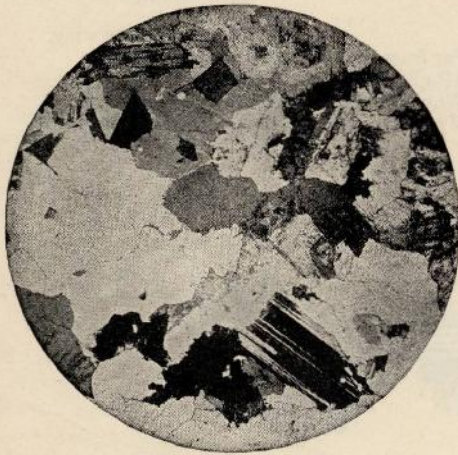


THE GRANITE INDUSTRY IN NEW ENGLAND.

By George Rich.

THE hills and shores of New England have been made to pay a double tribute to their owners. Their rugged beauty and picturesque slopes have attracted thither countless visitors, while their constituent elements in the

where else on this continent, in equal area, can such a variety of surface rocks be found. The most of these, through heat and pressure, have lost their original character, becoming thereby more dense and crystalline, while at the same time they are marked by frequent joints and cleavage surfaces. The result of this is that they yield readily to the hand of the workman and the design of the artisan. Granite undoubtedly stands first in importance among these rocks. This is due very largely to its general distribution and its wide application to building purposes and to street and monumental work.

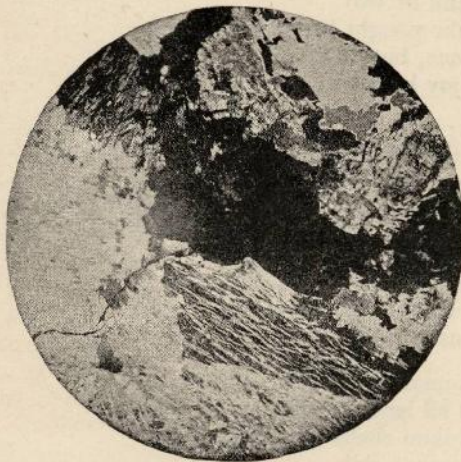


Biotite Granite.

form of slate, marble, and granite, have been quarried and sent throughout the whole country. The geological changes of New England have been peculiarly favorable to these latter enterprises. No-



Muscovite Granite.



Hornblende Granite.

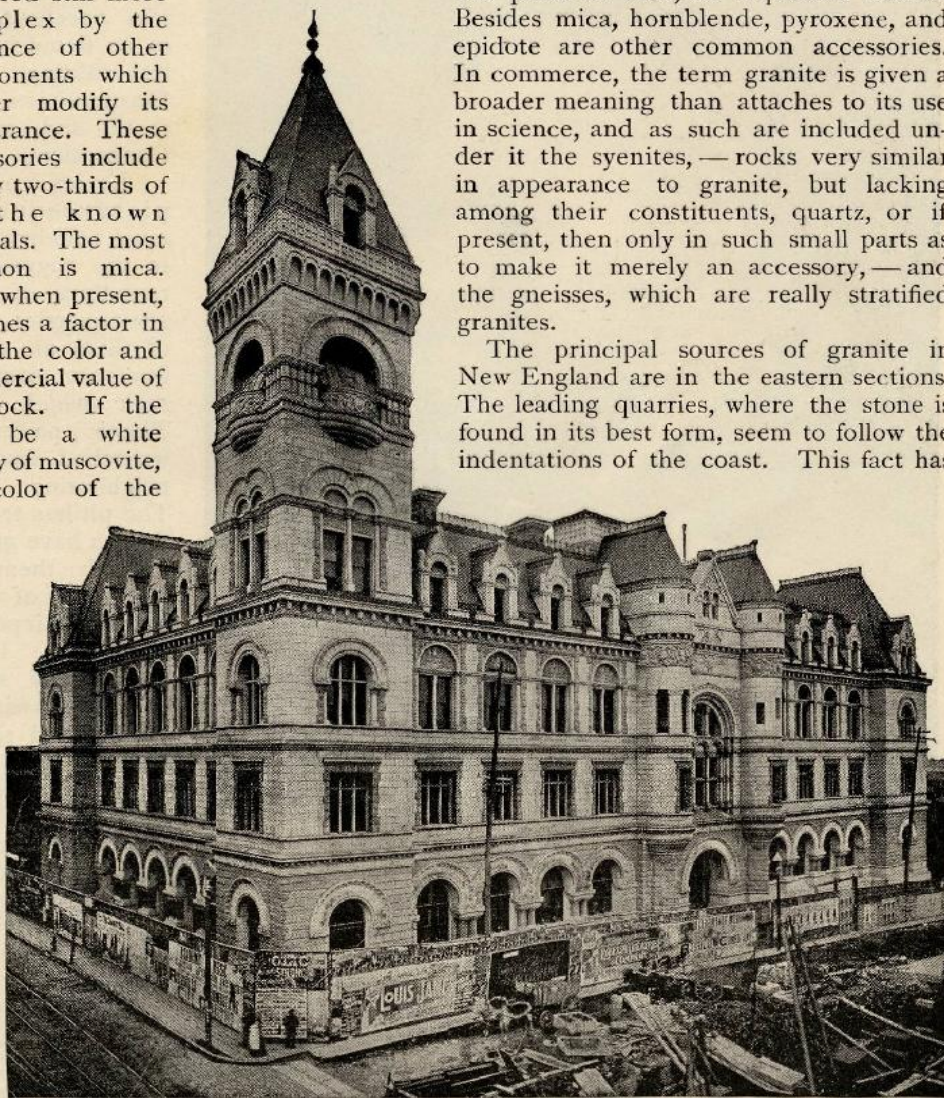
There is scarcely a part of New England in which granite does not appear, and not one of the states in which the obtaining and dressing of it do not form an important item among the industries.

Granite, in its essential form, is a combination of quartz and potash feldspar. Both of these elements contribute to the strength and hardness of the rock, while the former in addition acts as a kind of cement for the other ingredients. The feldspar, also, largely determines the color of the rock. The quartz occurs in the form of rough crystals. These are subject to some considerable variation in the

way of shape and general appearance, but their composition is always the same. The feldspathic element, on the other hand, varies in both these particulars. One seldom finds a granite which contains only a single species of feldspar. The importance of this lies in the fact that the structure of the feldspar plays a leading part in the resistability of the granite to discoloration and decay, and effects its readiness to receive a polish. As usually found, however, granite is rendered still more complex by the presence of other components which further modify its appearance. These accessories include nearly two-thirds of all the known minerals. The most common is mica. This, when present, becomes a factor in both the color and commercial value of the rock. If the mica be a white variety of muscovite, the color of the

granite in that case will be very light, as for example in that obtained at Hallowell, Me.; if the black biotite prevails, then the color will be dark, possibly approaching the black; while if the two are mixed, the rock will assume a speckled appearance, an excellent type of which is the granite found at Concord, N. H. Mica does not polish as quartz or feldspar, nor does it retain its lustre as long, and for that reason the amount of it present in a particular granite becomes, from an economical point of view, an important matter. Besides mica, hornblende, pyroxene, and epidote are other common accessories. In commerce, the term granite is given a broader meaning than attaches to its use in science, and as such are included under it the syenites, — rocks very similar in appearance to granite, but lacking among their constituents, quartz, or if present, then only in such small parts as to make it merely an accessory, — and the gneisses, which are really stratified granites.

The principal sources of granite in New England are in the eastern sections. The leading quarries, where the stone is found in its best form, seem to follow the indentations of the coast. This fact has



U. S. Post-Office, Brooklyn, N. Y., in Course of Construction. — Built of Fox Island Granite.

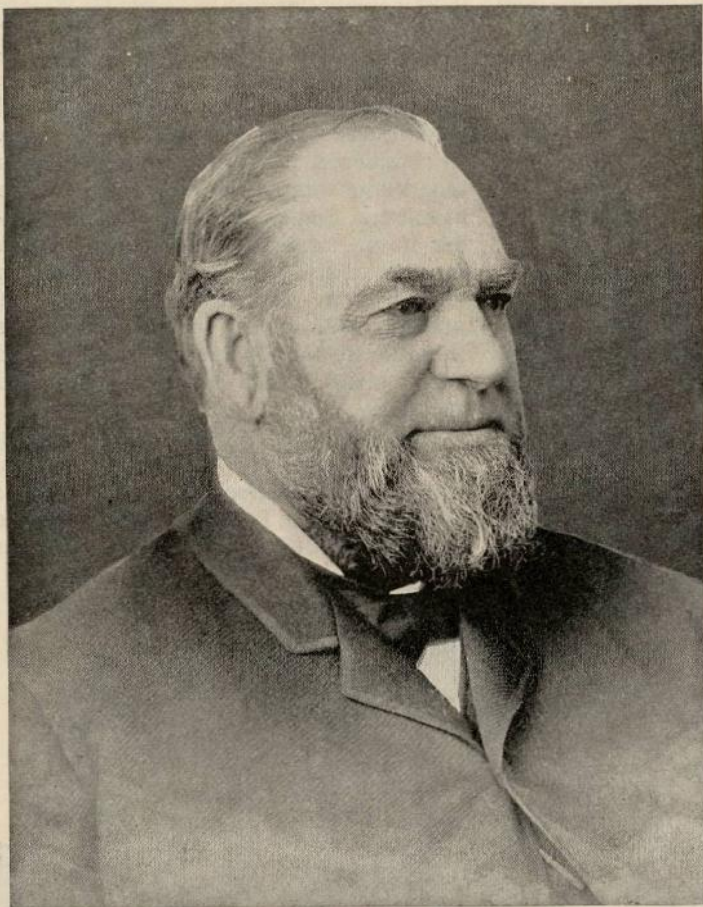
M. E. BELL, ARCHITECT.

proved a strong element in the development of the industry. Transportation is a vital factor in the progress of most enterprises, but especially so in one where the product is heavy to handle and of small value as compared with its bulk. This proximity to the coast has done two things for the quarry-owners of eastern New England. It has made granite a

of the sea and the glaciers of the ice age. They may be divided into three general systems. The first, under such an arrangement, would include those quarries which follow the coast line from Eastport to Boston, the converging points of which are the Penobscot Bay, Cape Ann and the Quincy district. To the second would be assigned the Rhode

Island and Long Island Sound quarries; while the third would embrace certain excellent beds to be found in central Maine, New Hampshire, Vermont, and western Connecticut.

