# THROVGH THE AGES

AUGUST, 1923

When Life's last chapter is written
And the clays of the earth crumble dry—
Will the future find marble enduring,
As it has in the centuries passed by?

J. G. D.

# THROVGH THE AGES

VOL. 1 AUGUST, 1923 NO. 4

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THROVGH THE AGES

A Monthly Magazine devoted to the uses of Marble - its universal adaptability, beauty, permanency and economy.

VOL. 1 AUGUST, 1923 NO. 4

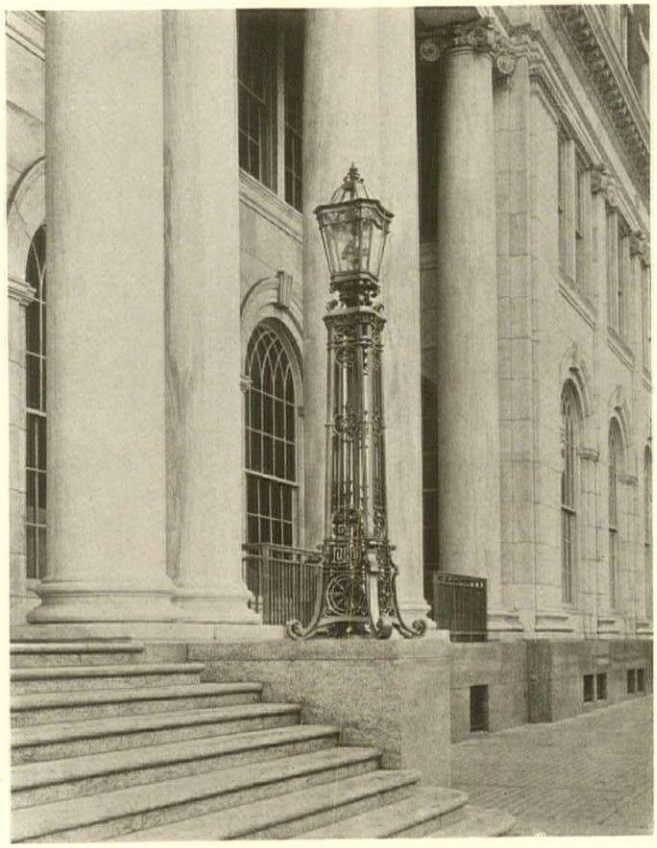
# A TEN-STORY PUBLISHING HOUSE

## Philadelphia has Modern Structure in which Marble Plays Very Important Part

THERE is no combination of materials more familiar to Philadelphians than the red brick and white marble shown in Independence Hall and which later was found in almost all the domestic building of the Quaker City. It was natural, therefore, when the publishers of that trinity of typical American magazines, *The Saturday Evening Post*, *The Ladies' Home Journal* and *The Country Gentleman*, having acquired a tract of the most expensive land in the heart of the city facing Independence Square, that they should choose for their business home a style of architecture that would conform to the traditions of the locality.

The Curtis Building occupies the block bounded by Sixth and Seventh Streets on the east and west, and by Sansom and Walnut Streets on the north and south. Independence Square is on the east and Washington Square on the South, both of historic interest. The site measures 235 feet by 387 feet and cost over one million dollars, including the old buildings, and was cheap at the price.

The general character of the building is in conformity with that of its neighbors, the architects and engineers following and adopting in a general way the simple colonial motives used in the design of Independence Hall. The removal of the old buildings was begun in April, 1909, and the excavations for the foundations of the power buildings in May, 1909. The erection of the steel frame of the power building followed in August and by the first of the year this part was finished. This was followed in turn by the Walnut Street portion of the manufacturing building, while the publication building, the convenience belt and the Sansom Street addition were constructed in sections, in the order named. The general structural character is that of the fireproof steel cage supporting the floors and roofs and their loads and also the partitions and outside enclosing walls. Allowance has been made for the additions of other sections as needs require them. For this purpose, there is about 25,000 square feet set apart, fronting on Walnut, Seventh and Sansom Streets. All the buildings except the power house and the convenience belt have ten stories above grade and rise to a height of about 176 feet. An eleventh story over part of the structure

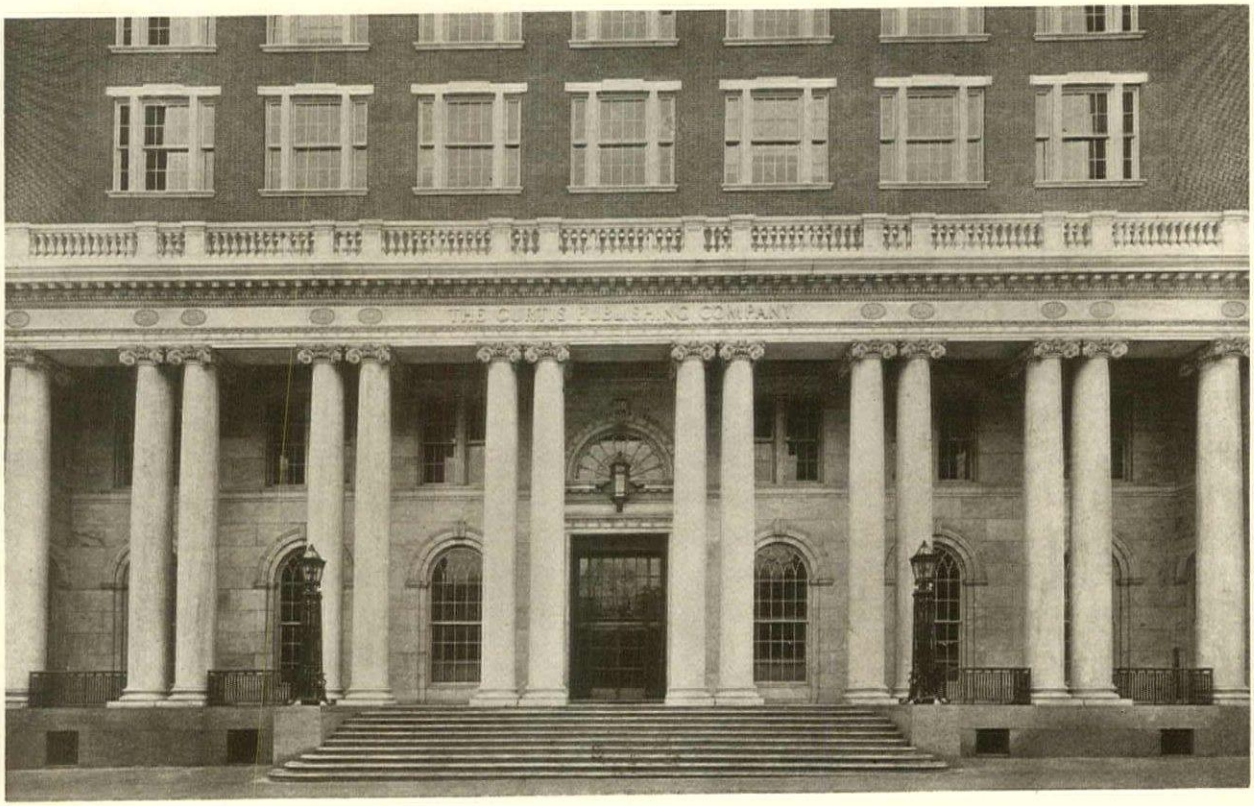


View of Front Entrance, showing bronze standards.

increases the height to about 220 feet.

The ten-story structure is of "Old English" red brick made in a special size, with white Vermont marble for the trimmings in general, and for the entire first, second, ninth and tenth stories of the publication building, including its Sixth Street colonnade, and third story and roof balustrades. This colonnade contains fourteen monolithic Ionic columns each thirty-two feet eight inches high and three feet four inches in lower diameter, and weighing about twenty-one tons each. A year was required to quarry them (this was in 1909) and a special tackle was designed to set them in place.

While there has been every provision made for the comfort, health and general well-being of the more than four thousand people employed in the various departments, at the same time the architecture of efficiency has not been carried

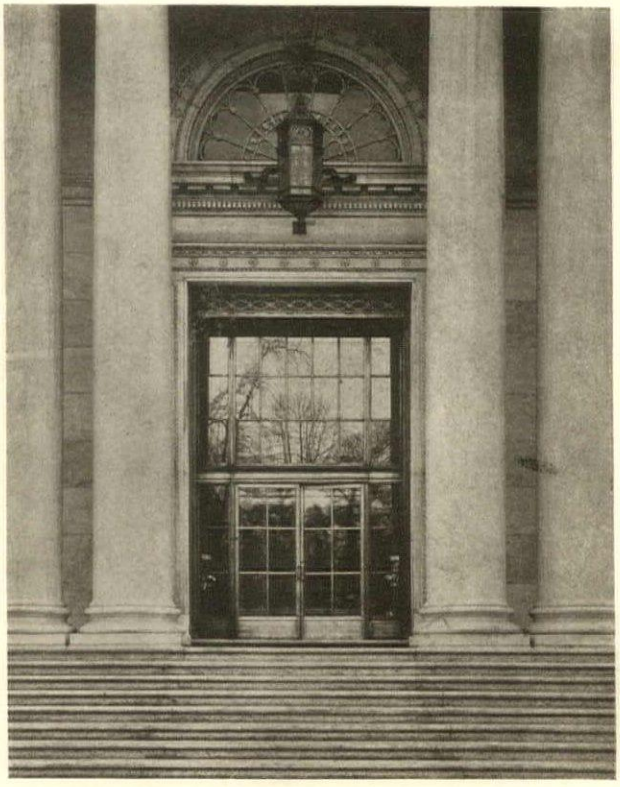



The Marble Colonnade The columns are monoliths from quarries in Vermont.

