. Tenth Census, 1880. 26672.
- Serpentine** [*ophiolite. Verdantique marble*]. Green and white speckled; coarsely granular. Moriah, Essex County. Centennial, 1876. 17465.
- Dolomite** [*marble*]. Archæan; white; coarsely crystalline. Tuckahoe, Westchester County. J. M. Masterton's quarry. Tenth Census, 1880. 26444.
- Archæan; white; coarsely crystalline. Tuckahoe, Westchester County. J. M. Masterton's quarry. Tenth Census, 1880. 26445.
- Archæan; white; coarsely crystalline. Tuckahoe, Westchester County. Tuckahoe Marble Company. Tenth Census, 1880. 26414.
- Archæan; white; coarsely crystalline. Tuckahoe, Westchester County. Tuckahoe Marble Company. Tenth Census, 1880. 26413.
- Archæan; white; very coarsely crystalline. Pleasantville, Westchester County. Snow Flake Marble Company. Tenth Census, 1880. 26522.
- Lower Silurian; white; coarsely crystalline. Sing Sing, Westchester County. Colonel Clark, 1880. 25205.
- Lower Silurian; white; crystalline. Sing Sing, Westchester County. Tenth Census, 1880. 25011.
- Archæan; pure white; crystalline. South Dover, Dutchess County. E. A. Preston's quarry. Tenth Census, 1880. 26506.
- Limestone** [*marble*]. Gray, with pink spots; compact; fossiliferous. Used for furniture and interior decorative work. Chazy, Clinton County. Tenth Census, 1880. 26925.
- Lower Silurian; dark, red spotted; compact; fossiliferous. Used for furniture and interior decorations. Near Plattsburgh, Clinton County. Burlington Manufacturing Company. Tenth Census, 1880. 26671.
- Upper Silurian; gray, with large fossils. Greensport, Columbia County. F. W. Jones's quarry. Tenth Census, 1880. 26074.
- "Warwick marble;" red mottled; very coarsely crystalline. 6 by 6 by 1 inch. Orange County. United States General Land Office, 1882. 27258.
- Magnesian limestone** [*marble*]. Lower Silurian; nearly black; fossiliferous. Near Saratoga, Saratoga County. Prince Wing's quarry. Tenth Census, 1880. 26089.
- Lower Silurian; black; very fine and compact. South Glens Falls, Saratoga County. Thomas Reynolds's quarry. Tenth Census, 1880. 26112.
- Archæan; blue-gray; coarsely crystalline. Near Gouverneur, Saint Lawrence County. Gouverneur Marble Company. Tenth Census, 1880. 26942.
- Calcareous dolomite** [*marble*]. Upper Silurian; gray; fossiliferous. Used in the construction of Lenox Library building, New York City. Lockport, Niagara County. R. & J. Carpenter's quarry. Tenth Census, 1880. 26506.
- Limestone**. Lower Silurian; mottled blue-gray; compact. Sandy Hill, Washington County. Sandy Hill quarry. Tenth Census, 1880. 26828.
- Lower Silurian; gray; semi-crystalline. Lowville, Lewis County. L. H. Carter's quarry. Tenth Census, 1880. 26980.
- Devonian; dark gray; fossiliferous. Syracuse, Onondaga County. Centennial, 1876. 17471.
- Devonian; light drab; fossiliferous. Williamsville, Erie County. J. B. Young's quarry. Tenth Census, 1880. 26622.

- Limestone.** Devonian; gray; finely fossiliferous; compact. Williamsville, Erie County. W. Foglesanger's quarry. Tenth Census, 1880. 26623.
- Magnesian limestone.** Lower Silurian; dark blue-gray; fossiliferous. South Glens Falls, Saratoga County. Quarry of Thomas Reynolds & Co. Tenth Census, 1880. 26111
- Lower Silurian; dark blue-gray; compact. Near Crown Point, Essex County. Frank Clark's quarry. Tenth Census, 1880. 26123.
- Lower Silurian; nearly black; compact. Willsborough Point, Essex County. Centennial, 1876. 17519.
- Lower Silurian; fine; dark gray; nearly black. Willsborough, Essex County. Lake Champlain Quarry Company. Tenth Census, 1880, 26128.
- Lower Silurian; dark drab; fossiliferous. Three Mile Bay, Jefferson County. O. Fish's quarry. Tenth Census, 1880. 26279.
- Lower Silurian; gray; finely fossiliferous; compact. Near Prescott, Oneida County. Evan T. Thona's quarry. Tenth Census, 1880. 26329.
- Lower Silurian; fine; dark gray; nearly black. Amsterdam, Montgomery County. James Griswold's quarry. Tenth Census, 1880. 26238.
- Lower Silurian; dark gray; fossiliferous. Amsterdam, Montgomery County. D. C. & N. Hewitt's quarry. Tenth Census, 1880. 26239.
- Lower Silurian; dark gray; fossiliferous. Canajoharie, Montgomery County. Sharper's quarry. Tenth Census, 1880. 26240.
- Upper Silurian; fine; black; compact. Schoharie, Schoharie County. Z. Brown's quarry. Tenth Census, 1880. 26310.
- Devonian; fine; dark gray; compact. Cobleskill, Schoharie County. Quarry of Reilly & Scanlan. Tenth Census, 1880. 25909.
- Upper Silurian; fine; dark gray; nearly black. Howe's Cave, Schoharie County. Howe's Cave Association. Tenth Census, 1880. 26149.
- Upper Silurian; fine; black. Howe's Cave, Schoharie County. Howe's Cave Association. Tenth Census, 1880. 25841.
- Upper Silurian; fine; dark gray; nearly black. Howe's Cave, Schoharie County. Howe's Cave Lime and Cement Company. Tenth Census, 1880. 25908.
- Devonian; dark gray; fine and compact. Springfield Centre, Otsego County. McCabe quarry. Tenth Census, 1880. 25763.
- Devonian; gray; compact; fossiliferous. Onondaga, Onondaga County. Quarry of Hughes Bros. & Co. Tenth Census, 1880. 26372.
- Devonian; gray; compact; fossiliferous. Fairmont, Onondaga County. J. Connor's quarry. Tenth Census, 1880. 26354.
- Devonian; gray; semi crystalline. Indian Reservation, Onondaga County. Adam Nie's quarry. Tenth Census, 1880. 27069.
- Devonian; dark gray; fine and compact. Auburn, Cayuga County. Quarry of Goodrich & Son. Tenth Census, 1880. 26389.
- Devonian; nearly black; fine and compact. Union Springs, Cayuga County. A. B. Miles's quarry. Tenth Census, 1880. 26402.
- Devonian; nearly black; fine and compact. Waterloo, Seneca County. L. Thomas's quarry. Tenth Census, 1880. 26430.
- Devonian; nearly black; fine and compact. Waterloo, Seneca County. J. Emmett's quarry. Tenth Census, 1880. 26431.
- Devonian; dark gray; fine; compact. Le Roy, Genesee County. L. D. Howell's quarry. Tenth Census, 1880. 26511.
- Devonian; dark mottled; compact. Buffalo, Erie County. J. B. Young quarry. Tenth Census, 1880. Two specimens. 26621.

Magnesian limestone. Blue-gray; fine; compact. Kingston, Ulster County. Quarry of Noon & Madden. Tenth Census, 1880. 26617.

Dolomite. Upper Silurian; dark drab; fine; compact. Rochester, Monroe County. J. B. Pike's quarry. Tenth Census, 1880. 26454.

Calcareous dolomite. Upper Silurian; drab; finely fossiliferous. Lockport, Niagara County. R. & J. Carpenter's quarry. Tenth Census, 1880. 26513.

Biotite granite. Fine; light gray. Garrison, Putnam County. A. C. King's quarry. A. C. King, 1883. 27531.

Hornblende mica granite. Coarse; bright red. Grindstone Island, Jefferson County. R. Forsyth's quarry. Tenth Census, 1880. 27024.

NOTE.—Two large beautiful pillars of this stone are in the senate chamber of the capitol building at Albany, N. Y.

Hornblende gneiss. Medium; dark gray. Glenville, near Tarrytown, Westchester County. Sackett's quarry. Tenth Census, 1880. 26455.

Biotite gneiss. Medium; banded gray and white. Near Hastings, Westchester County. Quarry of Munson & Co. Tenth Census, 1880. 26521.

Gneiss. Coarse; greenish gray. Suffern, Rockland County. Copeland quarry. Tenth Census, 1880. 27050.

Norite. Coarse; dark greenish gray, with blue iridescent spots. Quarries of the Au Sable Granite Company, Keeseville. C. D. Walcott, 1887. 38740.

This stone, which is known commercially as "Au Sable granite," consists essentially of the mineral labradorite and hypersthene. When polished the bluish iridescence from the labradorite is very noticeable. It is a beautiful stone for polished columns and pilasters.

Sandstone. Devonian; brown; very fine and compact. Roxbury, Delaware County. Quarry of Robinson & Soop. Tenth Census, 1880. 25626.

— Devonian; brown; very fine and compact. Roxbury, Delaware County. B. B. Boughton's quarry. Tenth Census, 1880. 25627.

— Devonian; gray; fine and compact. Margarettsville, Delaware County. Quarry of Grant Bros. Tenth Census, 1880. 25628.

— Devonian; two specimens; brownish-gray and olive-tinted; fine and compact. Phœnicia, Ulster County. J. L. McGrath's quarry. Tenth Census, 1880. 25638.

— Devonian; brownish gray; fine and compact. Snider Hollow, Ulster County. Quarry of Jamieson Bros. Tenth Census, 1880. 25639.

— Devonian; dark blue-gr , fine and compact. Phœnicia, Ulster County. Quarry of Delemater & Bouse. Tenth Census, 1880. 25640.

— Devonian; dark blue-gray; fine and compact. Phœnicia, Ulster County. J. McGrath's quarry. Tenth Census, 1880. 25641.

— Devonian; dark blue-gray; fine and compact. Cold Brook Hollow, Ulster County. Quarry of Lane & Co. Tenth Census, 1880. 25670.

— Devonian; dark blue-gray; fine and compact. Near Boiceville, Ulster County. Quarry of Hewitt Boice. Tenth Census, 1880. 25671.

— Devonian; dark blue-gray; fine and compact. Broadhead's Bridge, Ulster County. Quarry of Cornish & Rowe. Tenth Census, 1880. 25672.

— Devonian; dark blue-gray; fine and compact. Broadhead's Bridge, Ulster County. Quarry of W. Davis. Tenth Census, 1880. 25673.

— Devonian; dark blue-gray; fine and compact. Broadhead's Bridge, Ulster County. Quarry of Hemgerford & Boice. Tenth Census, 1880. 25674.

— Devonian; dark blue-gray; fine and compact. Stony Hollow, Ulster County. Sweeney's quarry. Tenth Census, 1880. 25704.

- Sandstone.** Devonian; dark blue-gray; fine and compact. Woodstock, Ulster County. N. Wolven's quarry. Tenth Census, 1880. Two specimens. 25758.
- Devonian; dark blue-gray; fine and compact. Hallihan's Hill, Ulster County. Quarry of Leakey & Co. Tenth Census, 1880. 25759.
- Devonian; dark blue-gray; fine and compact. Highwoods Hill, Ulster County. Quarry of Green & Co. Tenth Census, 1880. 25760.
- Devonian; dark blue-gray; fine and compact. West Hurley, Ulster County. L. Lawson's quarry. Tenth Census, 1880. 25761.
- Devonian; dark blue-gray; fine and compact. Saw Kill, Ulster County. D. Henderson's quarry. Tenth Census, 1880. 25842.
- Devonian; very dark bluish-drab; fine and compact. Steeney Kill, Ulster County. R. Dunn's quarry. Tenth Census, 1880. 25843.
- Devonian; blue-gray; fine and compact. Bristol Hill, Ulster County. T. Grant's quarry. Tenth Census, 1880. 26150.
- Devonian; dark blue-gray; fine and compact. Morgan Hill, Ulster County. J. Scully's quarry. Tenth Census, 1880. 25844.
- Devonian; dark blue-gray; fine and compact. Quarryville, Ulster County. Quarry of Mason & Mack. Tenth Census, 1880. 25926.
- Devonian; dark blue-gray; fine and compact. Quarryville, Ulster County. Quarry of Cunningham Bros. Tenth Census, 1880. 25927.
- Devonian; blue-gray; fine and compact. Quarryville, Ulster County. Quarry of Peter Daly & Co. Tenth Census, 1880. 25928.
- Devonian; blue-gray; fine and compact. Near Huntersland, Schoharie County. Middleburgh Bluestone Company. Tenth Census, 1880. 26196.
- Lower Silurian; compact; reddish. Hammond, Saint Lawrence County. J. Finnegan's quarry. Tenth Census, 1880. 26278.
- Upper Silurian; fine; light gray. Camden, Oneida County. N. Beebe's quarry. Tenth Census, 1880. 26280.
- Upper Silurian; fine; light reddish-brown. Albion, Orleans County. G. Brady's quarry. Tenth Census, 1880. 26496.
- Upper Silurian; fine; light reddish-brown. Albion, Orleans County. Albion and Medina Sandstone Company. Tenth Census, 1880. 26497.
- Upper Silurian; fine; light reddish-brown. Hulberton, Orleans County. A. J. Squires's quarry. Tenth Census, 1880. 26498.
- Upper Silurian; fine; very light reddish-brown. Medina, Orleans County. A. J. McCormick's quarry. Tenth Census, 1880. 26514.
- Fine; very light reddish brown. Hulberton, Orleans County. Quarry of O'Brien & O'Reilly. Tenth Census, 1880. 26515.
- Upper Silurian; fine; light colored. Medina, Orleans County. Quarry of Kearney, Barrett & Co. Tenth Census, 1880. 26516.
- Upper Silurian; fine; light colored. Medina, Orleans County. I. Holloway's quarry. Tenth Census, 1880. 26518.
- Upper Silurian; fine; light reddish-brown. Medina, Orleans County. P. Horan's quarry. Tenth Census, 1880. 26519.
- Upper Silurian; fine; very light gray. Medina, Orleans County. P. Horan's quarry. Tenth Census, 1880. 26520.
- Upper Silurian. 12-inch cube. Albion, Orleans County. Quarry of G. S. Brady & Co. Gilbert S. Brady, 1884. 35705.
- Devonian; fine; gray. Corning, Steuben County. L. Field's quarry. Tenth Census, 1880. 26712.

- Sandstone.** Devonian; fine; blue-gray. Pultney, Steuben County. W. Wagener's quarry. Tenth Census, 1880. 26761.
- Devonian; fine; blue-gray. Atwater, Cayuga County. J. G. Baeger's quarry. Tenth Census, 1880. 26401.
- Upper Silurian; reddish brown; medium. Albion, Orleans County. G. Brady's quarry. Tenth Census, 1880. 26494.
- Upper Silurian; fine; reddish brown. Albion, Orleans County. G. Brady's quarry. Tenth Census, 1880. 26495.
- Upper Silurian; fine; light gray. 10-inch cube. Lockport, Niagara County. C. Whitmore's quarry. Tenth Census, 1880. 27341.
- Upper Silurian; fine; light colored. Lockport, Niagara County. C. Whitmore's quarry. Tenth Census, 1880. 26517.
- Devonian; very dark drab and dark blue-gray; fine and compact. Two specimens. Otsego Lake, Otsego County. J. Wood's quarry. Tenth Census, 1880. 25762.
- Devonian; fine; blue-gray. Oneonto, Otsego County. L. Orr's quarry. Tenth Census, 1880. 26798.
- Triassic; medium; reddish brown. Near Nyack, Rockland County. N. Puff's quarry. Tenth Census, 1880. 26590.
- Devonian; fine; dark blue-gray. Near West Brookville, Sullivan County. West Brookville quarry. Tenth Census, 1880. 26618.
- Devonian; fine; dark blue-gray. Near West Brookville, Sullivan County. West Brookville quarry. Tenth Census, 1880. 26619.
- Devonian; fine; gray. Two specimens. Near Liberty, Sullivan County. J. J. Fuller's quarry. Tenth Census, 1880. 26432.
- Devonian; fine; light gray. Belfast, Allegany County. J. Lang's quarry. Tenth Census, 1880. 26749.
- Devonian; fine; dark drab. Guilford Centre, Chenango County. L. W. Smith's quarry. Tenth Census, 1880. 26750.
- Devonian; fine; gray. Guilford, Chenango County. Mrs. W. W. Davis's quarry. Tenth Census, 1880. 26751.
- Devonian; fine; blue-gray. Trumansburgh, Tompkins County. Quarry of Dumont & Cusic. Tenth Census, 1880. 26760.
- Devonian; fine; gray. Ithaca, Tompkins County. McClune's quarry. Tenth Census, 1880. 26734.
- Devonian; fine; light gray. Watkins Glen, Schuyler County. Northern Central Railroad Company. Tenth Census, 1880. 26736.
- Devonian; blue-gray; fine and compact. Near Reedsville, Albany County. E. Udell's quarry. Tenth Census, 1880. 26151.
- Lower Silurian; dark blue-gray; fine and compact. Schenectady, Schenectady County. Upper Aqueduct Quarry Company. Tenth Census, 1880. 26075.
- Fine; blue-gray. Olean, Cattaraugus County. Milo Cook's quarry. Tenth Census, 1880. 26651.
- Quartzite.** Cambrian; light colored; fine and compact. Fort Ann, Washington County. J. White's quarry. Tenth Census, 1880. 25946.
- Potsdam; compact; light red. Near Potsdam, Saint Lawrence County. Potsdam quarry. Tenth Census, 1880. 26268.
- Argillaceous sandstone.** Devonian; fine; blue-gray. Warsaw, Wyoming County. Quarry of Morris & Son. Tenth Census, 1880. 26650.
- Slate.** Purple. Middle Granville, Washington County. Albany Slate Company. Tenth Census, 1880. 25945.

- Slate.** Green. 4 by 4 by 3 inches. Hampton, Washington County. Quarry of D. Williams & Brothers. Tenth Census, 1880. 25973.
- Red. 4 by 4 by 1½ inches. Hampton, Washington County. Quarry of L. J. Warren. Tenth Census, 1880. 25974.
- Green. 4 by 4 by 2½ inches. Hampton, Washington County. New England Quarry Company. Tenth Census, 1880. 25976.
- Purple. 4 by 4 by 1½ inches. Hampton, Washington County. New England Quarry Company. Tenth Census, 1880. 25977.
- Dull red. 4 by 4 by 1½ inches. Middle Granville, Washington County. Middle Granville Quarry. Tenth Census, 1880. 25978.
- Bright red. 4 by 4 by 1 inch. Granville, Washington County. Tenth Census. 25979.
- Bright red. 4 by 4 by 1 inch. Granville, Washington County. North Bend Quarry Company. Tenth Census, 1880. 25980.
- Dull, reddish brown. 4 by 4 by 1½ inches. Middle Granville, Washington County. Penrhyn Slate Company. Tenth Census, 1880. 25981.
- Dull, reddish brown. 4 by 4 by 1½ inches. Middle Granville, Washington County. Penrhyn Slate Company. Tenth Census, 1880. 25982.
- Greenish. 4 by 4 by 1 inch. Middle Granville, Washington County. Penrhyn Slate Company. Tenth Census, 1880. 25983.
- Greenish, purple and blue-black. Six specimens. Slabs 8 inches square. Centennial, 1876. 26032.
- Grayish brown. 4 by 3 by 2 inches. Salem, Washington County. Salem Slate Company. Tenth Census, 1880. 26052.
- Greenish. Slab 8 inches square, and 4 by 4 by 1 inch. Two specimens. Granville, Washington County. Warren Slate Company. Centennial, 1876. 27001.
- Calcareous sandstone.** Devonian; fine; very light gray. Two specimens. Canisteo, Steuben County. J. Mullen's quarry. Tenth Census, 1880. 26706.
- Devonian; fine; blue-gray. Covert, Seneca County. C. O. Ogden's quarry. Tenth Census, 1880. 26735.

NORTH CAROLINA.

- Steatite.** Fine; compact; light greenish gray. Used for "white earth" and French chalk. Nantahalalah, Swain County. Tenth Census, 1880. 26137.
- Fine compact; light greenish gray. Used as above. Seven miles northeast of Murphy, Cherokee County. W. C. Kerr, 1883. 27654.
- Steatite [soapstone].** Coarse; compact; dark gray. Near Greensborough, Guilford County. W. C. Kerr, 1883. 27662.
- Coarse; compact; blue-gray. Ball Mountain, Ashe County. J. Hardin's quarry. J. B. Colvan, 1883. 28168.
- Fine; light blue-gray; schistose. Myatt's Mill, Wake County. (Through W. S. Yates.) 1884. 36853.
- Coarse; porous; blue-gray. Alamance County. W. C. Kerr, 1887. 27664.
- Limestone [marble].** Dark blue-gray; crystalline. Cherokee County. 36142.
- Archæan; light pink; greenish spots; crystalline. 7½ by 6 by 2 inches. Cherokee County. 27822.
- Archæan; blue-gray; crystalline. Near Murphy, Cherokee County. Valley River Mining Company. W. H. Kerr, 1883. 27655.

- Limestone [marble].** Archæan; blue-gray; crystalline. Valley Town, Cherokee County. S. Whittaker's quarry. W. H. Kerr, 1883. 27656.
- Archæan; light blue-gray; finely crystalline. Nottla, Cherokee County. Centennial, 1876. 17512.
- Archæan; dark gray; crystalline. Near Valley Town, Cherokee County. T. Young's quarry. Tenth Census, 1880. 27658.
- Archæan; light pink; finely crystalline. Two specimens. Red Marble Gap, Macon County. W. H. Kerr, 1883. 27659.
- Archæan; light pink, with greenish mottling; crystalline. Nantahalal, Swain County. Centennial, 1876. 17513.
- Siliceous dolomite.** Archæan; red; compact. Warm Springs, Madison County. W. C. Kerr, 1883. 27605.
- Magnesian limestone.** Archæan; dark mottled; fine; compact. Warm Springs, Madison County. Tenth Census, 1880. 27604.
- Shell limestone.** Eocene; coarse; cellular. 12-inch cube. New Berne, Craven County. Centennial, 1876. 25345.
- Eocene; coarse; cellular. New Berne, Craven County. Tenth Census, 1880. 27624.
- Eocene; light colored; cellular. Rocky Point, Pender County. Quarry of French Brothers. Tenth Census, 1880. 27625.
- Limestone.** Archæan; blue-gray; crystalline. Near Murphy, Cherokee County. Valley River Mining Company. W. H. Kerr, 1883. 27655.
- Biotite granite.** Medium; pink. Louisburgh, Franklin County. Colonel Ruffin's quarry. W. C. Kerr, 1883. 27633.
- Fine; pinkish gray. Louisburgh, Franklin County. W. C. Kerr, 1883. 27600.
- Medium; pink. Cedar Rock, Franklin County. W. T. King's quarry. W. H. Kerr, 1883. 27636.
- Coarse; porphyritic; pink and yellowish spotted. Contentnea Creek, Wilson County. W. H. Kerr, 1883. 27626.
- Fine; light gray. Nine miles south of Warrenton, Warren County. J. S. Smith's quarry. W. H. Kerr, 1883. 27649.
- Medium; gray. Lexington, Davidson County. C. H. Scott, 1883. 27594.
- Medium; gray. Lexington, Davidson County. C. H. Scott, 1883. 27596.
- Fine; gray. Alamance County. C. H. Scott, 1883. 27597.
- Fine; gray. Alamance County. C. H. Scott, 1883. 27599.
- Fine; light gray. Seven miles below Asheville, Buncombe County. W. C. Kerr, 1883. 27606.
- Medium; gray. Oxford, Granville County. J. H. Horner's quarry. W. C. Kerr, 1883. 27632.
- Coarse; light gray. Mount Airy, Surry County. R. S. Gilmer's quarry. W. H. Kerr, 1883. 27613.
- Coarse; gray. Near Charlotte, Mecklenburgh County. W. Phifer's quarry. W. C. Kerr, 1883. 27589.
- Medium; gray. Near Charlotte, Mecklenburgh County. W. C. Kerr, 1883. 27590.
- Medium; gray. Charlotte, Mecklenburgh County. W. C. Kerr, 1883. 27591.
- Coarse; gray. Davidson College, Mecklenburgh County. L. Pott's quarry. W. H. Kerr, 1883. 27644.
- Fine; gray. Near Gastonia, Gaston County. Quarry of Holland & Paysour. W. H. Kerr, 1880. 27622.

Biotite granite. Fine; light gray. Near Gastonia, Gaston County. J. Hawkin's quarry. W. H. Kerr, 1880. 27621.

— Coarse; gray. Three miles north of Garibaldi, Gaston County. C. L. Hope's quarry. W. H. Kerr, 1880. 27620.

— Medium; light gray. Near Winston, Forsyth County. Mrs. Charles's quarry. W. H. Kerr, 1883. 27614.

— Medium; greenish gray. Buck Horn Falls, Harnett County. Quarry of Hick & Lobdell. W. H. Kerr, 1883. 27653.

— Fine; gray. Mooresville, Iredell County. J. C. Hargrave's quarry. W. H. Kerr, 1883. 27646.

— Coarse; indistinctly porphyritic; gray. Mount Mourne, Iredell County. J. H. Reid's quarry. W. H. Kerr, 1883. 27645.

— Medium; gray. Greensborough, Guilford County. C. H. Scott, 1883. 27629.

— Medium; gray. Greensborough, Guilford County. C. H. Scott, 1883. 27630.

— Coarse; greenish with large porphyritic crystals of pinkish feldspar. Rockingham, Richmond County. W. C. Kerr, 1883. 27610.

— Coarsely porphyritic; pinkish and olive-green. Two and a half miles west of Rockingham, Richmond County. Cheraw and Chester Railroad. W. C. Kerr, 1883. 27640.

— Gray; coarsely porphyritic, with light pink feldspars. Foot cube. Anson County. Centennial, 1876. 25509.

Muscovite granite. Fine; light gray. Warrenton, Warren County. N. M. Norwood's quarry. W. H. Kerr, 1883. 27648.

Granite. Medium; very light pink. Near Salisbury, Rowan County. W. C. Kerr, 1883. 27601.

— Medium; very light gray. Salisbury, Rowan County. J. J. Bassingo's quarry. W. H. Kerr, 1883. 27615.

— Medium; very light pinkish gray. Ten miles south of Salisbury, Rowan County. J. J. Bassingo's quarry. W. H. Kerr, 1880. 27617.

— Fine; pink. Hillsborough, Orange County. A. W. Graham's quarry. W. C. Kerr, 1883. 27631.

Biotite muscovite granite. Medium; light pinkish gray. Nineteen miles south of Salisbury, Rowan County. J. J. Bassingo's quarry. W. H. Kerr, 1883. 27616.

Hornblende biotite granite. Coarse; gray with light green spots. Near Charlotte, Mecklenburgh County. T. Graham's quarry. W. C. Kerr, 1883. 27588.

Biotite gneiss. Medium; gray. Near Shelby, Cleveland County. C. Hendrick's quarry. W. H. Kerr, 1880. 27623.

— Gray; porphyritic. Henry's Station, McDowell County. Western North Carolina Railroad. W. H. Kerr, 1883. 27637.

— Coarse; gray. Hickory, Caldwell County. G. W. Harper's quarry. W. H. Kerr, 1883. 27641.

— Coarse; pinkish gray. Three and a half miles north of Toisnot, Wilson County. P. Linehan's quarry. W. H. Kerr, 1883. 27627.

— Medium; dark gray. Henderson, Vance County. W. C. Kerr, 1883. 27603.

— Very coarse; light greenish gray. Near Danbury, Stokes County. W. H. Kerr, 1883. 27612.