Lovers of the picturesque find much to delight them in the rugged surroundings of these great quarries. Many of them are simply immense masses of rock which some Titanic power has wrenched from the neighboring land. The pitiless teeth of the sea have gnawed through them and the storms of winter scarred their ponderous faces. Others form really significant islands with safe harbors and sequestered valleys. Others, again, stand apart, rising high above the surrounding country and from



The late Governor Jos. R. Bodwell of Maine.

possibility as a building stone. This it has done by affording cheap transportation to the leading building centres. Then, having made a market for the stone, it has given these owners the permanent advantage over many of their rivals of water shipping rates.

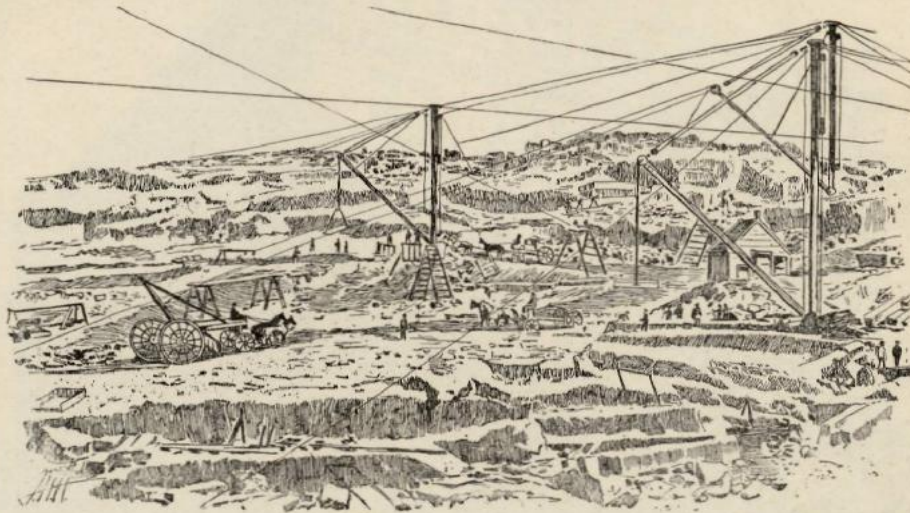
The quarries are the centres or cores of old mountain ranges which have been worn down to their bases by the action

their rugged summits affording views of fields and woods, vales and winding rivers. The prevailing type, however, is a series of low, rounded hills, broken by occasional cuts and marked by out-croppings of granite rock.

Historically, the quarries of the Quincy group stand first, as it was there that the granite industry had its beginning in New England. That was not so many decades

ago, either. It was about 1820 when these quarries first began to be worked, and the success of the original venture caused a rapid development of the business. Two interesting events are linked

lature to build a road from the granite ledges in Quincy to tide-water. This original charter was for forty years, but in 1831 it was made perpetual. The purpose of the company was to form a



Sands Quarry, Vinal Haven, Me.

with that undertaking, one the Bunker Hill Monument, and the other the first railroad in America. This latter had its origin with a number of Boston and Quincy men, who in 1826 formed the Granite Railway Company. A charter was secured from the Massachusetts legis-

means of communication between the quarries and the wharves, and the only revenue expected was from the tolls received for transportation. The railroad as built was about two miles long, and had granite sleepers and iron rails resting upon granite beds. The cost was some



Shipping Granite at Vinal Haven, Me.



Methodist Book Concern, New York. — Built of Red Jonesborough Granite.

E. H. KENDALL, ARCHITECT.

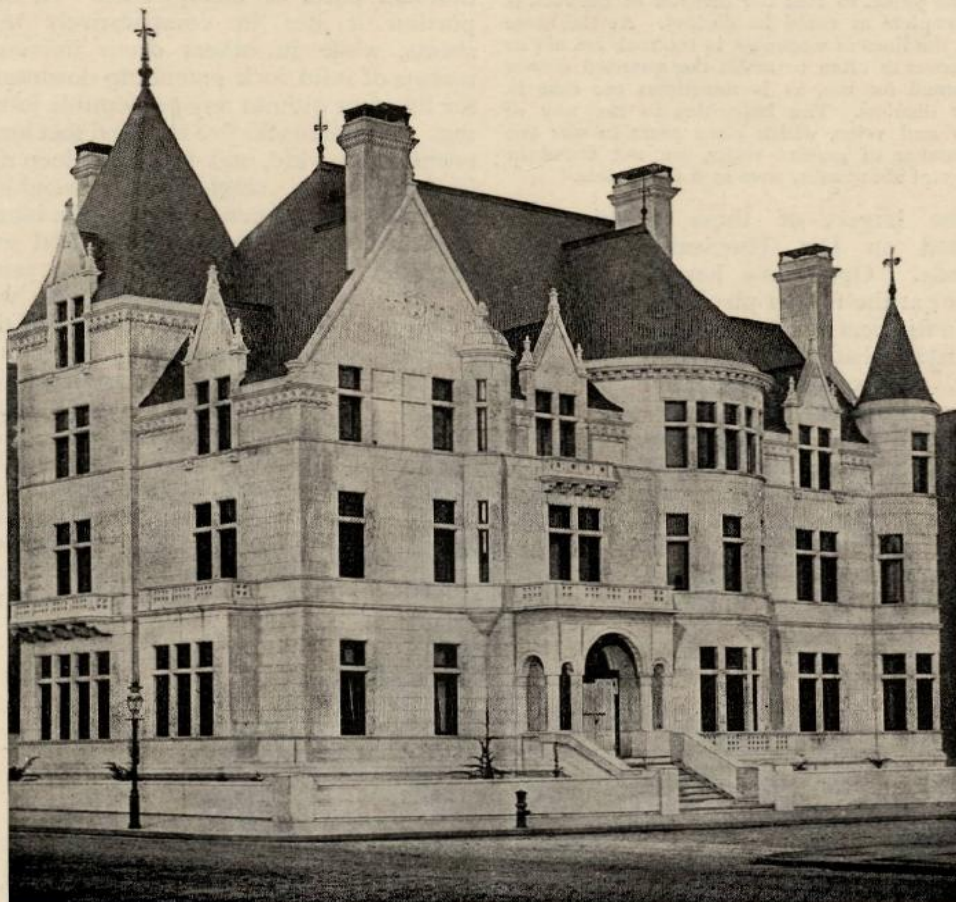
\$60,000 per mile. This was the first railroad, with a possible exception in South Carolina, built in this country. The new company obtained its first contract in 1827, and it was for the delivery of the granite for the Bunker Hill Monument. The company was paid fifty cents per ton weight for carrying the stone from the quarry to the wharf at Milton, and forty cents for taking it from there to Charlestown. To complete the latter part of the contract, the company bought the little steamer *Robin Hood* for

\$6,500, and two tow boats for \$1,000 each. This led the proprietors to branch out, and in the same year they purchased one of the granite ledges. This was extended until the railway enterprise became altogether subordinate to the quarrying interests of the company.

The granite business at Quincy is peculiar in some respects. There are probably more separate quarries there than in any other district of equal area in the country. Instead of three or four large companies excavating, finishing, and

shipping the stone, there is a vast number of small firms. These are centred at Quincy, Quincy Adams, West Quincy, Milford and the adjoining places. Some of these do nothing but take the stone from the quarry, some cut it, some polish it, while others make the boxes in which the finished product is packed for shipping.

There is a considerable range in tints, however,—in one quarry the stone being a pale green; in another, a purplish blue; and in a third, a delicate pink. This makes possible a variety of combinations. The texture of the stone, too, is firm and uniform, and the trials that have been given it are evidences of its durability.



Residence of Isaac V. Brokaw, New York. — Built of Hallowell Granite.

ROSE & STONE, ARCHITECTS.

These small plants are seen everywhere, and the whole district, as a result, appears like an immense workshop, where the ring of the hammer and the click of the chisel are always heard. There are fully three thousand men employed in the various operations, and the granite has a wide use in general building and monumental work. The Quincy granite on the whole is rather sombre in tone.