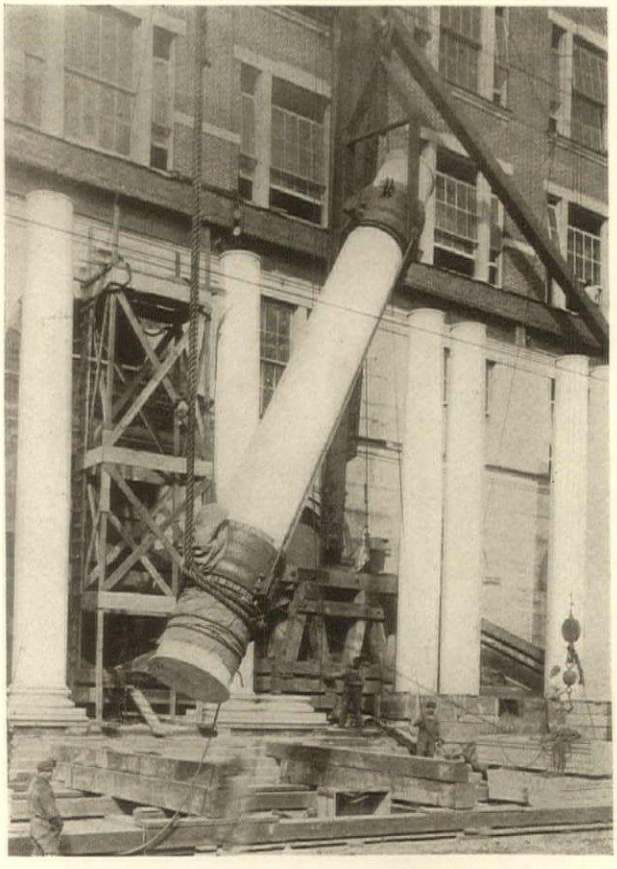
to extremes. It is relieved by touches of humanitarianism—and even by elegance. The recreation room, for instance, while obviously part of a business place, is also evidently a place of social relaxation. The fireplace suggests good cheer and human intercourse, and the cold bars of business formalism are easily let down before its home-like appeal.

In the entrance lobby the flooring is laid with a field of Georgia Creole marble bordered by white marble of particular beauty from southern Norway; and Greek Pentelicon from the old quarries near Athens. This latter is also used for the side walls, while the lamp standards are of Carrara marble with alabaster light-fixture bowls.

In this entrance hall is to be seen "The Dream Garden," a mural decoration rendered in favrile glass mosaics by Louis C. Tiffany from a painting by Maxfield Parrish. It fills a space forty-nine feet long by twenty-one feet high, and is made of over one million pieces of glass, opaque and transparent, lustrous and opalescent, set in cement, after the manner of the mosaics of the past. The most remarkable and beautiful effect is secured when different lights play upon this composition, and the setting of wondrous white marble greatly enhances the beauty of this magnificent creation.

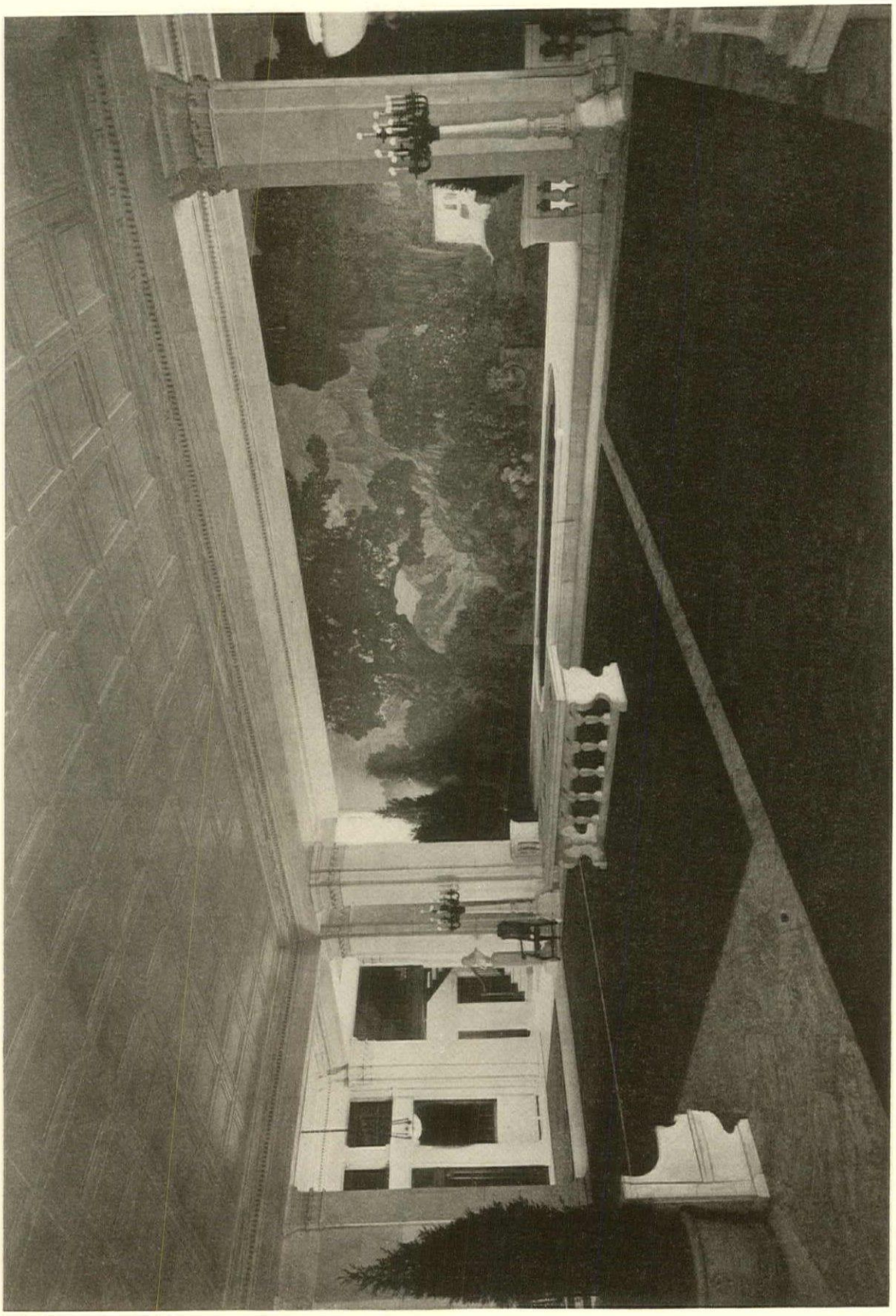


Main entrance detail.

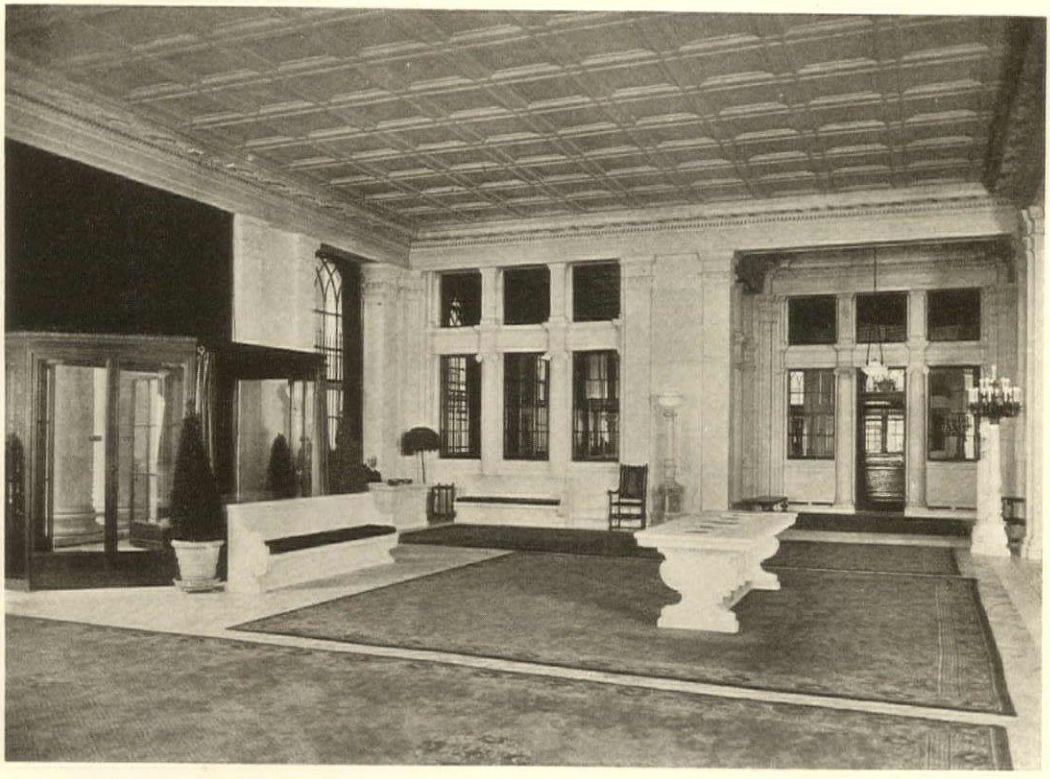


Special tackle was used when the monolith marble columns were put in place.