— Medium; dark gray. Poison Springs, Iredell County. J. Linster's quarry. W. H. Kerr, 1883. 27642.

— Fine; light gray. Raleigh, Wake County. State quarries. W. C. Kerr, 1883. 27660.

Biotite gneiss. Fine; light gray. Near Raleigh, Wake County. W. C. Kerr, 1883. 29639.

— Coarse; light gray; indistinctly porphyritic. Ten miles north of Greensborough, Guilford County. C. H. Scott, 1883. 27593.

— Medium; light gray. Jamestown, Guilford County. C. H. Scott, 1883. 27611.

Gneiss. Fine; pink. Concord, Cabarrus County. W. H. Kerr, 1880. 27619.

Hornblende biotite gneiss. Medium; dark gray. Near Alexander, Buncombe County. W. C. Kerr, 1883. 27607.

— Medium; dark gray. Davidson College, Mecklenburgh County. D. Slonn's quarry. W. H. Kerr, 1883. 27643.

Gneiss. Fine; red and light mottled. Mooresville, Iredell County. Quarry of McNeilly & McPherson. W. H. Kerr, 1883. 27647.

Hornblende gneiss. Fine; light greenish gray. Morgan ton Depot, Burke County. Avery's quarry. W. H. Kerr, 1883. 27639.

Quartz porphyry [leopardite]. White; black spotted; 4 by 4 by 1½ inches. Near Charlotte, Mecklenburgh County. W. J. Yates quarry. Tenth Census, 1880. 25840.

— Nearly white with dark spots. Charlotte, Mecklenburgh County. Centennial 1876. 10770.

These porphyries take the popular name "leopardite" from their spotted appearance. In some cases the coloring material instead of being arranged in oval spots takes most delicate dendritic or fern-like forms. They are very hard and consequently used only for purposes of rough construction.

Sandstone. Triassic; fine; reddish brown. Wadesborough, Anson County. W. C. Kerr, 1883. 27608.

— Triassic; fine; light brown. Sanford, Moore County. J. W. Scott's quarry. W. H. Kerr, 1883. 27634.

— Triassic; fine; light brown. Egypt, Chatham County. J. Legroves's quarry. W. H. Kerr, 1883. 27635.

— Triassic; light colored; medium. Durham, Durham County. Trap quarry W. C. Kerr, 1883. 27651.

— Triassic; fine; reddish brown. Near Durham, Durham County. Quarry of Needham & McPherson. W. C. Kerr, 1883. 27652.

— Triassic; fine; very light brown. Near Morrisville, Wake County. Gift of the county through W. S. Yeates, 1884. 36852.

— Fine; gray; 10-inch cube. Raleigh, Wake County. Centennial 1876. 17475.

OHIO.

Limestone. Lower Silurian; dark gray. 12 by 13 by 7 inches. Centennial, 1876. 25198.

— Lower Silurian; dark gray. 14 by 14 by 8 inches. Centennial, 1876. 25199.

— Devonian; drab; fine; compact. Kelley's Island, Erie County. Quarry of Kelley & Co. Tenth Census, 1880. 26284.

— Devonian. Bellefontaine, Logan County. Quarry of Angel, Miller & Co. Tenth Census, 1880. 27162.

— Carboniferous; drab; fine; compact. Two specimens. Bellaire, Belmont County. Samuel Rowe's quarry. Tenth Census, 1880. 25613.

— Upper Silurian; light colored. 12-inch cube. Covington, Miami County. T. W. Butt's quarry. Tenth Census, 1880. 27200.

— Upper Silurian; dark mottled; fine-grained. Two specimens. Piqua, Miami County. Quarry of H. Clark & Son. Tenth Census, 1880. 25317.

Limestone. Carboniferous; dark; compact; fossiliferous. Zanesville, Muskingum County. Philip Moran's quarry. Tenth Census, 1880. 25535.

— Sub-Carboniferous; light colored; fine; compact. Two specimens. Newtonville, Muskingum County. T. B. Townsend's quarry. Tenth Census, 1880. 25536.

— Upper Silurian; drab; fine and compact; pyritiferous. Two specimens. Near Xenia, Greene County. W. McDonald's quarry. Tenth Census, 1880. 25357.

— Upper Silurian; light colored; fine and compact. Two specimens. Near Dayton, Montgomery County. Huffman Stone Company. Tenth Census, 1880. 27163.

— Lower Silurian; dark mottled; fossiliferous. Two specimens. Hamilton, Butler County. Quarry of Kilfoyle & Joyce. Tenth Census, 1880. 25274.

— Upper Silurian; fine-grained; yellow spotted. Near Lumberton, Clinton County. W. F. Oglesbee's quarry. Tenth Census, 1880. 25382.

Bituminous dolomite. Devonian; light colored; fossiliferous. Two specimens. Point Marblehead, Ottawa County. Quarry of Clemons & Sons. Tenth Census, 1880. 26087.

— Upper Silurian; light colored; fine-grained and cellular. Two specimens. Near Fremont, Sandusky County. Quarry of Quilter Brothers. Tenth Census, 1880. 25283.

— Devonian; drab; fine and compact. Sandusky, Erie County. Quarry of I. T. Davis. Tenth Census, 1880. 26084.

— Devonian; drab; fine and compact. Sandusky, Erie County. W. Hubbard's quarry. Tenth Census, 1880. 26085.

— Devonian; drab; fine and compact. Two specimens. Sandusky, Erie County. C. Schoepfle's quarry. Tenth Census, 1880. 26086.

— Devonian; light colored; fine; compact. Sandusky, Erie County. Ambrose Lieb's quarry. Tenth Census, 1880. 26106.

— Upper Silurian; light colored; fine-grained; cellular. Two specimens. Tiffin, Seneca County. J. L. King's quarry. Tenth Census, 1880. 25527.

— Upper Silurian; drab; fine; compact. Findlay, Hancock County. Quarry of Altman & Pressnell Company. Tenth Census, 1880. 25294.

— Upper Silurian; dark mottled; vesicular; semi-crystalline. Two specimens. Near Ottawa, Putnam County. J. Hager's quarry. Tenth Census, 1880. 25315.

— Upper Silurian; gray; laminated. Near Columbus Grove, Putnam County. J. Postlewait's quarry. Tenth Census, 1880. 25333.

— Upper Silurian; brown mottled; fine-grained; compact. Two specimens. Bluffton, Allen County. Quarry of Ritzler & Greenwald. Tenth Census, 1880. 25312.

— Upper Silurian; brown; fine-grained; compact. Two specimens. Near Lima, Allen County. J. Custer's quarry. Tenth Census, 1880. 25313.

— Upper Silurian; dark drab; fine-grained; compact. Near Lima, Allen County. B. A. Armentrout's quarry. Tenth Census, 1880. 25337.

— Upper Silurian; dark mottled; fine-grained. Two specimens. Lima, Allen County. William Pugh's quarry. Tenth Census, 1880. 25320.

— Upper Silurian; light colored; fine and compact. Two specimens. Near Urbana, Champaign County. D. W. Happersett's quarry. Tenth Census, 1880. 25296.

— Upper Silurian; very light brown; fine and compact. Two specimens. Greenfield, Highland County. Quarry of G. I. Rucker & Son. Tenth Census, 1880. 25381.

Bituminous dolomite. Upper Silurian; brown; fine-grained; compact. Two specimens. Lexington, Highland County. Mrs. L. Dunn's quarry. Tenth Census, 1880. 25427.

Dolomite. Devonian. Light colored; fine-grained; compact. Two specimens. White House, Lucas County. Quarry of Pray & Hall. Tenth Census, 1880. 25282.

— Devonian; drab; fine; compact. Two specimens. Near Weston, Wood County. L. S. Pugh's quarry. Tenth Census, 1880. 25324.

— Upper Silurian; drab mottled; coarsely vesicular. Near Van Wert, Van Wert County. Palmer's quarry. Tenth Census, 1880. 26510.

— Devonian; dark gray; fine-grained; compact. Two specimens. Marion, Marion County. Quarry of Peters & Lawrence. Tenth Census, 1880. 25322.

— Devonian; dark; fine-grained compact. Two specimens. Marion, Marion County. Quarry of Haberman & Riley. Tenth Census, 1880. 25323.

— Devonian; light colored; fine-grained; compact. Two specimens. Near Bellefontaine, Logan County. Quarry of Angel, Miller & Co. Tenth Census, 1880. 25290.

— Upper Silurian; light colored; cellular. Two specimens. Near Springfield, Clarke County. Quarry of Moores & Co. Tenth Census, 1880. 27164.

— Upper Silurian; light drab; fine and compact. Springfield, Clarke County. J. Mowatt's quarry. Tenth Census, 1880. 25293.

— Upper Silurian; drab; cellular. Springfield Clarke County. W. S. Thompson's quarry. Tenth Census, 1880. 25291.

— Upper Silurian; light drab and blue-gray. Two specimens. Yellow Springs, Greene County. W. Sroufe's quarry. Tenth Census, 1880. 25292.

— Upper Silurian; drab mottled; fine; compact. Eaton, Preble County. Quarry of Young & Christman. Tenth Census, 1880. 25268.

Magnesian limestone. Devonian; drab; fine-grained; fossiliferous. Bloomville, Seneca County. A. Reichert's quarry. Tenth Census, 1880. 25660.

— Upper Silurian; very light drab. Piqua River, Miami County. H. G. Deweese's quarry. H. G. Deweese, 1883. 27514.

— Upper Silurian; bluish drab; fine and compact. Two specimens. Covington, Miami County. Quarry of Butt & Battorf. Tenth Census, 1880. 27173.

— Devonian; drab; fine-grained; compact. Near Columbus, Franklin County. Quarry of Lilley & Poston. Tenth Census, 1880. 25376.

— Upper Silurian; bluish drab; fine and compact. Near Dayton, Montgomery County. Huffman Stone Company. Tenth Census, 1880. 27175.

— Upper Silurian; bluish drab; fine and compact. 12-inch cube. Near Dayton, Montgomery County. Huffman Stone Company. Tenth Census, 1880. 27175.

— Upper Silurian; light drab; fine and compact. Two specimens. Near Dayton, Montgomery County. W. H. Huston's quarry. Tenth Census, 1880. 27192.

— Upper Silurian; drab; fine and compact. Two specimens. Near Dayton, Montgomery County. Huffman Stone Company. Tenth Census, 1880. 25297.

Siliceous dolomite. Upper Silurian; light and drab; fine-grained. Two specimens. Covington, Miami County. Quarry of N. W. Furnas. Tenth Census, 1880. 25319.

— Devonian; dark; fine-grained; compact. Two specimens. Near Marion, Marion County. F. Hinamon's quarry. Tenth Census, 1880. 25321.

— Upper Silurian; light drab; finely cellular. Two specimens. Springfield, Clarke County. George H. Frey's quarry. Tenth Census, 1880. 25295.

Siliceous dolomite. Upper Silurian; drab; fine-grained. New Paris, Preble County. T. J. Smith's quarry. Tenth Census, 1880. 25264.

— Upper Silurian; drab; fine-grained; compact. Two specimens. Euphemia, Preble County. H. J. Weaver's quarry. Tenth Census, 1880. 25267.

Ferruginous limestone. Carboniferous; dark; fine and compact. Two specimens. Near Millersburgh, Holmes County. A. Geib's quarry. Tenth Census, 1880. 25449.

Sandstone. Devonian; fine; gray. Monclova, Lucas County. S. Wagner's quarry. Tenth Census, 1880. 25281.

— Circular slab, 3 feet 2 inches in diameter and $3\frac{1}{4}$ inches thick. Amherst, Lorain County. Centennial, 1876. 25194.

— Broken column, 12 inches at base by 20 inches high. Amherst. Centennial, 1876. 25193.

— Carved post, about 14 inches at base by 26 inches high. Amherst. Centennial, 1876. 18931.

— Sub-Carboniferous; fine; light gray. Amherst, Lorain County. Amherst Stone Company. Tenth Census, 1880. 25472.

— Sub-Carboniferous; fine; light gray. Amherst, Lorain County. Quarry of Worthington & Sons. Tenth Census, 1880. 25706.

— Sub-Carboniferous; fine; light brown. Foot cube. Amherst, Lorain County. Centennial, 1876. 26034.

— Sub-Carboniferous; light brown; medium. Amherst, Lorain County. Ohio Building Stone Company. J. S. F. Batchen, 1883. 27357.

— Sub-Carboniferous; fine; light gray. Amherst, Lorain County. Colonel Clark, 1881. 25023.

— Sub-Carboniferous; fine; light gray. Amherst, Lorain County. Quarry of Haldeman & Son. Tenth Census, 1880. 25384.

— Sub-Carboniferous; fine; light gray and very light brown; two specimens. Amherst, Lorain County. J. Nicholl's quarry. Tenth Census, 1880. 25385.

— Sub-Carboniferous; very light buff; medium. Amherst, Lorain County. Quarry of Wilson & Hughes. Tenth Census, 1880. 25421.

— Sub-Carboniferous; fine; light gray and buff. Two specimens. Elyria, Lorain County. Quarry of Mussey & Co. Tenth Census, 1880. 25383.

— Sub-Carboniferous; gray and very light brown. Two specimens. Near Elyria, Lorain County. J. Eschtruth's quarry. Tenth Census, 1880. 25386.

— Sub-Carboniferous; Elyria, Lorain County. J. Weller's quarry. Tenth Census, 1880. 25389.

— Sub-Carboniferous; fine; light colored, Brownhelm, Lorain County. Quarry of Worthington & Son. Tenth Census, 1880. 25707.

— Sub-Carboniferous; medium; light buff. Ridgeville, Lorain County. H. L. Beebe's quarry. Tenth Census, 1880. 25471.

— Sub-Carboniferous; coarse; light colored. Independence, Cuyahoga County. J. R. Hurst's quarry. Tenth Census, 1880. 25473.

— Sub-Carboniferous; coarse; light colored. Bedford, Cuyahoga County. Bedford Stone Company. Tenth Census, 1880. 25458.

— Sub-Carboniferous; fine; light colored. Brooklyn, Cuyahoga County. J. Hoehn's quarry. Tenth Census, 1880. 25459.

— Sub-Carboniferous; medium; light colored. Independence, Cuyahoga County. Quarry of Wilson & Hughes. Tenth Census, 1880. 25456.

— Sub-Carboniferous; fine; light blue-gray. Newburgh, Cuyahoga County. Quarry of W. H. Caine. Tenth Census, 1880. 25457.

Sandstone. Sub-Carboniferous; light colored; medium. Two specimens. Newburgh, Cuyahoga County. Quarry of Edwards Brothers. Tenth Census, 1880. 25433.

- Sub-Carboniferous; light colored; medium. East Cleveland, Cuyahoga County. W. A. Neff's Quarry. Tenth Census, 1880. 25423.
- Sub-Carboniferous; light colored; medium. Two specimens. East Cleveland. Cuyahoga County. C. E. Reader's quarry. Tenth Census, 1880. 25434.
- Sub-Carboniferous; light colored; medium. East Cleveland, Cuyahoga County. J. Haycox's quarry. Tenth Census, 1880. 25435.
- Sub-Carboniferous; fine; light gray. Slab, 4 by 8 feet. Euclid, Cuyahoga County. Forest City Stone Company. Centennial, 1876. 25195.
- Sub-Carboniferous; fine; blue-gray. Euclid, Cuyahoga County. J. Wagner's quarry. Tenth Census, 1880. 25388.
- Sub-Carboniferous; fine; light blue-gray. Euclid, Cuyahoga County. Forest City Stone Company. Tenth Census, 1880. 25430.
- Sub-Carboniferous; fine; light blue-gray. Euclid, Cuyahoga County. Quarry of McFarland Brothers. Tenth Census, 1880. 25431.
- Sub-Carboniferous; fine; very light gray. Euclid, Cuyahoga County. Quarry of Maxwell & Malone. Tenth Census, 1880. 25432.
- Sub-Carboniferous; fine; very light gray. Berea, Cuyahoga County. Colonel Clark, 1881. 25018.
- Sub-Carboniferous; fine; light gray. Three specimens. Berea, Cuyahoga County. McDermott and Berea Stone Company. Tenth Census, 1880. 25387.
- Sub-Carboniferous; light colored; medium. Three miles east of Berea, in Middleburg Township, Cuyahoga County. B. Rafferty's quarry. Tenth Census, 1880. 25390.
- Sub-Carboniferous; fine; light gray. Foot cube. Berea, Cuyahoga County. Centennial, 1876. 26035.
- Sub-Carboniferous; fine; very light gray. Windsor, Ashtabula County. R. T. Stewart's quarry. Tenth Census, 1880. 25391.
- Sub-Carboniferous; fine; light gray and very light brown. Two specimens. Near Norwalk, Huron County. C. Grannell's quarry. Tenth Census, 1880. 25285.
- Sub-Carboniferous; fine; gray. Near Norwalk, Huron County. William Perrin's quarry. Tenth Census, 1880. 25284.
- Sub-Carboniferous; fine; light gray. Greenfield, Huron County. G. Graham's quarry. Tenth Census, 1880. 25522.
- Carboniferous; coarse; buff. Twinsburgh, Summit County. G. Parmelee's quarry. Tenth Census, 1880. 25422.
- Sub-Carboniferous; medium; light colored. Two specimens. Peninsula, Summit County. F. Schumacher's quarry. Tenth Census, 1880. 25494.
- Carboniferous; light yellow; medium. Akron, Summit County. J. Hugill's quarry. Tenth Census, 1880. 25495.
- Sub-Carboniferous; fine; very light blue-gray. North Hampton, Summit County. Quarry of Hovey & Brown. Tenth Census, 1880. 25496.
- Carboniferous; light colored; medium. Windham, Portage County. Quarry of Case & King. Tenth Census, 1880. 25392.
- Sub-Carboniferous; fine; dark gray. Two specimens. Near Warren, Trumbull County. Austin Flagstone Company. Tenth Census, 1880. 26509.
- Sub-Carboniferous; fine; light gray. Leesville, Crawford County. Leesville Stone Company. Tenth Census, 1880. 25534.

- Sandstone.** Sub-Carboniferous; light and dark brown. Two specimens. Bellville, Richland County. D. W. Zent's quarry. Tenth Census, 1880. 25380.
- Sub-Carboniferous; fine; very light gray. Plymouth, Richland County. William J. Bevier's quarry. Tenth Census, 1880. 25526.
 - Sub-Carboniferous; coarse; red and pink. Two specimens. Mansfield, Richland County. Quarry of C. Voetsch. Tenth Census, 1880. 25518.
 - Sub-Carboniferous; medium; yellow. Mansfield, Richmond County. T. Cline's quarry. Tenth Census, 1880. 25519.
 - Sub-Carboniferous; coarse; light colored. Weller, Richland County. S. Shively's quarry. Tenth Census, 1880. 25520.
 - Sub-Carboniferous; fine; very light drab. Plymouth, Richland County. S. W. Tuttle's quarry. Tenth Census, 1880. 25521.
 - Carboniferous; medium; yellowish. Warwick, Wayne County. Walnut Grove Stone Company. Tenth Census, 1880. 25497.
 - Sub-Carboniferous; fine; very light colored. Wooster, Wayne County. Quarry of Coe Brothers. Tenth Census, 1880. 25517.
 - Carboniferous; light colored; medium. Near Massillon, Stark County. Quarry of Warthorst & Co. Tenth Census, 1880. 25468.
 - Carboniferous; light pink; medium. Near Massillon, Stark County. Quarry of Warthorst & Co. Tenth Census, 1880. 25468.
 - Carboniferous; coarse; light colored. Near New Lisbon, Columbiana County. J. H. O'Mara's quarry. Tenth Census, 1880. 25876.
 - Carboniferous; light colored; medium. Near Youngstown, Mahoning County. T. Connell's quarry. Tenth Census, 1880. 25877.
 - Carboniferous; fine; gray. Youngstown, Mahoning County. J. Holden's quarry. Tenth Census, 1880. 25878.
 - Sub-Carboniferous; fine; very light gray. North Bloomfield, Morrow County. J. Flower's quarry. Tenth Census, 1880. 25552.
 - Sub-Carboniferous; fine; very light gray. Iberia, Morrow County. Quarry of Crane Brothers. Tenth Census, 1880. 25553.
 - Sub-Carboniferous; fine; light colored. Two specimens. Mount Gilead, Morrow County. B. S. Russell's quarry. Tenth Census, 1880. 25406.
 - Sub-Carboniferous; fine; light colored. Near Iberia, Morrow County. J. J. McClarren's quarry. Tenth Census, 1880. 25875.
 - Sub-Carboniferous; coarse; dark yellow. Ten miles east of Mount Vernon, Howard Station, Knox County. I. Crichfield's quarry. Tenth Census, 1880. 25416.
 - Carboniferous; fine; light colored. Footcube. Berlin, Holmes County. Centennial, 1876. 17472.
 - Carboniferous; medium; light colored. Near Millersburgh, Holmes County. W. H. Ling's quarry. Tenth Census, 1880. 25450.
 - Carboniferous; fine; light gray. Near Millersburgh, Holmes County. W. Cary's quarry. Tenth Census, 1880. 25615.
 - Carboniferous; light colored; medium. Near New Philadelphia, Tuscarawas County. Quarry of A. Mathias. Tenth Census, 1880. 25515.
 - Carboniferous; light colored. Near canal, Dover, Tuscarawas County. Tuscarawas Valley Coal and Iron Company. Tenth Census, 1880. 25516.
 - Carboniferous; coarse; light colored. Near Carrollton, Carroll County. N. M. Smith's quarry. Tenth Census, 1880. 25498.
 - Sub-Carboniferous; fine; light blue-gray and light brown. Two specimens. Near Sunbury, Delaware County. H. Fleckner's quarry. Tenth Census, 1880. 25378.

- Sandstone.** Sub-Carboniferous; fine; very light gray. Near Sunbury, Delaware County. C. B. Gaylord's quarry. Tenth Census, 1880. 25379.
- Sub-Carboniferous; medium; light pinkish. Near Newark, Licking County. C. Daugherty's quarry. Tenth Census, 1880. 25316.
 - Sub-Carboniferous; coarse; buff. Near Newark, Licking County. C. Daugherty's quarry. Tenth Census, 1880. 25318.
 - Sub-Carboniferous; coarse; light colored. Near Newark, Licking County. O. Z. Hillery's quarry. Tenth Census, 1880. 25336.
 - Sub-Carboniferous; fine; very light gray; olive-tinted. Newark, Licking County. J. Coyle's quarry. Tenth Census, 1880. 25373.
 - Sub-Carboniferous; fine; light blue-gray. Near Newark, Licking County. J. Coyle's quarry. Tenth Census, 1880. 25311.
 - Carboniferous; medium; light colored and red. Two specimens. Coshocton, Coshocton County. M. Cheney's quarry. Tenth Census, 1880. 25524.
 - Carboniferous; medium; very light colored. Near Coshocton, Coshocton County. M. Cheney's quarry. Tenth Census, 1880. 25525.
 - Carboniferous; light colored; medium. Steubenville, Jefferson County. Quarry of Archer and Boals. Tenth Census, 1880. 25642.
 - Carboniferous; light colored; medium. Steubenville, Jefferson County. Quarry of Archer & Boals. Tenth Census, 1880. 25643.
 - Carboniferous; light colored; medium. Steubenville, Jefferson County. Quarry of Floto & Bros. Tenth Census, 1880. 25644.
 - Carboniferous; coarse; light colored. Zanesville, Muskingum County. T. B. Townsend's quarry. Tenth Census, 1880. 25537.
 - Carboniferous; fine; gray and light brown. Two specimens. Cumberland, Guernsey, and Noble Counties. T. B. Townsend's quarry. Tenth Census, 1880. 25568.
 - Carboniferous; coarse; light colored. Cambridge, Guernsey County. S. Barr's quarry. Tenth Census, 1880. 25574.
 - Carboniferous; light colored; medium. Lewis's Mills, Belmont County. J. Hutchinson's quarry. Tenth Census, 1880. 25588.
 - Carboniferous; fine; gray; olive-tinted. Bellaire, Belmont County. W. J. McClain's quarry. Tenth Census, 1880. 25612.
 - Carboniferous; coarse; light colored. Near Bellaire, Belmont County. J. R. Robinson's quarry. Tenth Census, 1880. 25614.
 - Sub-Carboniferous; coarse; buff and yellow. Two specimens. Lancaster, Fairfield County. C. Bowmaster's quarry. Tenth Census, 1880. 25326.
 - Sub-Carboniferous; coarse; light colored. Lancaster, Fairfield County. C. Bowmaster's quarry. Tenth Census, 1880. 25332.
 - Sub-Carboniferous; coarse; light colored. Lancaster, Fairfield County. Quarry of Sharp & Crook. Tenth Census, 1880. 25335.
 - Sub-Carboniferous; fine; gray. Lithopolis, Fairfield County. Lithopolis quarry. Tenth Census, 1880. 25325.
 - Sub-Carboniferous; coarse; yellow. Near Lancaster, Fairfield County. Quarry of Sharp & Crook. Tenth Census, 1880. 25314.
 - Sub-Carboniferous; fine; light blue-gray. Near Columbus, Franklin County. William A. Forrester's quarry. Tenth Census, 1880. 25377.
 - Sub-Carboniferous; coarse; buff. Logan, Hocking County. Quarry of Weitzell Bros. Tenth Census, 1880. 25334.
 - Carboniferous; fine; gray; olive-tinted. Near Marietta, Washington County. P. L. Cole's quarry. Tenth Census, 1880. 26639.

- Sandstone.** Sub-Carboniferous; gray. Near Marietta, Washington County. P. L. Cole's quarry. Tenth Census, 1880. 26640.
- Sub-Carboniferous; light colored. Harmer, Washington County. T. B. Townsend's quarry. Tenth Census, 1880. 26680.
- Carboniferous; dark gray. Near Marietta, Washington County. D. B. Calder's quarry. Tenth Census, 1880. 26681.
- Carboniferous; fine; gray. Near Marietta, Washington County. D. Briggs's quarry. Tenth Census, 1880. 26697.
- Carboniferous; fine; gray. Near Marietta, Washington County. Constitution Stone Company. Tenth Census, 1880. 26741.
- Carboniferous; fine; light brown. Near Constitution, Washington County. Constitution Stone Company. Tenth Census, 1880. 26742.
- Carboniferous; fine; gray. Near Marietta, Washington County. C. Finch's quarry. Tenth Census, 1880. 26762.
- Sub-Carboniferous; fine; brown. Piketon, Pike County. Waverly Brownstone Quarry. Tenth Census, 1880. 25834.
- Sub-Carboniferous; fine; very light gray. Piketon, Pike County. Green Quarry. Tenth Census, 1880. 25756.
- Sub-Carboniferous; fine; light brown. Rockville, Adams County. Rockville Freestone Works. Tenth Census, 1880. 25754.
- Sub-Carboniferous; fine; very light gray. Near Portsmouth, Scioto County. Quarry of Reitz & Co. Tenth Census, 1880. 25751.
- Sub-Carboniferous; fine; drab. Near Portsmouth, Scioto County. Quarry of Reitz & Co. Tenth Census, 1880. 25752.
- Sub-Carboniferous; fine; drab. Buena Vista, Scioto County. Buena Vista Freestone Company. Tenth Census, 1880. 25753.
- Sub-Carboniferous; fine; drab. Buena Vista and Scioto Counties. Buena Vista Excelsior Freestone Works. Tenth Census, 1880. 25755.

OREGON.