The quarries of the Penobscot Bay form one of the most interesting groups in this country. Nature has dealt out the granite with such lavish hand, that it is not necessary to delve deeply for it. The operations are, therefore, on a broader scale, and more open to the eye of the visitor. Prof. N. S. Shaler, of Harvard University, who made a special examination of the building stones of New

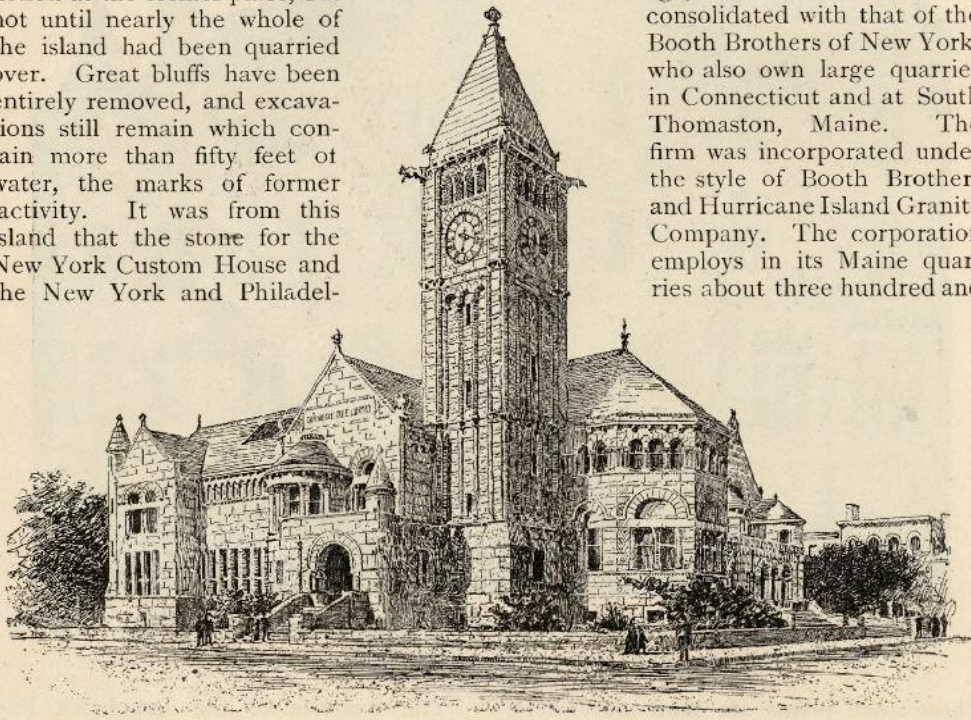
England for the census of 1880, says in his report:

"These granite quarries afford very excellent conditions for working. The stone opens easily, having the peculiar inchoate joints that are such striking features in the syenite or granite of New England. There are generally at least two of these rift-lines. Then there is a more or less complete division of what appears to be line beds, as well as joints, so that the division of the rock is as complete as could be desired. At the same time, the lines of weakness in the rock are not so numerous as often to make the quarried masses too small for use, as is sometimes the case in other districts. The impurities in the way of spots and veins, which often seem to mar the appearance of granite rocks, are not found in any great abundance, save at a few points."

The largest of these quarries are located on Dix, Hurricane, and Fox Islands. Operations have been abandoned at the former place, but not until nearly the whole of the island had been quarried over. Great bluffs have been entirely removed, and excavations still remain which contain more than fifty feet of water, the marks of former activity. It was from this island that the stone for the New York Custom House and the New York and Philadel-

ing of it, in the near presence of other stone, unprofitable.

Hurricane Island, as its name suggests, is scarcely more than a centre for the storms which sweep the Penobscot Bay. It is very rich, however, in a heavy, dark gray granite sometimes tinged with pink. The structure of the stone differs in different parts of the quarries. In one portion it lies in comparatively thin sheets, while in others occur immense masses of solid rock extending downward for fifty feet without any perceptible jointing. Natural blocks five hundred feet long, twenty feet wide, and twice as deep are frequent, while single blocks weighing eighty tons have been moved. The island is owned by Mr. David Tillson, and was operated by him until about two years ago, when the business was consolidated with that of the Booth Brothers of New York, who also own large quarries in Connecticut and at South Thomaston, Maine. The firm was incorporated under the style of Booth Brothers and Hurricane Island Granite Company. The corporation employs in its Maine quarries about three hundred and



Carnegie Free Library, Allegheny City, Pa. — Built of Fox Island Granite.

SMITHMEYER & FELTZ, ARCHITECTS.

phia Post-Office buildings was obtained. It is a dark gray stone, well suited to building purposes, but it has no certain cleavage. This caused a waste of both effort and material, and made the work-

twenty-five men, and the annual output approaches in value \$300,000. The most notable contract filled by Mr. Tillson is the St. Louis Post-Office which is built almost entirely of Hurricane Island stone.



John Peirce, President of the New York & Maine Granite Paving Block Company.

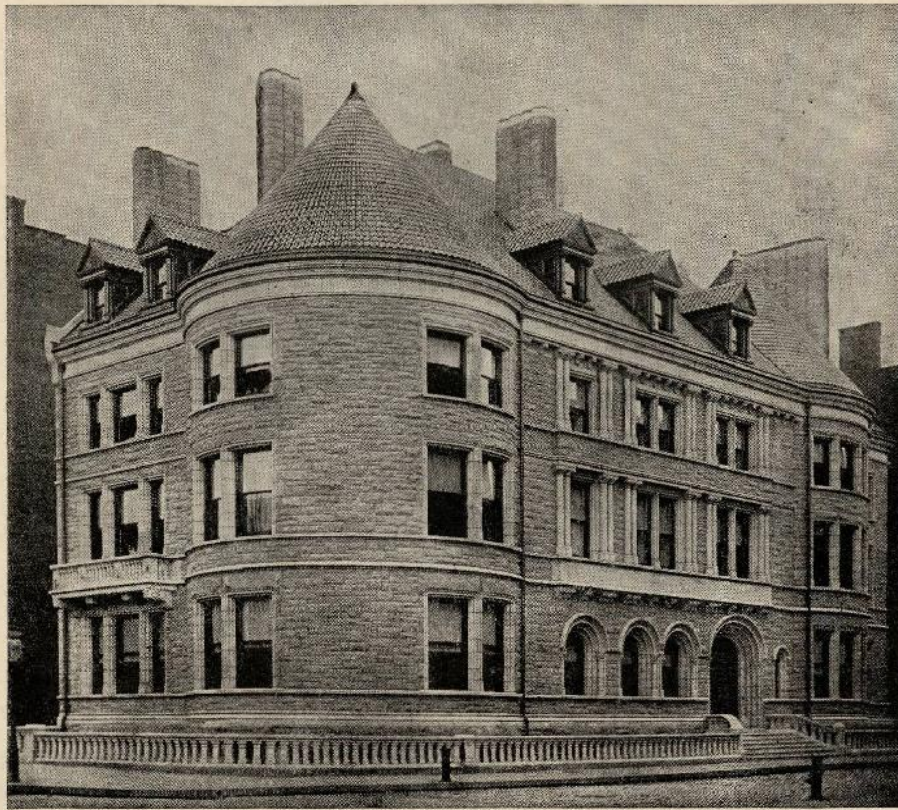
Fox Island is a near neighbor to Hurricane. The South Island is long and narrow, and much resembles a series of hills whose bases have become submerged by the ocean. Its geological structure suggests two epochs. The island seems to be divided by a line cutting it east and west. On the south side of this, granite is found almost to the exclusion of other stones, while north of it there is scarcely a trace of granitic rock. There are two good harbors at the southern end of the island, Vinal Haven and Carver's Harbor, and these are supplied with docks, derricks, and engines for loading and shipping the stone.

The plant at Vinal Haven is owned by the Bodwell Granite Company, whose

president is Mr. George M. Brainerd of Rockland. It is not known at just what time the quarrying of granite was begun at Vinal Haven, but local historians place it at about 1829. Then a New Hampshire man named Tuck quarried a cargo of stone for a Massachusetts prison, and shipped it to Boston in the schooner *Plymouth Rock*. Two years later, Captain Nelson Spear of Rockland obtained a small cargo at Dyer's Island. This, with occasional small jobs for local use, was probably the extent of the business until 1846. What is known as East Boston quarry was opened in 1849 by Joseph Kittredge and Enoch Carlton. The work was continued the next year by Joseph and his brother William, and

later these two were joined by Moses Webster of New Hampshire. The property in 1852 fell into the hands of Mr. Webster and the late Governor Bodwell of Maine, who formed the firm of Bodwell, Webster & Company. Vinal Haven was fortunate when these two men took an interest in its well-being. Both were shrewd and enterprising, and indefatigable in their labors. Both, too, were men of

from time to time until now it is \$500,000. The company, beside its work at Vinal Haven, also owns valuable quarries at Spruce Head and St. George, near Rockland, and at Jonesborough in the eastern portion of the state. The product of the latter quarry is a beautiful feldspathic rock of fine texture and rich red tint, and is held in high regard for monumental and ornamental purposes. The Spruce

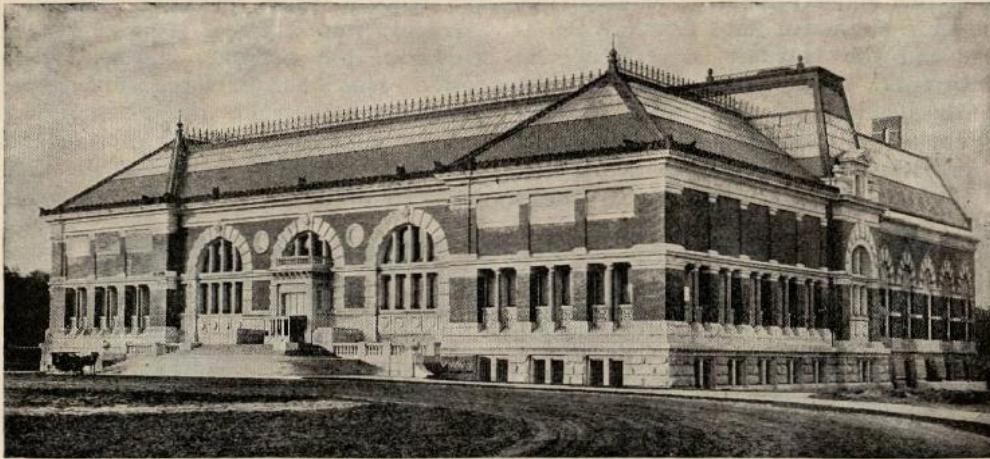


Residence of H. O. Havemayer, New York. — Built of Jonesborough Granite.