The convenience belt contains the elevators, toilet-rooms, stairways, shafts for pipes, wires, heating ducts, and in fact practically all the connections of the mechanical service of the entire plant. It provides a fire-wall as well as a means of preventing the noises of manufacturing from reaching the publication departments. The side walls of all public hallways and stairways in this belt are faced with gray Tennessee marble,



Lobby of Curtis Building, showing the marvelous mosaic by Tiffany after a painting by Maxfield Parrish.



Another view of the entrance lobby. Georgia marble is used in the floor, while marble from Norway, Greece and Italy help to enrich this beautiful room.

as are also the walls of all toilet-rooms.

In the manufacturing building the basement is used for paper storage. When it is considered that the paper used in printing the three magazines during the course of a year, if put in a strip the width of a page of one of them, would extend around the world eighty-nine times—or nine times the distance from the earth to the moon—and that 650,000 pounds of wrapping paper is required each year to bundle the output, the space given over to paper-storage must needs be considerable.

The first floor of the manufacturing building is occupied by the mailing division, with the press-rooms, binderies, circulation, engraving and photographic departments on the floors above.

The volume of business done by the Curtis Publishing Company is so enormous that a summary of statistics presents the most astounding figures. With a weekly having a circulation of over two and a quarter millions, one monthly publication with over two million copies an issue and another almost a million, it is not hard to believe that well over three million pounds of ink are used a year, or that two hundred and fifty tons of publications leave the shipping department every working day. The summary of one day's mail often amounts to thirty thousand letters and forty-seven thousand paid-in-advance subscriptions have been received in the same period. There are twenty-two acres of floor space in the entire building and every foot of it is needed. More than four hundred and fifty typewriters are in daily use; about twenty-five hundred employees are served with luncheon; and the pay roll covers over four thousand people.

# A LIST OF THE WORLD'S MARBLES

By J. J. McCLYMONT

*Note*—In our May issue, Mr. McClymont proposed, for the sake of convenience, to divide the different marbles into four groups. These arbitrary groupings were as follows:

GROUP A — Any marble or stone sold to the trade in fair-sized slabs or blocks of commercial size, rectangular shape and guaranteed by the seller to be sound, free from natural defects, that can be finished at a minimum cost, and sold to the consumer as sound marble.

GROUP B — Any marble or stone sold to the trade in slabs or blocks of fair or medium size, generally rectangular shape, guaranteed to be sound and free from natural defects, the finishing of which, because of texture, the size of slabs, the shape and size of blocks, is somewhat more expensive than those in Group A.

GROUP C — Any marble or stone that cannot be sold as sound but contains a minimum amount of natural defects, such as dry seams, old fractures, partially or completely healed surface voids, etc., to be treated by the manufacturer in the most approved manner, reinforced where necessary by liners on back or metal inlays and sold to the consumer as semi-sound marble.

GROUP D—All marble, stone and so-called serpentine marbles, and Onyx, which, by their peculiar formation are known to be fragile, such as Breccias and nearly all highly colored marbles and serpentines, and that are sold to the trade in irregular shaped blocks or slabs without a guarantee as to their soundness, treated by the manufacturer in the most approved manner, reinforced where necessary by liners on back or metal inlays and sold to the consumer as unsound marble.

*Abancado das Lameiras*—Group C
Lameira Quarry, Pero Pinheiro, Portugal.
Mottled with various shades of pink.
Produced in large quantities of reasonable size.
Takes high polish.

*Aberdaron*—Same as Welsh Jasper stone or Jasper Marble.

*Abri*—Group C
Abri Quarry, Rawulpindi, India.
Brown with numerous dark, winding marks.
Takes a medium polish.

*Abul Hassan*—Group C
Quarried in Spain.
Amber-colored background with dashes of cream.
Do not confuse this marble with the Algerian Onyx used in the Mosque of Sidi, Abul Hassan.

*Abur Stone*
Abur Quarry, Jaisalmer, India.
Brown background with bright yellow spots and marks.
Takes medium polish.

*Acajou*—Mahogany

*Adanac Light*—Group C
Quarried in Canada.
Gray background finely mottled and marked with light green.
Takes high polish.
Available in fair-sized blocks and large quantity.

*Adnet or Adneter*
May mean any of the marble quarried at Adnet, Salzburg, Hungary; see Grau Schnoll, Licht Urbano, Rosa Urbano, Rot Grau, Rot Lienbacher, Rot Motzau, Rot Scheck and Rot Tropf.

*Aeolian*—Group B
Quarry at Dorset, Vermont.
White background with light green bands or lines sometimes wavy and running in various directions.
Takes fair polish.
Is not available at present. Is sold to the trade in slabs.

*African Marbles*
The only African marbles generally known as such are the Numidians, although other marbles are found in Africa (Red Numidian, Pink Numidian, and Numidian Pavanazzo).

*African Alabaster*
Same as Oriental Alabaster or Algerian Onyx.

*African Onyx*—See Algerian Onyx.

*Africano* (Brechi)—Group C
Supposed to have been quarried in Asia Minor; exact location unknown.
Black background almost completely obscured with transparent fragments tinged with pink and light brown.
Takes high polish. Not available.

*Africano*—Group C
Quarried at West Rutland, Vermont.
Dark gray with bands and clouds of clear black.
Takes fair polish.

*Agate*
A stone of the quartz family used almost exclusively in the jewelry trade.
Is found in Brazil, Faroe Islands, Germany, Iceland, India and Scotland.
By special treatment of this stone the colors become more intense and new colors are brought out and the treated stone is known as Onyx.
In the natural state it is gray, white, yellow or a brownish red.

*Agatato Alabaster*—See Alabaster Agatato.

*Agrillei* (Brechi)—Group D
Pallizzi Quarry, Calabria, Italy.
Grayish brown background with reddish brown and orange mottling.
Takes high polish.

*Ain Smara*
Is the name of a quarry in Algeria, which produces Breche African, Onyx Dove Coutre Passe, Onyx Dove Passe, Onyx Nugal, Onyx Nugal Coutre Passe and Rouge Agate.

*Alabama Marbles*
Marble is found in many places in Alabama.
For those available see Alabama No. 1, Alabama Cream White, Alabama Grade A, Alabama Ivory Pavanazzo, Alabama Madri Veined or Alabama Madri Pavonazzo, Alabama Pentelic No. 1, Alabama Pentelic B-B, Alabama Selected A, Alabama Veined A.

*Alabama No. 1*—Group A
Gantt's Quarry, Alabama.
White creamy tone; almost no clouding and that very faint.
Takes good polish.
Limited supply in slabs not over ten feet.
Trade-Mark—G. Q.

*Alabama Cream A*—Group B
Quarried at Brownson, Alabama.
White cream - tinted background with from fine to wide wavy veins of bluish cast and occasional clouds from faint to a decided cast.
Takes high polish.
The available supply of irregular shaped blocks up to eight feet in length is generally equal to demands.

*Alabama Cream White*
Gantt's Quarry, Sylacauga, Alabama.
Creamy white with occasional clouds.
Not available.

*Alabama Grade A*—Group A
Gantt's Quarry, Alabama.
White creamy tone, freely and sometimes rather heavily clouded.
Takes high polish.
Available in any size required and should be sawed with the bed.
Trade-Mark—G. Q.

*Alabama Madri Pavanazzo*
Same as Alabama Madri Veined.

*Alabama Ivory Pavanazzo*—Group C
Gantt's Quarry, Alabama.
White ivory cream tone with black and generally yellowish orange markings.
Takes high Polish.
Trade-Mark—G. Q.
Available blocks will fill all requirements. Quantity limited. Best results obtained by sawing with the bed.

*Alabama Madri Veined*—Group C
(Also known as Alabama Madri Pavanazzo)
Quarried at Brownson, Alabama.
Cream-white background with blue-black and gray veins.
Takes high polish.
Can be obtained in blocks as large as needed. Should be sawed with the bed.
Available supply fair.

*Alabama Pentelic No. 1*—Group B
Gantt's Quarry, Alabama.
Bluish white tone with slight clouds.
Takes high polish.
Not available.

*Alabama Pentelic B-B*
Gantt's Quarry, Alabama.
Clouded blue and white.
Not available.

*Alabama Selected A*—Group A
Gantt's Quarry, Alabama.
White cream tone, freely but not heavily clouded.
Takes high polish.
No limit to sizes that can be furnished.
The supply is fair.
Trade-Mark—G. Q.

*Alabama Veined A*—Group C
Gantt's Quarry, Alabama.
White with veins that match with great accuracy.
Takes high polish.
No limit to size of blocks available. Supply on hand good, future supply limited to one thousand feet, monthly production.
Trade-Mark—G. Q.