- Diabase.** Medium; gray. Twenty miles east of Albany, Linn County. F. Wood's quarry. Frank Wood, 1885. 37006.
- Basalt.** Fine; gray. Near Clackamas, Clackamas County. William Young's quarry. Tenth Census, 1880. 26249.
- Sandstone.** Fine; drab. Oakland, Douglas County. W. N. Leeper's quarry. Tenth Census, 1880. 26504.
- Fine; very light brown. Near Albany, Linn County. F. Wood's quarry. Frank Wood, 1885. 37005.

PENNSYLVANIA.

- Serpentine.** Light green; coarse; porous. Will not polish; used only for general building. West Chester, Chester County. J. H. Brinton's quarry. Tenth Census, 1880. 25592.
- Light green; coarse; porous. Will not polish; used only for general building. Three miles south of West Chester, Chester County. J. H. Brinton's quarry. Tenth Census, 1880. 27319.
- Light green; coarse; porous. Will not polish; used only for general building. Chester County (near Rising Sun, Md.). Carter & Reynolds's quarries. Tenth Census, 1880. 25668.
- Limestone.** Lower Silurian; blue-gray; micaceous. East Conshohocken, Montgomery County. American Society Mining Engineers, 1886. 37873.

- Limestone.** Dark blue-gray; fine and compact. Mertztown, Berks County. American Society Mining Engineers, 1886. 37879.
- Lower Silurian; dark blue-gray. Wernersville, Berks County. American Society Mining Engineers, 1886. 37861.
 - Lower Silurian; dark blue-gray. Wernersville, Berks County. American Society Mining Engineers, 1886. 37855.
 - Lower Silurian; water-blue, dark veined. Wernersville, Berks County. American Society Mining Engineers, 1886. 37854.
 - Lower Silurian; fine; blue gray. Myerstown, Lebanon County. American Society Mining Engineers, 1886. 37864.
 - Lower Silurian; Myerstown, Lebanon County. American Society Mining Engineers, 1886. 37863.
 - Lower Silurian; dark blue-gray. North of Annville, Lebanon County. American Society Mining Engineers, 1886. 37867.
 - Lower Silurian; dark blue gray. Palmyra, Lebanon County. American Society Mining Engineers, 1886. 37871.
 - Lower Silurian; blue-gray, white spotted. North of Annville, Lebanon County. American Society Mining Engineers, 1886. 37882.
 - Lower Silurian; dark blue-gray. North of Annville, Lebanon County. American Society Mining Engineers, 1886. 37887.
 - Lower Silurian; blue-gray. Richland Station, Lebanon County. American Society Mining Engineers, 1886. 37874.
 - Lower Silurian; water-blue; crystalline. Richland Station, Lebanon County. American Society Mining Engineers, 1886. 37865.
 - Lower Silurian; blue-gray; crystalline. Richland Station, Lebanon County. American Society Mining Engineers, 1886. 37866.
 - Lower Silurian; dark blue-gray. Harrisburg, Dauphin County. American Society Mining Engineers, 1886. 37878.
 - Lower Silurian; dark blue-gray, nearly black; fine and compact. Near Harrisburg, Dauphin County. J. A. Rutherford's quarry. Tenth Census, 1880. 25328.
 - Lower Silurian; blue. Hummelstown, Dauphin County. American Society Mining Engineers, 1886. 37883.
 - Lower Silurian; dark blue-gray, nearly black. Paxton Station, Dauphin County. American Society Mining Engineers, 1886. 37870.
 - Lower Silurian; nearly black; fine and compact. Near York, York County. C. F. Winters's quarry. Tenth Census, 1880. 26237.
 - Lower Silurian; dark gray, nearly black; fine and compact. Chambersburgh, Franklin County. Henry Lippy's quarry. Tenth Census, 1880. 26312.
 - Sub-Carboniferous; light gray; granular. Connellsville, Fayette County. A. R. Banning's quarry. Tenth Census, 1880. 26058.
 - Devonian; very dark drab; fine and compact. Near Huntingdon, Huntingdon County. F. Hefright's quarry. Tenth Census, 1880. 26170.
 - Very dark gray; fine and compact. Near Spruce Creek, Huntingdon County. Robert Henderson's quarry. Tenth Census, 1880. 26235.
 - Lower Silurian; water-blue; crystalline. Howellsville, Delaware County. American Society Mining Engineers, 1886. 37869.
 - Lower Silurian; nearly white; crystalline. Howellsville, Delaware County. American Society Mining Engineers, 1886. 37853.
 - Lower Silurian; dark blue-gray. Lebanon, Allegheny County. American Society Mining Engineers, 1886. 37858.

Limestone. Lower Silurian; dark blue-gray. Lebanon, Allegheny County. American Society Mining Engineers, 1886. 37859.

— Lower Silurian; dark blue-gray. Lebanon, Allegheny County. American Society Mining Engineers, 1886. 37860.

— Lower Silurian; dark blue-gray. Schuylkill Haven, Schuylkill County. American Society Mining Engineers, 1886. 37872.

Calcareous dolomite. Lower Silurian; gray; granular. Two specimens. Near Columbia, Lancaster County. C. S. Kauffman's quarry. Tenth Census, 1880. 26331.

— Lower Silurian; nearly black; pyritiferous. Leamon Place Station, Lancaster County. J. Young's quarry. Tenth Census, 1880. 25666.

— Lower Silurian; dark; nearly black. Reading, Berks County. John H. Sternburg's quarry. Tenth Census, 1880. 26437.

— Lower Silurian. Wrightsville, York County. Quarry of Kerr, Weitzel & Co. Tenth Census, 1880. 26332.

— Lower Silurian; dark gray; nearly black; fine and compact. Carlisle, Cumberland County. W. F. Noble's quarry. Tenth Census, 1880. 26302.

— Lower Silurian; gray; coarsely laminated. Near Shiremanstown, Cumberland County. Quarry of Moses & Sidle. Tenth Census, 1880. 26301.

Dolomite. Lower Silurian; black; fine and compact. Easton, Northampton County. Quarry of George & Isaac A. Smith. Tenth Census, 1880. 25767.

— Lower Silurian; yellowish. Two specimens. Flourtown, Montgomery County. American Society Mining Engineers, 1886. 37876.

— Lower Silurian; light yellow, blue spotted. Flourtown, Montgomery County. American Society Mining Engineers, 1886. 37884.

— Lower Silurian; bluish drab; compact. Philadelphia and Reading Railroad, Chester Valley Branch, McLunes Siding, Chester County. American Society Mining Engineers, 1886. 37857.

— Lower Silurian; light colored. Mill Lane, Chester County. American Society Mining Engineers, 1886. 37868.

— Lower Silurian; blue mottled. Near Pott's Landing, Berks County. American Society Mining Engineers, 1886. 37855.

— Lower Silurian; light yellow; fine and compact. Williams Station, Berks County. American Society Mining Engineers, 1886. 37886.

— Lower Silurian; dark blue-gray; fine and compact. Near Lancaster, Lancaster County. Westman's quarry. Tenth Census, 1880. 26374.

— Lower Silurian; dark blue-gray; fine and compact. Near Harrisburg, Dauphin County. Quarry of McCormick & Co. Tenth Census, 1880. 26281.

— Lower Silurian; dark gray; fine and compact. Near Orbisonia, Huntingdon County. Quarry of D. Grove & Son. Tenth Census, 1880. 26204.

— Lower Silurian; fine; light yellow. Kerberburgh. American Society Mining Engineers, 1886. 37877.

— Lower Silurian; light drab. Plymouth, Luzerne County. American Society Mining Engineers, 1886. 37880.

— Lower Silurian; light colored; crystalline. Cedar Hollow, Lime County. American Society Mining Engineers, 1886. 37885.

Limestone [marble]. Lower Silurian; nearly white; fine grained; compact. Morristown, Montgomery County. Centennial, 1876. 17573.

— Lower Silurian; light gray; crystalline. Two specimens. Near Spring Mill Station, Montgomery County. Cedar Grove Marble Works. Tenth Census, 1880. 25356.

Limestone [marble]. Lower Silurian; light blue-gray; crystalline; King of Prussia, Montgomery County. Reeseville Blue Marble Company. Tenth Census, 1880. 2555.

- Light blue-gray; crystalline. Near Columbia, Lancaster County. C. S. Kaufman's quarry. Tenth Census. 26331.
- Bluish white; pink veins; fine; compact; crystalline. York, York County. C. H. Smith's quarry. Tenth Census, 1880. 26236.
- Lower Silurian; dark gray. Pine Grove, Schuylkill County. American Society Mining Engineers, 1886. 37875.
- Lower Silurian; gray; dark veined; white spotted; fine and compact. Myerstown, Lebanon County. American Society Mining Engineers, 1886. 37862.
- Lower Silurian. Gray; dark veined; fine and compact. American Society Mining Engineers. 37863.
- Lower Silurian; dark blue-gray. North of Annville, Lebanon County. American Society Mining Engineers, 1886. 37881.

Magnesian limestone. Lower Silurian very dark gray; fossiliferous. Morrell, Huntingdon County. Quarry of A. G. Morris. Tenth Census, 1880. 26162.

- Lower Silurian; dark gray; coarse. East Conshohocken, Montgomery County. East Conshohocken quarry. Tenth Census, 1880. 26983.
- Devonian; dark gray; fine and compact. Two specimens. Hyndman, Bedford County. Peerless Lime Company. Tenth Census, 1880. 26201.
- Devonian; drab; semi-crystalline; fossiliferous. Cove Station, Bedford County. J. T. Shirley's quarry. Tenth Census, 1880. 26202.
- Carboniferous; dark drab; coarse. Two specimens. Van Port, Beaver County. W. J. Dunn's quarry. Tenth Census, 1880. 25846.

Calcareous breccia. Triassic; coarse; variegated. Near Fairfield, Adams County. Tenth Census, 1880. 26376.

Calcareous breccia [marble]. Triassic; coarse; reddish; variegated. Near Fairfield, Adams County. Tenth Census, 1880. 26376.

- Triassic; coarse; variegated. Near Amityville, Berks County. Col. J. Weaver's quarry. Tenth Census, 1880. 26465.

Calcareous dolomite. [marble]. Lower Silurian; nearly white; crystalline. Near Columbia, Lancaster County. Quarry of Kerr, Weitzel & Co. Tenth Census, 1880. 26332.

Biotite gneiss. Coarse; gray. Near Chester, Delaware County. Crum Creek quarry. Tenth Census, 1880. 25404.

- Fine; gray. Two specimens. Near Chester, Delaware County. Quarry of Leiper & Lewis. Tenth Census, 1880. 25407.
- Fine; gray. Frankford, Philadelphia County. Quarry of Barbour, Ireland & S. Faunce. Tenth Census, 1880. 25561.

Biotite muscovite gneiss. Fine; light gray. Near Chester, Delaware County. quarry of A. O. & I. O. Deshong, jr. Tenth Census, 1880. 25436.

Gneiss. Coarse; gray. Near Reading, Berks County. Tenth Census, 1880. 26470.

Muscovite gneiss. Coarse; very light gray. Germantown, Twenty-second Ward, Philadelphia County. J. Nolan's quarry. Tenth Census, 1880. 25669.

Hornblende gneiss. Fine; dark gray. Germantown, Philadelphia County. Quarry of Neeter & Shelmire. Tenth Census, 1880. 25551.

- Fine; dark gray. Rittenhousetown, Philadelphia County. McKinney's quarry. Tenth Census, 1880. 25556.

Quartz porphyry. Dull red. Near Pine Grove Furnace, Cumberland County. Tenth Census, 1880. 26382

- Diabase.** Nearly black; fine and compact. Near Reading, Berks County. Tenth Census, 1880. 26467.
- Coarse; dark gray. Little Dam, near Reading, Berks County. Used for street pavements. Tenth Census, 1880. 26476.
- Fine; dark gray. Used as above. Near Jacksonwald, Berks County. Tenth Census, 1880. 26479.
- Mesozoic; medium; gray. Used as above. Round Top, 3 miles south of Gettysburgh, Adams County. Tenth Census. 26375.
- Mesozoic; fine; gray. Near Goldsborough, York County. Used as above. Northern Central Railroad Company. Tenth Census, 1880. 26282.
- Mesozoic; fine; gray. Collins Station, Lancaster County. Used chiefly for street pavement and road ballast. J. Keller's quarry. Tenth Census, 1880. 25327.
- Diorite.** Medium; dark gray. Near Reading, Berks County. Ohlinger Dam Cut. Tenth Census, 1880. 26466.
- Coarse; dark gray. Reading, Berks County. Tenth Census, 1880. 26474.
- Sandstone.** Sub-Carboniferous; fine; light colored. Corry, Erie County. J. M. Colegrove's quarry. Tenth Census, 1880. 25890.
- Devonian; fine; light colored. Leboeuf, Erie County. F. Sanger's quarry. Tenth Census, 1880. 25738.
- Devonian; fine; drab. Near Erie, Erie County. J. Leask's quarry. Tenth Census, 1880. 25739.
- Carboniferous; coarse; light colored. Meadville, Crawford County. B. McNeil's quarry. Tenth Census, 1880. 25772.
- Carboniferous; fine; light colored. Titusville, Crawford County. D. Brennan's quarry. Tenth Census, 1880. 25850.
- Carboniferous; fine; light colored. Near Warren, Warren County. W. Smith's quarry. Tenth Census, 1880. 26523.
- Carboniferous; fine; very light brown. North Warren, Warren County. Tenth Census, 1880. 25888.
- Carboniferous; light colored; medium. Garland, Warren County. Quarry of Linn & Leary. Tenth Census, 1880. 25889.
- Carboniferous; coarse; cellular; light colored. Antrim, Tioga County. P. Bradley's quarry. Tenth Census, 1880. 25988.
- Devonian; fine; blue-gray. Mainesburgh, Tioga County. Mainesburgh Flagging Company. Tenth Census, 1880. 25989.
- Carboniferous; fine; light gray. Greenville, Mercer County. Quarry of Amy & Kappenberger. Tenth Census, 1880. 25773.
- Carboniferous; fine; very light olive. Greenville, Mercer County. P. Leech's quarry. Tenth Census, 1880. 25774.
- Carboniferous; fine; light colored. Sharon, Mercer County. C. Herrmann's quarry. Tenth Census, 1880. 25775.
- Sub-Carboniferous; fine; gray and light brown. Two specimens. Franklin, Venango County. Quarry of J. Bell & Son. Tenth Census, 1880. 25848.
- Carboniferous; fine; light buff. Rockwood, Venango County. D. Ready's quarry. Tenth Census, 1880. 25849.
- Carboniferous; coarse; light colored. Iowa Station, Jefferson County. Allegheny Valley Railroad Company. Tenth Census, 1880. 25915.
- Devonian; brown; fine and compact. Queen's Run, Clinton County. J. McNally's quarry. Tenth Census. 1880. 25948.

Sandstone. Devonian; fine; buff. Farrandville, Clinton County. Quarry of H. F. Hawk & Co. Tenth Census, 1880. 25961.

- Upper Silurian; dark blue-gray; very fine and compact. Near Danville, Montour County. ~~Pinneo estates.~~ Tenth Census, 1880. 25962.
- Devonian; very fine; light blue-gray. Near Nicholson, Wyoming County. Quarry of Moses Shields & Son. Tenth Census, 1880. 27020.
- Devonian; fine; blue-gray. Two specimens. Black Walnut, Wyoming County. Wyoming Stone Company. Tenth Census, 1880. 27032.
- Devonian; fine; light blue-gray. Skinner's Eddy, Wyoming County. Quarry of A. R. Forlyce & Co. Tenth Census, 1880. 27033.
- Devonian; fine; light blue-gray. Meshoppen, Wyoming County. Quarry of Browncombe & King. Tenth Census, 1880. 27037.
- Devonian; fine; dark purplish. Plains, Luzerne County. P. Banker's quarry. Tenth Census, 1880. 27039.
- Carboniferous; fine; gray. Shickshinny, Luzerne County. G. Niceley's quarry. Tenth Census, 1880. 25960.
- Devonian; fine; blue-gray. Brandt, Susquehanna County. Harmony Brick Company. Tenth Census, 1880. 27016.
- Sub-Carboniferous; fine; gray. Near Scranton, Lackawanna County. Quarry of J. Williams. Tenth Census, 1880. 27017.
- Devonian; fine; light colored. Near Scranton, Lackawanna County. Quarry of J. Williams. Tenth Census, 1880. 27018.
- Coarse; pink. Olyphant, Lackawanna County. Olyphant quarry. Tenth Census, 1880. 27019.
- Devonian; fine; dark blue-gray. Pond Eddy, Pike County. Quarry of C. W. Maxwell & Co. Tenth Census, 1880. 27015.
- Carboniferous; light colored. Homewood, Beaver County. Quarry of Richie & McGinnis. Tenth Census, 1880. 25258.
- Carboniferous; light colored and brown. Two specimens. Homewood, Beaver County. A. J. Jolly's quarry. Tenth Census, 1880. 25259.
- Carboniferous; fine; light colored. Near Beaver Falls, Beaver County. Quarry of J. Harlman & D. Bernard. Tenth Census, 1880. 25355.
- Carboniferous; coarse; gray. Kiasola Station, Beaver County. Quarry of Reed & Ewing. Tenth Census, 1880. 25260.
- Carboniferous; coarse; gray; rust spotted. Baden, Beaver County. J. G. Gallagher's quarry. Tenth Census, 1880. 25261.
- Devonian; fine; dark brown. Schuylkill Haven, Schuylkill County. Tenth Census, 1880. 25779.
- Lower Silurian; coarse; gray. Near Pottsville, Schuylkill County. Tenth Census, 1880. 25780.
- Carboniferous; coarse; gray. Mauch Chunk, Carbon County. Tenth Census, 1880. 25858.
- Devonian; fine; dark gray. Mauch Chunk, Carbon County. Tenth Census, 1880. 25854.
- Devonian; fine; brown. Mauch Chunk, Carbon County. Tenth Census, 1880. 25855.
- Lower Silurian; coarse; brownish. Mauch Chunk, Carbon County. Tenth Census, 1880. 25856.
- Devonian; fine; blue-gray. Weissport, Carbon County. H. Mertz's quarry. Tenth Census, 1880. 27038.

Sandstone. Carboniferous; fine; olive. Pittsburgh, Allegheny County. T. Rourke's quarry. Tenth Census, 1880. 25768.

- Carboniferous; fine; light-gray. Johnstown, Cambria County. Quarry of Gore & Levergood. Tenth Census, 1880. 26121.
- Carboniferous; fine; gray. Prospect, Cambria County. Cambria Iron Company. Tenth Census, 1880. 25922.
- Sub-Carboniferous; fine; light colored. Near Altoona, Blair County. William Myer's quarry. Tenth Census, 1880, 26148.
- Upper Silurian; very light colored; compact and hard. Near Mapleton, Huntingdon County. F. Heffright's quarry. Tenth Census, 1880. 26171.
- Triassic; coarse; porous; reddish brown. Norristown, Montgomery County. L. Flinn's quarry. Tenth Census, 1880. 26433.
- Triassic; purplish brown; fine and medium. Two specimens. Near Reading, Berks County. Quarry of Eppler & Rischville. Tenth Census, 1880. 26436.
- Potsdam; light colored; compact and hard. Reading, Berks County. Tenth Census, 1880. 26471.
- Triassic; fine; light reddish brown. Centre Bridge, Bucks County. A. Manderson's quarry. Tenth Census, 1880. 25837.
- Triassic; coarse; light bluish drab, rust spotted. Centre Bridge, Bucks County. A. Manderson's quarry. Tenth Census, 1880. 25833.
- Triassic; reddish gray, rust spotted. Centre Bridge, Bucks County. A. Manderson's quarry. Tenth Census, 1880. 25839.
- Carboniferous; brown; medium. Near Wampum, Lawrence County. J. Friday's quarry. Tenth Census, 1880. 25852.
- Carboniferous; light colored; medium. Near Wampum, Lawrence County. Quarry of New York, Pittsburgh and Chicago Railroad Company. Tenth Census, 1880. 25853.
- Carboniferous; fine; light colored. Wampum, Lawrence County. J. Friday's quarry. Tenth Census, 1880. 25776.
- Carboniferous; coarse; porous; light colored. Freeport, Armstrong County. D. Taylor's quarry. Tenth Census, 1880. 25851.
- Triassic; fine; reddish brown. Centre Bridge, Bucks County. A. Manderson's quarry. Tenth Census, 1880. 25836.
- Triassic; light brown; porous. Two specimens. Yardleyville, Bucks County. Quarry of S. B. & E. W. Twinning. Tenth Census, 1880. 25667.
- Triassic; fine; brown. Two specimens. Lumberville, Bucks County. T. H. Kemble's quarry. Tenth Census, 1880. 25676.
- Carboniferous; coarse; buff. Two specimens. Waynesburgh, Greene County. S. Rinehart's quarry. Tenth Census. 1880. 25769.
- Carboniferous; fine; bluish drab. Near Cannonsburgh, Washington County. J. Cook's quarry. Tenth Census, 1880. 25845.
- Carboniferous; coarse; light colored. Near Monongahela City, Washington County. Tenth Census, 1880. 25239.
- Carboniferous; light yellowish brown. Near Washington, Washington County. Quarry of Hallam Bros. Tenth Census, 1880. 25770.
- Carboniferous; light yellowish brown. Near Washington, Washington County. D. Haggerty's quarry. Tenth Census, 1880. 25771.
- Carboniferous; fine; gray. Near Webster, Westmoreland County. William Nelson's quarry. Tenth Census, 1880. 25353.
- Carboniferous; fine; gray. Greensburgh, Westmoreland County. S. Zimmerman's quarry. Tenth Census, 1880. 25924.

- Sandstone.** Carboniferous; fine; gray, dark streaked. Lucecco, Westmoreland County. J. A. Huffman's quarry. Tenth Census, 1880. 25903.
- Carboniferous; fine; bluish gray. Derry Station, Westmoreland County. Loyahanna Coal and Coke Company. Tenth Census, 1880. 25913.
- Carboniferous; buff; medium. Derry Station, Westmoreland County. J. C. Campbell's quarry. Tenth Census, 1880. 25914.
- Carboniferous; fine; brown and brown with yellow bands. Two specimens. Scottdale, Westmoreland County. S. Dunmire's quarry. Tenth Census, 1880. 25935.
- Carboniferous; coarse; buff. Near Uniontown, Fayette County. J. Fraser's quarry. Tenth Census, 1880. 25990.
- Sub-Carboniferous; fine; light colored. Near Uniontown, Fayette County. D. Shipley's quarry. Tenth Census, 1880. 25991.
- Sub-Carboniferous; fine; light reddish gray. Near Uniontown, Fayette County. D. Shipley's quarry. Tenth Census, 1880. 25992.
- Carboniferous; fine; light colored. Near Connellsville, Fayette County. Speer White & Co. Tenth Census, 1880. 26059.
- Carboniferous; medium; light colored. Connellsville, Fayette County. C. Shibley's quarry. Tenth Census, 1880. 25984.
- Carboniferous; fine; light colored. Layton's Station, Fayette County. Speer White & Co. Tenth Census, 1880. 26060.
- Carboniferous; fine; light colored. Fayette Station, Fayette County. Quarry of Porter Bros. Tenth Census, 1880. 20061.
- Carboniferous; fine; light drab. Somerset, Somerset County. J. McAdam's quarry. Tenth Census, 1880. 26109.
- Triassic; fine; brown. Used for general building. Goldsborough, York County, Hummelstown Brownstone Company. Tenth Census, 1880. 25265.
- Triassic; reddish brown. Used as above. Near Hummelstown, Dauphin County. Hummelstown Brownstone Company. Tenth Census, 1880. 25266.
- Triassic; fine; brown. Near Goldsborough, York County. F. Reiling's quarry. Tenth Census, 1880. 26283.
- Argillaceous sandstone.** Carboniferous; fine; gray. Stoops Ferry, Allegheny County. U. S. Government quarry. Tenth Census, 1880. 25342.
- Conglomerate.** Devonian; coarse; light colored. Pottsville, Schuylkill County. Tenth Census, 1880. 27049.
- Potsdam; coarse; friable. Friedensburg, Berks County. Clymer quarry. Tenth Census, 1880. 26468.
- Potsdam; pinkish gray; compact. Near Pikeville, Berks County. G. M. Keim's quarry. Tenth Census, 1880. 26469.
- Sub-Carboniferous; gray; compact. Pottsville, Schuylkill County. Tenth Census, 1880. 25782.
- Quartzite.** Devonian; fine; light colored. Near Altoona, Blair County. Quarry of Booth & Mackey. Tenth Census, 1880. 26147.
- Potsdam; light colored; compact and hard. Jacksonwald, Berks County. Tenth Census, 1880. 26473.
- Upper Silurian; very light colored; compact and hard. Near Huntingdon, Huntingdon County. S. P. Wensel's quarry. Tenth Census, 1880. 26203.
- Sandstone (nearly quartzite).** Carboniferous; blue-gray; very compact and hard. Near Shickshinny, Luzerne County. Delaware, Lackawanna and Western Railroad quarry. Tenth Census, 1880. 25923.
- Slate.** Lower Silurian (Hudson River). Blue-black. Slatington, Lehigh County. Quarry of D. Williams. Tenth Census, 1880. 25740.

Slate. Lower Silurian. Blue-black. 4 by 4 by 3 inches. Chapman's Station, Northampton County. Chapman's New York Slate Company. Tenth Census, 1880. 25820.

- Lower Silurian. Blue-black. Bangor, Northampton County. Bangor Slate Company. Tenth Census, 1880. 25934.
- Lower Silurian. Blue-black. Slatedale, Lehigh County. Quarries of the Lock Slate Company. Tenth Census, 1880. 25959.
- Lower Silurian. Blue-black. 4 by 4 by 2½ inches. Catasauqua, Lehigh County. Tenth Census, 1880. 25993.
- Lower Silurian. Blue black and brownish. Three specimens. Bangor, Northampton County. Bangor Slate Company. Tenth Census, 1880. 25934.
- Lower Silurian. Blue-black. Slatington, Lehigh County. Quarry of Kuntz & Jacobs. Tenth Census, 1880. 26912.
- Lower Silurian. Blue-black. Slatington, Lehigh County. Quarry of J. Hess & Co. Tenth Census, 1880. 26913.
- Lower Silurian. Blue-black. Two specimens. Slatington, Lehigh County. Pennsylvania quarries. Tenth Census, 1880. 26914.
- Archæan (?) Blue-black. Bangor, York County. Peach Bottom Slate Company. Tenth Census, 1880. 25949.
- Archæan (?) Blue-black. Slab 8 inches square. West Bangor, York County. Quarry of R. L. Jones & Co. Tenth Census, 1880. 26480.
- Archæan (?) Blue-black. 4 by 4 by 1½ inches. West Bangor, York County. Quarry of W. C. Parry & Co. Tenth Census, 1880. 26852.
- Archæan (?) Blue-black. Slab 8 inches square. West Bangor, York County. Quarry of W. C. Parry & Co. Tenth Census, 1880. 26853.

RHODE ISLAND.