C. C. HAIGHT, ARCHITECT.

strict integrity and high moral purpose. Mr. Bodwell took the more active part in the development of the resources of his state, and hence has left the deeper impress on its commercial and political history. Under their hands, operations at Vinal Haven developed so largely that it was deemed best to form a corporation. The result was the organization of the Bodwell Granite Company, starting first with a capital of \$200,000, and increasing

Head stone is a mottled white and black syenite with constituents firmly united. There is an unusually striking contrast between the hornblende and feldspar, which gives a peculiarly lively tint to the stone, making it one of the handsomest of the gray granites. The annual output of the company is valued at about \$800,000. The number of men employed varies, of course, from time to time, but there have averaged at Vinal Haven

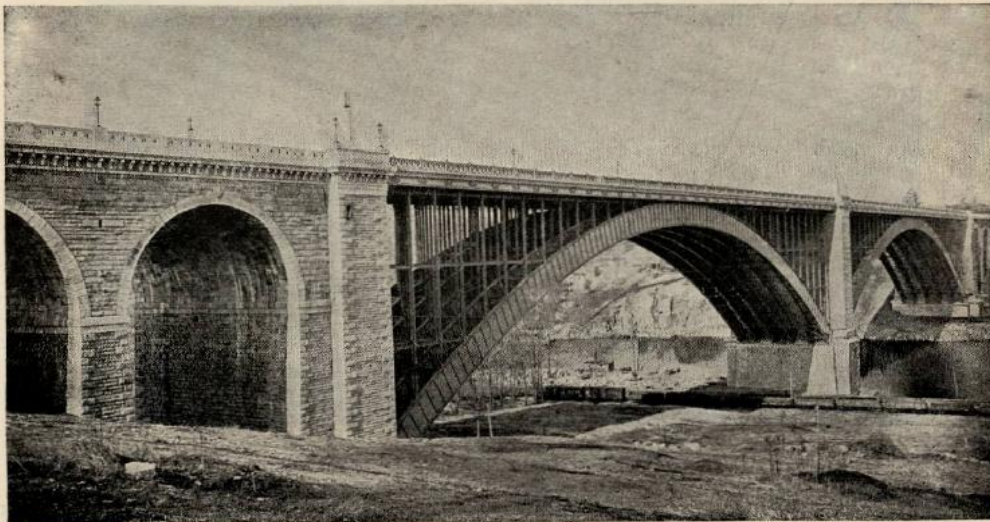


Metropolitan Art Museum, New York. — Built of Hallowell Granite.

WESTON & TUCKERMAN, ARCHITECTS.

during the past season between 800 and 900 men. The introduction of machinery has done considerable to reduce the numbers necessary to the work. Before these innovations, the Bodwell Company used to

The product of the Bodwell Company quarries has been widely distributed. Among the buildings constructed wholly or in part by it are the State, War, and Navy Departments at Washington, the



Washington Bridge over the Harlem River. — Built of Mount Waldo Granite.

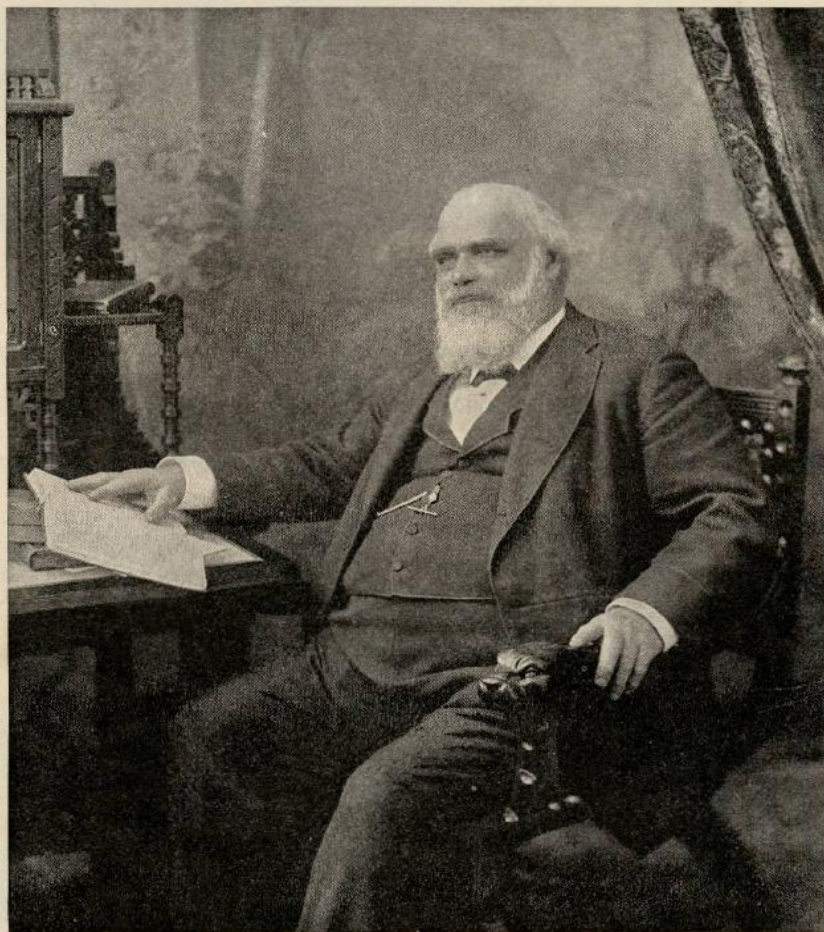
W. R. HUTTON, ENGINEER.

employ between 1,200 and 1,500 men, and its monthly pay-roll often reached \$60,000. The company owns a fleet of schooners, which it uses in the shipping of its granite and the carrying of supplies.

great Auditorium, the Pullman offices and the Home Insurance Company Building in Chicago, the Custom House and Post-Office at Cincinnati, the polished granite in the State House at Indiana-

polis, the Federal Building at Brooklyn, the new Methodist Book Concern Building, and the Havemeyer residence in New York. Both the artistic and the sturdy qualities of the granite are apparent in the Brooklyn Federal Building. There is no exaggeration in saying that this is one of the handsomest structures

the frequent arches, gives easy division to the wings into which it is broken. The crown of the building, however, is its tower. This is all hammered work, shaped about the base much like a basket, with graceful curves and delicate carvings that give it a beautiful tracery effect. The plans for the building were drawn by Mr.



James G. Batterson, President New England Granite Works.

of the kind in this country, and its success is, in a large measure, due to the readiness with which the granite has lent itself to architectural treatment. Rock-face finish is used very largely in the lower stories of the building, while above, the stone is nearly all hammered, giving it the appearance of unpolished marble. There is considerable pointed work, too, about the windows and doors, and this, with

M. E. Bell, and the stone was from the Fox Island quarry. The residence of Mr. H. O. Havemeyer, the wealthy New York sugar refiner, on the corner of Fifth Avenue and Sixty-sixth Street, is proof that granite makes one of the most satisfactory stones for such purposes. The stone used in that is of the pink Jonesborough variety. One is impressed at once by the sturdy strength of this resi-