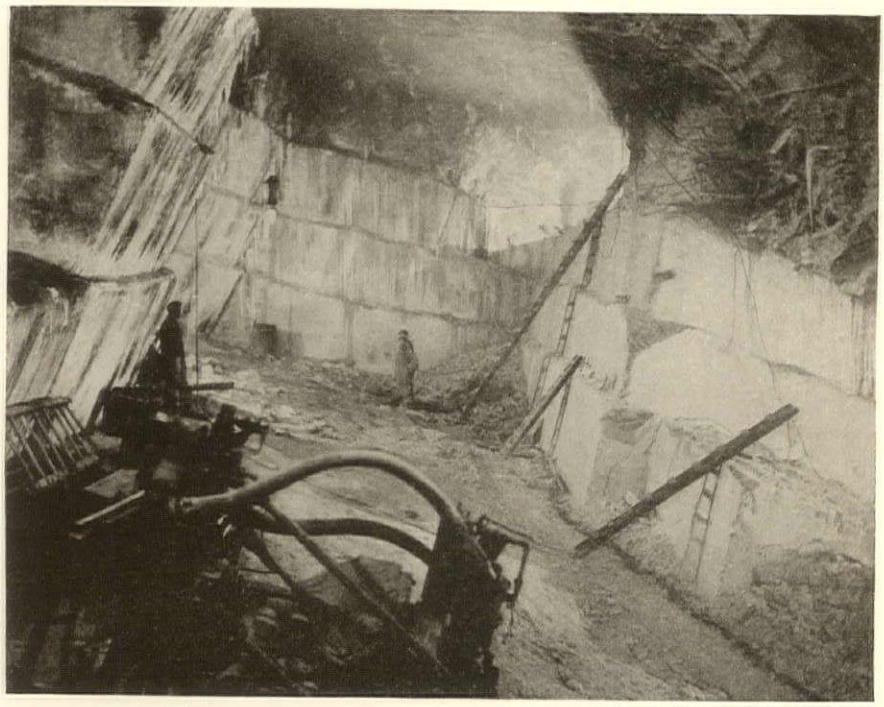
*Alabaster*
Is a variety of Gypsum (not marble) used principally for vases, small statues, lamps, etc. It has, however, been used for interior decoration.
Do not confuse this with Oriental or African Alabaster, which is a name applied by some writers to Algerian Onyx.
Alabaster is quarried in Salto de Agua, Chili; in Derbyshire and Staffordshire, England (where it is sometimes known as Potter's stone); at Belesta and Lagny, France; at Castellina, Italy; at Sea Cliffs, near Penarth, Wales; and many other places.
Generally the color is a light cream with traces of pink, although the Welsh Alabaster shows some mottling of darker shade.

*Alabaster African*
See Algerian Onyx. (This is an Onyx marble, not an Alabaster.)

*Alabaster (English)*
(Also known as English Alabaster and Potter's stone.)
Quarried at Derbyshire and Staffordshire, England.
Pearly white.
Takes low polish.

*Alabaster (French)*
Quarried at Belesta and Lagny, France.
Creamish white.

*Alabaster (Italian)*
Castellina Quarry, Tuscany, Italy.
Pearly white.
Takes low polish.



Channeling machine at work on an inclined floor in a marble quarry. This method of work was made possible through the invention of the modern electric channeler.

# THE MECHANICAL SIDE OF MARBLE QUARRYING

### A Comparison Between the Old Methods and the New

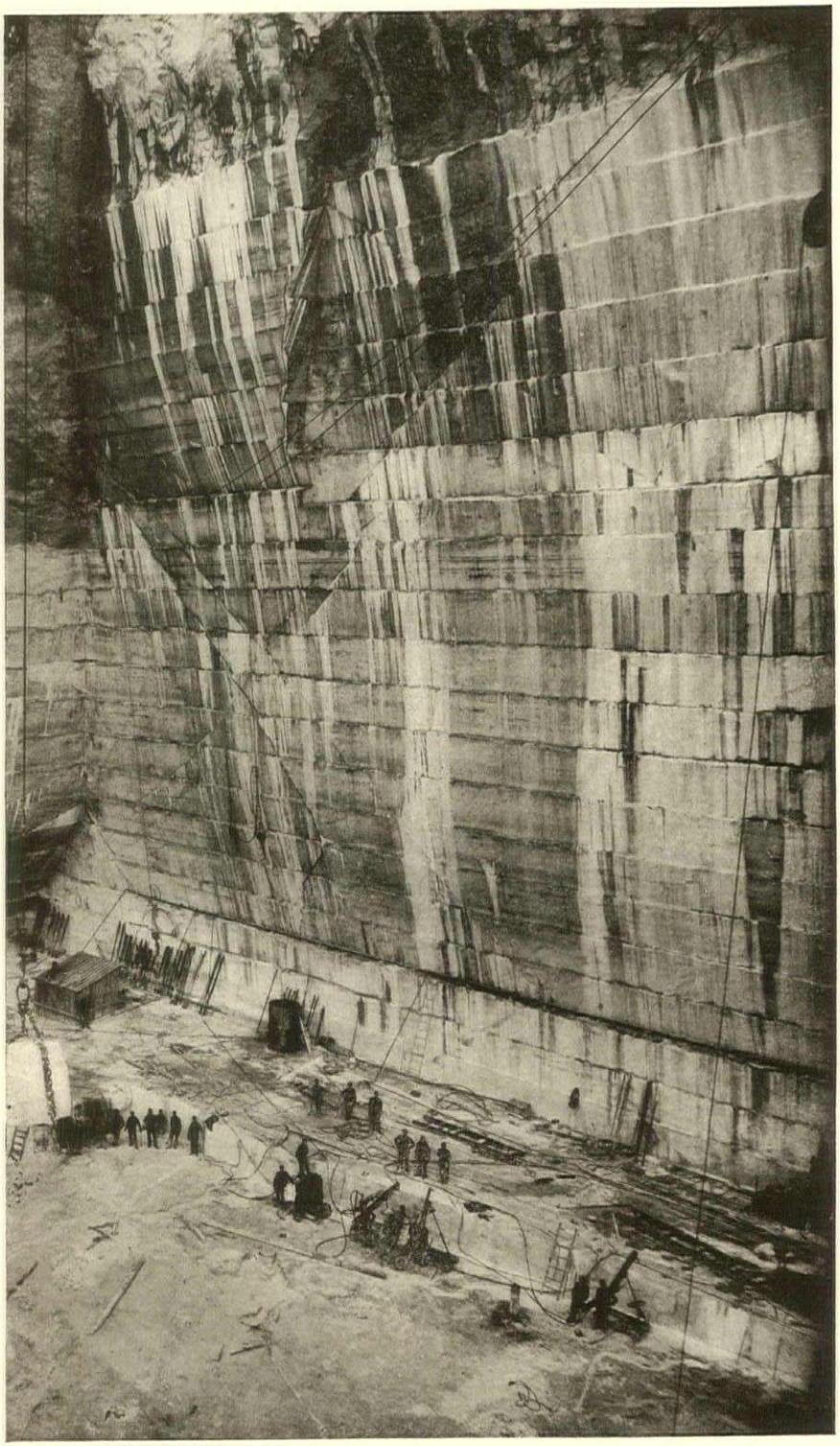
A STURDY old Vermont pioneer, Nathaniel Chipman by name, in writing to Gen. Philip Schuyler, of New York, refers to certain quarries of marble within the Green Mountain State which should be made to produce an "important article of commerce." All that was needed, as he looked at the problem, was the water power and the machinery for sawing the marble up into slabs. At the time his letter was written, something over a hundred years ago, people had little conception of the demands of the marble business, or of the time which would be required to bring the industry up to a paying basis.

Take the quarry for example. In other words, take that part of the marble-working process which comes before the sawing. Under the present system, not a little of the work is done before the marble reaches the mill, and the story of how it is done and how the methods have been standardized, has a well-earned place in the annals of industrial history.

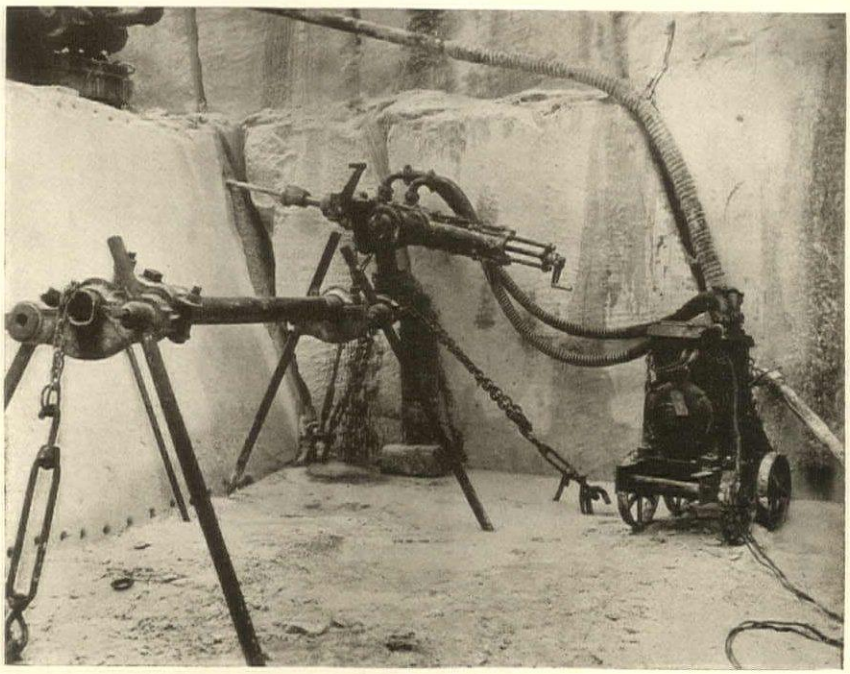
When Vermont marble was first worked, it required no great effort to split the slabs from the projecting ledges. But a little later, when the outer edges of the deposit had been worn away, the operators were forced to devise other ways of loosening the stone. It was then that blasting was given a trial and for a time it looked as if the wasteful methods of the Old World were to be continued unchecked in the new country.