- Biotite granite.** Fine; gray. Near Westerly, Washington County. Smith Granite Company. Tenth Census, 1880. 25491.
- Medium; light pink. Near Westerly, Washington County. Smith Granite Company. Tenth Census, 1880. 25492.
 - Fine; gray. Near Westerly, Washington County. New England Granite Works. Tenth Census, 1880. 25510.
 - Fine; gray. Near Westerly, Washington County. New England Granite Works. Tenth Census, 1880. 25511.
 - Fine; gray. Foot cube. Westerly, Washington County. Centennial, 1876. 17526.
 - Fine; pink. Westerly, Washington County. Centennial, 1876. 17553.
 - Fine; gray. Near Westerly, Washington County. Smith Granite Company. Tenth Census, 1880. 25490.
 - Medium; gray. Near Westerly, Washington County. C. P. Chapman's quarry. Tenth Census, 1880. 25529.
 - Fine; pink. Near Westerly, Washington County. C. P. Chapman's quarry. Tenth Census, 1880. 25530.
 - Medium; pink. Near Westerly, Washington County. New England Granite Works. Tenth Census, 1880. 25512.
 - Fine; gray. Near Westerly, Washington County. C. P. Chapman's quarry. Tenth Census, 1880. 25528.
 - Medium; pink. Six-inch cube. Westerly, Washington County. New England Granite Works. Tenth Census, 1880. 26998.
 - Fine; gray. Six-inch cube. Westerly, Washington County. New England Granite Works. Tenth Census, 1880. 26999.

- Biotite granite.** Fine; gray. Six-inch cube. Westerly, Washington County. New England Granite Works. Tenth Census, 1880. 27000.
- Fine; gray. Niantic, Washington County. A. G. Crumb's quarry. Tenth Census, 1880. 25952.
- Coarse; light pink. West Greenwich, Kent County. H. Vaughn's quarry. Tenth Census, 1880. 25513.
- Coarse; pinkish gray. West Greenwich, Kent County. J. Tarbox's quarry. Tenth Census, 1880. 25514.
- Coarse; light pinkish gray. Near Smithfield, Providence County. Smithfield Granite Company. Tenth Census, 1880. 25531.
- Granite.** Fine; light gray. Polished slab 7 feet 5 inches long by 3 feet 8 inches wide by 2½ inches thick. Westerly, Washington County. New England Granite Company. Tenth Census, 1880. 27063.
- Biotite gneiss.** Coarse; light gray. Pascoag, Providence County. Quarry of Garvey Bros. Tenth Census, 1880. 26318.
- Hornblende gneiss.** Medium; dark greenish gray. Diamond Hill, Cumberland Township, Providence County. Tenth Census, 1880. 25532.

SOUTH CAROLINA.

- Steatite (?) [soapstone].** Very compact and quite hard; nearly black. Quarry of F. Happenfield, Yorkville, York County. Centennial, 1876. 39019.
- Medium; greenish gray. Spartanburgh, Spartanburgh County, 1885. 37590.
- Limestone [marble].** Light blue-gray; crystalline. 37591.
- Biotite granite.** Medium; gray. Winnsborough, Fairfield County. 37578.
- Fine; gray. Fairfield County. 37588.
- Medium; gray. Fairfield County. 37587.
- Fine; gray. Charleston, Charleston County. E. R. White, 1895. 37583.
- Fine; gray. Aiken County. 37585.
- Coarse; dark gray. Aiken County. 37601.
- Medium; dark gray. Batesburgh, Lexington County. 37584.
- Medium; gray. Columbia, Richland County. 37582.
- Fine; gray. Edgefield County. 37586.
- Fine; gray. Newburry County. 37589.

TENNESSEE.

- Limestone [marble].** Lower Silurian; pink; fossiliferous. Slab 12 by 10 by ½ inches. R. Gouldsbury & Son, New York, 1884. 36760.
- Lower Silurian; pink; crystalline. Near Cleveland, Bradley County. Quarry of Patrick & Smith. Tenth Census, 1880. 26825.
- Lower Silurian; pink; fossiliferous. Near Cleveland, Bradley County. Quarry of Patrick & Smith. Tenth Census, 1880. 26824.
- Lower Silurian; dull red and white mottled; fossiliferous. Near Whitesburgh, Hamblen County. Joseph Stamp's quarry. Tenth Census, 1880. 25995.
- Lower Silurian; olive-green; fossiliferous. Eleventh district of Davidson County. N. H. Boyd's quarry. Tenth Census, 1880. 27186.
- Lower Silurian; very light gray; crystalline. Two specimens. Knoxville, Knox County. Quarry of Frierson & Morgan. Tenth Census, 1880. 26555.
- Lower Silurian; light pink; crystalline. Knoxville, Knox County. Crescent quarry. Tenth Census, 1880. 26556.
- Lower Silurian; pink; crystalline. Knoxville, Knox County. Crescent quarry. Tenth Census, 1880. 26557.

Limestone [marble]. Lower Silurian; pink; crystalline. Near Knoxville, Knox County. Knoxville Marble Company. Tenth Census, 1880. 26558.

— Lower Silurian; pink; crystalline. Knoxville, Knox County. Quarry of John M. Ross. Tenth Census, 1880. 26209.

— Lower Silurian; dull pink; crystalline. Near Knoxville, Knox County. Quarry of J. M. Ross. Tenth Census, 1880. 26975.

— Lower Silurian; light pink; crystalline. Near Knoxville, Knox County. Tennessee River Marble Company. Tenth Census, 1880. 26653.

— Lower Silurian; red and white mottled; fossiliferous. Near Knoxville, Knox County. Tennessee River Marble Company. Tenth Census, 1880. 26654.

— Lower Silurian; pink; crystalline. 12-inch cube. Knoxville, Knox County. Knoxville Marble Company. 17450.

— Lower Silurian; pinkish drab with dark veins; crystalline. About 10 by 10 by 2½ inches. Knoxville, Knox County. Knoxville Marble Company. Centennial, 1876. 17480.

— Lower Silurian; red and white mottled; fossiliferous. Knoxville, Knox County. Rosebud quarry. Tenth Census, 1880. 26559.

— Lower Silurian; pink; crystalline. Knoxville, Knox County. Knoxville Marble Company. Tenth Census, 1880. 26627.

— Reddish brown; fossiliferous. Third civil district, Knox County. Quarry of Harvey & Brown. T. Toumey, 1881. 25242.

— Lower Silurian; dull red; variegated; fossiliferous. Slab 24 by 21 by 1½ inches. Quarryville, Hawkins County. Centennial, 1876. 25253.

— Lower Silurian; red and white mottled; fossiliferous. 12-inch cube. Quarryville, Hawkins County. Dougherty Marble quarry. Centennial, 1876. 17452.

— Lower Silurian; red and white mottled; fossiliferous. 12-inch cube. Doughertyville, Hawkins County. Centennial, 1876. 17453.

— Lower Silurian; dull red; variegated; semi-crystalline; fossiliferous. Doughertyville, Hawkins County. Col. Edward Clark, 1880. 25004.

— Lower Silurian; red and white mottled; fossiliferous. 12-inch cube. Doughertyville, Hawkins County. Centennial, 1876. 25240.

— Lower Silurian; dull red and white mottled; fossiliferous. Rogersville, Hawkins County. J. Hasson's quarry. Tenth Census, 1880. 25330.

— Lower Silurian; dull red and white mottled; fossiliferous. Rogersville, Hawkins County. John Hasson's quarry. Tenth Census, 1880. 25338.

— Lower Silurian; red and white mottled; fossiliferous. Rogersville, Hawkins County. Quarry of Chesnut & Chesnut. Tenth Census, 1880. 26211.

— Lower Silurian; red and white mottled; fossiliferous. Near Rogersville, Hawkins County. J. Price's quarry. Tenth Census, 1880. 26652.

— Lower Silurian; red and white mottled; fossiliferous. Near Rogersville, Hawkins County. J. Wright's quarry. Tenth Census, 1880. 26805.

— Lower Silurian; red and white mottled; fossiliferous. Two specimens. Near Rogersville, Hawkins County. Cole's Ridge quarry. Tenth Census, 1880. 26937.

— Lower Silurian; red and white mottled; fossiliferous. Two specimens. Mooresburgh, Hawkins County. E. D. Dougherty's quarry. Tenth Census, 1880. 26916.

Magnesian limestone [marble]. Lower Silurian; pink; crystalline. Two specimens, light and dark. Cleveland, Bradley County. Quarry of Patrick & Smith. Tenth Census, 1880. 26560.

Magnesian limestone [marble]. Lower Silurian; red and white mottled; fossiliferous. Two specimens, light and dark. Knoxville, Knox County. Quarry of Thomas & Co. Tenth Census, 1880. 26210.

— Lower Silurian; red and white mottled; fossiliferous. Rogersville, Hawkins County. Quarry of Fulkerson & Chesnutt. Tenth Census, 1880. 26172.

— Lower Silurian; variegated; brecciated. Near Calhoun, McMinn County. Hiwassee quarry No. 2. Tenth Census, 1880. 27169.

— Lower Silurian; variegated; brecciated. Near Calhoun, McMinn County. Hiwassee quarry No. 2. Tenth Census, 1880. 27170.

— Lower Silurian; light variegated; fossiliferous. Near Calhoun, McMinn County. Hiwassee quarry No. 2. Tenth Census, 1880. 27171.

— Lower Silurian; light variegated; fossiliferous. Near Calhoun, McMinn County. Hiwassee quarry No. 2. Tenth Census, 1880. 27172.

— Lower Silurian; pinkish drab; compact; finely fossiliferous. Near Calhoun, McMinn County. Hiwassee quarry No. 2. Tenth Census, 1880. 37165.

— Lower Silurian; pinkish drab; compact; finely fossiliferous. Near Calhoun, McMinn County. Hiwassee quarry No. 2. Tenth Census, 1880. 27166.

— Lower Silurian; pinkish drab; compact; finely fossiliferous. Near Calhoun, McMinn County. Hiwassee quarry No. 2. Tenth Census, 1880. 27167.

— Lower Silurian; pinkish drab; compact; finely fossiliferous. Near Calhoun, McMinn County. Hiwassee quarry No. 2. Tenth Census, 1880. 27168.

Limestone. Light colored; finely fossiliferous. Twenty-fifth district of Davidson County. Quarry of Joseph Clus & Bro. Tenth Census, 1880. 27187.

— Carter's Creek, Davidson County. Trehen's Farm. Tenth Census, 1880. 26785.

— Dark blue-gray; compact; fossiliferous. Charlotte Pike, near Nashville, Davidson County. Tenth Census, 1880. 26787.

— Dark gray; fossiliferous. Near Nashville, Davidson County. Tenth Census, 1880. 26978.

— Lower Silurian; light colored; finely fossiliferous. Near Nashville, Davidson County. Capitol quarry. Tenth Census, 1880. 25538.

— Light colored; coarsely vesicular through the weathering out of fossil shells. Nashville, Davidson County. Tenth Census, 1880. 26976.

— Lower Silurian; drab; fossiliferous; cellular. Two specimens. Nashville, Davidson County. Vanderbilt quarries. Tenth Census, 1880. 25562.

— Lower Silurian; drab; compact. Nashville, Davidson County. Vanderbilt quarries. Tenth Census, 1880. 25563.

— Sub-Carboniferous; light colored; oolitic. Sherwood Station, Franklin County. Swan's quarry. Tenth Census, 1880. 25559.

— Drab; finely fossiliferous. Near Cowan, Franklin County. Tenth Census, 1880. 26795.

— Drab; with light spots. Nolensville Pike, Williamson County. Old quarry. Tenth Census, 1880. 26789.

— Light colored; fine and compact. Nolensville, Williamson County. Tenth Census, 1880. 26965.

— Light colored; semi-crystalline. Columbia, Maury County. Tenth Census, 1880. 26968.

— Light colored; fossiliferous. Two specimens. Carter's Creek Station, Maury County. Tenth Census, 1880. 26967.

— Dark drab; semi-crystalline. Lebanon Pike, Wilson County. Mrs. Nichol's quarry. Tenth Census, 1880. 26734.

Limestone. Dark drab; compact. Murfreesborough, Rutherford County. Tenth Census, 1880. 26788.

— Dull red; fossiliferous. Near Springfield, Henry County. Burns's quarry. Tenth Census, 1880. 25564.

— Light colored; semi-crystalline; compact. Near Morristown, Hamblen County. M. Carriger's quarry. Tenth Census, 1880. 25994.

— Light colored; finely fossiliferous. Breen's quarry. Tenth Census, 1880. 26786.

Granite. Coarse; gray. Southeast part of Carter County. Tenth Census, 1880. 26777.

Hornblende gneiss (?). Medium; gray. Hiwassee Copper Mines, Monroe County. Tenth Census, 1880. 26793.

Diorite (?). Very compact; nearly black; coarsely porphyritic; with scattering crystals of white feldspar. Carter County. Tenth Census, 1880. 26791.

Sandstone. Fine; dark blue-gray. Carter's Creek, Davidson County. Tenth Census, 1880. 26785.

— Bright yellow; soft and porous. Twelfth district of Davidson County. J. Sullivan's quarry. Tenth Census, 1880. 27185.

— Red; very ferruginous; soft and porous. Ducktown, Polk County. Tenth Census, 1880. 26966.

— Fine; light drab. Church Mountain, Grainger County. Tenth Census, 1880. 26794.

— Medium; light colored and pinkish. Two specimens. Sewanee, Franklin County. Tenth Census, 1880. 26796.

— Coarse; light brown; cellular. Parksville, Polk County. Tenth Census, 1880. 26835.

— Fine; light colored rust spotted. Parksville, Polk County. Tenth Census, 1880. 26836.

Conglomerate. Gray pink spotted; very hard and compact. Wolf Creek, Cocke County. Tenth Census, 1880. 26775.

— Cambrian; greenish gray; fine; very hard and compact. Ocoee River, Polk County. Tenth Census, 1880. 26833.

— Cambrian; gray; very hard and compact. Owen's Bluff on the Ocoee River, Polk County. Tenth Census, 1880. 26832.

Slate. Greenish, 4 by 4 by 3 inches. Near Ducktown, Polk County. Tenth Census, 1880. 26969.

TEXAS.

Limestone [marble]. Light yellow; compact; fossiliferous. Near Austin, Travis County. Quarry of C. W. Van Resenbury. J. S. F. Batchen, 1884. 35576.

— Cretaceous; drab; compact; coarsely fossiliferous. Austin, Travis County. J. McDonald's quarry. Tenth Census, 1880. 25716.

— Lower Silurian; light drab, with purple veins; very fine and compact. Near Burnet, Burnet County. Holland's quarry. Tenth Census, 1880. 25720.

— Lower Silurian; very light drab; fine and compact. Near San Saba, San Saba County. Dr. A. Gregg's quarry. Tenth Census, 1880. 26692.

— Blue-gray crystalline. Burnet, Burnet County. A. R. Johnson, 1887. 38819.

Dolomite [marble]. Dull red, with net-work of lighter lines. Burnet, Burnet County. A. R. Johnson, 1887. 38820.

Dolomite. Silurian; buff; fine and compact. Near San Saba, San Saba County. Dr. A. Gregg's quarry. Tenth Census, 1880. 26272.

- Dolomite.** Silurian; fine; light colored. Near San Saba, San Saba County. Dr. A. Gregg's quarry. Tenth Census, 1880. 26691.
- Silurian; light buff; fine and compact. Near San Saba, San Saba County. Dr. A. Gregg's quarry. Tenth Census, 1880. 26690.
- Lower Silurian; nearly white; coarsely crystalline. Near San Saba, San Saba County. Dr. A. Gregg's quarry. Tenth Census, 1880. 26693.
- Silurian; pink; fine and compact. Near San Saba, San Saba County. Dr. A. Gregg's quarry. Tenth Census, 1880. 26271.
- Ferruginous dolomite.** Silurian; fine and compact; pinkish. Near San Saba, San Saba County. Dr. A. Gregg's quarry. Tenth Census, 1880. 25726.
- Limestone.** Light colored; fine; porous. Near Austin, Travis County. Tenth Census, 1880. 25723.
- Light colored; fine; porous. Near Austin, Travis County. Tenth Census, 1880. 25560.
- Cretaceous; light colored; fine; porous. Near Austin, Travis County. G. W. Brackinredge's quarry. Tenth Census, 1880. 25713.
- Light colored; fine; porous. Round Rock, Williamson County. G. W. Davis's quarry. John S. F. Batchen, 1884. 35577.
- Drab; compact. Near Burnet, Burnet County. Tenth Census, 1880. 25719.
- Magnesian limestone.** Cretaceous; light colored; fine; porous. Near Austin, Travis County. J. Sheehan's quarry. Tenth Census, 1880. 25714.
- Cretaceous; light colored; fossiliferous. Two specimens. Near Austin, Travis County. J. Sheehan's quarry. Tenth Census, 1880. 25715.
- Biotite granite.** Fine; pink. Eight miles from Burnet, Burnet County. Tenth Census, 1880. 25722.
- Coarse; red. Eight miles from Burnet, Burnet County. Tenth Census, 1880. 25721.
- Diorite.** Medium; light greenish gray. Near El Paso, El Paso County. J. S. F. Batchen, 1883. 28585.
- Sandstone.** Lower Silurian; coarse brown. Near Burnet, Burnet County. Tenth Census, 1880. 25717.
- Lower Silurian; coarse; dull red. Near Burnet, Burnet County. Tenth Census, 1880. 25718.
- Carboniferous; fine; very light gray. 4 by 3½ by 3 inches. Near Mormon Mills, Burnet County. Tenth Census, 1880. 25724.

UTAH.

- Limestone [marble].** White; dark mottled; crystalline. Near Payson, Utah County. Tenth Census, 1880. 25393.
- Dolomite [marble].** Black, with white fossils. Near Payson, Utah County. Tenth Census, 1880. 25452.
- Limestone.** Drab; fine and compact. Near Payson, Utah County. Tenth Census, 1880. 25453.
- Light colored; porous. San Pete Valley. Tenth Census, 1880. 25352.
- Hornblende biotite granite.** Coarse; light gray. Two miles south of Salt Lake City. Tenth Census, 1880. 25351.
- This stone was used in the construction of the new Mormon temple at Salt Lake City.
- Sandstone.** Fine; light pink. Near Red Butte, Salt Lake County. Tenth Census, 1880. 25399.

Sanatstone. Fine; very light pink. Red Butte, $2\frac{1}{2}$ miles east of Salt Lake City. Tenth Census, 1880. 25400.

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Steatite [soapstone]. Fine; compact; light blue-gray. Grafton. Centennial, 1876. 17569.

— Coarse; compact; blue-gray. Townsend, Windham County. Bemis's quarry. Tenth Census, 1880. 26626.

Serpentine [ophiolite, verd-antique marble]. Green; white veined. Takes a high polish. Roxbury, Washington County. S. G. Emory, Washington, D. C., 1883. 27824.

— Green; white veined. Takes a high polish. $5\frac{1}{2}$ by $4\frac{1}{2}$ by 1 inch. Roxbury, Washington County. S. G. Emory, Washington, D. C., 1883. 27825.

— Dark green, with white veins. Takes a high polish. $11\frac{1}{2}$ by $11\frac{1}{2}$ by 5 inches. Roxbury, Washington County. Centennial, 1876. 17389.

Limestone [marble]. Turned column and urn, about 10 inches at base by 70 inches high, of white, dark-veined, crystalline limestone. Rutland, Rutland County. Centennial, 1876. 26013.

— Turned column, about 10 inches at base by 50 inches high, of dark blue-gray crystalline limestone. Rutland, Rutland County. Centennial, 1876. 26014.

— Turned vase, about 10 by 19 inches. Gray mottled crystalline limestone. Rutland, Rutland County. Centennial, 1876. 26016.

— Turned column and urn, about 8 inches at base by 36 inches high, of blue-gray and white-mottled crystalline limestone. Rutland, Rutland County. Centennial, 1876. 26017.

— Flooring tiles, set in a black walnut frame. Size, 3 feet square. The following marbles are represented, all from Vermont: Common white, Isle La Motte black, and red and white variegated from Swanton and Mallet's Bay. Centennial, 1876. 17447.

— Flooring tiles, set in frame as above, comprising the following marbles: Vermont white; Isle La Motte black; Swanton and Mallet's Bay red and white variegated; Clinton, N. Y., gray; and Glen's Falls black. Centennial, 1876. 17448.

— Lower Silurian. Dark blue-gray mottled. Three specimens. West Rutland, Rutland County. Esperanza Marble Company, 1884. 36833.

— Lower Silurian. Dark blue-gray and white mottled; crystalline. About 16 by 38 by $\frac{1}{4}$ inches. West Rutland. Esperanza Marble Company, 1884. 36848.

— Lower Silurian. 10 by 10 by 6 inches. Blue-gray and white mottled; crystalline. West Rutland, Rutland County. Centennial, 1876. 17387.

— Lower Silurian. White and dark mottled; crystalline. Three specimens. West Rutland, Rutland County. Columbian Marble Company. Tenth Census, 1880. 25710.

— Lower Silurian. Blue-gray; crystalline. About 10 by 10 by $5\frac{1}{2}$ inches. West Rutland, Rutland County. Columbian Marble Company. Centennial, 1876. 17385.

— Lower Silurian. Gray and white mottled; crystalline. About 10 by 10 by 6 inches. West Rutland, Rutland County. Columbian Marble Company. Centennial, 1876. 17386.

— Lower Silurian. White; crystalline. 12-inch cube. West Rutland, Rutland County. Eureka Marble Company. Centennial, 1876. 17388.

— Lower Silurian. Light blue; dark veined; crystalline. West Rutland, Rutland County. Rutland Marble Company. Tenth Census, 1880. 25730.

- Limestone [marble].** Lower Silurian. Pure white; crystalline; statuary marble. West Rutland, Rutland County. Rutland Marble Company. Tenth Census, 1880. 25731.
- Lower Silurian. White; dark spotted; crystalline. West Rutland, Rutland County. Rutland Marble Company. Tenth Census, 1880. 25732.
- Lower Silurian. Blue-gray and white mottled; crystalline. About 10 by 10 by 6 inches. West Rutland, Rutland County. Columbian Marble Company. Centennial, 1876. 17380.
- Lower Silurian. Blue-gray and white mottled; crystalline. About 10 by 10 by 6 inches. West Rutland, Rutland County. Columbian Marble Company. Centennial, 1876. 17381.
- Lower Silurian. Blue-gray and white mottled; crystalline. About 8½ by 6 inches. West Rutland, Rutland County. Columbian Marble Company. Centennial, 1876. 17382.
- Lower Silurian. White; dark veined; crystalline. About 8½ by 8½ by 6 inches. West Rutland, Rutland County. Columbian Marble Company. Centennial, 1876. 17384.
- Lower Silurian. White; dark veined; crystalline. About 10 by 10 by 6 inches. West Rutland, Rutland County. Columbian Marble Company. Centennial, 1876. 17384.
- Lower Silurian. Blue-gray and white mottled; crystalline. About 10 by 10 by 6 inches. West Rutland, Rutland County. Columbian Marble Company. Centennial, 1876. 17361.
- Lower Silurian. White; crystalline. About 10 by 9½ by 6 inches. West Rutland, Rutland County. Columbian Marble Company. Centennial, 1876. 17362.
- Lower Silurian. White; dark veined; crystalline. About 10 by 9 by 6 inches. West Rutland, Rutland County. Columbian Marble Company. Centennial, 1876. 17364.
- Lower Silurian. Blue-gray mottled; crystalline. About 10 by 10 by 6 inches. West Rutland, Rutland County. Columbian Marble Company. Centennial, 1876. 17365.
- Lower Silurian. White; dark spotted; crystalline. About 10 by 10 by 6 inches. West Rutland, Rutland County. Columbian Marble Company. Centennial, 1876. 17366.
- Lower Silurian. Blue-gray; white mottled; crystalline. About 8½ by 6 inches. West Rutland, Rutland County. Columbian Marble Company. Centennial, 1876. 17376.
- Lower Silurian. White; dark veined; crystalline. About 10 by 10 by 6 inches. West Rutland, Rutland County. Columbian Marble Company. Centennial, 1876. 17377.
- Lower Silurian. Gray and white mottled. About 10 by 10 by 6 inches. West Rutland, Rutland County. Columbian Marble Company. Centennial, 1876. 17378.
- Lower Silurian. Blue-gray and white mottled; crystalline. About 8 by 8 by 4 inches. West Rutland, Rutland County. Centennial, 1876. 26015.
- Lower Silurian; blue-gray and white, mottled; crystalline. About 12 by 12 by 8 inches. West Rutland, Rutland County. Centennial, 1876. 26027.
- Lower Silurian; white crystalline. West Rutland, Rutland County. Quarry of Sherman & Slason. Tenth Census, 1880. 25802.
- Lower Silurian; white, green-veined; crystalline. Two specimens. West Rutland, Rutland County. Quarry of Sherman & Slason. Tenth Census, 1880. 25803.

- Limestone [marble].** Lower Silurian; pure white; crystalline. West Rutland, Rutland County. Quarry of Gibson & Woodfin. Tenth Census, 1880. 25734.
- Lower Silurian; light blue; dark veined; crystalline. West Rutland, Rutland County. Quarry of Gibson & Woodfin. Tenth Census, 1880. 25735.
- Lower Silurian; gray and white, mottled; crystalline. 12-inch cube. West Rutland, Rutland County. Centennial, 1876. 25217.
- Lower Silurian; light blue, dark veined; crystalline. West Rutland, Rutland County. Quarry of Sheldon & Slason. Tenth Census, 1880. 25723.
- Lower Silurian; white; crystalline. Marble slab, about 3 feet by 11 by 18 inches; used as a shelf. West Rutland, 1876. 17349.
- Lower Silurian; white; crystalline. Marble slab, about 3 feet by 11 by 18 inches; used as a shelf. West Rutland, 1876. 17350.
- Lower Silurian; white; crystalline. Marble slab, about 3 feet by 11 by 18 inches; used as a shelf. West Rutland, 1876. 17351.
- Lower Silurian; white; crystalline. Marble slab, about 3 feet by 11 by 18 inches; used as a shelf. West Rutland, 1876. 17340.
- Lower Silurian; white; green veined; crystalline. 12-inch cube. West Rutland, Rutland County. Centennial, 1876. 17453.
- Lower Silurian; water blue; dark veined; crystalline. 12-inch cube. West Rutland, Rutland County. Rutland Marble Company. Centennial, 1876. 17460.
- Lower Silurian; white; green veined; crystalline. 12-inch cube. West Rutland, Rutland County. Rutland Marble Company. Centennial, 1876. 17461.
- Lower Silurian; white; crystalline. West Rutland, Rutland County. Centennial, 1876. 17390.
- Lower Silurian; white; green veined; crystalline. West Rutland, Rutland County. Centennial, 1876. 17391.
- Lower Silurian; pure white; crystalline. 12-inch cube. West Rutland, Rutland County. Rutland Marble Company. Centennial, 1876. 17451.
- Lower Silurian; pure white; crystalline. 12-inch cube. West Rutland, Rutland County. Rutland Marble Company. Centennial, 1876. 17454.
- Lower Silurian; white; crystalline. 12-inch cube. West Rutland, Rutland County. Rutland Marble Company. Centennial, 1876. 17455.
- Lower Silurian; white; green veined; crystalline. 12-inch cube. West Rutland, Rutland County. Centennial, 1876. 17456.
- Lower Silurian; white; green veined; crystalline. 12-inch cube. West Rutland, Rutland County. Rutland Marble Company. Centennial, 1876. 17459.
- Lower Silurian; white; crystalline. West Rutland, Rutland County. Rutland Marble Company. Centennial, 1876. 17392.
- Lower Silurian; white; green veined; crystalline. West Rutland, Rutland County. Rutland Marble Company. Centennial, 1876. 17393.
- Lower Silurian; light blue; dark veined; crystalline. West Rutland, Rutland County. Rutland Marble Company. Centennial, 1876. 17395.
- Lower Silurian; light blue; white spotted; crystalline. West Rutland, Rutland County. Rutland Marble Company. Centennial, 1876. 17396.
- Lower Silurian; white; dark veined; crystalline. West Rutland, Rutland County. Rutland Marble Company. Centennial, 1876. 17397.
- Lower Silurian; pure white; crystalline. West Rutland, Rutland County. Rutland Marble Company. Centennial, 1876. 17398.
- Lower Silurian; pure white; crystalline. West Rutland, Rutland County. Rutland Marble Company. Centennial, 1876. 17400.