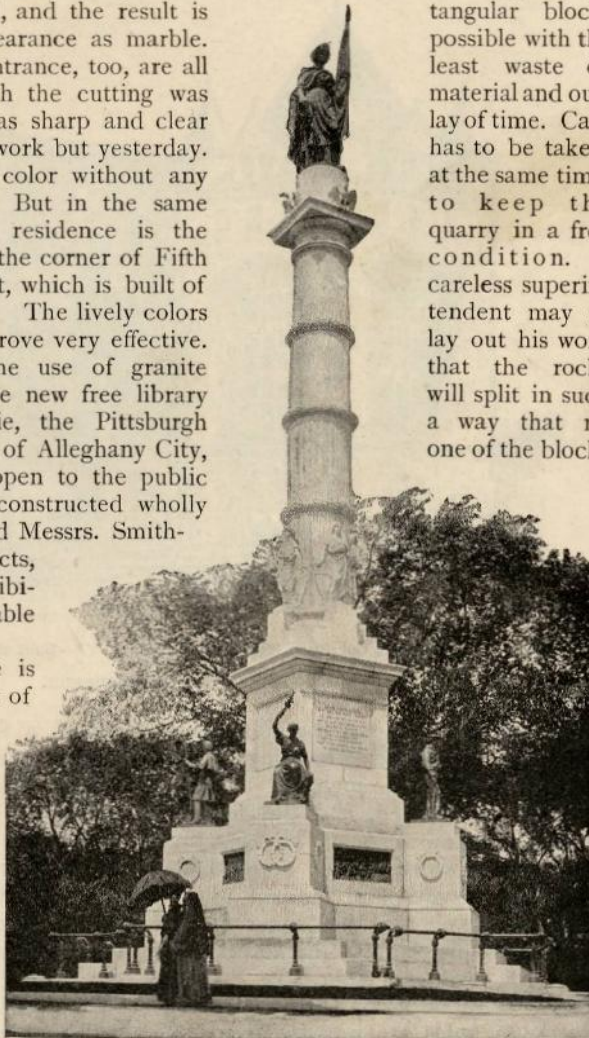
dence, but the lively color and warmth of the stone remove any suggestion of the public building order, the type with which granite has largely been associated. The stone is used rock-face, dressed only about the windows and entrance, with handsome carvings and ornamentations at those points. Mr. C. C. Haight was the architect, and his handling of the stone has been markedly successful. This residence presents an interesting contrast to that of Mr. Isaac V. Brokaw, farther up on Fifth Avenue which is also built of granite, but of the fine Hallowell variety. The stone in this is all hammered, and the result is that it has the same soft appearance as marble. The cornices, windows, and entrance, too, are all elaborately carved, and though the cutting was done years ago, the lines are as sharp and clear as if the chisel had done its work but yesterday. The stone, also, retains its color without any traces of age or dinginess. But in the same line with Mr. Havemeyer's residence is the Methodist Book Concern on the corner of Fifth Avenue and Twentieth Street, which is built of the pink Jonesborough stone. The lively colors of the granite in that case prove very effective. A very handsome job in the use of granite for ornamental building is the new free library which Mr. Andrew Carnegie, the Pittsburgh millionaire, gave the citizens of Alleghany City, Pa., and which was thrown open to the public some months ago. This is constructed wholly from the Fox Island stone, and Messrs. Smithmeyer & Peltz, the architects, have shown the artistic possibilities of it in an admirable manner.

Rather interesting to note is the fact that the largest shaft of granite quarried in modern times was obtained at Vinal Haven. The stone was designed for the monument to General Wool at Troy, N. Y., and in dimensions compares favorably with the monoliths of the ancient Egyptians. The shaft was 60 feet long by 5 by 5½ feet, and in the rough weighed 185 tons. Four long blocks had to be quarried before a satisfactory one

was obtained. As completed, the monument contained 7 stones, the bottom of the base measuring 17.6 feet by 17.6 feet by 2 feet, and weighed on shipboard 650 tons. In order to set the shaft on board of the vessel, it was necessary to cut a hole in the bow and lay the column on a bed of cross timbers in line with the keel.

The works at Vinal Haven are very complete. Unlike Quincy, all the operations, from the exploiting of the stone to the carving of it, are carried on by a single company. In quarrying, the primary object, of course, is the removal of

the largest rectangular blocks possible with the least waste of material and outlay of time. Care has to be taken, at the same time, to keep the quarry in a free condition. A careless superintendent may so lay out his work that the rocks will split in such a way that no one of the blocks

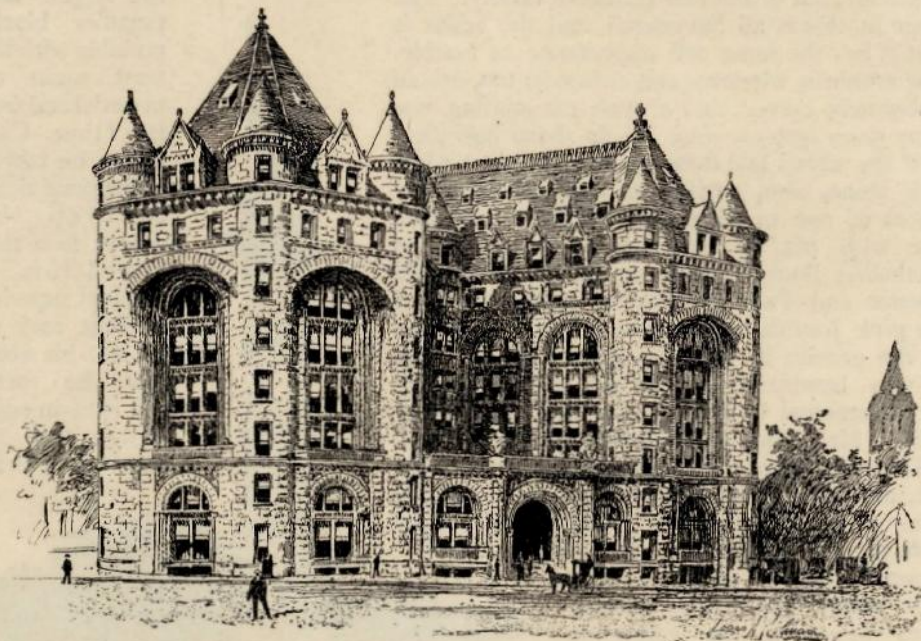


Soldiers' and Sailors' Monument, Boston. — Built of Hallowell Granite.

can be removed, each securely wedging in another. The quarry is then said to be "bound up." New England granite shows very little decay on top so that scarcely any preliminary work is necessary in removing useless stone. This is especially true in the case of the island quarries like those at Vinal Haven. Blasting is usually the first operation in getting out the stone. The chief care in that is to so direct the force of the powder that it will split the rock in the direction desired without shattering the piece removed or the

feet long have been made by a single lewis hole, and at Mount Waldo in this way a block 125 feet long, 20 feet wide, and 14 feet deep, containing some 30,000 cubic feet of solid granite, was loosened. Lewising can be done successfully, however, only when the rocks are detached at the ends and bottom, and have a free chance to move out in front.

In some parts of the quarries at Vinal Haven the sheets are thin and marked by numerous vertical joints. A little different method of splitting the rock is adopted in that case. Small holes are



New Erie County Savings Bank, Buffalo, N. Y. — Built of Stony Creek Granite.

GEO. B. POST, ARCHITECT.

standing ledge. One of the methods resorted to is termed "lewising." Two holes, each about one inch and a half in diameter, are drilled, and the core between them then cut out. The diamond-shaped hole which results from this is filled with powder and tamped in with sand. On explosion the longer axis of the diamond determines the direction in which the rock will split. In case the fracture is to be a long one a series of these lewis holes are prepared and then fired simultaneously by means of an electric battery. Free fractures 125 and 130

drilled a few inches apart along a prescribed line. Two slips of iron or half-rounds are then inserted in each hole and small steel wedges placed between them. Every few feet a deeper hole of larger dimensions is drilled to guide the fracture. This done, a man then passes down the line of wedges and hits each a sharp blow with a sledge, the result being that the entire mass cleaves from the bed-rock. Still another method is first to drill a rounded hole of the required depth and afterwards drive a reamer into the opening, producing in that way at op-

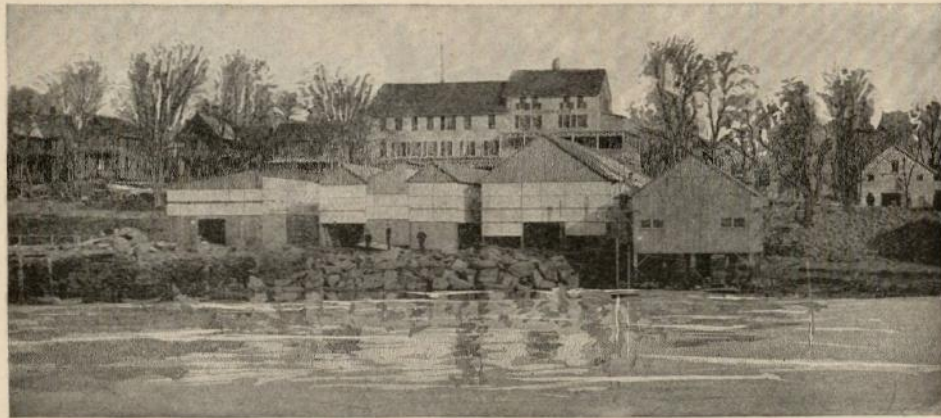


Stony Creek Granite Quarry.

posite sides V-shaped apertures. The charge is then inserted and the tamping done in the usual manner, except that instead of driving the tamping down upon the top of the charge, an open space is reserved between them. The explosive thus has the greatest possible chance for expansion before actually breaking the rock. As a result the force of the explosion follows the grooves, and if the rock be solid no shattering of it occurs. When the cleavage is especially straight, the well-known Ingersoll steam-drill is used. This will carry holes to the depth of twelve or fifteen feet, and when a number of them have been drilled a few feet apart and charged with powder, they can be exploded with tremendous results.