In the early days of West Rutland quarrying, it was no uncommon sight to see men waving red flags and shouting a warning to the townspeople. That was only the climax to a long round of toil. It signified that a gang of laborers had spent many hours on a rough temporary staging, striking into the marble with the heavy hand drill. It meant that the hole had been sunk to the customary depth and the black powder tamped home, that the fuse had been lighted and that it was time to look out for flying stone.

With each explosion, the pile of shattered, wasted marble became larger and more formidable. Finally, it drove the owners to consider ways of economy. It was too early then to think seriously of machinery—the best that could be done was to make the handwork more efficient. And so instead of drilling holes here and there and leaving the results to the blast, they brought in more men and began drilling the holes in rows. It was in that way that the first crude channel



The old Sutherland Falls Quarry, in Vermont, where the first Wardwell Channeler was operated. This quarry is not being worked at the present time. In days past, it was one of the most productive of Vermont quarries.



The Radialax Drill attachment in the quarry. This is a machine which is comparatively new to the marble industry. It is electrically operated, and works in corners and in narrow openings difficult of access with the ordinary drill.

cuts were formed. As late as 1860, the work was being carried on in this manner. By turning to an old wartime booklet one may get this impression of the handworked quarry at the zenith of its career:

> "It is an interesting scene to behold two hundred quarrymen ranged in rows, each with his long sharp drill steadily cutting deeper and deeper those grooves that are destined to sunder the fetters that bind those valuable blocks to their parent bed. The musical ring of the quarryman's drill that reverberates to the ear from the deep-vaulted quarry is pleasing to the spectator as he stands and looks down into it, and to the proprietor it is the welcome harbinger of a good time coming."

It was only three years after this was penned that the channeling machine was perfected and set at work in the old Sutherland Falls Quarry. It was built by George J. Wardwell, of Rutland. There may have been other experimenters along this line but to Mr. Wardwell has been given the credit of introducing the first successful machine. It is unnecessary to set forth in detail the theory of the channeler. It was designed to take the drills out of the hands of the workman and set them in a frame so that they could be made to move up and down by steam power instead of man power. The saving, both in labor and in time, was an alluring asset and the machines were soon adopted by other quarries.

Although the Wardwell or the so-called "double-lever" channeler was a long step in advance of hand work, it had not been in operation many years before various faults and weaknesses began to develop. In the course of time, certain parts were changed and new features added. The individual boilers were taken away and the steam was piped in to each channeler from a large central boiler which stood near the edge of the quarry. But there was one thing which the Wardwell channeler was never able to do. It could not be made to work successfully on an inclined floor.

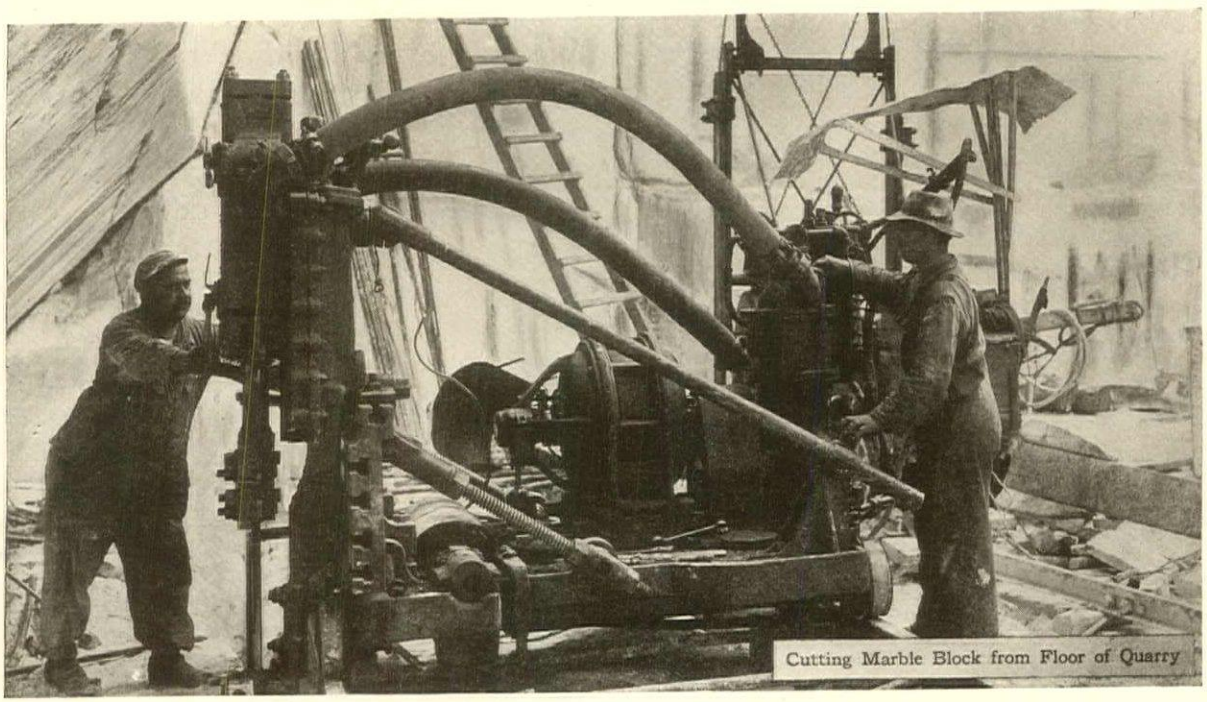
The first machine to meet that need was the diamond channeler. Through its agency, a series of deep holes could be drilled so near together as to actually form a channel. The objection to the drilling method was that the price of diamonds was high and kept

going higher. These black diamonds, or carbons as they were termed, advanced in a few months' time from $6.00 to $18.00 per carat. Naturally, this placed the producers under a severe handicap.

They were still struggling under the burden when a new steam channeler was placed on the market, one which would run on either a level or an incline. For a time it looked as if this more elastic model might continue to serve all the needs of the quarryman. And so it has in many cases. One need not look far even now to find marble quarries that are still wearing a harness of steam pipes.

With the advent of electricity, however, there was a strong inclination to find fault with steam. It thickened the atmosphere of the quarry past all reason; the pipes were always leaking and breaking apart; a vast amount of time was wasted in adjusting the pipes to the shifting channelers. Not only was electricity cleaner, handier and more economical, but it would get more work out of the machines. With these arguments as an incentive, it was inevitable that the more fortunately situated quarries should give up their engines in exchange for electric motors. Thus may we account for the transformation within the boundaries of the Vermont marble belt. Today nearly all the quarries are being operated by electricity drawing light as well as power from the wire-entrenched Otter Creek river.

It has cost something to make all these changes. Whenever an older type of machine has been replaced by something new, the outlay has included not simply the cost of the new equipment; it has included as well the working capital which dwindles away when the discarded models are relegated to the scrap pile. Thousands of dollars were eaten up in that way when the diamond drill was cast aside; many more thousands