- Limestone [marble].** Lower Silurian; white; dark spotted; crystalline. West Rutland, Rutland County. Centennial, 1876. 17394.
- Lower Silurian; white; dark veined; crystalline. 10-inch cube. Centre Rutland, Rutland County. Eureka Marble Company. Centennial, 1876. 17356.
 - Lower Silurian; white; dark spotted; crystalline. 12-inch cube. Centre Rutland, Rutland County. Eureka Marble Company. Centennial, 1876. 17357.
 - White; crystalline. Slab about 2 feet 9 inches high, 2 feet wide, and 2 inches thick. Centre Rutland, Rutland County. Centennial, 1876. 17341.
 - White; crystalline. Slab about 2 feet 9 inches high, 2 feet wide, and 2 inches thick. Centre Rutland, Rutland County. Centennial, 1876. 17343.
 - White; crystalline. Slab about 2 feet 9 inches high, 2 feet wide, and 2 inches thick. Centre Rutland, Rutland County. Centennial, 1876. 17345.
 - Lower Silurian; white; dark veined; crystalline. 10-inch cube. Centre Rutland, Rutland County. Centennial, 1876. 17355.
 - Crystalline; white; green veined. Slab about 2 feet 9 inches by 2 feet wide by 2 inches thick. Centre Rutland. Centennial, 1876. 17338.
 - Lower Silurian; pure white; crystalline. Two specimens. Pittsford, Rutland County. Pittsford Marble Company. Tenth Census, 1880. 25690.
 - Lower Silurian; white; dark veined; crystalline. 12-inch cube. Pittsford, Rutland County. Burlington Manufacturing Company. Centennial, 1876. 17468.
 - Lower Silurian; water-blue; crystalline. 12-inch cube. North Pittsford, Rutland County. Burlington Manufacturing Company. Centennial, 1876. 17464.
 - Lower Silurian; white; dark veined; crystalline. 12-inch cube. North Pittsford, Rutland County. Burlington Manufacturing Company. Centennial, 1876. 17466.
 - Lower Silurian; white; dark veined; crystalline. About 12 by 12 by 12 inches. North Pittsford, Rutland County. Burlington Manufacturing Company. Centennial, 1876. 17467.
 - Lower Silurian; pure white; fine crystalline. South Wallingford, Rutland County. William W. Kelley's quarry. Tenth Census, 1880. 26300.
 - Lower Silurian; 10 by 10 by 6 inches; white, dark veined; crystalline. Sutherland Falls, Rutland County. Centennial, 1876. 17358.
 - Lower Silurian, white, dark spotted; crystalline. Sutherland Falls, Rutland County. Centennial, 1876. 17509.
 - Lower Silurian; white, dark veined; crystalline. Sutherland Falls, Rutland County. Centennial, 1876. 17500.
 - Lower Silurian; white, dark spotted; crystalline. Sutherland Falls, Rutland County. Centennial, 1876. 17501.
 - Lower Silurian; white, dark spotted; crystalline. About 10 by 10 by 8 inches. Sutherland Falls, Rutland County; Sutherland Falls Marble Company. Centennial, 1876. 17369.
 - Lower Silurian; white, dark spotted; crystalline. 12-inch cube. Sutherland Falls, Rutland County. Centennial, 1876. 17370.
 - Lower Silurian; white, dark veined; crystalline. About 8½ by 6 inches. Sutherland Falls, Rutland County. Centennial, 1876. 17371.
 - Lower Silurian; white, dark spotted; crystalline. 12-inch cube. Sutherland Falls, Rutland County. Centennial, 1876. 17373.

- Limestone [marble].** Lower Silurian; white; crystalline. Sutherland Falls, Rutland County. Centennial, 1876. 17502.
- Lower Silurian; white, dark mottled; crystalline. Sutherland Falls, Rutland County. Centennial, 1876. 17503.
- Lower Silurian; white, dark veined; crystalline. Sutherland Falls, Rutland County. Centennial, 1876. 17506.
- Lower Silurian; blue and white mottled; crystalline. Sutherland Falls, Rutland County. Centennial, 1876. 17507.
- Lower Silurian; white, dark veined; crystalline. Sutherland Falls, Rutland County. Centennial, 1876. 17508.
- Lower Silurian; white, dark veined; crystalline. 12-inch cube. Sutherland Falls, Rutland County; Sutherland Falls Marble Company. Centennial, 1876. 17374.
- Lower Silurian; white, dark spotted; crystalline. 12-inch cube. Southerland Falls, Rutland County. Centennial, 1876. 17359.
- Lower Silurian; dark gray; fossiliferous. Isle La Motte, Grand Isle County. Quarry of Fiske and Barney. Tenth Census, 1880. 26926.
- Lower Silurian; white; crystalline. Dorset, Bennington County. Quarry of Freedly & Son. Tenth Census, 1880. 26273.
- Lower Silurian; white; crystalline. Dorset, Bennington County. S. F. Prince's quarry. Tenth Census, 1880. 26274.
- Lower Silurian; white; crystalline. Dorset, Bennington County. Quarry of S. F. Prince & Co. Tenth Census, 1880. 26733.
- Lower Silurian; white, dark spotted; crystalline. 12-inch cube. East Dorset, Bennington County. Centennial, 1876. 25087.
- Lower Silurian; white, dark spotted; crystalline. 10-inch cube. East Dorset, Bennington County. Centennial, 1876. 17462.
- Lower Silurian; white, dark veined; crystalline. Rutland, Rutland County. Quarry of Flint Bros. & Co. Tenth Census, 1880. 25805.
- Lower Silurian; white, dark veined; crystalline. Two specimens. Rutland, Rutland County. Quarry of Flint Bros. & Co. Tenth Census, 1880. 25736.
- Lower Silurian; pure white; crystalline; statuary marble. West Rutland, Rutland County. Quarry of Sheldon & Slason. Tenth Census, 1880. 25729.
- Lower Silurian; white; crystalline. Pittsford, Rutland County. Quarry of F. W. Smith & Co. Tenth Census, 1880. 26674.
- Lower Silurian; light blue and white; crystalline. Pittsford, Rutland County. Quarry of F. W. Smith & Co. Tenth Census, 1880. 26675.
- Lower Silurian; white, dark spotted; crystalline. Pittsford, Rutland County. Quarry of F. W. Smith & Co. Tenth Census, 1880. 26676.
- Lower Silurian; white, dark veined; crystalline. Pittsford, Rutland County. George E. Hall's quarry. Tenth Census, 1880. 25692.
- Lower Silurian; white, dark spotted; crystalline. South Wallingford, Rutland County. William W. Kelley's quarry. Tenth Census, 1880. 26677.
- Lower Silurian; light blue, and white mottled; crystalline. Two specimens. South Wallingford, Rutland County. William W. Kelley's quarry. Tenth Census, 1880. 26678.
- Lower Silurian; pure white; crystalline; statuary marble. Brandon, Rutland County. Brandon Statuary Marble Company. Tenth Census, 1880. 25689.
- Lower Silurian; white, dark veined; crystalline. East Dorset, Bennington County. Quarry of D. L. Kent & Company. Tenth Census, 1880. 26275.

Limestone [marble]. Lower Silurian; white, dark veined; crystalline. New Haven, Addison County. Cutter Marble Company. Tenth Census, 1880. 27034.

— Lower Silurian; French gray; very fine and compact. Swanton, Franklin County. Quarry of George and R. L. Barney. Tenth Census, 1890. 26928.

— Lower Silurian; gray and white mottled. About 10 by 10 by 6 inches. West Rutland, Rutland County. Columbian Marble Company. Centennial, 1876. 17379.

— Lower Silurian; white, dark veined; crystalline. About 8½ by 6 inches. West Rutland, Rutland County. Columbian Marble Company. Centennial, 1876. 17360.

— Lower Silurian; water-blue; dark veined; crystalline. 12-inch cube. West Rutland, Rutland County. Rutland Marble Company. Centennial, 1876. 17459.

— Lower Silurian; white green veined; crystalline. West Rutland, Rutland County. Rutland Marble Company. Centennial, 1876. 17399.

— Lower Silurian; white dark veined; crystalline. About 10 by 10 by 7½ inches. Sutherland Falls, Rutland County. Centennial, 1876. 17367.

Magnesian limestone. Lower Silurian; dark gray, nearly black; fossiliferous. Isle La Motte, Grand Isle County. Quarry of Goodsell & Hursh. Tenth Census, 1880. 26185.

— Lower Silurian; gray; fine grained; fossiliferous. Isle La Motte, Grand Isle County. Tenth Census, 1880. 26186.

— Lower Silurian; dark gray; compact; fossiliferous. Isle La Motte, Grand Isle County. Quarry of Ira & J. P. Hall. Tenth Census, 1880. 26188.

— Lower Silurian; blue-black; compact. Isle La Motte, Grand Isle County. Quarry of Ira & J. P. Hall. Tenth Census, 1880. 26189.

— Lower Silurian; dark gray; compact; fossiliferous. Isle La Motte, Grand Isle County. Quarry of H. C. Fisk & Son. Tenth Census, 1880. 26190.

— Lower Silurian; blue-black; compact. Isle La Motte, Grand Isle County. Quarry of H. C. Fisk & Son. Tenth Census, 1880. 26191.

— Lower Silurian; dark gray; fine and compact. Isle La Motte, Grand Isle County. Burlington Manufacturing Company. Tenth Census, 1880. 26673.

— Lower Silurian; dark gray; fossiliferous. Isle La Motte, Grand Isle County. Quarry of Fiske & Barney. Centennial, 1876. 17420.

— Lower Silurian; black; compact; fossiliferous. Isle La Motte, Grand Isle County. Quarry of Fiske & Barney. Centennial, 1876. 17421.

— Lower Silurian; nearly black; fossiliferous. 12-inch cube. Isle La Motte, Grand Isle County. Quarry of Fiske & Barney. Centennial, 1876. 17422.

Dolomite [marble]. Cambrian; pink and gray mottled; fine; compact. Mallet's Bay, Chittenden County. Centennial, 1876. 17495.

— Cambrian; light red mottled; fine and compact. About 5½ by 5½ by 2½ inches. Mallet's Bay, Chittenden County. Centennial, 1876. 17496.

— Cambrian; pink mottled. About 7 by 7½ by 7½ inches. Mallet's Bay, Chittenden, County. Centennial, 1876. 17497.

— Cambrian; red mottled. 6-inch cube. Mallet's Bay, Chittenden County. Centennial, 1876. 17489.

— Cambrian; dark pink; fine and compact. About 4 by 4 by 2½ inches. Mallet's Bay, Chittenden County. Centennial, 1876. 17490.

— Cambrian; pink mottled; fine and compact. Mallet's Bay, Chittenden County. Centennial, 1876. Two specimens. 17493.

Dolomite [marble]. Cambrian; red mottled; fine and compact. About 4½ by 4 by 2 inches. Mallet's Bay, Chittenden County. Centennial, 1876. 17492.

— Cambrian; red mottled; fine; compact. About 9½ by 7½ by 2 inches. Mallet's Bay, Chittenden County. Centennial, 1876. 17494.

— Cambrian; red mottled; fine and compact. Mallet's Bay, Chittenden County. Centennial, 1876. 25200.

— Cambrian; red and white mottled; fine and compact. Swanton, Franklin County. Quarry of George and R. L. Barney. Tenth Census, 1880. 26929.

— Cambrian; red and white mottled; 12-inch cube. Swanton, Franklin County. Centennial, 1876. 17416.

— Lower Silurian; red and white mottled; fine and compact. Swanton, Franklin County. George Barney's quarry. Centennial, 1876. 17419.

— Cambrian; red and white mottled; fine and compact. Swanton, Franklin County. Quarry of George and R. L. Barney. Tenth Census, 1880. 26927.

Biotite granite. Medium; gray. Near Woodbury, Washington County. Quarry of J. Ainsworth & Son. Tenth Census, 1880. 25581.

— Medium; dark gray. Near Woodbury, Washington County. C. W. Cilley's quarry. Tenth Census, 1880. 25582.

— Medium; dark gray. Near Woodbury, Washington County. C. W. Cilley's quarry. Tenth Census, 1880. 26647.

— Medium; gray. Barre, Washington County. Quarry of Wetmore & Morse. Tenth Census, 1880. 25584.

— Medium; gray. Barre, Washington County. E. L. Smith's quarry. Tenth Census, 1880. 25585.

— Medium; gray. Barre, Washington County. G. W. Mann's quarry. Tenth Census, 1880. 25586.

— Fine; gray. Foot cube. Barre, Washington County. Centennial, 1876. 17478.

— Fine; dark gray. Brunswick, Essex County. Saint Johnsbury Granite Company. Tenth Census, 1880. 26184.

Muscovite granite. Fine; very light gray, nearly white. Bethel, Windsor County. E. Kittredge's quarry. Tenth Census, 1880. 25566.

— Fine; very light gray, nearly white. Bethel, Windsor County. Quarry of E. Sturtevant & Co. Tenth Census, 1880. 25567.

— Fine; very light gray, nearly white. Foot cube. Bethel, Windsor County. Centennial, 1876. 17469.

Biotite muscovite granite. Medium; light gray. Ryegate, Caledonia County. R. W. Laird's quarry. Tenth Census, 1880. 26183.

— Coarse; gray. Ryegate, Caledonia County. R. F. Carter's quarry. Tenth Census, 1880. 26437.

Slate. Cambrian; blue-black. Two specimens. Northfield, Washington County. Adams Slate and Tile Company. Tenth Census, 1880. 25587.

— Cambrian; brownish gray. 4 by 4 by 1 inches. Castleton, Rutland County. Eagle Slate Company. Tenth Census, 1880. 25807.

— Cambrian; green and purple. 4 by 4 by 1 inches. Castleton, Rutland County. Eagle Slate Company. Tenth Census, 1880. 25808.

— Cambrian; greenish. 4 by 4 by 1 inches. Castleton, Rutland County. Eagle Slate Company. Tenth Census, 1880. 25809.

— Cambrian; greenish. 4 by 4 by 1½ inches. Castleton, Rutland County. Blue Slate Company. Tenth Census, 1880. 25810.

- Slate.** Cambrian; greenish. 4 by 4 by 3 inches. Fair Haven, Rutland County. Quarry of P. Roberts. Tenth Census, 1880. 25811.
- Cambrian; purple. 4 by 4 by $1\frac{1}{4}$ inches. Two specimens. Castleton, Rutland County. Quarry of Clifford & Litchfield. Tenth Census, 1880. 25813.
- Cambrian; purple. Castleton, Rutland County. Quarry of R. Conway. Tenth Census, 1880. 25814.
- Cambrian; purple. 4 by 4 by $\frac{1}{2}$ inches. Castleton, Rutland County. Snowden Slate Company. Tenth Census, 1880. 25815.
- Cambrian; blue-black. Castleton, Rutland County. Lake Shore Company. Tenth Census, 1880. 25816.
- Cambrian; greenish. Poultney, Rutland County. Evergreen Slate Company. Tenth Census, 1880. 25817.
- Cambrian; reddish. Fair Haven, Rutland County. Quarry of Griffiths Owen & Co. Tenth Census, 1880. 25818.
- Cambrian; red. 4 by 4 by $1\frac{1}{4}$ inches. Rutland, Rutland County. Quarry of L. Owens & Co. Tenth Census, 1880. 25953.
- Cambrian; green. 4 by 4 by $1\frac{1}{4}$ inches. Poultney, Rutland County. Quarry of L. Owens & Co. Tenth Census, 1880. 25954.
- Cambrian; blue-black. 4 by 4 by 2 inches. Two specimens. Poultney, Rutland County. Globe Slate Company. Tenth Census, 1880. 25955.
- Cambrian; greenish. 4 by 4 by 2 inches. Two specimens. Poultney, Rutland County. Quarry of J. Evans & Co. Tenth Census, 1880. 25956.
- Cambrian; green. 4 by 4 by 2 inches. Poultney, Rutland County. Macgrath's quarry. Tenth Census, 1880. 25970.
- Cambrian; green. 4 by 4 by $1\frac{1}{4}$ inches. Poultney, Rutland County. Quarry of D. Culver. Tenth Census, 1880. 25971.
- Cambrian; greenish. 4 by 4 by $\frac{1}{2}$ inches. Pawlet, Rutland County. M. Welch's quarry. Tenth Census, 1880. 26039.
- Cambrian; green. 4 by 4 by $2\frac{1}{4}$ inches. Pawlet, Rutland County. Quarry of W. J. Evans. Tenth Census, 1880. 26040.
- Cambrian; green. 4 by 4 by 1 inches. Pawlet, Rutland County. J. S. Warren's quarry. Tenth Census, 1880. 26041.
- Cambrian; greenish. 4 by 4 by 2 inches. Pawlet, Rutland County. Quarry of H. J. Williams. Tenth Census, 1880. 26042.
- Cambrian; purple. 4 by 4 by $1\frac{1}{4}$ inches. Pawlet, Rutland County. E. R. Norton's quarry. Tenth Census, 1880. 26043.
- Cambrian; green. West Pawlet, Rutland County. Brownell Slate and Flagging Company. Tenth Census, 1880. 26044.
- Cambrian; green. 4 by 4 by 1 inches. West Pawlet, Rutland County. Quarry of H. W. Hughes. Tenth Census, 1880. 26045.
- Cambrian; green. 4 by 4 by $2\frac{1}{4}$ inches. West Pawlet, Rutland County. Quarry of Rising & Nelson. Tenth Census, 1880. 26046.
- Cambrian; greenish. 4 by 4 by $2\frac{1}{4}$ inches. West Pawlet, Rutland County. Quarry of O. Evans & Son. Tenth Census, 1880. 26047.
- Cambrian; greenish. 4 by 4 by 1, and 4 by 4 by 2 inches. Two specimens. West Pawlet, Rutland County. H. Dillingham's quarry. Tenth Census, 1880. 26048.
- Cambrian; blue-black. Slab 8 inches square. Dummerston, Windham County. Tenth Census, 1880. 26160.
- Cambrian; blue-black. 4 by 4 by 2 inches. 8 miles from Brattleborough, Windham County. T. Johnson's quarry. Tenth Census, 1880. 26161.

Slate. Cambrian; green. 4 by 4 by $1\frac{1}{4}$ inches. Two specimens. Poultney, Rutland County. Eureka quarry. Tenth Census, 1880. 27183.

VIRGINIA.

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Steatite [soapstone]. Medium; compact; blue-gray. Near Langley, Fairfax County. Tenth Census, 1880. 25254.

— Very light colored, schistose. Near Falls Church, Fairfax County. E. L. Howard, 1883. 28649.

Gypsum. Coarse; gray; white mottled. Saltville, Smyth County Holston Salt and Plaster Company. Centennial, 1876. 27129.

— White; dark veined. Saltville, Smyth County. Quarries of Stuart & Palmer. Centennial, 1876. 27153.

Limestone [stalagmitic marble]. About 13 by 8 inches. Luray, Page County. From Luray Cave. Gift of Henry Horan, 1855. 37643.

— About $14\frac{1}{2}$ by $10\frac{1}{2}$ by $7\frac{1}{4}$ inches. Luray, Page County. From Luray Cave. Robert Corson, 1881. 25637.

— About $4\frac{1}{2}$ by $3\frac{1}{2}$ by $3\frac{1}{2}$ inches. Luray, Page County. From Luray Cave. Robert Corson, 1881. 25374.

Limestone [stalagmite marble]. Light brown. $4\frac{1}{2}$ by 2 by 1 inches. Rockbridge County. U. S. General Land Office, 1882. 27268.

— A polished slab 14 by 15 by $\frac{1}{2}$ inches, mounted in a black frame. Taken from a small cave that had become completely filled up by the stalagmitic deposit. Locality, about 20 miles northwest from Lexington, Rockbridge County. Dr. George W. Hawes. 26434.

Limestone [marble]. Cross-section of a stalagmite. Oval in shape; about $8\frac{1}{2}$ by 6 by 2 inches. Luray Cave, Page County. Robert R. Corson, 1881. 27056.

— Pink, crystalline. Near Aldie, Loudoun County. Miss Carter's quarry. E. Howard, 1883. 36788.

— Upper Silurian. Gray with pink spots; fossiliferous. Craigsville, Augusta County. Coral Marble Company. Tenth Census, 1880. 25481.

— Upper Silurian. Reddish; fossiliferous; semi-crystalline. Craigsville, Augusta County. Craig's quarry. Tenth Census. 25598.

Dolomite [marble]. Red; finely crystalline. Madison Run Station, Orange County. H. T. & W. G. Douglass, 1882. 26989.

Calcareous Dolomite [marble]. Pale; pink; crystalline. Loudoun County. Loudoun County Marble Quarry. Tenth Census, 1880. 27073.

Marble. Red and green mottled. 6 by 4 by 1 inches. Ashby's Gap, Cumberland County. A. S. Payne's quarry. Centennial, 1876. 27198.

Magnesian Limestone [marble]. Upper Silurian. Gray, with pink spots; fossiliferous. Craigsville, Augusta County. Coral Marble Company. Tenth Census, 1880. 25482.

— Gray, and dark-blue gray, nearly black. Two specimens. Near Natural Bridge, Rockbridge County. J. G. Steele's quarry. Tenth Census, 1880. 26752.

Biotite granite. Medium; gray and greenish gray. Two specimens. Namozin district, Dinwiddie County. D. W. Lassiter's quarry. Tenth Census, 1880. 25278.

— Medium; greenish gray. Namozin district, Dinwiddie County. Mayfield quarry. Tenth Census, 1880. 25279.

— Medium; gray. Granite, Chesterfield County. Old Dominion Granite Company. Tenth Census, 1880. 25272.

- Biotite granite.** Medium; gray. Two specimens. Manchester, Chesterfield County. Westham Granite Company. Tenth Census, 1880. 25271.
- Fine; gray. Tuckahoe district, Henrico County. Quarry of J. B. Mitchel & Co. Tenth Census, 1880. 25269.
- Medium; gray. Near Richmond, Henrico County. Richmond Granite Company. Tenth Census, 1880. 25270.
- Muscovite granite.** Medium; light gray. Near Fredericksburgh, Spottsylvania County. E. J. Leyburn's quarry. Tenth Census, 1880. 25263.
- Biotite gneiss.** Fine; dark gray; two specimens. Lynchburgh, Campbell County. Fishing Creek Quarry. Tenth Census, 1880. 25270.
- Biotite schist.** Fine; dark gray. Near Chain Bridge, Fauquier County. Gilbert's quarry. Tenth Census, 1880. 25289.
- Amphibolite.** Compact; dark green. Lynchburgh, Campbell County. R. Evans, 1884. 35908.
- Diabase.** Mesozoic. Medium; dark gray. Used only for street pavements; three miles from Leesburgh, Loudoun County. T. W. Edwards' quarry. Tenth Census, 1880. 25963.
- Mesozoic. Fine; dark gray. Near Catletts Station, Fauquier County. Used only for street pavements. Fauquier quarry. Tenth Census, 1880. 25341.
- Sandstone.** Juro-Cretaceous. Light colored, soft and friable. Acquia Creek, Stafford County. Colonel Edward Clark, 1861. 25007.
- Fine; very light brown. Saltville, Washington County. Centennial, 1876. 27131.
- Triassic. Light reddish-brown; fine. Manassas, Prince William County. Mayfield Brownstone Company. Tenth Census, 1880. 27243.
- Slate.** Blue-black. Slab 8 inches square. New Canton, Buckingham County. Quarry of Edwards & Roberts. Tenth Census, 1880. 25275.
- Blue-black. Slab 8 inches square. New Canton, Buckingham County. Quarry of J. R. Williams & Co. Tenth Census, 1880. 25277.

WEST VIRGINIA.

- Limestone [marble].** Light gray; coarse. Near Snyder's Mills, Jefferson County. Tenth Census, 1880. 26100.
- Magnesian limestone [marble].** Coarsely variegated, crystalline. Near Dam No. 4, Jefferson and Berkeley Counties. Snyder's Mills quarry. Tenth Census, 1880. 26101.
- Sandstone.** Medium; light colored. Wheeling, Ohio County. Quarry of Schule & Lotz. Tenth Census, 1880. 25659.
- Coarse; buff. Near Grafton, Taylor County. Grafton quarries. Tenth Census, 1880. 26849.
- Fine; dark gray. Rowlesburgh, Preston County. Quarry of Sullivan & Peat. Tenth Census, 1880. 26850.
- Carboniferous; medium; light colored. Near Charleston, Kanawha County. Connor's quarry. Tenth Census, 1880. 26949.
- Carboniferous, medium; light gray. Near Charleston, Kanawha County. J. T. Quarrier's quarry. Tenth Census, 1880. 26950.
- Carboniferous; medium; light colored. Near Charleston, Kanawha County. "Coon-Skin" quarry. Tenth Census, 1880. 26952.
- Medium; light colored. Parkersburgh, Wood County. "Pole-Cat" quarry. Tenth Census, 1880. 26963.

Sandstone. Dull red; fine and compact. Berkeley Springs, Morgan County. Philip Pendleton. 36829.

WASHINGTON TERRITORY.

Sandstone. Carboniferous; fine; gray. Bellingham Bay, Whatcom County. Quarry of C. Seidel & Co. Tenth Census, 1880. 26248.

— Carboniferous; fine; gray. Chukanut Bay, Whatcom County. Quarry of C. Seidel & Co. Tenth Census, 1880. 26961.

WISCONSIN.

Dolomite. Upper Silurian. Light drab; cellular. Near Racine, Racine County. Quarry of C. Fox & Sons. Tenth Census, 1880. 27155.

— Upper Silurian. Light drab; fine and compact. Waukesha, Waukesha County. Quarry of Hadfield & Co. Tenth Census, 1880. 27066.

— Upper Silurian. Light colored; fine and compact. Waukesha, Waukesha County. Quarry of Hadfield & Co. Tenth Census, 1880. 27067.

— Upper Silurian. Light colored; very fine and compact; two specimens. Milwaukee, Milwaukee County. Story Brothers quarry. Tenth Census, 1880. 27083.

— Upper Silurian. Coarse and fine; light drab; two specimens. Milwaukee, Milwaukee County. Milwaukee Stone Company. Tenth Census, 1880. 27112.

— Lower Silurian. Fine; porous; very light buff. Near La Crosse, La Crosse County. J. Neilson's quarry. Tenth Census, 1880. 26463.

— Lower Silurian. Fine; porous; very light buff. Near La Crosse, La Crosse County. M. Neilson's quarry. Tenth Census, 1880. 26464.

— Upper Silurian. Light drab; very fine and compact. Near Fond du Lac, Fond du Lac County. C. Geiger's quarry. Tenth Census, 1880. 25864.

— Upper Silurian; drab; cellular. Waupun, Fond du Lac County. Waupun quarry. Tenth Census, 1880. 27176.

— Upper Silurian; light colored; very fine and porous. Taycheedah Township, Fond du Lac County. Quarry of Berry & Bannister. Tenth Census, 1880. 25883.

— Upper Silurian; light drab; very fine and compact; will take a good polish; 2 specimens. Byron, Fond du Lac County. S. Sylvester's quarry. Tenth Census, 1880. 25881.

— Upper Silurian; light colored and drab; very fine and compact; 2 specimens. Byron, Fond du Lac County. Quarry of S. Sylvester, jr. Tenth Census, 1880. 25882.

— Upper Silurian; very light drab; fine and compact. Near Eden Station, Fond du Lac County. Marblehead Lime Company. Tenth Census, 1880. 25884.