The operations of quarrying are seen also in a telling form at Mount Waldo. Mount Waldo forms a part of the town of Frankfort, Maine. It stands about one thousand feet above the sea, and contains nearly the same number of acres of solid granitic rock. The view from the top of the mountain is most pleasing. The whole panorama of the Penobscot

Valley, with its rolling fields and thrifty upland, is spread out for miles before the eye. The waters of the South Branch flash at its base as they sweep toward the greater Penobscot; on either side rise the rival peaks of Mosquito and Hegan, while far beyond are the blue hills of Holden. The rock itself is a massive biotite of rather coarse texture. Contained within it, however, is a rock of finer grain, so that the local impression is that a belt of fine granite runs through the mountain. The granite occurs in immense sheets, which dip off from the mountain and vary in thickness from 1 to 20 feet. Probably the average is about 5 feet. The rift or direction of easiest cleavage is parallel to the sheets, and this makes possible the moving of great blocks. Blocks 80 feet long, 40 feet wide, and 20 feet deep have been moved, and it is believed that others, 150 feet by 50 by 12 feet, could be taken from the quarry. This fact, combined with the altitude of the quarry, makes the removal of the blocks a particularly interesting operation. Three

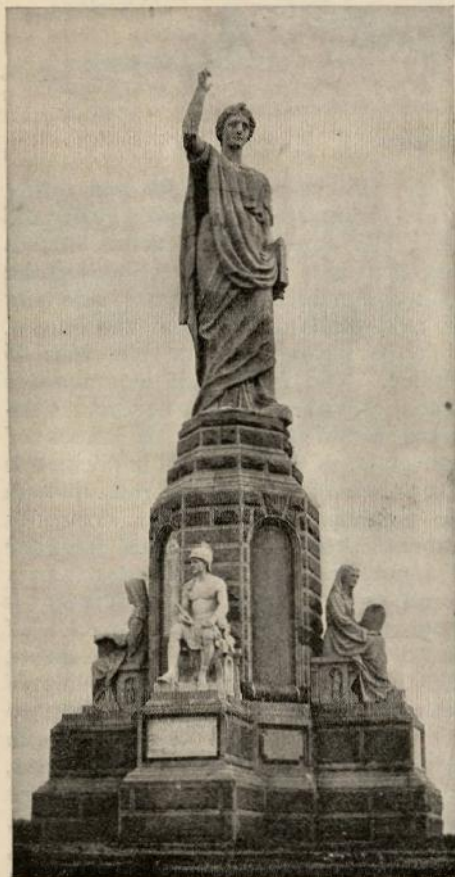


Shipping Place, Stony Creek, Conn.

forms of power are brought into service—oxen, steam, and the force of gravity. The oxen are used to drag the great blocks from where the blast leaves them

into a free space where they can be more readily handled. The company operating the quarry has as large sleek oxen as one will find in many days' travel, and the way in which the refractory rocks are dragged from the beds where some ancient glacier left them is marvellous. The sheds where the stone is cut and dressed are at the lower part of the quarry, sharp down the mountain-side. The stone is taken thither by what is termed a Blondin cable railway. This has its termini in two towers, one fixed at the top of the quarry and the other at the bottom. The cable is about eight hundred feet in length, of steel and copper wires closely woven, and the inclination of the line is between twelve and fifteen degrees. The cable is operated from the engine-house which stands just beyond and above the higher of the two towers. The car, which consists of a pair of long steel arms regulated by an under line parallel to the cable, is strongly clamped to a block of granite which the oxen have previously dragged from its first resting-place. The power is then turned on and the coil of steel around the great cylinder in the engine-house begins slowly to unwind, the block of granite beginning at the same time to descend its balustrade path. When the block has reached the lower tower the engine is stopped, the car lowered, and the block released. The machinery is then reversed and the car returns for another load.

At the sheds the blocks are cut and



National Monument to the Forefathers, Plymouth.

shaped as desired, and then boxed for shipping. This is done by vessels, but the company's wharf is a half mile away on the South Branch. This space is covered, however, by means of a narrow-gauge gravity railway. The blocks are placed on the cars at the sheds, and these, by the incline of the mountain and the weight of the load, are made to shoot downward to the river. The speed is regulated by stout brakes, and very seldom does an accident of any kind happen. The packing of the stone is no minor matter. The Mount Waldo quarry is operated by the Mount Waldo Granite Works, whose president is Mr. John T. Rowe of Frankfort, who, though seventy years old is yet as sprightly in climbing over the rocks as the youngest man in his employ. The quarry was opened in 1853 by Mr. Rowe and the late George A. Peirce. On the death of Mr. Peirce in 1873, his sons, John and George Peirce, became identified with the business, and this was continued until 1880, when the present corporation was formed. The stone, however, is especially suited to heavy masonry, bridges, and similar structures. For such purposes it has been sent as far south as Mobile and New Orleans. Mount Waldo stone entered largely into the construction of the Brooklyn Bridge.

Mount Waldo stone, also, is used on the St. Louis bridge across the Mississippi River, and others less known. The stone has been used in the basement of the State war and navy building at Washington, the municipal building at Philadelphia, the art museum at Central Park, New York, and the new court house at Boston. The pedestal of the Admiral Farragut monument at Washington is of this same stone. Work is being done now for the congressional library building at the national capital. Large contracts also have been filled for sidewalks, flagging, and street materials for Boston, New York, and other cities.

The quarries about Hallowell form another interesting group. These are operated by the Hallowell Granite Works which has an invested capital of three hundred thousand dollars. The late Governor Bodwell was very active in this

enterprise also. His son, Mr. J. F. Bodwell, is the president of the corporation; Gen. G. W. Tilden, the treasurer, and Mr. J. P. Hunt, superintendent of the quarries. The office and main cutting sheds of the company are in the city of Hallowell, adjacent to the station of the Maine Central Railway, and also near the wharves on the Kennebec River. The quarries are about two miles beyond the city. It is necessary, of course, to haul the granite thither, but the difficulty has been reduced to a minimum. The road, which is a steady descent from the granite beds to the river's edge, has all been underlaid with broken stone. The granite is a light, fine-grained one, consisting chiefly of white orthoclase feldspar with small crystals of quartz, specks of black hornblende, and scales of silvery mica. Dressed surfaces are almost as white as white marble, while polished ones possess a peculiar glitter, the spangles of mica sparkling like diamonds. The stone, owing to the preponderance of the feldspar, works easily both in the quarry and under the chisel. For these reasons it is used very extensively for carvings, columns, and monuments. The granite in the quarry is arranged in sheets which dip slightly to the north. These increase in thickness as one goes downward, being about a foot on the surface and ten feet at a distance of fifty feet below. Two large excavations have been made in the sides of the hill, each possibly sixty to seventy-five feet in depth. The blocks of granite are raised from these by means of steam and stout derricks. Some of the stone is cut in sheds near the quarry, but the most of it is hauled to the city.

The finishing and cutting sheds are scenes of unusual activity. Granite as it leaves the quarry is seldom available for use. The dressing of it varies all the way from the simple splitting of a block or rude spalling of an ashlar face to the delicate carving of a statue. Great skill is required by the stone-cutter in the manipulation of his tools to produce good results, owing to the obduracy of the stone and the fact that the minerals composing it vary widely in hardness. The

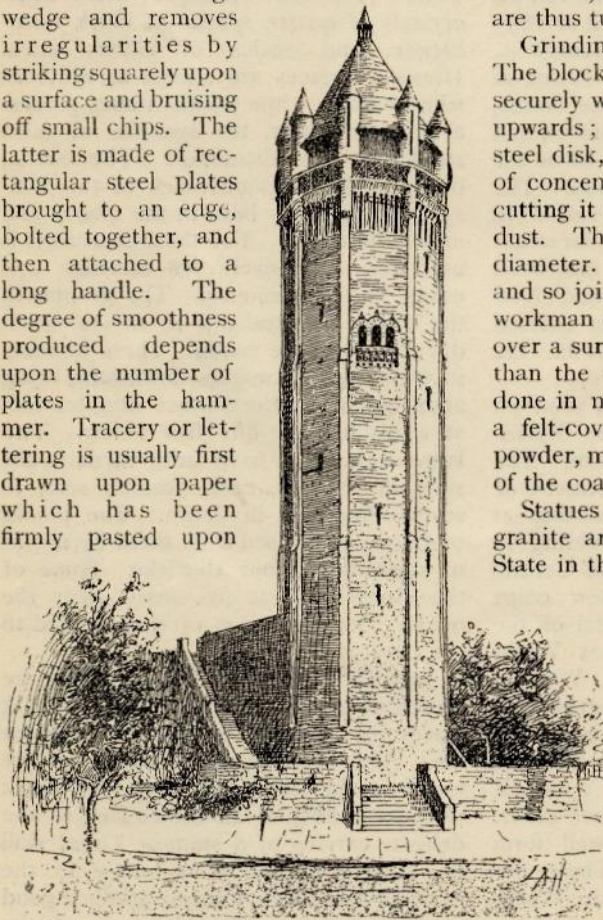
chief work in shaping it is still performed by hand. In blocks for building purposes, the size, shape, and finish of them depends on the places they are to occupy. Fronts or walls are laid up in various kinds of ranges, which are usually designated as coursed range, broken range, broken ashlar, and random range. The various finishes given the face are known as brush-hammered, pean-hammered, pointed work, or rock face. The blocks are brought to a plane surface on one side by knocking off the rough points by means of a spalling hammer. This is simply a heavy, three-cornered sledge. The surface is then worked down to a smooth plane by means of the pean and brush hammers. The former is shaped like a double-edge wedge and removes irregularities by striking squarely upon a surface and bruising off small chips. The latter is made of rectangular steel plates brought to an edge, bolted together, and then attached to a long handle. The degree of smoothness produced depends upon the number of plates in the hammer. Tracery or lettering is usually first drawn upon paper which has been firmly pasted upon

the block and the design then chiseled through to the requisite depth. Statues and highly ornamental designs are all worked out by chisel from detailed drawings or plaster casts.