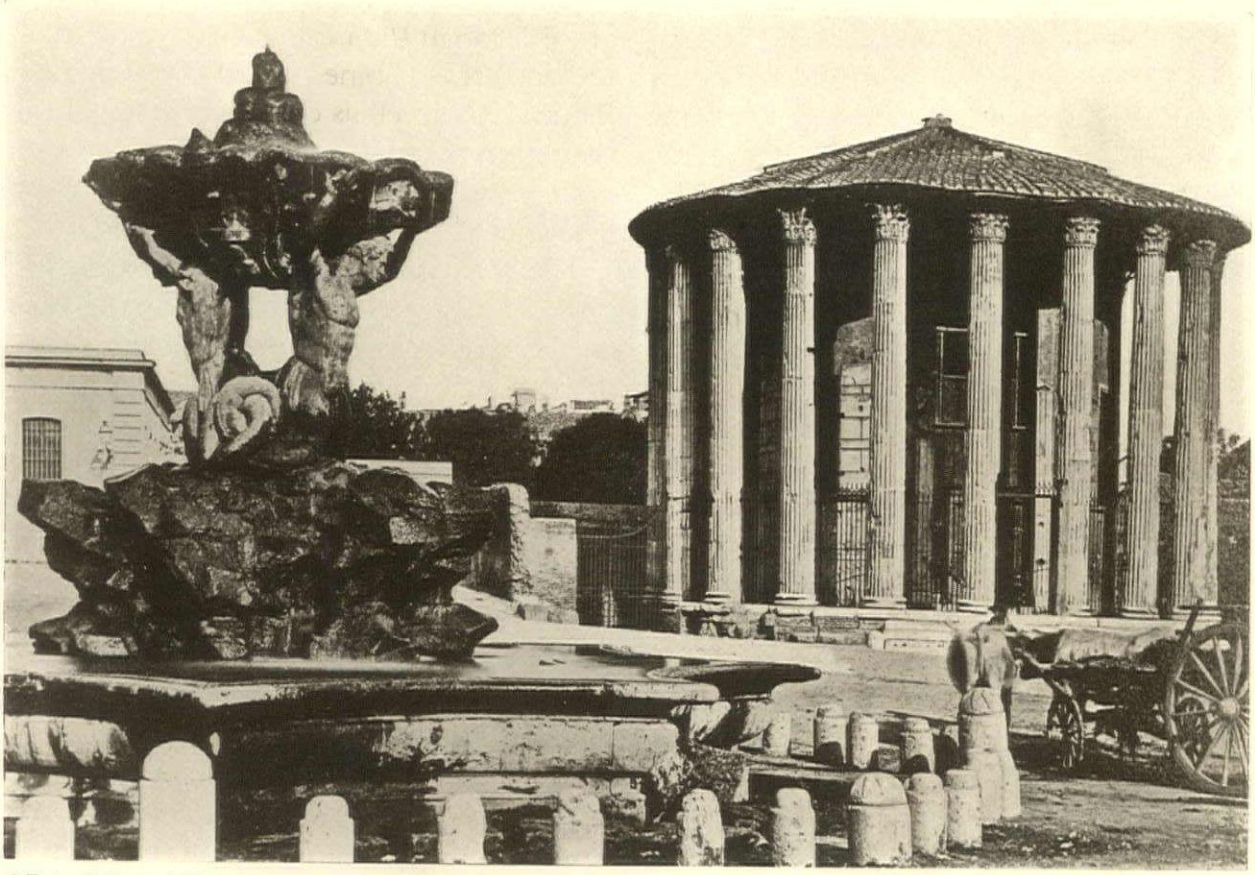


Cutting Marble Block from Floor of Quarry

This electric channeling machine runs on a movable track placed on the quarry floor. It sinks a narrow groove to a depth of several feet, making it possible to take out blocks of uniform size and shape. The cutting is done by five drills, clamped together in a row.

were involved when steam gave way to electricity. Each step forward has called for a tremendous outlay of capital.

On the other hand there has come as a reward an enlarged capacity for service. In so far as economy of time and stock is concerned, marble quarrying today is far ahead of other days. Never before has there been so great a certainty of getting any particular layer out of the ground when it is wanted, and in good condition. Limitations there must always be—quarries at best are still beset by the unalterable restrictions of nature. But by reason of the constant striving to perfect and systematize, the natural barriers have been reduced to a minimum.





The Temple of Vesta at Tivoli, built about 27 B.C. of Lapis Albanus, a volcanic ash peppered with scoriæ of black lava, and called Peperino. A circular peripteral temple of the Corinthian order. Vitruvius classifies circular temples as Tuscan. The cella was 24 feet in diameter, surrounded by a peristyle of eighteen Corinthian columns each 23 feet 6 inches high, resting on a podium. The cella had two windows and a doorway approached by a flight of steps. The columns are nearly ten diameters high, and the capitals, of which the foliage is derived from the acanthus mollis, are one diameter in height.

# AN INTERNATIONAL CAPITAL

## The Pan American Building is the Washington Home of Twenty-one American Nations—A Most Unusual Structure

ONE of the most interesting buildings in Washington as well as one of the most unique, stands at the corner of Seventeenth Street, Northwest, and Potomac Park. It is the third one of a group of white marble edifices, each of which is in its own way distinctive and palatial. First on Seventeenth Street comes the Corcoran Art Gallery. Further down stands the building of the Daughters of the American Revolution. Then comes that beautiful temple of international peace and good-will, the home in Washington of the American Republics, the Pan American Building.

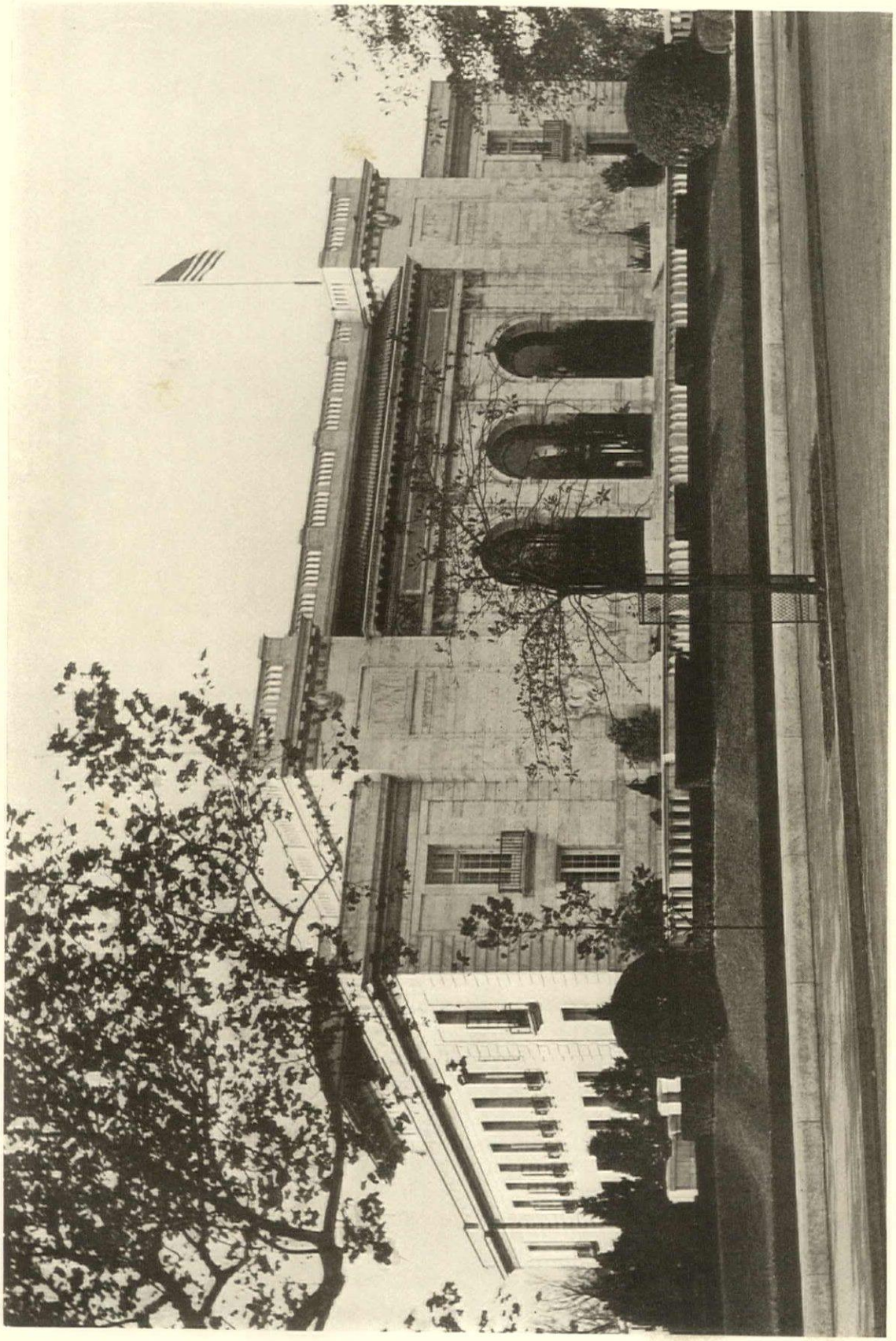
The building was occupied on May 10, 1910, and since that time it has been visited by thousands from all parts of the world, most of whom depart with a clearer idea of the resources and possibilities of the Latin-American countries. This is indeed, but the partial realization of the ideals of Mr. Andrew Carnegie when he generously gave three-quarters of a million dollars toward the cost of the new buildings and grounds. Mr. Carnegie's appreciation of the importance of the Pan American Union as an instrument for furthering universal peace and amity among nations and extending commerce among the members of the Union took this tangible form; the result is a building which is at once a physical demonstration that the Union is an actual force and that its Washington office is a practical, effective headquarters for the dissemination of dependable data.

The architects were chosen after a competition so keen that it surpassed any previous experience in the capital. Seventy-eight out of several hundred designs submitted possessed sufficient merit to justify serious consideration. The winners were Albert Kelsey and Paul P. Crét, both of Philadelphia. The design is in keeping with the noble environment, and yet at the same time there is incorporated into the general plans the characteristics of a stately domesticity. Furthermore, the various refinements of form which the Latin race gave to architecture are combined with the aboriginal influences, as well as the peculiarities of the twenty-one countries, and the whole treated with respect to the local history of these countries.