— Upper Silurian; light drab; very fine and compact. Takes a good polish. Near Eden, Fond du Lac County. Quarry of Nast Bros. & Co. Tenth Census, 1880. 25885.

— Upper Silurian; very fine and compact; light colored. Eden, Fond du Lac County. Cardiff quarry. J. S. F. Batchen, 1883. 27517.

— Upper Silurian; drab; very fine and compact. Near Sheboygan, Sheboygan County. Quarry of H. E. Roth. Tenth Census, 1880. 26940.

— Upper Silurian; drab; very fine and compact. Sheboygan Falls, Sheboygan County. Tenth Census, 1880. 26941.

— Upper Silurian; drab; very fine and compact. Near Manitowoc, Manitowoc County. Quarry of Lewis Miller & Co. Tenth Census, 1880. 26933.

- Dolomite.** Lower Silurian; coarse; dark drab. Near Oshkosh, Winnebago County. F. Last's quarry. Tenth Census, 1880. 25886.
- Lower Silurian. Coarse; dark drab. Near Oshkosh, Winnebago County. Quarry of Schneider & Frank. Tenth Census, 1880. 25887.
- Lower Silurian; dark drab. Near Menasha, Winnebago County. R. Scott's quarry. Tenth Census, 1880. 25942.
- Lower Silurian; dark drab. Neenah, Winnebago County. P. McGrath's quarry. Tenth Census, 1880. 25943.
- Lower Silurian; light colored and dark mottled; 2 specimens. River Falls, Pierce County. T. Walker's quarry. Tenth Census, 1880. 27174.
- Lower Silurian; fine; very light buff. Near Winona mine, Buffalo County. Quarry of H. J. Willis. Tenth Census, 1880. 26641.
- Lower Silurian; coarse; buff mottled. Near Winona mine, Buffalo County. Quarry of H. J. Willis. Tenth Census, 1880. 26642.
- Lower Silurian; drab. Near Kaukauna, Outagamie County. United States Government quarry. Tenth Census, 1880. 25940.
- Lower Silurian; drab. Ledyard, Outagamie County. Kaukauna Water Power Company. Tenth Census, 1880. 25941.
- Lower Silurian; dark drab. Near Duck Creek Station, Brown County. Chicago and Northwestern Railway Company. Tenth Census, 1880. 25957.
- Light drab; cellular. Hayton, Calumet County. Cardiff quarry. J. S. F. Batchen, 1883. 27509.
- Light drab; fine and porous. Prairie du Chien, Crawford County. Marsden's quarry. Tenth Census, 1880. 27054.
- Biotite gneiss.** Fine; red. Village of Black River Falls, Jackson County. Tenth Census, 1880. 26702.
- Granite.** Medium; reddish brown. Montello, Marquette County. Montello Granite Company. Tenth Census, 1880. 26915.
- Wausau, Marathon County. J. Kolter's quarry. Tenth Census, 1880. 26921.
- Hornblende granite.** Medium; dark brownish. Wausau, Marathon County. Big Bull Falls quarry. Tenth Census, 1880. 26922.
- Quartz Porphyry.** Dark, nearly black. Marquette, Green Lake County. Wampum Granite Company. Tenth Census, 1880. 27177.
- Dark, nearly black. Near Brandon, Fond du Lac County. J. Densmore's quarry. J. S. F. Batchen, 1883. 28503.
- Sandstone.** Lower Silurian; light colored; fine and compact. Near Ableman, Sauk County. Tenth Census, 1880. 26703.
- Lower Silurian; light colored; fine and compact. Ableman, Sauk County. W. Lee's quarry. Tenth Census, 1880. 26704.
- Lower Silurian; light red and very light colored; fine and friable. Two specimens. Mauston, Juneau County. H. V. Train's quarry. Tenth Census, 1880. 26917.
- Lower Silurian; fine; light colored. Near Mauston, Juneau County. C. W. Potter's quarry. Tenth Census, 1880. 26939.
- Very light colored. Near Packwaukee, Marquette County. T. B. Hawes's quarry. Tenth Census, 1880. 26919.
- Nearly quartzite. Lower Silurian; light colored. Stevens' Point, Portage County. J. N. Avery's quarry. Tenth Census, 1880. 26920.
- Nearly quartzite. Lower Silurian; light colored; compact. Grand Rapids, Wood County. Quarry of J. Edwards & Co. Tenth Census, 1880. 26918.

Sandstone. Lower Silurian; fine; very light buff. Near Madison, Dane County. A. Kinnear's quarry. Tenth Census, 1880. 27077.

Quartzite. Lower Silurian; gray; very hard and compact. Near Waterloo, Jefferson County. Wisconsin and Chicago Quarrying Company. Tenth Census, 1880. 27154.

— Lower Silurian; gray; very hard and compact. Near Waterloo, Jefferson County. Chicago and Wisconsin Quarrying Company. J. S. F. Batchen, 1882. 27193.

WYOMING.

Granite. Medium; pink. Sherman, Albany County. Tenth Census, 1880. 26984.

— Fine; light reddish. Sherman, Albany County. Tenth Census, 1880. 26986.

Hornblende granite. Very coarse; red. Dale Creek. G. Griffith's quarry. Tenth Census, 1880. 25558.

METHODS OF CUTTING AND POLISHING.

The three independent series enumerated below are designed to show the kind of finish commonly applied to the different varieties of stone. The illustrations on Plate IV were drawn from these, and the descriptions given on page 319 explain the methods by which each finish is produced and for what kind of work each is particularly adapted.

(1) The first of these is a series of nineteen blocks, white and colored marbles, in sizes about 12 inches square by 2 inches thick, from quarries at West Rutland, Vt. Gift of the Vermont Marble Company, 1882. They are finished as follows: Rock face, 26878; rough-pointed surface, 26877 and 27334; fine-pointed surface, 26876 and 27340; tooth-chiseled surface, 26875 and 27332; bush-hammered surface, 26874; square-droved surface, 26873 and 27335; sanded surface, 27337; fine-sanded surface, 26871 and 27333; pumiced surface, 26872; honed surface, 27336; acid-gloss surface (polished), 26870 and 27338; putty-gloss surface (polished), 26879 and 27339.

(2) The second is a series of eight blocks of Quincy (Mass.) granite, in sizes as above, the gift of Henry Barker & Son, Quincy, Mass. Rock face, 27120; pointed surface, 27118; ax-hammered surface, 27117; sawed surface, 27119; six-cut surface, 27116; eight-cut surface, 27115; ten-cut surface, 27114; polished surface, 27117.

(3) The third is a series of eight blocks of light-colored Ohio sandstone, in sizes about 12 inches square by 3 inches thick. Gift of the McDermott & Berea Stone Company, of Cleveland, Ohio. Rough-pointed surface, 26993; pointed surface, 26995, 26992, and 26990; fine-pointed surface, 26994; sanded surface, 26997; tooth-chiseled surface, 26991; droved surface, 26996.

II. FOREIGN.

(1) BRITISH PROVINCES OF NORTH AMERICA—CANADA.

Limestone. Dark gray; crystalline. Montreal, Province of Quebec. J. S. F. Batchen, 1883. 28643.

— Dark gray; semi-crystalline; fossiliferous. Near Montreal, Province of Quebec. J. S. F. Batchen, 1883. 28644.

— Dark; semi-crystalline; fossiliferous. Kingston, Province of Ontario. J. S. F. Batchen, 1883. 28645.

Slate. Blue-black. Montreal, Province of Quebec. New Rockland Slate Company. Centennial, 1876. 25241.

Sandstone. Lower Silurian; fine; reddish. Nepigon Bay, Lake Superior, Province of Ontario. Verte Island quarry. J. S. F. Batchen, 1883. 27322.

Sandstone. Lower Silurian; fine; reddish. 18-inch cube. North shore of Lake Superior, Province of Ontario. Verte Island Quarry. John S. F. Batchen, 1883. 27526.

— Fine; light colored. Georgetown, Province of Ontario. John S. F. Batchen, 1883. 28646.

— Fine; light brown. Near Brampton, Credit River Valley. Quarry of K. Chisholm, M. P. John S. F. Batchen, 1884. 34993.

— Medium; brown. Pyramidal block, about 9 inches high and 4 inches square at base. Harvey, Albert & Co., Province of New Brunswick. Mary's Point Quarry. Tenth Census, 1880. 27006.

— Medium; brown. Pyramidal block, about 8 inches high and 4 inches square at base. Sackville, Westmoreland County, Province of New Brunswick. Wood Point Quarry. Tenth Census, 1880. 27007.

— Sub-Carboniferous; fine; gray. Dorchester, Province of New Brunswick. J. S. F. Batchen, 1883. 27524.

— Sub-Carboniferous; fine; gray. Dressed block, 30 inches high, cut in shape of Liberty Bell. Dorchester, Province of New Brunswick. Centennial, 1876. 25070.

— Sub-Carboniferous; fine; gray. Large block, 22 inches wide, 3 feet 9 inches high, surmounted by Liberty Bell. Dorchester, Province of New Brunswick. Centennial, 1876. 25071.

— Sub-Carboniferous; fine; olive. Dorchester, Westmoreland County, Province of New Brunswick, Canada. Tenth Census, 1880. 26665.

— Sub-Carboniferous; fine; brown. Mary's Point, Province of New Brunswick. Tenth Census, 1880. 26669.

— Fine; light brown and gray. 6 by 4 by 1½ inches. Two specimens. Clifton, Province of New Brunswick. New Orleans Exposition, 1885. 37669.

Biotite granite. Coarse gray. 13 by 12 by 10 inches. Purcell Cove quarries, northwest arm of Halifax County, Province of Nova Scotia. American Society Mining Engineers, 1886. 37852.

— Medium; gray. 12-inch cube. Shelburne, Province of Nova Scotia. Shelburne Quarry Company. American Society Mining Engineers, 1886. 37851.

— Coarse; pinkish gray. Broken column, 4½ by 4 inches and 4½ by 3 inches. Two specimens. St. George, Province of New Brunswick. 37666.

Hornblende granite. Polished urn of dark red granite. St. George, Province of New Brunswick. 35729.

— Coarse; bright red. St. George, Province of New Brunswick. 37626.

(2) BERMUDA.

Coralline limestone. Nearly white; coarsely cellular. 10 by 4 by 3½ inches. Centennial, 1876. 26009.

(3) MEXICO.

Gypsum. White; dark veined. Slab, 6 inches square. Mexican Geographical Exploring Commission, 1885. 37761.

— White; fibrous. Slab, 6 inches square. State of Sonora. Mexican Geographical Exploring Commission, 1885. 37763.

Marble. Compact; yellowish. Vera Cruz. Mexican Geographical Exploring Commission, 1885. 37762.

Limestone [marble]. Fine; white; crystalline. Slab, 6 inches square. Vera Cruz. Mexican Geographical Exploring Commission, 1885. 37759.

— White, with rust spots; crystalline. Slab, 6 inches square. State of Sonora. Mexican Geographical Exploring Commission, 1885. 37760.

Limestone [marble]. White; crystalline. Slab, 6 inches square. State of Sonora. Mexican Geographical Exploring Commission, 1885. 37814.

— White; crystalline. Zumpango, State of Mexico. Mexican Geographical Exploring Commission, 1885. 37715.

— Dull pinkish; fine and compact. Slab, 6 inches square. Tecali, State of Puebla. Mexican Geographical Exploring Commission, 1885. 37729.

— Cretaceous. Water-blue and gray; fossiliferous. Three specimens. Tezintlan, State of Puebla. Mexican Geographical Exploring Commission, 1885. 37998.

Limestone. Drab; fine and compact. State of Puebla. Mexican Geographical Exploring Commission, 1885. 38126.

Travertine [Mexican onyx]. Paper-weight, composed of a red kidney-shaped body on a white base, 3 by 3 by 2 inches. State of Puebla. Purchased, 1885. 37593.

— Paper-weight. State of Puebla. Purchased, 1885. 37594.

— Nearly colorless; transparent. Irregular slab, 6 by 3 by $\frac{1}{4}$ inch. State of Tecali, Puebla. Mexican Geographical Exploring Commission, 1885. 37596.

— Paper-knife, $7\frac{1}{2}$ inches long. State of Puebla. Purchased, 1885. 37595.

— Nearly white; $7\frac{1}{2}$ by $5\frac{1}{2}$ by $\frac{1}{4}$ inch. State of Puebla. Charles E. Hall & Co., 1884. 36757.

— Light green and white. Three blocks, one $7\frac{1}{2}$ by $7\frac{1}{2}$ by 6 inches, and two 4 by 4 by $1\frac{1}{2}$ inches; also three thin slabs of the same, mounted on stands, to show veination. Tecali, State of Puebla. Mexican Geographical Exploring Commission, 1885. 37640.

Travertine. Light variegated; $6\frac{1}{2}$ by $11\frac{1}{2}$ by 2 inches. State of Aguas Calientes. Mexican Geographical Exploring Commission, 1885. 37642.

Tuff. Light colored; coarsely vesicular. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37709.

— Fine; pinkish. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37710.

— Fine; light colored; soft and pliable. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37694.

— Fine; salmon color. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37718.

— Pink. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37785.

— Fine; light pinkish. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37713.

— Coarsely porous; light pink. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37781.

— Coarse; light reddish. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37782.

— Nearly white, streaked with yellow and red. Two specimens. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37743.

— Light colored; slightly pinkish. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37738.

— Very light pinkish. Santa Cruz, State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37732.

— Compact. Five-inch cube. Two specimens. State of Zacatecas. J. S. F. Batchen, 1884. 36805.

— Compact; reddish. Five-inch cube. State of Zacatecas. J. S. F. Batchen, 1884. 36804.

- Tuff.** Gray. Carved block, 8 by 8 by 6 inches. State of Hidalgo. Mexican Geographical Exploring Commission, 1885. 37806.
- Green. Carved block, 10½ by 8 by 4 inches. State of Hidalgo. Mexican Geographical Exploring Commission, 1885. 37704.
- Green. Carved block, 10½ by 8 by 4 inches. State of Hidalgo. Mexican Geographical Exploring Commission, 1885. 37705.
- Red. Carved block, 11 by 6 by 7 inches. State of Hidalgo. Mexican Geographical Exploring Commission, 1885. 37706.
- Green. State of Hidalgo. Mexican Geographical Exploring Commission, 1885. 37724.
- Brown. Carved block, 11 by 8½ by 5 inches. State of Hidalgo. Mexican Geological Exploring Commission, 1885. 37788.
- Purplish gray. State of Oaxaca. Mexican Geographical Exploring Commission, 1885. 37751.
- Compact; red, purplish, and white mottled. State of Oaxaca. Mexican Geographical Exploring Commission, 1885. 37764.
- Light colored, with dark reddish spots. State of Oaxaca. Mexican Geographical Exploring Commission, 1885. 37797.
- Medium; light lavender. State of Oaxaca. Mexican Geographical Exploring Commission, 1885. 37819.
- Compact; gray, with reddish spots. Six-inch cube. State of Morelos. Mexican Geographical Exploring Commission, 1885. 37720.
- Compact; light reddish-brown. Six-inch cube. State of Morelos. Mexican Geographical Exploring Commission, 1885. 37721.
- Very light gray; vesicular. Mexican Geographical Exploring Commission, 1885. 37692.
- Gray; coarsely vesicular. Vera Cruz. Mexican Geographical Exploring Commission, 1885. 37992.
- Coarse; gray. State of Puebla. Mexican Geographical Exploring Commission, 1885. 37793.
- Fine; very light brown. Five-inch cube. Lagos, State of Jalisco. J. S. F. Batchen, 1884. 36800.
- Light brownish; cellular. Five-inch cube. Lagos, State of Jalisco. J. S. F. Batchen, 1884. 36799.
- Fine; light colored. Five-inch cube. State of Aguas Calientes. J. S. F. Batchen, 1884. 36802.
- Light red. La Paz, Lower California. Mexican Geographical Exploring Commission, 1885. 38002.
- Compact; reddish. Five-inch cube. State of Queretaro. J. S. F. Batchen, 1884. 36793.
- Fine; very light brown. Five-inch cube. Leon, State of Guanajuato. J. S. F. Batchen, 1884. 36797.
- Light colored; porous. Five-inch cube. Leon, State of Guanajuato. J. S. F. Batchen, 1884. 36798.
- Coarse; light greenish-gray. Mexican Geographical Exploring Commission, 1885. 37719.
- Red; friable. Mexican Geographical Exploring Commission, 1885. 37999.
- Tuff** (?). Compact; light reddish-brown. Six-inch cube. State of Morelos. Mexican Geographical Exploring Commission, 1885. 37722.
- Gray, streaked with ferruginous red. Six-inch cube. State of Morelos. Mexican Geographical Exploring Commission, 1885. 37723.

Rhyolite tuff. Reddish; coarse and friable. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37756.

— Fine; light gray. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37757.

— Fine; light fawn colored. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37717.

— Fine; nearly white. State of Hidalgo. Mexican Geographical Exploring Commission, 1885. 37810.

— Coarse; light colored; soft and friable. State of Hidalgo. Mexican Geographical Exploring Commission, 1885. 37740.

— Light colored; soft and friable. State of Hidalgo. Mexican Geographical Exploring Commission, 1885. 37742.

— Fine; light pinkish. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37775.

— Fine; pinkish. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37776.

— Coarse, light pinkish. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 3778.

— Fine; light lavender. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37779.

— Fine; light greenish gray. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37784.

— Light pinkish. State of Zacatecas. Mexican Geographical Exploring Commission, 1875. 37737.

— Very light gray. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37731.

— Fine; light reddish. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37733.

— Compact; light green. State of Oaxaca. Mexican Geographical Exploring Commission, 1885. 37747.

— Compact; light green. State of Oaxaca. Mexican Geographical Exploring Commission, 1885. 37750.

— Coarse; light green. Zumpango, State of Mexico. Mexican Geographical Exploring Commission, 1885. 37725.

— Fine; very light colored; soft and friable. State of Oaxaca. Mexican Geographical Exploring Commission, 1885. 37749.

— Coarsely vesicular; yellowish. Mexican Geographical Exploring Commission, 1885. 37714.

— Fine; nearly white, streaked with red and yellow. Mexican Geographical Exploring Commission, 1885. 37736.

Rhyolite (?) tuff. Coarse; red. Hueimetoca. Mexican Geographical Exploring Commission 1885. 37691.

Rhyolite. Brownish. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37994.

— Compact; light reddish. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37730.

— Brownish gray. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37758.

— Fine; pinkish. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37744.

Rhyolite. Fine; very light colored. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37745.

— Fine; light brown. State of Oaxaca. Mexican Geographical Exploring Commission, 1885. 37748.

— Light red. State of Oaxaca. Mexican Geographical Exploring Commission, 1885. 37746.

— Fine; light lavender, pink and light colored; friable. Three specimens. State of Aguas Calientes. Mexican Geographical Exploring Commission, 1885. 37766.

— Reddish; 5-inch cube. Leon, State of Guanajuato. J. S. F. Batchen, 1884. 36796.

— Fine; light colored. State of San Luis Potosi. Mexican Geographical Exploring Commission, 1885. 37739.

— Gray; 5-inch cube. J. S. F. Batchen, 1884. 36790.

— Light colored. Santa Rosa. Mexican Geographical Exploring Commission, 1885. 37689.

— Gray; 5-inch cube. San Joaquin. J. S. F. Batchen, 1884. 36801.

Rhyolite pithstone(?). Bluish gray; glassy. State of Mexico. Mexican Geographical Exploring Commission, 1885. 37768.

Andesite. Reddish; fine and compact. State of Mexico. J. S. F. Batchen, 1884. 36791.

— Dark gray; finely vesicular. State of Mexico. Mexican Geographical Exploring Commission, 1885. 37800.

Andesite(?). Dark gray; fine and compact. State of Hidalgo. Mexican Geographical Exploring Commission, 1885. 37807.

— Brown. Tenacingo, State of Mexico. Mexican Geographical Exploring Commission, 1885. 37772.

— Fine; dull red. State of Mexico. Mexican Geographical Exploring Commission, 1885. 37769.

Hypersthene andesite. Reddish. Carved block 13 by 9 by 4 inches. State of Hidalgo. Mexican Geographical Exploring Commission, 1885. 37771.

— Light colored. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37707.

— Medium; light brownish. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37783.

— Finely vesicular; reddish. State of Mexico. Mexican Geographical Exploring Commission, 1885. 37712.

— Black; finely vesicular. Ixtapalapa, State of Mexico. Mexican Geographical Exploring Commission, 1885. 37789.

Hornblende andesite. Compact; gray. State of Oaxaca. Mexican Geographical Exploring Commission, 1885. 37752.

— Fine; light red. State of Mexico. Mexican Geographical Exploring Commission, 1885. 37770.

— Fine; very light gray. State of Mexico. Mexican Geographical Exploring Commission, 1885. 37703.

— Fine; reddish brown. State of Mexico. Mexican Geographical Exploring Commission, 1885. 37735.

— Fine; dull red. Tenamingo, State of Mexico. Mexican Geographical Exploring Commission, 1885. 37741.

— Coarse; light gray. Ixtapalapa, State of Mexico. Mexican Geographical Exploring Commission, 1885. 37711.

- Hornblende andesite (?)**. Reddish gray. San Juan de los Llanos, State of Puebla. Mexican Geographical Exploring Commission, 1885. 38001.
- Basalt**. Dark gray; vesicular, with large olivines. State of Zacatecas. Mexican Geographical Exploring Commission, 1885. 37786.
- Gray; vesicular. State of Oaxaca. Mexican Geographical Exploring Commission, 1885. 37754.
 - Gray; vesicular. State of Oaxaca. Mexican Geographical Exploring Commission, 1885. 37755.
 - Light gray; coarsely and finely vesicular. State of Mexico. Mexican Geographical Exploring Commission, 1885. 37701.
 - Nearly black; vesicular. State of Mexico. Mexican Geographical Exploring Commission, 1885. 37799.
 - Nearly black; finely and coarsely vesicular. Two specimens. State of Puebla. Mexican Geographical Exploring Commission, 1885. 37699.
 - Dark brown; coarsely vesicular. State of Mexico. Mexican Geographical Exploring Commission, 1885. 37802.
 - Black; coarsely vesicular. Tula, State of Mexico. J. S. F. Batchen, 1884. 36792.
- Basalt (?)**. Fine; reddish brown. State of Hidalgo. Mexican Geographical Exploring Commission, 1885. 37808.
- Reddish brown; vesicular. State of Mexico. Mexican Geographical Exploring Commission, 1885. 37700.
 - Dark brown; coarsely vesicular. State of Mexico. Mexican Geographical Exploring Commission, 1885. 37798.
 - Dull red; very vesicular. State of Mexico. Mexican Geographical Exploring Commission, 1885. 37773.
 - Reddish brown; vesicular. San Miguel, San Salvador (?). Mexican Geographical Exploring Commission, 1885. 37687.
 - Reddish brown; finely vesicular. Toluca. Mexican Geographical Exploring Commission, 1885. 38128.
- Basalt (?) tuff**. Black; friable. State of Mexico. Mexican Geographical Exploring Commission, 1885. 37792.
- Basaltic (?) tuff**. Dull grayish; finely vesicular. San Miguel. Mexican Geographical Exploring Commission, 1885. 37690.
- Pumice**. Fine; light gray. State of Hidalgo. Mexican Geographical Exploring Commission, 1885. 37804.
- Gray; finely and coarsely vesicular. Two specimens. San Juan de los Llanos, State of Puebla. Mexican Geographical Exploring Commission, 1885. 37698.
- Pumice tuff**. Compact; very light gray; soft and friable. State of Hidalgo. Mexican Geographical Exploring Commission, 1885. 37809.
- Dacite**. Fine; light reddish. State of Mexico. Mexican Geographical Exploring Commission, 1885. 37716.
- Sandstone**. Greenish. 5 by 4 by 3½ inches. State of Guanajuato. J. S. F. Batchen, 1884, 36794.
- Greenish. 5 by 4 by 3½ inches. State of Guanajuato. J. S. F. Batchen, 1884. 36795.
 - Light brown. 5-inch cube. State of Aguas Calientes. J. S. F. Batchen, 1884. 36803.
 - Fine; gray. State of Morelos. Mexican Geographical Exploring Commission, 1885. 37997.

(4) SOUTH AMERICA.

Marble. Light green, dark veined; very compact. 6 by 6 by 1 inches. Encruzilhada, Province of Rio Grande do Sul, Brazil. American Institute of Mining Engineers, 1885. 37835.

Marble [bituminous limestone]. Black with irregular white veins. 6 by 6 by 1 inches. Province of Sao Paulo, Brazil. American Institute of Mining Engineers, 1885. 37837.

Marble [ophicalcite]. Light and dark green banded. 6 by 6 by 1 inches. Province of Sao Paulo, Brazil. American Institute of Mining Engineers, 1885. 37838.

Marble [limestone]. Fine; green and dark mottled; crystalline. 6 by 6 by 1 inch. Brazil. American Institute of Mining Engineers, 1885. 37839.

Building stone. Dark gray and pinkish. Four specimens. 4 by 4 by 2½ inches. Argentine Confederation. Centennial, 1876. 25072.

Biotite gneiss. Memorial stone from the Washington Monument. Brazil. D. O'Leary, 1885. 37629.

(5) GREAT BRITAIN.

ENGLAND.

Serpentine. Dark olive-green, with veins, streaks, and blotches of greenish white, chocolate brown, and blood red. Six specimens. 4½ by 5 by 1½; 4½ by 4½ by 1½; 7½ by 4 by ½; 5 by 3½ by 1½; 4½ by 3½ by 1½ and 4½ by 2½ by 1 inch. Lizard district, Cornwall. R. N. Worth, 1887. 39011.

Slate. Purple. Slab 8 inches square. Two specimens. North Wales. Centennial, 1876. 26030.

— Model of a roof, showing the timber framing, with the method of fixing the slate. 24 inches long, 18 inches broad, and 12 inches high. North Wales. Centennial, 1876. 36999.

— Blue-black and purple. Two specimens. Carnarvon, North Wales. Centennial, 1876. 37000.

SCOTLAND.

Hornblende granite. Polished column of; coarse red. 8 by 3½ inches. Aberdeen. A. Macdonald, Field & Co. 27011.

— Polished column of; coarse gray. 8 by 3½ inches. Aberdeen. A. Macdonald, Field & Co. 27010.

Biotite granite. Polished column of; coarse red. 8 by 3½ inches. Aberdeen. A. Macdonald, Field & Co. 27012.

— Polished column of; coarse gray, with large porphyritic crystals of pink feldspar. 8 by 3½ inches. Aberdeen.* A. Macdonald, Field & Co. 27013.

— Polished column of; dark gray. 8 by 3½ inches. Aberdeen. A. Macdonald, Field & Co. 27009.

Muscovite biotite granite. Polished column of; light gray. 8 by 3½ inches. Aberdeen. A. Macdonald, Field & Co. 27008.

Muscovite granite. Coarse; very light gray. 4 by 4 by 1½ inches. Aberdeen. Thomas Wilson, 1887. 38825.

Sandstone. Carboniferous; fine; light red. Ballochmyle. Tenth Census, 1880. 26668.

— Permian; fine; dull red. Near Anan. Tenth Census, 1880. 27349.

* This stone is probably from Shap, in Cumberland, England.