Mechanical inventions, however, have done much to expedite the simpler operations, such as turning and polishing. The turning lathe is similar to that used in marble quarries. The granite in this is ground away by the wedge-like action of a number of thick steel disks. These disks are set at an angle to the stone, and move with an automatic carriage along the lathe bed. Some of the large lathes will reduce a granite column two inches in diameter the whole length of it by a single lateral movement of the carriage. Columns, round posts, balusters, and urns are thus turned out.

Grinding is another common process. The block of granite in that case is fixed securely with the face to be smoothened upwards; a horizontal revolving iron or steel disk, perforated with holes or made of concentric rings, then passes over it, cutting it down with sand or chilled-iron dust. These disks are about a foot in diameter. They are operated by a lever and so joined to the main shaft that the workman operating them can move them over a surface of stone many times larger than the disks themselves. Polishing is done in much the same way, except that a felt-covered disk is used and putty-powder, mixed with water, takes the place of the coarser grinding material.

Statues and monuments of Hallowell granite are to be found in nearly every State in the Union. The possibilities of granite for outdoor statuary cannot be better shown than in the national monument to the Pilgrim Fathers at Plymouth, Massachusetts,—this monument, consisting of a massive base 45 feet in height, surmounted by a statue 36 feet in height. The shape of the principal pedestal is octagonal, with four small and four large faces. From the former of these faces, also, project four buttresses or wing pedestals.



Prospect Heights Water Tower, Brooklyn, N. Y. — Built of Stony Creek Granite.

THAYER & WALLACE, ARCHITECTS.

On the central or main pedestal stands a majestic figure of Faith. One foot is firmly planted on Plymouth Rock. In the left hand is a Bible, while the right points towards heaven. The face, which is marked by an expression of sublime trust, is turned downward as if with the intent of raising those below from the material things which surround them to the contemplation of the great power which upheld the heart and nerved the arm of the forefathers during the perilous and discouraging days of their work in founding new homes and a new commonwealth. The figure is one of the largest and finest examples of granite statuary in the world. The total length of the outstretched arm is 19 feet, 10½ inches, while the measurement from the shoulder to the elbow is 10 feet, 1½ inches. The head at the forehead measures 13 feet, 7 inches, while the arm just below the short sleeve measures 6 feet, 10 inches, in circumference. The other measurements are in like proportion, the figure being about 216 times life size. On each of the four smaller pedestals are seated figures emblematic of the principles upon which the Pilgrims sought to found their commonwealth. The figures are Morality, holding the decalogue in one hand and the scroll of Revelation in the other; Law, with Justice and Mercy in attendance; Education, with ripe Wisdom on one side and Youth led by Experience on the other; and Freedom with Peace resting under its protection and Tyranny hurled down by its power. Upon the faces of the projecting pedestals are alto-reliefs representing scenes from the history of the Pilgrims, the departure from Delft-Haven, the signing of the Compact, the landing at Plymouth, and the first treaty with the Indians. The base of the monument was furnished by the Bodwell Granite Company, but all of the figures, with a single exception, were made by the Hallowell Granite Works. The work was all done at Hallowell and the larger figures were shipped to Plymouth in pieces and there set up.

Another notable piece of Hallowell work is the Yorktown monument. This stands about 100 feet in height and cost

roundly \$80,000. It includes thirteen large figures representing the thirteen original colonies. These are grouped about the column in a graceful manner and each is beautifully carved, the faces in artistic finish and strength equalling work in marble. The monument for the late John Wentworth of Chicago, cut also at Hallowell, is remarkable in some ways. It had a height of 66¼ feet. The first base of it was 18 feet square and 2 feet thick and weighed 55 tons; while the shaft was 4½ feet square and 50 feet long, weighing 65 tons. Some difficulty was experienced in shipping this to Chicago. The shaft was loaded on two flat cars and sent through direct by rail. The base was placed in a vessel and sent by the lakes and canals to the West. In taking it through one of the canals, the edge of the shaft was chipped so that the latter had to be cut down after all. Superintendent Hunt regards the Anderson Monument at Brooklyn as the most artistic piece of carving ever done at Hallowell and as a good illustration of the delicate purposes to which the stone can be put. The shaft is a single stone with a Grecian wreath about its top. Upon the drum are the figures of the apostles, with the finest tracery work above and below. The base is 12 feet square and 2 feet thick and weighs about 25 tons.

Other monuments are the Soldiers' and Sailors' monument at Boston, the Soldiers' monuments at Marblehead, Mass., Portsmouth, O., and Augusta, Boothbay and Gardiner, Me., to General Stedman at Hartford, Conn., Stephen A. Douglass at Chicago, the Washington Artillery Monument, and the Hernandez Tomb at New Orleans. The New York State Monument at Gettysburg and all the Maine State monuments, with a single exception are from the same shops. The Hallowell company also has the contract for the Trenton, N. J., monument. This is to be 100 feet in height with a base 30 feet square. It is at work, too, on a vault for Mr. H. H. Rogers of Fairhaven, Mass., which is to consist of three great stones 15 feet by 8.4 feet by 4 feet in dimensions.

Hallowell stone is also used largely for

general building. The largest single contract filled by the company in that line is the state capitol at Albany, N. Y. Other buildings are the Equitable, Mutual Life, Manhattan, and Union Trust Buildings and the Brokaw residence in New York. All these buildings are in styles which require elaborate finish and carving. The Union Trust Building is especially valuable in its ornamentation of the stones composing the window casings and the entrances. The building stands $9\frac{1}{2}$ storeys high, with broad, arching windows which give it a Gothic appearance. This impression is deepened by the massive character of the ornamental work and the heavy balustrades which mark the front of the building. The granite is rock face and the fine carving put into the finish about the entrance would be notable were the stone even some rare marble. Mr. Barr Feree of Philadelphia, in a late article on "Tendencies in Recent Architecture," says:

"One of the most successful handlings of the window problem is in the new building of the Union Trust Company. The three great recesses which form the feature of its façade are admirably managed and exceedingly effective, though perhaps some exceptions might be taken to the manner in which the windows fill them."

The contract for this amounted to \$150,000, while the granite put into the Brokaw residence aggregated in value \$75,000. This residence has already been described in connection with the Havemeyer house. The Metropolitan Museum of Art in Central Park, also, is being extended, the stone used coming from these quarries. Used in connection with brick, the stone, with its fine grain and soft finish, produces a beautiful effect. Work upon this is now in progress, under the direction of Mr. John Peirce.

The principal New Hampshire quarries are found in the vicinity of Concord. Many of them are situated on what is known as Rattlesnake Hill. There is an elevation of about six hundred feet above the Merrimack River which is almost wholly granite in formation. There is a peculiarity about the arrangement of the stone; that on the south side of the hill being very light in color, and that on the north side, dark. Glacial action is very

marked, the surface of the rock showing it in an unusual polish. Oak Hill is another elevation of similar character, but the granite from it is coarser and more broken. Extensive quarries are in operation, also, at Fitzwilliam, in Cheshire County. These are especially fortunate in their location. They form the broad north slope of a hill, thus draining themselves, and possess a very large surface exposure. The market for these granites is largely a New England one.

Vermont granites are usually of the gray biotite variety. The expense of transportation rather limits the market for the product, and prevents an extensive development of the resources of the state in that mineral.

In Massachusetts there are, besides those already named, valuable quarries at Cape Ann, in the vicinity of Fitchburg and about Fall River. The Cape Ann quarries form a continuous line from Rockport to Bay View and they are worked by at least a dozen different companies. The stone is a heavy, coarse gray one, and is used largely for foundation pieces and street work. Some of them produce a stone, however, well suited to general building—and many Boston business blocks are constructed from it. The stone is shipped in sloops and schooners to Boston, New York, and Philadelphia. Some of the craft are rather crazy old affairs, and this fact coupled with the absence of good harbors, makes the carrying of the stone a more or less hazardous enterprise.

The best known quarries in Rhode Island are in the vicinity of Westerly. The stone obtained there is remarkably fine grained and homogeneous in texture. The tints take a wide range, running from a pinkish white through the shades of brown, red, and pale blue. As a result, the stone has been extensively used in monuments and cemetery work.