The result is a building that, externally, shows the usual classic and renaissance lines of the neighboring structures. Only closer inspection reveals the Latin-American influence. Aztec and Mayan designs, for instance, are used in belts of ornament on the façade and on the garden front. The parapet of the sections that flank the pylons has a decoration borrowed from the fountain of the Salto del Agua, in the City of Mexico.

White Georgia marble with bluish veins was employed entirely for the exterior. The three doorways of the main entrance are approached by a short flight of white marble steps. Here on either side are two sculptured groups depicting North and South America, with pedestal bases serving as fountains. Gutzon Borglum and Isidore Konti were the artists, and they also created the low-relief groups in the panels above.

Upon entering the vestibule, with its barrel-vault ceiling, and rising through the two stories and running the full width of the



The Front of the Pan American Building on Seventeenth Street, showing the arched entrances flanked by the statuary groups symbolical of North and South America. Beneath each group is a fountain, not discernible in the picture.

Looking across the Patio, showing the fountain, and the tiled pavement with its original designs in dull red and black.

central section, one is impressed with the stately character of the building. At either end are two columns and two pilasters of black and white "Grand Antique" marble; these support a balcony that overlooks the vestibule. The floors are of two kinds of Tennessee marble, with an outer part of Knoxville; while the two grand stairways, one on each side, leading to the second floor, are also of Tennessee. Behind the wall-brackets of the stairways are slabs of Formosa marble, while the loops at the foot of each stairway have centers of Formosa.

It is in the vestibule that one first finds the individual character of the ornament. Instead of the usual details to be found in dozens of buildings of modern design—and therefore of no particular interest—here one finds striking departures from conventional treatments. The fact that these unconventionalities are derived from Latin-American sources makes them so noticeably unusual as to impress the most casual beholder. This same treatment is found throughout the interior of the building, as well as in the Aztec garden and its Hall of Tiles.

Passing through the vestibule, the visitor is at once attracted by the Patio, a central court which, under the more clement skies of the tropics, would be left open the year round. Beneath the harsher winds of Washington, provision had to be made for roofing over this space during the cold periods. To this end, a sliding roof of glass, operated noiselessly by electricity, has been constructed. It is in two sections, each of which may be slid back onto the adjacent flat roof of the staircase.

The main feature of the Patio is the pink Georgia marble fountain and its surrounding curbing. This curbing is carried out on

The Aztec Garden with its lily-pond and Hall of Tiles. The balustrade is of Georgia marble.

to the pavement and up eight inches. In the corners it holds the soil of the four L-shaped flower beds. All the pieces are cut from large single blocks of marble and ingeniously fitted together. The fountain was modeled and executed by Mrs. Harry Payne Whitney and symbolizes the continuity of the Americans on their own soil. A pillar rises from the center of an octagonal basin, the floor of which is paved with pink and white marble in the form of a Mexican star. Between the points of this star boiling springs bubble up. The pillar supports a smaller basin crowned by a "tholos" bearing a third and smaller basin from which the water descends. Vari-colored lights are displayed in the running water and through the eyes of carved feathered serpents, and these are controlled by a keyboard desk in an adjacent room, the entire mechanism ingeniously concealed.

The pavement of the Patio shows mosaic designs of Mayan and Incan origin. The growing plants are exotic, and the visitor finds himself transported to the land of waving palms and chattering parakeets. Here is a banana tree bearing bunches of green fruit; there, a bread-fruit tree, next to a Royal palm. Jipa-Japa palms, from which come the fibres for Panama hats, are side by side with Para rubber trees, while the Cocaine and Tapioca plants are crowding close to the Fig and Alligator pear trees.

The Columbus Library occupies the ground floor of the building developed for the Hall of the Americas, together with almost the entire portion in both stories on the north side of the Patio. The reading-room is one hundred feet long and forty wide. There are two private studies, the offices of the librarian, and stack room sufficient to care for 120,000 volumes.

The south side of the building is devoted to the working offices for the large staff of the Union. In the basement, where mail is assorted, is found the heating and venti-

Another view of the Aztec Garden showing the Washington Monument reflected in the surface of the pool.

lating plant, and finely equipped kitchen.

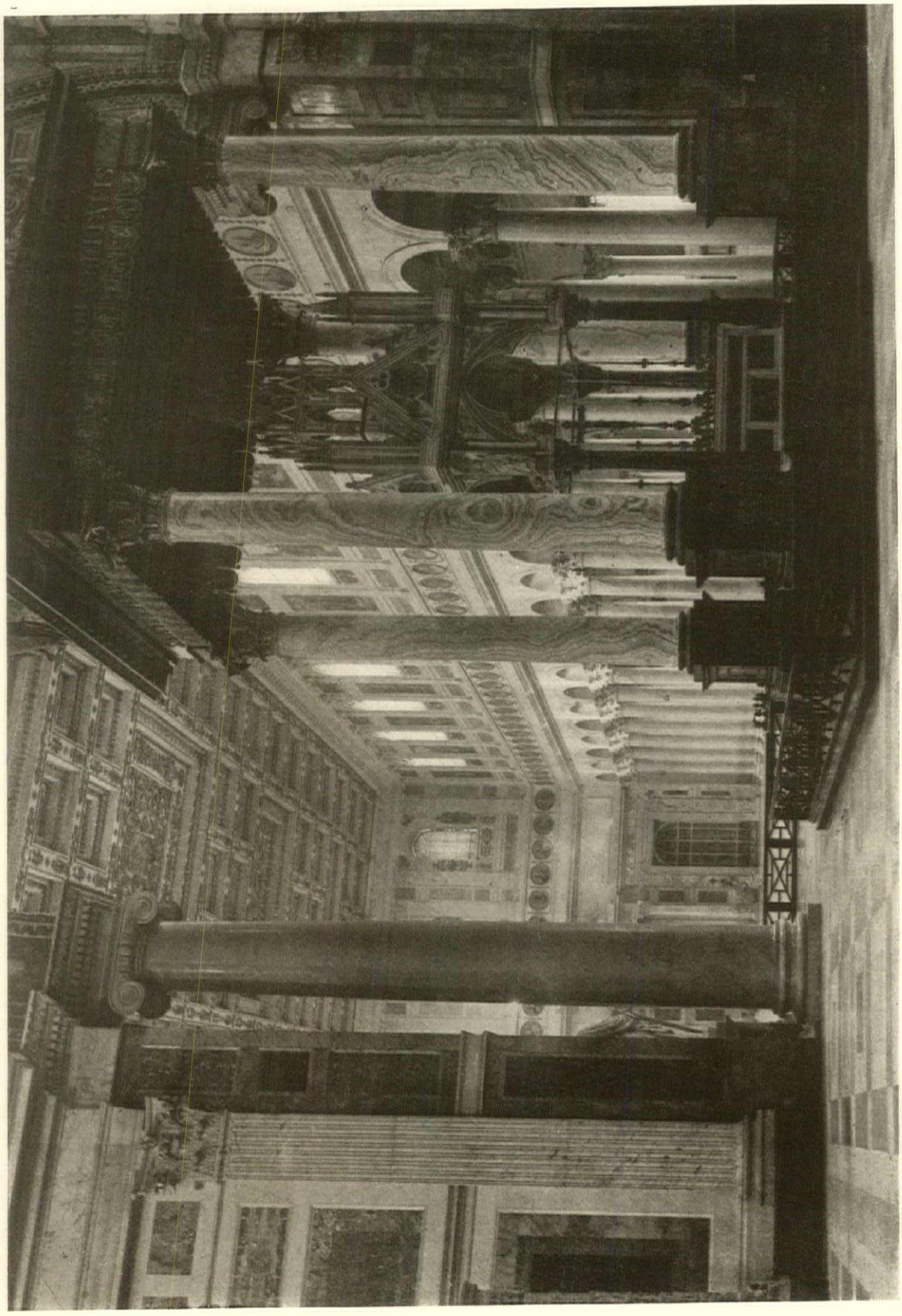
Back of the Patio, down a flight of steps of Italian green marble, one reaches the Hall of the Maps, with its floor of Tennessee marble and trim of Italian. Passing out the rear of the building, you come to the Aztec garden with its balustrade of Georgia marble on the raised terrace that supports the Hall of Tiles. The pool in front of this latter is a charming touch, with its white and blue and brilliant red water lilies. From one side it reflects the tall shaft of the monument to Washington that stands so majestically in the near distance.

Hall of the Patriots with the flags of the countries composing the Union and white marble busts of men famous in the Americas. Pedestals, floor bases and door-casings are of reddish Languedoc marble.

Within the main building the broad marble stairways pass up by easy stages from the vestibule to the second floor, revealing the spacious Hall of the Americas with its large windows and noble colonnade. At the top of the stairway in the Gallery of Patriots one stands among the portrait busts of the great men of North and South America, beneath the flags of the twenty-one republics. Below, the Patio with its growth of greenery is visible, and serves to emphasize the openness of the entire structure from every spot and its suitability to accommodate large gatherings.

The rooms for the Director-General and his staff, with accommodations for visitors, committee rooms, and the like, are found on this floor. All doorways and lintels are of reddish Languedoc marble, as are the engaged pedestals for the portrait busts in the Gallery of Patriots. In the contrast of this color with the white marble busts, we have an impressive effect of monumental order.