- Sandstone.** Permian; fine; red. 18-inch cube. Near Anan. John S. F. Batchen, 1883. 27350.
- Medium; light colored. Burg-Head, Moray. John S. F. Batchen, 1883. 28588. www.libtool.com.cn
- Coarse; light colored. Elgin, Moray. John S. F. Batchen, 1883. 28589.
- Devonian; fine; light colored. Nairn, Nairn. John S. F. Batchen, 1883. 28590.
- Devonian; medium; buff. Thurso, Caithness. John S. F. Batchen, 1883. 28591.
- Fine; pinkish. Near Elgin, Moray. John S. F. Batchen, 1883. 28592.
- Fine; light colored. Near Brora, Sutherland, John S. F. Batchen, 1883. 28594.
- Fine; light colored. Golspie, Sutherland. John S. F. Batchen, 1883. 28595.
- Fine; light colored. Tortrose, Ross. Suddie's quarry. John S. F. Batchen, 1883. 28596.
- Fine; very light red. Beauty, Ross. Tarradale quarry. John S. F. Batchen, 1883. 28597.

(6) EUROPE.

BELGIUM.

- Marble.** Dark gray, nearly black, with white veins. $4\frac{1}{2}$ by $4\frac{1}{2}$ by $\frac{3}{4}$ inches. Conillet, near Charleroi, Province of Hainaut. L. Charpy, 1886. 38268.
- Gray and white; breccia. $4\frac{1}{2}$ by $4\frac{1}{2}$ by $\frac{3}{4}$ inches. Conillet, near Charleroi, Province of Hainaut. L. Charpy, 1886. 38272.
- White; pink mottled. $4\frac{1}{2}$ by $4\frac{1}{2}$ by $\frac{3}{4}$ inches. Merlemont, near Philippeville, Province of Namur. L. Charpy, 1886. 38274.
- Marble [rouge royal].** Pink, with white veins. $4\frac{1}{2}$ by $4\frac{1}{2}$ by $\frac{3}{4}$ inches. Cerfontaine, near Philippeville. L. Charpy, 1886. 38273.
- Saint Ann marble.** Very dark gray, nearly black. $4\frac{1}{2}$ by $4\frac{1}{2}$ by $\frac{3}{4}$ inches. Busnie, Province of Namur. L. Charpy, 1886. 38277.
- Marble [rouge impérial].** Dark red and gray mottled. Cerfontaine, near Philippeville. L. Charpy, 1886. 38306.
- Marble [rouge griotte fleuri].** Dark red and white mottled. $4\frac{1}{2}$ by $4\frac{1}{2}$ by $\frac{3}{4}$ inches. Cerfontaine, near Philippeville. L. Charpy, 1886. 38307.
- Marble [rouge griotte].** Dull red, with gray spots. $4\frac{1}{2}$ by $4\frac{1}{2}$ by $\frac{3}{4}$ inches. Cerfontaine, near Philippeville. L. Charpy, 1886. 38325.

BAVARIA.

- Lithographic limestone.** Light colored. $7\frac{1}{2}$ by 7 by 3 inches. John S. F. Batchen, 1884. 35706.
- Drab. 2 by $8\frac{1}{2}$ by $6\frac{1}{2}$ inches. Solenhofen. A. G. Gedney, Washington, D. C. 1884. 35888.
- Granite.** Coarse; reddish brown. Piece of memorial stone from Washington Monument. Dennis O'Leary, 1885. 37627.

FRANCE.

- Limestone.** Very light buff. Caen. Ellin & Kitson, New York. 26695.
- Marble [French griotte].** Dark red. Slab about 6 by 7 by $\frac{3}{4}$ inches. Charles Lipincott & Co., Philadelphia. 35927.

Marble [Breche du Roussillon(?)]. Dull red, with coarsely anastomizing and very irregular light-drab and yellow veins. 15 by 18 by 1 inches. Pyrénées Orientales (?). Centennial Commission, 1876. 37474.

Marble [Sampans petit grain]. Dull pink; oolitic. 4 by 4 by $\frac{1}{2}$ inches. Sampans, Jura. L. Charpy, 1886. 38269.

Marble [griotte]. Dark red. $3\frac{1}{2}$ by $2\frac{1}{2}$ by $\frac{1}{2}$ inches. Carcassone, Aude. L. Charpy, 1886. 38270.

Fossil marble [Sampans jaune doré]. Yellow; coarsely oolitic. 4 by 4 by $\frac{1}{2}$ inches. Sampans, Jura. L. Charpy, 1886. 38271.

Marble [Sampans grain doré]. Dull red. 4 by 4 by $\frac{1}{2}$ inches. Sampans, Jura. L. Charpy, 1886. 38275.

Marble. Very light yellow. 4 by 4 by $\frac{1}{2}$ inches. Belvoys, Jura. L. Charpy, 1886. 38276.

Marble [Sampans rouge antique]. Dull red. 4 by 4 by $\frac{1}{2}$ inches. Sampans, Jura. L. Charpy, 1886. 38279.

Jasper marble. Pink and yellow mottled. $4\frac{1}{2}$ by 3 by $\frac{1}{2}$ inches. L'Ablage, Damparis, Jura. L. Charpy, 1886. 38280.

GERMANY.

Marble [bougard]. Gray, with white and yellowish tints. Slab 12 by 2 by 1 inches. Nassau. Gift of E. Fritsch, New York.

Marble [formosa]. Blue-gray and drab; some yellow spots. Slab 12 by 12 by 1 inches. Nassau. Gift of E. Fritsch, New York.

ITALY.

Serpentine [verd-antique marble]. Dark green; white veined. 4 by 4 by 1 inches. Genoa. W. W. Story, 1883. 28633.

— Greenish, with white veins. 4 by 4 by 1 inches. W. W. Story, 1883. 28639.

— Green; white veined; first quality. 4 by 4 by 1 inches. Genoa quarry. W. T. Rice, 1882. 26906.

Marble. White; dark spotted. Col. Edw. Clark, 1880. 25005.

— White, with dark veins. 3-inch cube. Serravezza. J. W. Tufts, Boston, 1881. 26164.

— Red mixed. $3\frac{1}{2}$ by 5 by $1\frac{1}{2}$ inches. Levanto, 1881. 26449.

— Black and gold. Slab about $5\frac{1}{2}$ by $6\frac{1}{2}$ by 1 inches. Specia, 1881. 26452.

— Pure white; statuary; first quality. 12-inch cube. Poggio Silvestro quarry. William T. Rice, 1882. 26879.

— White, with dark spots; statuary; second quality. 12-inch cube. William T. Rice, 1882. 26880.

— White; ordinary; second quality. 12-inch cube. William T. Rice, 1882. 26881.

— White; statuary; second quality. 12-inch cube. William T. Rice, 1882. 26882.

— White; ordinary; first quality. 12-inch cube. William T. Rice, 1882. 26883.

— White; dark veined; second quality. $8\frac{1}{2}$ -inch cube. Gioja quarry. William T. Rice, 1882. 26884.

— Light blue-gray; Bardiglio; second quality. 12-inch cube. Gioja quarry. William T. Rice, 1882. 26885.

— Light blue; dark veined; Bardiglio; first quality. $10\frac{1}{2}$ -inch cube. William T. Rice, 1882. 26886.

- Marble.** Light blue; Bardiglio veined; second quality. 11-inch cube. William T. Rice, 1882. 26887.
- Pink; Breccia; first quality; 4 by 4 by 1 inches. Serravezza quarry. William T. Rice, 1882. 26888.
 - Light drab; pink veined. Breccia; first quality. 4 by 4 by 1½ inches. Gragnana quarry. William T. Rice, 1882. 26889.
 - Yellow; first quality. 4 by 4 by 1½ inches. Gragnana quarry. William T. Rice, 1882. 26890.
 - Pinkish; Breccia; first quality. 4 by 4 by 1½ inches. Gragnana quarry. William T. Rice, 1882. 26891.
 - White; ordinary; first quality. 12-inch cube. William T. Rice, 1882. 26892.
 - White; ordinary; second quality. 12-inch cube. William T. Rice, 1882. 26893.
 - White; statuary; second quality. 12-inch cube. William T. Rice, 1882. 26894.
 - White; veined; first quality. 12-inch cube. Vara quarry. William T. Rice, 1882. 26892.
 - Blue; Bardiglio; first quality. 12-inch cube. William T. Rice, 1882. 26896.
 - Black and gold. 12-inch cube. William T. Rice, 1882. 26897.
 - Red mixed; first quality. 11 by 11 by 6 inches. William T. Rice, 1882. 26898.
 - White; dark veined. Paunazo; first quality. 8½ by 8½ by 5 inches. Miseglia quarry. William T. Rice, 1882. 26899.
 - White; dark veined; Paunazo; first quality. 6 by 6 by 4½ inches. Pescina quarry. William T. Rice, 1882. 26900.
 - Green; Breccia; first quality. 4 by 4 by 1 inches. Garfagnana quarry. William T. Rice, 1882. 26905.
 - Deep yellowish pink; first quality. 4 by 4 by ½ inches. Verona quarry. William T. Rice, 1882. 26907.
 - Brown; first quality. 4 by 4 by 1 inches. Castel Poggia quarry. William T. Rice, 1883. 26908.
 - White; dark veined; Paunazo; first quality. 6-inch cube. William T. Rice, 1882. 26901.
 - Yellow. 6-inch cube. William T. Rice, 1882. 26902.
 - Marble; black; first quality. 12-inch cube. Collonnata quarry. William T. Rice, 1882. 26904.
 - Pure white. 4 by 4 by ½ inches. Carrara. Grestola quarry. W. W. Story, 1883. 28603.
 - White; clouded. 4 by 4 by ½ inches. Carrara. W. W. Story, 1883. 28604.
 - White; ordinary; second quality. 4 by 4 by ½ inches. Carrara. Fantiscritti quarry. W. W. Story, 1883. 28605.
 - White; dark veined. 4 by 4 by ½ inches. Carrara. Canale Bianco quarry. W. W. Story, 1883. 28606.
 - Pure white; statuary first quality. 4 by 4 by ½ inches. Carrara. Mossa Cava quarry. W. W. Story, 1883. 28607.
 - Pure white. 4 by 4 by ½ inches. Carrara. Poggio Silvestro quarry. W. W. Story, 1883. 28608.
 - White; first quality. 4 by 4 by ½ inches. Carrara. Canale Bianco quarry. W. W. Story, 1883. 28609.
 - Deep blue-gray; nearly black. Nero di Colona. 4 by 4 by ½ inches. Carrara. W. W. Story, 1883. 28610.
 - Pure white. 4 by 4 by 3½ inches. Carrara. Carpevola quarry. W. W. Story, 1883. 28611.

- Marble.** White; slightly bluish; ordinary. 4 by 4 by $\frac{1}{2}$ inches. Carrara. Ravacione quarry. W. W. Story, 1883. 28612.
- Red mixed. 4 by 4 by 1 inch. Specia. Rosso di Levante quarry. W. W. Story, 1883. 28613.
- Black and gold. 4 by 4 by $\frac{1}{2}$ inches. Specia. Porto Venere quarry. W. W. Story, 1883. 28614.
- White. 4 by 4 by 1 inches. Serravezza. W. W. Story, 1883. 28620.
- White and dark; brecciated. 4 by 4 by 1 inches. Serravezza. W. W. Story, 1883. 28621.
- Pure white statuary; first quality. $5\frac{1}{2}$ by $3\frac{1}{2}$ by $\frac{1}{2}$ inches. Serravezza. W. W. Story, 1883. 28622.
- White; Bianco Falcovaia. 4 by 4 by $\frac{1}{2}$ inches. Serravezza. W. W. Story, 1883. 28623.
- White; Bianco Chiaro. 4 by 4 by $\frac{1}{2}$ inches. Serravezza. W. W. Story, 1883. 28624.
- White; statuary. 4 by 4 by $\frac{1}{2}$ inches. Serravezza. W. W. Story, 1883. 28625.
- Blue veined (florito). 4 by 4 by $\frac{1}{2}$ inches. Serravezza. W. W. Story, 1883. 28626.
- Blue veined (florito); first quality. 4 by 4 by $\frac{1}{2}$ inches. Serravezza. W. W. Story, 1883. 28627.
- Pink and white (miscio). 4 by 4 by 1 inches. Serravezza. W. W. Story, 1883. 28628.
- Blue (Bardiglio). 4 by 4 by $\frac{1}{2}$ inches. Serravezza. W. W. Story, 1883. 28629.
- Pinkish (Umbria). $5\frac{1}{2}$ by $3\frac{1}{2}$ by $\frac{1}{2}$ inches. Umbria. W. W. Story, 1883. 28630.
- Light fawn color. 4 by 4 by 1 inches. Umbria. W. W. Story, 1883. 28632.
- Red. 4 by 4 by 1 inches. Perugia. Rosso di Perugia quarry. W. W. Story, 1883. 28634.
- Nearly black. 4 by 4 by 1 inches. Lavagno. W. W. Story, 1883. 28640.
- White. 4 by 4 by $\frac{1}{2}$ inches. Arni. L. Charpy, 1886. 38278.
- White, dark, spotted. 4 by 4 by $\frac{1}{2}$ inches. Piastraccin, near Arni. L. Charpy, 1886. 38281.
- Breccia marble.** Red and white with dark spots; a fine breccia. $5\frac{1}{2}$ by $3\frac{1}{2}$ by $\frac{1}{2}$ inches. Monte Cavo. W. W. Story, 1883. 28631.
- Black, yellow veined. Portoro. First quality. 6 by 6 by 3 inches. Monte d'Arma quarries. William T. Rice, 1882. 26903.
- Bardiglio marble.** Light blue-gray; mottled. 4 by 4 by $\frac{1}{2}$ inches. Gioja. W. W. Story, 1883. 28601.
- Light blue-gray; dark veined. 4 by 4 by $\frac{1}{2}$ inches. Gioja. W. W. Story, 1883. 28602.
- Marble [fiore di Persico].** Four by 4 by $\frac{1}{2}$ inches. W. W. Story, 1883. 26615.
- Chocolate red and white; mottled. $5\frac{1}{2}$ by $3\frac{1}{2}$ by $\frac{1}{2}$ inches. W. W. Story, 1883. 26616.
- Red, mixed. 4 by 4 by $\frac{1}{2}$ inches. Levanto. W. W. Story, 1883. 28617.
- Marble [giallo di Siena].** Yellow. Four specimens. $2\frac{1}{2}$ by 4 by $\frac{1}{2}$ inches. Cappadocia. W. W. Story, 1883. 28618.
- Yellow and purplish; brecciated. Two specimens. $2\frac{1}{2}$ by 4 by $\frac{1}{2}$ inches. Cappadocia. W. W. Story, 1883. 28619.
- Travertine.** Nearly white; porous. 4 by 4 by 1 inches. Tivoli. W. W. Story, 1883. 28641.

- Travertine.** Yellowish. This stone is popularly called "alabaster." 4 by 4 by 1 inches. Civita Vecchia. W. W. Story, 1883. 28637.
- Yellowish; called "alabaster." 4 by 4 by 1 inches. W. W. Story, 1883. 28638.
- Limestone.** One of the principal building stones throughout Tuscany and Northern Italy. Is used for fine work, door and window trimmings, and facings of the basements of houses, especially in Florence. Does not withstand the climate for a longer period than twenty years. 12 by 8 by 8 inches. Florence, Italy. Hon. William T. Rice, United States consul at Leghorn, Italy, 1882. 27025.
- A coarse hard limestone used for door and window trimmings and facings for the basements of houses. It is one of the principal building stones in use throughout Tuscany and Northern Italy; 12 by 8 by 8 inches. Leghorn, Italy. Hon. William T. Rice, United States consul at Leghorn, Italy, 1882. 27026.
- A coarse stone used generally for paving streets. Is also one of the principal building stones used throughout Tuscany and Northern Italy. 12 by 8 by 8 inches. Leghorn, Italy. Hon. William T. Rice, United States consul at Leghorn, Italy, 1882. 27027.
- Breccia Di Nugola. One of the principal stones used for house trimmings and similar work throughout Tuscany and Northern Italy. Many of the old palaces are faced with it. The stone is soft when quarried, but hardens on exposure. 12 by 8 by 8 inches. Leghorn, Italy. Hon. William T. Rice, United States consul at Leghorn, Italy, 1882. 27028.
- Hard travertine. A hard, fine-grained limestone used for general building purposes. Was much used in old times in building palaces. Is one of the principal building stones used throughout Tuscany and Northern Italy. 12 by 8 by 8 inches. Leghorn, Italy. Hon. William T. Rice, United States consul at Leghorn, Italy, 1882. 27029.
- Travertine of Tarrana. One of the principal stones used for house-trimmings and monuments throughout Tuscany, and in general use in the North of Italy. Is a soft stone, but is said to stand the weather well. 12 by 8 by 8 inches. Leghorn, Italy. Hon. William T. Rice, United States consul at Leghorn, Italy, 1882. 27030.
- An ordinary stone from quarries around Leghorn. Is used generally only where it is to be covered with mortar. Rarely used for firm work. One of the principal building stones throughout Tuscany and Northern Italy. 12 by 8 by 8 inches. Leghorn, Italy. Hon. William T. Rice, United States consul at Leghorn, Italy, 1882. 27031.
- Granite.** Coarse; light gray. 6-inch cube. Milan. Montorfina quarry. William T. Rice, 1882. 26909.
- Fine; dark gray. 6-inch cube. Milan. Biella quarry. William T. Rice, 1882. 26910.
- Coarse; light pink. 6-inch cube. Milan. Bavena Quarry. William T. Rice, 1882. 26911.
- Quartzite.** A natural slab. 4 feet 8½ inches long, 3 feet 4 inches wide, and 1 inch thick. Luserna. Centennial, 1876. 25207.
- Volcanic tuff.** (Peperino.) 4 by 4 by 1 inches. Marino. W. W. Story, 1883. 28635.
- Sandstone.** Micaceous; blue-gray. 4 by 4 by 1 inches. W. W. Story, 1883. 28636.

PORTUGAL.

- Limestone.** Light colored; fine and compact. From quarries at Ontil, Cantanhede, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27782.

- Limestone.** Very light drab; fine and compact. From quarries at Ilhostro, Coimbra, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27786.
- Light colored; fine and compact. Locality, etc., the same as last. 27779.
 - Light pink tinted; fine and compact. From quarries at Zambujal, Cantanhede, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27781.
 - Light drab; fine and compact. From quarries at Pampilhora, Coimbra, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27787.
 - Buff; fine and compact; with many small veins. Used for making quicklime. From quarries at Covez, Cantanhede, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27757.
 - Light colored; fine and compact. Used for making quicklime. Quarries at Ega, Condeixa, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27745.
 - Gray; fine and compact. Locality, etc., as above. 27791.
 - Light colored; fine and compact. Locality, etc., same as above. 27793.
 - Very light drab; fine and compact. Quarries at Loureira, Condeixa, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27748.
 - Lithographic; very light brown; compact; finely fossiliferous. From quarries at Pedreiras do Coiço, Condeixa, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27755.
 - Light colored; very fine and compact. From quarries at Alto do Sangradas, Condeixa, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27746.
 - Dark gray; fine and compact. From quarries at Cape Mondego, Beira Province. Centennial, 1876. 27803.
 - Dark gray; fine and compact. Cape Mondego, Beira Province. Centennial, 1876. 27802.
 - Very dark gray; fine and compact. From quarries at Dta. de Sto. Amaro, Figueira da Foz, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27805.
 - Light yellowish brown; very fine and compact. From quarries at Forrestillo, Figueira da Foz, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27814.
 - Light colored; fine and compact. From quarries at Boria, Figueira da Foz, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27809.
 - Light colored; fine and compact. From quarries at Brenha, Figueira da Foz, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27811.
 - Drab and yellow; fine and compact. Locality, etc., same as last. 27812.
 - Light colored; finely fossiliferous. From quarries at Salmanha, Figueira da Foz, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27798.
 - Light colored; compact; fossiliferous. Locality, etc., same as last. 27795.
 - Drab; fine and compact. From quarries at Arrovela, Figueira da Foz, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27751.

Limestone. Drab; fine and compact; semi-crystalline. Penella, Beira Province. 27726.

- Gray; fine and compact. Locality, etc., same as above. 27728.
- Very light brown; fine and compact. Locality, etc., same as above. 27739.
- Light colored; fine and compact. Quarries at Verride, Monte Mor-Velho, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27747.
- Coarse; light colored. From quarries at Penacora e Friumes, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27753.
- Light yellowish; compact; oolitic. From quarries at Alrito, Poiaras, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27721.
- Light colored; fine and vesicular. Quarries at Ponte do Espinhal, Penella, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27743.
- Lithographic; dull brownish; compact. Bordallo, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27783.
- Compact; light colored; oolitic. From quarries at Lombas, Batalha, District of Leiria. American Institute of Mining Engineers, 1886. 37899.
- Coarse; drab. From quarries at Corredara, Porto de Moz, District of Leiria, Estremadura Province. American Institute Mining Engineers, 1886. 37900.
- Dark blue-gray, nearly black; fine and compact. Locality, etc., same as above. 37901.
- Compact; light red. From quarries at Nazareth, Alcobaca, District of Leiria, Estremadura Province. American Institute of Mining Engineers, 1886. 37902.
- Pinkish; fine and compact; crystalline. Locality, etc., same as above. 37903.
- Light colored; compact; finely fossiliferous. American Institute of Mining Engineers, 1886. 37921.

Limestone, argillaceous. Dendritic; light yellow; fine and compact. From quarries at Cuzelhas, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27784.

- Fine; very light colored. From quarries at Ançan, Cantanhede, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27780.
- Drab; fine and compact. Quarries at Ega, Condeixa, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27758.
- Very light colored; fine and compact. From quarries at Alhadas, Figueira da Foz, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27808.
- Bluish drab; very fine and compact. From quarries at Serra da Boa Viagem, Figueira da Foz, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27804.
- Nearly white; chalky. From quarries at Carvalhal, Figueira da Foz, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27810.
- Light drab and gray. Quarries at Porto Barro, Montemor Velho, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27750.
- Very light colored; fine and compact. Quarries at Janianes, Penella, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27744.
- Light drab; fine and compact. From quarries at Janianes, Penella, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27816.

Limestone Breccia. Brown; from quarries at Monte Arrvia, Coimbra, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27785.

Limestone [marble]. Light yellow; fine and compact. From quarries at Andorinha, Cantanhede, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27778.

— Light pinkish drab; fine and compact. Quarries at Condeixa a Velha, Condeixa, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27788.

— Red and yellow; mottled; fine and compact. Two specimens. Locality, etc., same as last. 27789.

— Pink and yellow mottled, with dark spots; fine and compact. Locality, etc., same as last. 27790.

— Very light colored; fine and compact. From quarries at Amaxoeira, Condeixa, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27792.

— Compact; pinkish. Quarries at Arneiro de fora, Figueira da Foz, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27742.

— Light lavender; very fine and compact. From quarries at Pincho, Figueira da Foz, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27806.

— White, dark spotted; very fine and compact. From quarries at Zameirao, Figueira da Foz, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27754.

— Light colored; compact; fossiliferous. Locality, etc., same as last. 27799.

— Pink; fine and compact. Locality, etc., same as last. 27796.

— Light pink; fine and compact. Locality, etc., same as last. 27797.

— Very light colored, pink tinted; fine and compact. Locality, etc., same as last. 27807.

— Light pink; fine and compact. From quarries at Farrestello, Figueira da Foz, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27813.

— Gray; crystalline. 8 by 8 by 1 inches. Quarries at Alveite, Poiaras, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27720.

— Yellow, with light purple stripes; very fine and compact. From quarries denominated *Ferrarias*, *Fabricas*, *Ledadura*, and *Lobrai*, situated in the "Freguesias" of St. Miguel and Santa Eufemia, Penella, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27725.

— Light drab; very fine and compact. Locality, etc., same as above. 27815.

— Light brown with streaks of dull red; fine and compact. Locality, etc., same as above. 27727.

— Dull pinkish with fine veins of white calcite. Very fine and compact. Locality, etc., same as above. 27729.

— Dull red; very fine and compact. Locality, etc., same as above. 27730.

— Drab, pink tinted; very fine and compact. Locality, etc., same as above. 27731.

— White crystalline, spotted and blotched with light red; very fine and compact. Locality, etc., same as above. 27732.

— Yellow-tinged with pink, with vein of white calcite; very fine and compact. Locality, etc., same as above. 27734.

— Very light pinkish; fine and compact, with many minute veins. Locality, etc., same as above. 27735.

- Limestone [marble].** Dull red with light streaks; very fine and compact. From quarries denominated *Ferrarias*, *Fabricas*, *Ledadura*, and *Lobral*, situated in the "Freguesias" of St. Miguel and Santa Eufemia, Penella, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27736.
- Light pink with drab veins; very fine and compact. Locality, etc., same as above. 27737.
 - Very light brown with dull red stripes; very fine and compact. Locality, etc. same as above. 27738.
 - Very light pink; fine and compact. Locality, etc., same as above. 27740.
 - Drab with pink and yellow streaks; fine and compact. Locality, etc., same as above. 27741.
 - Dull reddish brown; very fine and compact. Locality, etc., same as above. 27733.
 - Light and dark gray mottled; crystalline. 8 by 8 by 1 inches. From the quarries of the Estremoz Marble Quarrying Company, Estremoz, Alemtejo Province. American Institute of Mining Engineers, 1886. 37914.
 - White; crystalline. 8 by 8 by 1 inches. Locality, etc., same as above. 37915.
 - White; crystalline. 8 by 8 by 1 inches. Locality, etc., as above. 37916.
 - Same as above. 37917.
 - Yellowish white, with red blotches; crystalline. 8 by 8 by 1½ inches. Locality, etc., same as above. 37918.
 - White; crystalline. 10½ by 10½ by ½ inches. Locality, etc., same as above. 37911.
 - White with yellow veins; crystalline. 8 by 8 by 1 inches. From quarries at Estremoz, Alemtejo Province. Portuguese Centennial Commission, 1876. 27723.
 - Yellow. 10½ by 10½ by ½ inches. Locality, etc., same as above. 27671.
 - Very light drab. 10½ by 10½ by 1 inches. From quarries at Porto Salvo, Alemtejo Province. American Institute of Mining Engineers, 1886. 37913.
 - White; crystalline. 8 by 8 by 1 inches. From quarries and Vianna do Alemtejo. American Institute of Mining Engineers, 1886. 37919.
 - White; crystalline. 8 by 8 by 1 inches. From quarries at Borba, Alemtejo Province. American Institute of Mining Engineers, 1886. 37920.
 - Dark blue gray and white mottled; crystalline. 6-inch cube. Locality as above. Portuguese Centennial Commission, 1876. 27724.
 - Pink mottled. 10½ by 10½ by ½ inches. Quarries at Pero Pinheiro Estremadura Province. Two specimens. Portuguese Centennial Commission, 1876. 27666.
 - Light red; mottled. 10½ by 10½ by ½ inches. Locality, etc., same as above. 27667.
 - Very light drab. 10½ by 10½ by ½ inches. Locality, etc., same as above. 27668.
 - Water blue; coarsely crystalline. 10½ by 10½ by ½ inches. Locality, etc., same as above. 27669.
 - Light and dark red. Two specimens. 10½ by 10½ by ½ inches. Locality, etc., same as above. 27673.
 - Light colored; fossiliferous. Locality, etc., same as above. American Institute of Mining Engineers, 1886. 37912.
 - Dull pink; very fine and compact. From the quarries of Joaquim Pires, Serra da Lagar, Anciao, District of Leiria, Estremadura Province. American Institute of Mining Engineers, 1886. 37895.
 - Dull red; very fine and compact. From the quarries of Manoel Znarte, Lagarteira, Anciao, District of Leiria, Estremadura Province. American Institute of Mining Engineers, 1883. 37894.