The principal points at which large beds of granite are to be found in Connecticut are near Thomaston and Roxbury in Richfield county, on Long Island Sound in Fairfield County, near Lyme, Niantic and Groton in New London County, and near Ansonia, Branford and

Stony Creek in New Haven County. Connecticut granites are usually fine grained and possess a characteristic appearance by which experts can always distinguish them from other granites of the Atlantic Coast states. As handsome and durable as any stone is that obtained at Stony Creek. The stone itself is very strong and compact. It contains considerable flesh-colored orthoclase which gives it a very pleasing tint and makes it very like Scotch granite. Indeed, the pillars and trimmings of many buildings which are praised as from Scotland, are really from the quarries at Stony Creek, and while those familiar with building stones recognize the difference between the two granites, yet with the majority of people, they would and do pass as one and the same thing. The Scotch stone is somewhat finer in grain and possibly a little pinker in color, but it works no better or takes no better polish. The stone is worked by the Stony Creek Red Granite Company. This company was organized in 1889, though the quarry had been operated after a fashion for a dozen years or more. The property consists of the quarry or ledge about one and a half miles north of the Shore Line Railway, and the cutting sheds and shipping wharf on the sound, two miles distant, just facing the famous Thimble Islands. The outlook for the development and extension of these quarries is the most promising of any in New England. The stone, in brilliancy and texture, is almost without a rival. The purpose is to connect the ledge and the wharves by a railroad. At present a mile and a quarter of full-gauge track has been laid to the Guilford turnpike. Hence the stone is carted a quarter of a mile to the Shore Line tracks, or a mile further to the company's cutting sheds and wharf. But with the completion of this road, the company will have easy access to both rail and water shipping, an advantage of great importance. The stone, furthermore, is a natural ledge, that is, it is arranged in sheets. This is rather remarkable for red granite, as that stone usually appears in the form of boulders. But as a result of this, the Stony Creek granite has a better color, is less marked by blotches,

and thereby is subject to less waste. This is a significant point, which builders and architects can appreciate. Red granite, naturally, is more expensive than the more common gray, but its cost has been largely increased through the great waste made on account of these blotches and irregular markings. Though comparatively new, the Stony Creek Red Granite Company has filled some notable contracts. One of the handsomest buildings erected by it, showing in a fine way both the possibility of granite as an artistic building stone and the especial adaptation of the red granite to the purposes of extended ornamentation, is the new Erie County Savings Bank building at Buffalo, N. Y. The building is simple in outline and design, but stands compact, every detail of it falling upon the eye at once. The windows are of the high, cathedral style, and all the casements and cornices are strikingly and delicately carved. The entrance and doorways are ornamented in the same style with vines and figures wrought in the stone. The building cost some \$500,000 and fully 60,000 cubic feet of stone were cut and sent from Stony Creek for it. The designs for it were drawn by Mr. George B. Post of New York, and the building stands without a rival for beauty in this country.

An interesting adjunct to the granite industry is the making of paving blocks. Experience has shown that streets subjected to heavy traffic wear best when paved with stone. All stones, however, are not suited to this use, some being too soft and thus wearing away quickly, and others too hard and so becoming smooth and slippery under usage. The qualities desired in a good paving stone are hardness and brittleness, and certain of the granites have been found to answer this requirement perfectly. Nearly all the quarries turn out more or less of these blocks, the broken and waste stone being worked up in that way. Some whole quarries, however, notably in Maine, are devoted to this one thing. The enterprise as a result has been a very growing one, the paving blocks manufactured in the United States in 1889 aggregating nearly 62,000,000. The chief

skill required in the making of the blocks is an ability to see quickly and to take advantage of the direction of cleavage. The tools used are principally hammers of various kinds for opening and breaking the stone. There are no uniform standards of size, the blocks varying from $3\frac{1}{4}$ to $4\frac{1}{2}$ inches in width, 6 to 7 inches in depth and 8 to 12 inches in length. In general the eastern cities prefer the larger sized blocks, while the western and southern cities like the smaller. New Orleans is an exception to this last, however, using, on account of the peculiar nature of its streets, the largest size. The cutters are usually paid by the piece for making the blocks, receiving from twenty to thirty dollars a thousand for them. The variation is due largely to whether the workmen furnish their own tools and quarry their own granite or receive the rough stone from their employers. The finished blocks sell in the large centres for from forty to seventy and sometimes ninety dollars a thousand. Assuming that sixty dollars is a fair average price the value of the output for granite paving blocks in 1889 would reach \$3,720,000. These blocks are very largely handled by the New York and Maine Granite Paving Block Company, whose offices are at Temple Court, New York city. The company was organized in 1882, with Mr. John Peirce as President. It started with an annual output of about 2,000,000 blocks, but this has now more than quadrupled; while some \$500,000 a year is paid out by the company, the most of which goes to the people of Maine. This company has furnished blocks, not only for the streets of New York and Brooklyn, but for those of St. Louis, Cincinnati, Washington, Baltimore, Philadelphia, and Albany. This shows the wide extent of the industry, granite blocks being available wherever reasonable shipping rates can be obtained. The New York and Maine Granite Paving Block Company also furnished the blocks for the repairing of Fifth Avenue, from Eighth to Ninetieth Streets, New York City, a distance of five miles, and it now has the contract for the same work on Broadway from Bowling Green to Fifty-ninth Street, some four miles.

New England leads the country in the granite industry. The total value of the output in the United States for 1889, as given in the returns for the eleventh census, was \$14,464,095, and of this amount the New England states produce \$8,031,161 worth or 55.52 per cent. In 1880 these same states, however, produced 75.11 per cent of the total. This apparent decline is explained by remarkable activity in certain of the western and southern states. Georgia jumps in the list from twelfth to sixth place, on account of extensive operations at Stone Mountain, near Atlanta, which were begun only a few years ago. The output in California has been greatly increased through the work at the Folsom Granite Quarries. This stone is used largely for constructing a dam for the Folsom Water Power Company and for the buildings of the power house of the State Prison, which is located near the spot. Remarkable activity is evident, also, in Colorado, South Dakota, and Minnesota. But despite this loss in relative percentage, New England has made tremendous strides during the decade. The value of the output for 1879 was \$3,897,567, showing the increase to have exceeded \$4,000,000. Massachusetts stands first with a product valued at \$2,503,503 and Maine a close rival with \$2,225,839. Connecticut's output had a value of \$1,061,202; Rhode Island, \$931,216; New Hampshire, \$727,531; Vermont, \$581,870. In these six states there are 488 firms operating 525 quarries and giving employment to 12,139 persons. The product aggregates 26,899,248 cubic feet of stone.

In detail this is shown by the following table:

State.	No. of Firms.	No. of Quarries.	Cub. ft. of Granite.	No. of Employes.
Maine	133	153	6,701,346	3,737
New Hampshire	77	78	2,822,026	1,253
Vermont	46	53	1,073,936	961
Mass.	148	151	9,587,996	3,333
Rhode Island	35	37	2,878,237	1,195
Connecticut	49	53	3,835,707	1,630

The business aspect of the industry is most concisely shown by this table :

Company, he has controlled a large part of the granite output of New England.

States.	Value of Product.	Total Wages.	Total Expenses.	Total Capital.	Percentage of profit or loss	
					On Capital.	On Value of Products.
Maine	\$2,225,839	\$1,517,025	\$1,823,976	\$3,192,317	12.59	18.05
New Hampshire	727,531	529,945	597,491	761,362	17.08	17.87
Vermont	581,870	408,916	477,114	967,750	10.82	18.
Massachusetts	2,503,503	1,630,118	1,973,723	2,235,759	23.70	21.16
Rhode Island	931,216	618,013	789,219	646,392	21.97	15.25
Connecticut	1,061,202	697,080	813,200	891,889	27.81	23.37

That New England holds the lead in this industry is due very largely to the energy and zealous efforts of three men. Those are the late Governor Bodwell of Maine, Hon. J. G. Batterson of Hartford, Conn., and Mr. John Peirce of New York. Governor Bodwell was among the first to recognize the value of the ledges which marked so large a part of his state. Recognizing their value, he possessed the business sagacity and the executive ability necessary to their development. Therein lies the important part which he performed in the establishment of the industry. Mr. Batterson has done the same thing for the quarries of Rhode Island, Connecticut, and New Hampshire, and through his labors Westerly granite has come to be known throughout the country. But it is not only necessary to develop the quarries. If the industry is to progress, new markets for the stone must be created. That has been the important function which Mr. John Peirce has performed for the granite industry of New England, pushing the stone into new fields, widening old markets, and demonstrating its superiority in point of beauty and durability to the most of the material currently used in building. Born in Maine, the son of one of the original proprietors of the Mount Waldo quarries, he has grown up with the industry. Thus, familiar with every feature of it, he has been well equipped for this work. As the representative of the Bodwell, Hallowell, Mount Waldo, and Stony Creek Red Granite Companies, and of the New York and Maine Granite Paving Block

It is through his efforts that New England granite has been put into such buildings as the Havemeyer mansion, the Brooklyn Federal Building, the Union Trust Building, the Metropolitan Museum of Art, the Erie County Savings Bank Building, and the Carnegie Library. It is largely through his efforts, also, that granite has come to be recognized as second to none as an all-round building stone. Chance and the dictates of fashion often play important parts in the architecture of a city. It was a current saying in New York a dozen years ago that "the architects found that city marble, and that they were likely to leave it brick." Public buildings, from the first use of stone in this country, have been largely constructed of granite. Commercial buildings in the larger cities, too, were constructed of this material after the use of wood was abandoned. Later, fashion dictated the use of marble, and this in turn was succeeded by brick, and now the tendency is towards a return to granite. The stone is used, however, in a form different from that in the old buildings. The style in large blocks now is heavy frames of iron enclosed by casings of stone, and architects and builders regard granite rock as especially suited to such a purpose, both on account of its strength and its durability. The advance made in the ornamental and artistic application of granite has resulted in a wider use of the stone in residences and smaller public structures, while it has become almost a supplanter of marble for outdoor statuary.