Limestone [marble]. Red mottled; fossiliferous. $10\frac{1}{2}$ by $10\frac{1}{2}$ by 1 inches. Locality, etc., same as above. 37909.

- Dark blue gray; fine and compact. 5 by 5 by 1 inches. Quarries at Cintra, District of Lisbon, Estremadura Province. Centennial, 1876. 27677.
- Yellowish gray; crystalline. 5 by 5 by 1 inches. Quarries at Cintra, District of Lisbon, Estremadura Province. Centennial 1876. 27674.
- Gray; fine and compact. 5 by 5 by 1 inches. Locality, etc., same as above. 27675.
- Coarse; gray; crystalline. 5 by 5 by 1 inches. Locality, etc., same as above. 27676.
- Light and dark gray, mottled; fine and compact. $4\frac{1}{2}$ by $5\frac{1}{2}$ by 1 inches. Locality, etc., same as above. 27678.
- Coarsely crystalline; white. $4\frac{1}{2}$ by $5\frac{1}{2}$ by 1 inches. Locality, etc., same as above. 27679.
- Black; very fine and compact. $10\frac{1}{2}$ by $10\frac{1}{2}$ by 1 inches. Locality, etc., same as above. 27672.
- Yellow; fine and compact. 10 by 10 by 1 inches. From quarries at Cintra, District of Lisbon. American Institute of Mining Engineers, 1836. 37910.
- Lisbon, Portugal. American Institute Mining Engineers, 1885. 37841.
- White; crystalline. 5 by 5 by 1 inches. From the Penha Longa quarries. Cruz dos Quarto Carminhos, Cintra, District of Lisbon, Estremadura Province. American Institute of Mining Engineers, 1886. 37888.
- Dark gray; fine and compact. Locality, etc., same as above. 37889.
- Dark blue-gray and white; crystalline. 4 by 6 by 1 inches. Las Gouçala. Locality, etc., otherwise as above. 37890.
- Yellowish; coarsely fossiliferous. $10\frac{1}{2}$ by $10\frac{1}{2}$ by $3\frac{1}{2}$ inches. From quarries at Tonal, Estremadura Province. Portuguese Centennial Commission, 1876. 27670.
- White; coarsely crystalline. 8 by 8 by 1 inches. Portuguese Centennial Commission, 1876. 27722.

Shell limestone. Coarse, cellular. Locality, etc., same as above. 27794.

- Fine; light colored. Locality, etc., same as above. 27800.
- Fine; light colored. Locality, etc., same as above. 27801.

Bituminous limestone. Very light brown. Locality, etc., same as above. 27759.

Calcareous conglomerate. Coarse; reddish. Locality, etc., same as above. 27760.

Calcareous conglomerate [marble]. Coarse; reddish; variegated. 8 by 6 by 1 inches. From quarries in the Arrabida Mountains, District of Lisbon, Estremadura Province. Portuguese Centennial Commission, 1876. 27717.

- Marble. Coarse; red; variegated. $9\frac{1}{2}$ by $7\frac{1}{2}$ by $\frac{3}{4}$ inches. Locality, etc., same as above. 27718.
- Marble. Coarse; pink and yellow variegated. 8 by 6 by 1 inches. Locality, etc., same as above. 27719.

Dolomite. Compact; finely cellular; dark drab. Used for making quicklime. From quarries near San Miguel in the mountain of Poiares, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27752.

Sandstone. Fine; red. Penella, Beira Province. 27761.

- Ferruginous; fine; red. Locality, etc., same as above. 27767.
- Fine; gray. From quarries at San Miguel, District of Leiria, Estremadura Province. American Institute of Mining Engineers, 1836. 37893.
- Fine; very light brown. From quarries at Pombal, District of Leiria, Estremadura Province. American Institute of Mining Engineers, 1886. 37896.

Calcareous sandstone. Coarse; light colored. Penella, Beira Province. 27817.

Calcareous sandstone. Gray; compact. From quarries at Lapa, District of Leiria, Estremadura Province. American Institute of Mining Engineers, 1886. 37897.

Mica granite. Fine; reddish. From quarries at Gramacos, Oliveira do Hospital, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27818.

— Coarse; gray. From quarries at Santa Ovaia, Oliveira do Hospital, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27819.

— Gray; coarse; porphyritic. From quarries at Pedreirada Sé, Taboa, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27820.

— Fine; light gray. Portuguese Centennial Commission, 1876. 27775.

Slate. Coarse blue-gray. From quarries at Espariz, Taboa, District of Coimbra, Beira Province. Portuguese Centennial Commission, 1876. 27756.

Granite. Coarse; gray. 5 by 5 by 1 inches. Cintra, Estremadura Province. American Institute of Mining Engineers, 1886. 37893.

Marble. Pink; fine and compact. Lisbon. Portuguese Centennial Commission, 1876. 26450.

Dolomite [marble]. White; crystalline. 5 by 5 by 1 inches. Terra do Tanque. Estremadura Province. 37891.

— White; crystalline. 4 by 5 by $\frac{1}{2}$ inches. Locality, etc., same as last. 37892.

Limestone (stalagmatic). Brown mottled; irregular oval mass, about 17 by 8 by 4 inches. Rock of Gibraltar. Centennial Commission, 1876. 25027.

Stalagmite [marble]. Brown. Small slab, 3 by 4 inches. Rock of Gibraltar. A. R. Crittenden, 1886. 38444.

Hornblende andesite (?). Fine dark gray, nearly black, with small white spots. This stone is used in hewn and rubble work in localities where there is no other. It is very easy to cut in blocks of any size. 5-inch cube. From quarries near Ponta Delgada, on the Island of São Miguel, Azores. Portuguese Centennial Commission, 1876. 37304.

Basalt. Coarsely vesicular; dark gray, almost black in color. Used for hewn stone of inferior quality to remain in sight in buildings of a superior construction. Also used as an imitation of hewn stone when covered with cement, which adheres very well to the asperities of the stone, and as hewn and rubble stones in inferior constructions. Locality, etc., as above. 37905.

— Dark gray; fine and compact; somewhat vesicular. This stone is very hard and difficult to hew, and on this account is used only for rubble work and as loose stone in breakwaters. Locality, etc., as above. 37906.

— Dark gray, nearly black; very vesicular. Used as a second-rate stone in the commonest kind of hewn work. Locality, etc., as above. 37907.

— Fine and compact; dark gray. A first-class stone, used in hewn work in buildings of superior construction. Locality, etc., as above. 37908.

— Red; ferruginous; coarsely vesicular. Santa Cruz de Tenerife, Canary Islands. Portuguese Centennial Commission, 1876. 27712.

Pozzuolana. Volcanic clay; employed with great success to give, when mixed with lime not hydraulic or slightly hydraulic, the properties which the latter requires for composing hydraulic mortars. Very abundant in St. Michaels, and explored in great scale in the suburbs of Ponta Delgada for the buildings of the locality and for exportation to the continent of Portugal. It is generally employed in all the public works of the country. In constructions out of water, or in hydraulic works by tides or in fresh water, the masonry is made with mortar composed of one part of lime and three parts of pozzuolana, using lime not hydraulic for the first kind of works and slightly hydraulic for the second. For works constantly exposed to the sea slightly hydraulic lime, pozzuolana, and coarse sand are mixed together in equal parts. (Portuguese Centennial Catalogue, p. 95). Locality, etc., as above. 35527.

Artificial stone, formed by mixing pozzuolana with lime as described above. Local
ity, etc., same as last. 35527.

Volcanic tuff. Dark gray. Grand Canary Islands. Portuguese Centennial Com-
mission, 1876. 27710.

— Coarse; dull red. Grand Canary Islands. Portuguese Centennial Commission,
1876. 27713.

SPAIN.

Calcareous breccia [marble]. Coarse; drab and light brown. From quarries in
Saragossa Province. Spanish Centennial Commission, 1876. 27694.

— A coarse breccia, made up of fragments of nearly black limestone embedded
in a brown ground mass. From quarries at Chodes, Saragossa Province.
Spanish Centennial Commission, 1876. 27692.

— Like the last, but more compact. Locality, etc., the same. 27693.

— Coarse; dull, with white veins. Locality, etc., same as above. 27698.

— Made up of fragments of nearly black limestone embeded in a white crystalline
ground mass. From quarries at Riela, Saragossa Province. Spanish Cen-
tennial Commission, 1876. 27696.

— Coarse; composed of fragments of dark and ferruginous limestone cemented by
white crystalline carbonate of lime. From quarries at Morata, Saragossa
Province. Spanish Centennial Commission, 1876. 27714.

— Dull red and white; cellular. From quarries at Puebla de Alborton, Saragossa
Province. Spanish Centennial Commission, 1876. 27688.

Limestone [marble]. Very light drab, with fine pink veins; fine and compact.
From quarries in Saragossa Province. Spanish Centennial Commission, 1876.
27695.

— Coarse; yellowish. Locality, etc., same as above. 27697.

— Very dark drab, with white and red veins; fine and compact. Locality, etc.,
same as above. 27690.

— Dull red; fine and compact. From quarries at Riela, Saragossa Province.
Spanish Centennial Commission, 1876. 27684.

— Gray; crystalline. 6 by 6 by 1 inches. Murcia, Murcia Province. Spanish
Centennial Commission, 1876. 27774.

— Red and yellow mottled; fine and compact. 6 by 6 by 1 inches. Cehegin, Murcia
Province. Spanish Centennial Commission, 1876. 27706.

— Dark blue-gray and white mottled; crystalline. 5 by 5 by 1 inches. Alma-
zarron, Murcia Province. Spanish Centennial Commission, 1876. 27707.

— Dark blue-gray; crystalline. Panticosa, Huesca Province. Spanish Centen-
nial Commission, 1876. 27683.

— Nearly black with whitish veins; very fine and compact. 5 by 5 by 1 inches.
Callosa de Ensarria, Alicante Province. Spanish Centennial Commission,
1876. 27711.

— Dark yellow; compact. 8 by 8 by 1½ inches. Nueva Esparta. 36998.

Limestone. Bluish drab; fine and compact. From quarries in Saragossa Province.
Spanish Centennial Commission. 27700.

— Drab. Locality, etc., same as above. 27821.

— Deep blue-black; very fine and compact. From quarries at Riela, Saragossa
Province. Spanish Centennial Commission, 1876. 27763.

— Dark gray; compact. Puebla de Alborton, Saragossa Province. Spanish Cen-
tennial Commission, 1876. 27689.

— Pinkish; fine and compact. Locality, etc., same as above. 27765.

Limestone. Nearly white; coarse; cellular. From quarries at Calatayud, Saragossa Province. Spanish Centennial Commission, 1876. 27686.

— Dark gray; compact. Locality, etc., same as above. 27691.

— White; semi-crystalline. From quarries at Alhama, Saragossa Province. Spanish Centennial Commission, 1876. 27764.

— Compact; dark gray. 6-inch cube. Murcia, Murcia Province. Spanish Centennial Commission, 1876. 27773.

— Chalk. From quarries at Calatayud, Saragossa Province. Spanish Centennial Commission, 1876. 27685.

Gypsum. Compact; gray. From quarries at Riola, Saragossa Province. Spanish Centennial Commission, 1876. 27768.

— Compact; dark gray. Locality, etc., same as above. 27687.

— Alabaster; pure white; translucent. Locality, etc., same as above. 27699.

— Alabaster; white. From quarries at Saragossa, Saragossa Province. Spanish Centennial Commission, 1876. 27701.

— Alabaster; pure white; translucent. $7\frac{1}{4}$ by $7\frac{1}{4}$ by 1 inches. From quarries in the province of Guadalajara. American Institute Mining Engineers, 1886. 34535.

— Compact; blue-gray and yellowish gray, mottled. From Murcia, Murcia Province. Spanish Centennial Commission, 1886. 27705.

Shell limestone. Coarse; light buff. Murcia, Murcia Province. Spanish Centennial Commission, 1876. 27703.

— Coarse and friable; light colored. Locality, etc., same as above. 27772.

— Fine; light colored; cellular. Murcia, Murcia Province. Centennial, 1876. 27771.

Calcareous sandstone. Very light brown; fine; cellular. Locality, etc., as above. 27716.

— Light colored. Locality, etc., same as above. 27769.

— Fine; light yellow. 6-inch cube. Murcia, Murcia Province. Spanish Centennial Commission, 1876. 27776.

— Light pinkish; cellular. 5-inch cube. Santa Maria, Oveido Province. Spanish Centennial Commission, 1876. 27715.

Dolomite. Coarse; drab. Spanish Centennial Commission, 1876. 27777.

Calcareous tufa. Yellowish; compact but cellular. 6-inch cube. Locality, etc., as above. 27704.

Sandstone. Green; colored by copper oxide. San Romando Morrano, Huesca Province. Spanish Centennial Commission, 1876. 27702.

Slate. Blue-black. 25083.

(7) AFRICA.

ALGERIA.

Marble. "Jaune antique doré." Yellow and yellow pink-spotted. Two specimens. Slab 12 by 12 by $\frac{1}{2}$ inches. Western Algeria, E. Fritsch, New York, 1886. 38440.

— "Paonazzo rosso." Dull red. Slab 12 by 12 by $\frac{1}{2}$ inches. Western Algeria. E. Fritsch, New York, 1886. 38441.

— "Jaune chiaro ondaté." Yellowish; red veined. Slab 12 by 12 by $\frac{1}{2}$ inches. Western Algeria. E. Fritsch, New York, 1833. 38442.

— "Jaune rosé." Yellowish; red veined. Slab 12 by 12 by $\frac{1}{2}$ inches. Western Algeria. E. Fritsch, New York, 1886. 38443.

— "Rose clare." Light-rose tinted. Slab 12 by 12 by 1 inches. Western Algeria. E. Fritsch, New York, 1887. 38339.

Marble. "Jaspe rouge." A jasper red breccia, with light spots and streaks. Slab 12 by 12 by 1 inches. Western Algeria. Gift of E. Fritsch, New York. 38841.

— "Breche sanguiné." Blood-red, light and dark. Western Algeria. Gift of E. Fritsch, New York. 38840.

EGYPT.

Onyx marble. From quarries at Blad Recam, near ravine of Oued-Abdallah, Egypt (?). Polished block, $8\frac{1}{2}$ by 7 by 7 inches. 25343.

This stone, the so-called Egyptian onyx, is composed principally of carbonate of lime, and occurs in large beds among the Tertiary limestones of Blad Recam (marble country), near the ravine of Oued-Abdallah. The old quarries which supplied the inhabitants of Rome and Carthage with the fine translucent marble used in the interior decorations of their houses and monuments were here situated. These quarries were for over 1,000 years entirely lost sight of, and it was not until the year 1849 that they were rediscovered by a French gentleman, M. Delmonte. In ancient times the stone was cut into small vases for holding precious ointments. It is now imported in considerable quantities into Paris, where it is used in the manufacture of time-pieces, small vases, candlesticks, and similar objects. (On Building and Ornamental Stones, by E. Hull, p. 149.)

Onyx marble. From quarries at Blad Recam, near ravine of Oued-Abdallah, Egypt (?). Polished block, 18 by $8\frac{1}{2}$ by 7 inches.

This stone, popularly called Oriental alabaster, is another variety of marble derived from quarries in Egypt, and employed in works of art, except statuary, both in ancient and mediæval times. Its stalagmitic origin is at once apparent upon inspection. The color is that of amber, or rich yellowish brown, of various shades arranged in folds or wavy parallel bands; sometimes it is beautifully iridescent. The mammillated structure so characteristic of deposits due to filtration or percolation is also not infrequent. This stone was largely employed by the ancient inhabitants of Egypt in the formation of canopi (or jars surmounted by sculptured images of the dog-headed god), in which were deposited the ashes of the dead. Besides these smaller objects, large cinerary urns were formed of this material. This stone is popularly called alabaster, but is entirely different from true alabaster in composition. (On Building and Ornamental Stones, by E. Hull, p. 150. See text, p. 475.)

Travertine. "Oriental alabaster." Yellowish and nearly colorless. Two specimens. 4 by 4 by $\frac{1}{2}$ and 4 by 2 by $\frac{1}{2}$ inches. Bowker, Torrey & Co., Boston, 1884. 36774.

Porphyrite. Egyptian porphyry or "roseo antico." Very dark red, with pink porphyritic feldspars. $2\frac{1}{2}$ by 2 by $\frac{1}{2}$ inches. From quarries near the first cataract of the Nile. 4863.

Nummulitic limestone. A portion of one of the steps formerly leading to the obelisk at Alexandria, Egypt, now in Central Park, New York. Alexandria. Commander H. H. Gorringe, U. S. Navy, 1881. 26816.

Granite. A block of red hornblende biotite granite found in the débris at the foot of the Egyptian obelisk at Alexandria by Commander Gorringe during the excavations preparatory to its removal to New York. That the fragment was originally a portion of one of the obelisks now in New York and London is undoubted, though of which can not with certainty be told. The specimen still shows the original carving. Syene. Commander H. H. Gorringe, U. S. Navy, 1881. 26815.

— A block of blue-gray hornblende mica granite, being a portion of a large column found in the débris at Alexandria during the excavations preparatory to the removal of the obelisk to New York. The locality from whence the rock was originally taken is not known. Alexandria. Commander H. H. Gorringe, 1881. 26817.

(8) ASIA.

TURKEY.

Marble. Pink. ~~Selam, Isle of Samos.~~ 9 by 11 by 1 inches. Turkish Centennial Commission, 1876. 27086.

CHINA.

Granite. Light gray. Circular disk, about 5 inches in diameter and 1 inch thick. Hong-Kong John Long, 1883. 28576.

Rhyolite. Compact; light brown. Suburbs of Ningpo. 8 by 4 by 2 inches. Chinese. Centennial Commission, 1876. 38580.

Tuff. Compact; light brown. Two specimens, 8 by 4 by 2 inches. Locality, etc., same as above. 38581.

— Compact; light greenish. Two specimens, 8 by 4 by 2 inches. Locality, etc., same as above. 38582.

COREA.

Mottled yellow stone. Box made of. J. B. Bernadon, ensign U. S. Navy, 1886. 38327.

Yellow and green marble [Serpentine]. Stone pencil jar of. J. B. Bernadon, 1886. 38328.

Yellow marble. Disk of. J. B. Bernadon, 1886. 38329.

Ophiolite. White and green mottled. Slab 10 by 20 inches. J. B. Bernadon, 1886. 38330.

JAPAN.

Steatite (?) Massive; compact; dark greenish gray. $6\frac{1}{2}$ by $6\frac{1}{2}$ by 1 inches. Hitachi. Centennial, 1876. 27552.

— Massive; dark green, nearly black. $5\frac{1}{2}$ by $5\frac{1}{2}$ by 1 inches. Hitachi. Centennial, 1876. 27553.

— Massive; compact; dark green, nearly black. 6 by 6 by 1 inches. Hitachi. Centennial, 1876. 27554.

— Massive; compact; dark greenish gray. 6 by 6 by 1 inches. Hitachi. Centennial, 1876. 27534.

— Massive; compact; dark green, nearly black, with white spots. 6 by 6 by 1 inches. Hitachi. Centennial, 1876. 27535.

— Massive; compact; dark green and gray mottled. $6\frac{1}{2}$ by $6\frac{1}{2}$ by 1 inches. Hitachi. Centennial, 1876. 27560.

— Massive; compact; dark green, nearly black. 11 by $6\frac{1}{2}$ by $2\frac{1}{2}$ inches. Hizen. Centennial, 1876. 27561.

— Massive; compact; dark green, nearly black. 6 by 6 by 1 inches. Hitachi. Centennial, 1876. 27555.

— Massive; compact; dark green, nearly black. 6 by 6 by 1 inches. Hitachi. Centennial, 1876. 27557.

— Massive; compact; dark greenish gray. 6 by 6 by 1 inches. Hitachi. Centennial, 1876. 27559.

— Massive; compact; dark green and gray. 6 by 6 by 1 inches. Hitachi. Centennial, 1876. 27540.

— Massive; dark greenish gray. 6 by 6 by 1 inches. Hitachi. Centennial, 1876. 27550.

— Massive; dark green, nearly black. 6 by 6 by 1 inches. Tagagori, Hitachi. Centennial, 1876. 27551.

- Marble.** White. $3\frac{1}{2}$ by $3\frac{1}{2}$ by $\frac{1}{2}$ inches. Mino Province. Centennial, 1876. 27137.
- Pink, black, and white, brecciated. $3\frac{1}{2}$ by $3\frac{1}{2}$ by $\frac{1}{2}$ inches. Mino Province. Centennial, 1876. 27138.
- Black, with white fossils. $3\frac{1}{2}$ by $3\frac{1}{2}$ by $\frac{1}{2}$ inches. Mino Province. Centennial, 1876. 27139.
- Black and white; breccia. $3\frac{1}{2}$ by $3\frac{1}{2}$ by $\frac{1}{2}$ inches. Mino Province. Centennial, 1876. 27140.
- Dark gray, black spotted. $3\frac{1}{2}$ by $3\frac{1}{2}$ by $\frac{1}{2}$ inches. Mino Province. Centennial, 1876. 27141.
- White, green veined. $6\frac{1}{2}$ by $6\frac{1}{2}$ by 1 inches. Hitachi. Centennial, 1876. 27536.
- White; crystalline. $6\frac{1}{2}$ by $6\frac{1}{2}$ by 1 inches. Hitachi. Centennial, 1876. 27538.
- White, with blue-gray veins; resembles the Italian bardiglio. 6 by 6 by 1 inches. Two specimens. Hitachi. Centennial, 1876. 27539.
- White, green veined. 6 by 6 by 1 inches. Hitachi. Centennial, 1876. 27542.
- White, green veined. 6 by 6 by 1 inches. Hitachi. Centennial, 1876. 27541.
- White, green veined. $6\frac{1}{2}$ by $6\frac{1}{2}$ by 1 inches. Hitachi. Centennial, 1876. 27543.
- White, with blue-gray veins; resembles the Italian bardiglio. Two specimens. 6 by 6 by 1 inches. Hitachi. Centennial, 1876. 27544.
- White, green veined. 6 by 6 by 1 inches. Hitachi. Centennial, 1876. 27545.
- White; crystalline. $6\frac{1}{2}$ by $6\frac{1}{2}$ by 1 inches. Hitachi. Centennial, 1876. 27546.
- White; crystalline. $6\frac{1}{2}$ by $6\frac{1}{2}$ by 1 inches. Hitachi. Centennial, 1876. 27547.
- White, green veined. $6\frac{1}{2}$ by $6\frac{1}{2}$ by 1 inches. Hitachi. Centennial, 1876. 27558.
- White; crystalline. $6\frac{1}{2}$ by $6\frac{1}{2}$ by 1 inches. Hitachi. Centennial, 1876. 27548.
- White; crystalline. $6\frac{1}{2}$ by $6\frac{1}{2}$ by 1 inches. Hitachi. Centennial, 1876. 27549.

RUSSIA.

- Quartz porphyry.** Dull red base, with large porphyritic feldspars and quartzes. $2\frac{1}{2}$ by $2\frac{1}{2}$ inches. Isle Hoghland. Russian Centennial Commission, 1876. 27583.
- A compact purplish base, carrying porphyritic yellowish and reddish feldspars. 3 by 4 inches. Nishne-Issetsk Works, district of Katharinenburg, Ural. Russian Centennial Commission, 1876. 27565.
- (Porphyry.) A compact purplish rock, with very many white porphyritic feldspars and glassy quartz. 4 by 5 inches. Isle Hoghland. Russian Centennial Commission, 1876. 27580.
- (Porphyry.) Red base, with large reddish feldspars and glassy quartzes. $2\frac{1}{2}$ by 3 inches. Isle Hoghland. Russian Centennial Commission, 1876. 27581.
- (Keratitic porphyry.) Very fine and compact; nearly black, with small porphyritic feldspars and quartzes, arranged in nearly parallel indistinct bands. $3\frac{1}{2}$ by 4 inches. Lake Narori, district of Katharinenburg, Ural. Russian Centennial Commission, 1876. 27568.
- (Keratitic porphyry.) Dark gray, nearly black, with abundant porphyritic whitish feldspars and quartzes. Irregular fragment, 2 by 3 inches. River Tchervenka, district of Katharinenburg, Ural. Russian Centennial Commission, 1876. 27566.
- Porphyry conglomerate.** (Keratitic porphyry.) A greenish-black conglomerate, composed of felsitic (?) fragments very closely compacted by a siliceous paste. 3 by 4 inches. Redoubt Kolpatsk, district of Katharinenburg, Ural. Russian Centennial Commission, 1876. 27567.
- Porphyry breccia.** (Keratitic porphyry.) A red, compact breccia, composed of porphyry particles. 4 by 1 inches. Redoubt Kolpatsk, district of Katharinenburg, Ural. Russian Centennial Commission, 1876. 27570.

Diorite porphyry. A compact, greenish rock, with irregular yellowish blotches. 3 by 4 inches. District of Katharinenburg, Ural. Russian Centennial Commission, 1876. 27571.

— A compact felsitic rock, consisting of a deep purplish base, streaked and spotted with irregular white and brownish spots. 4 by 2½ inches. Village Sidelnikova, district of Katharinenburg, Ural. Russian Centennial Commission, 1876. 27572.

— Compact; green, with small porphyritic feldspars. 3½ by 4 inches. River Konda, district of Katharinenburg, Ural. Russian Centennial Commission, 1876. 27573.

Diorite. Very fine-grained and compact green, with yellowish flecks and streaks. 3 by 4½ inches. Beresovsk mines, district of Katharinenburg, Ural. Russian Centennial Commission, 1876. 27574.

— Very compact; nearly black, with grayish streaks. 3 by 4 inches. Fort Sannarskaia, district of Katharinenburg, Ural. Russian Centennial Commission, 1876. 27575.

Jasper. Compact; dull red. 3 by 4 inches. Neviansk Works, district of Katharinenburg, Ural. Russian Centennial Commission, 1876. 27578.

(9) AUSTRALIA.

Marble. White. 9 by 9 by 1 inches. New South Wales. Centennial, 1876. 19500.

— White, yellow veins. 9 by 9 by 1 inches. New South Wales. Centennial, 1876. 19501.

— Dark gray, nearly black. 9 by 9 by 1 inches. New South Wales. Centennial, 1876. 19502.

— Blue-gray mottled. 9 by 9 by 1 inches. New South Wales. Centennial, 1876. 19504.

— Gray. 8-inch cube. Centennial, 1876. 25215.

— White. 11½ by 12 by 4 inches. New South Wales. Centennial, 1876. 25201.

— Gray. About 12 by 12 by 4 inches. New South Wales. Centennial, 1876. 25210.

— White. 12 by 12 by 4 inches. New South Wales. Centennial, 1876. 25211.

— Black. 12 by 12 by 4½ inches. New South Wales. Centennial, 1876. 25212.

— Gray and yellow mottled. 12-inch cube. New South Wales. Centennial, 1876. 25092.

— Light mottled. 8½-inch cube. Centennial, 1876. 25216.

— Gray. 9-inch cube. Centennial, 1876. 26022.

— Gray mottled. 8½-inch cube. Centennial, 1876. 26024.

Sandstone. Light colored; medium. 12-inch cube. New South Wales. Centennial, 1876. 25202.

— Light colored; medium. 12-inch cube. New South Wales. Centennial, 1876. 25203.

— Light colored; medium. 12-inch cube. New South Wales. Centennial, 1876. 25214.

Hornblende biotite granite. Coarse; gray. 12-inch cube. New South Wales. Centennial, 1876. 25213.

(10) HAWAIIAN ISLANDS.

Limestone. Light colored; cellular. 12-inch cube. Island of Oahu. Waive quarry. Boston Foreign Exhibition, 1884. 35340.

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