The Pan American Building is without doubt, considering its size and cost, one of the most beautiful and distinctive buildings in the world. It is, as Elihu Root said at its dedication, "A confession of faith, a covenant of fraternal duty, a declaration of allegiance to an ideal. . . . This building is to be in its most manifest utilitarian service a convenient instrument for association and growth of mutual knowledge among the people of the different republics. . . . The building is more important, however, as the symbol or ever-present reminder of perpetual association of unity of common interest and purpose and hope among all the American republics. . . . May the structure stand for many generations to come."



Where Paul's dust lies buried. Interior of St. Paul's-Outside-the-Walls, Rome. The archivolt has taken the place of the architrave. Notice the variety of the capitals.

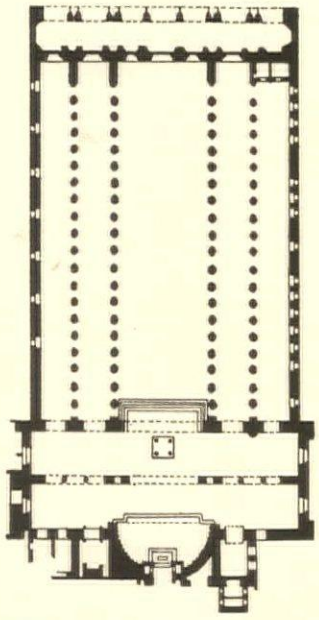
# EARLY CHRISTIAN AND BYZANTINE ARCHITECTURE

AS we saw in our last article on Roman architecture, the early Christians were despised and persecuted. They were forced to hold their meetings in secret, in the homes of the members, or in out-of-the-way places such as the Catacombs, where interference was unlikely. Rome itself was immersed in license. The old Pagan religion was about played out and the majority of the people had no religion of any kind. Such structures as were erected by the emperors were not prompted by piety, but by the desire to impress upon the spectator their own power and importance.

It was not until the year 328 A.D., when Constantine officially recognized the Christians and made theirs the State religion, that there sprang up a demand for places of Christian worship. Wherever the pressure of prosecution was lifted the Christian worship came to the light, and the churches multiplied. Before the persecution of Diocletian, Eusebius tells us there were more than forty Christian Basilicas in Rome. Naturally, there was a hesitancy about making use of the Pagan temples, and this was strengthened by the unsuitability of their design for the accommodation of large crowds.

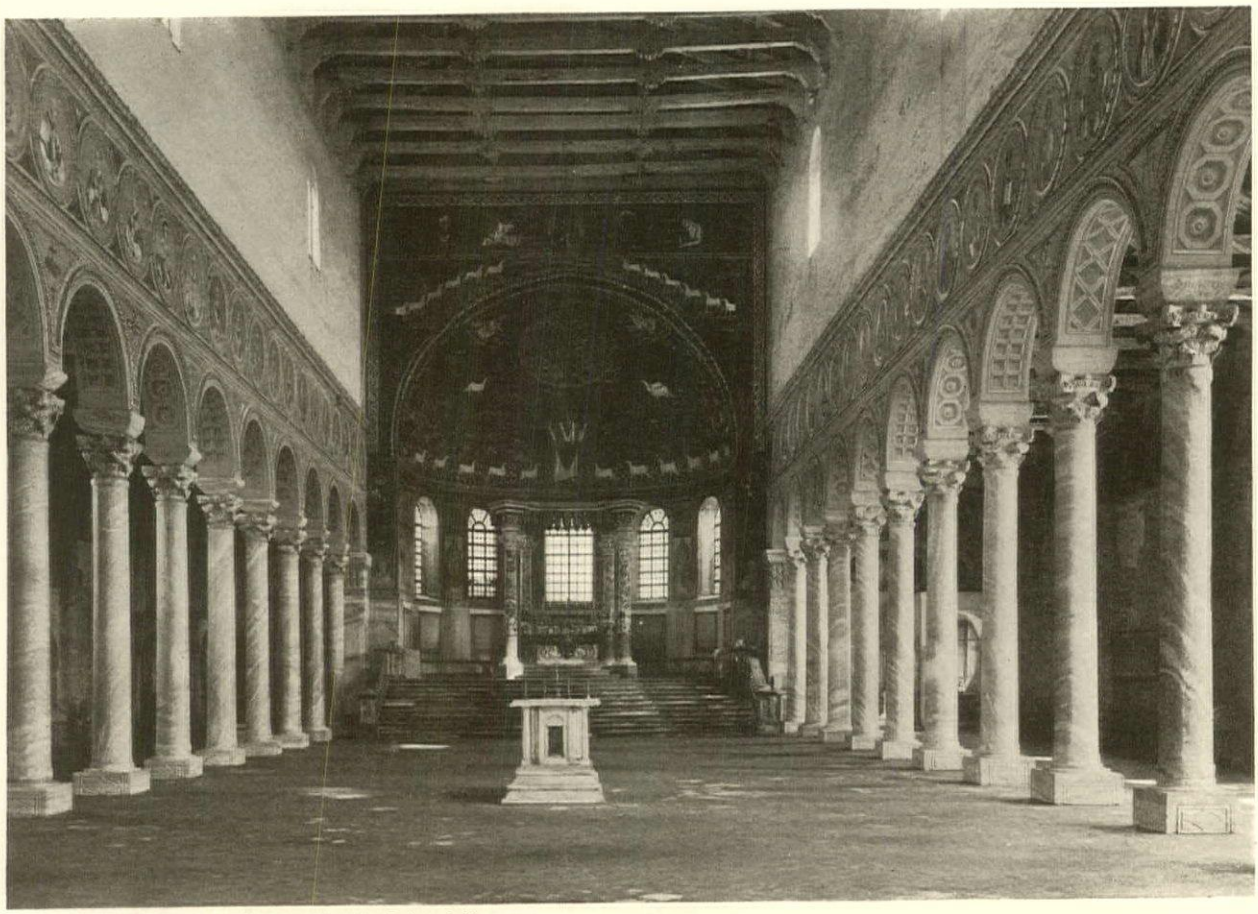
There was one type of building which was exactly adapted for their requirements, however, and this was the basilica, the great hall of commerce and justice, with its semi-circular apse and central nave. Creative imagination was scarce at this time and so it came about that the first Christian churches were direct imitations of these basilicas. The city was filled with buildings that were falling rapidly into ruins and these furnished the sources from which came abundant material for the churches. Marbles of every shape and hue, columns and capitals of elaborate design, were seized and put to new uses as these prototypes of the basilicas sprang up with astonishing rapidity.

How is it, then, that we find not one single Christian building in Rome dating from the time of Constantine? The changes made by time and circumstances in later centuries explain this apparent discrepancy. There is one church, that of St. John Lateran, which was altered later; and another, St. Paul's-Outside-the-Walls, which was destroyed by fire in the early part of the nineteenth century. Of this latter, Ruskin says it is "the noblest interior in Europe, and nobly and faithfully restored."



Plan of St. Paul's-Outside-the-Walls, Rome.

It is interesting to consider in detail the arrangement of parts of these basilican churches, because they developed in later centuries into the typical mediæval plan. In front of the church was an arcaded porch



Photograph from Thos. G. Machen, Architect, Balto., Md.
Interior of an early Christian church of the Basilican type. This is St. Apollinare in Classe (538). The triumphal arch and its lavish decoration is plainly shown, as well as the distinctive features of the Byzantine style.

or narthex, square in shape and forming an open courtyard. St. Clement in Rome and St. Ambrogio in Milan show this detail. Within was the nave, flanked by columns which divided the floor space into a central hall and side aisles. Occasionally we find double rows of aisles, as in St. Paul's and old St. Peter's. The roofs of these side aisles were considerably lower than that above the nave. The walls above the aisle-roofs were pierced by windows. At one end of the church, opposite the entrance, was a semi-circular apse which accommodated the bishop and chief officers. In front of the apse was a raised space for the clergy and before this stood the altar. The choir occupied a portion of the nave, enclosed by marble railings. Later, transepts were added, as in St. Paul's, by enlarging the side walls of the building and ambos or pulpits were arranged on each side of the choir space.

The outsides of these basilicas were very plain, whereas within we find the walls rich with marbles and brilliant with mosaics. Rich carvings and paintings were freely employed to give grandeur and splendor, while the floors were of inlaid marble in geometric patterns. The wall space over the triumphal arch of the apse was most always grandly decorated with pictures in mosaics. The columns and capitals were, as mentioned previously, collected from a number of older buildings, and were a heterogeneous mixture of sizes and styles. Plain and fluted shafts were placed side by side, Ionic with Corinthian, short columns with large capitals and

large columns with small capitals, bases of unequal heights. As Ruskin says: ". . . the architect . . . gathered his columns and capitals where he could find them, as an ant picks up sticks." Another authority, Mr. W. P. P. Longfellow, in his "The Column and the Arch," declares that: "Their one strictly architectural feature was the arcading; an exuberant decoration was the compensation for their architectural poverty. They were really churches of the decorator rather than of the architect."

So long as the apse sufficed for the demands of the early Christian service, with its limited number of higher officers of the church, it was retained in its original form.

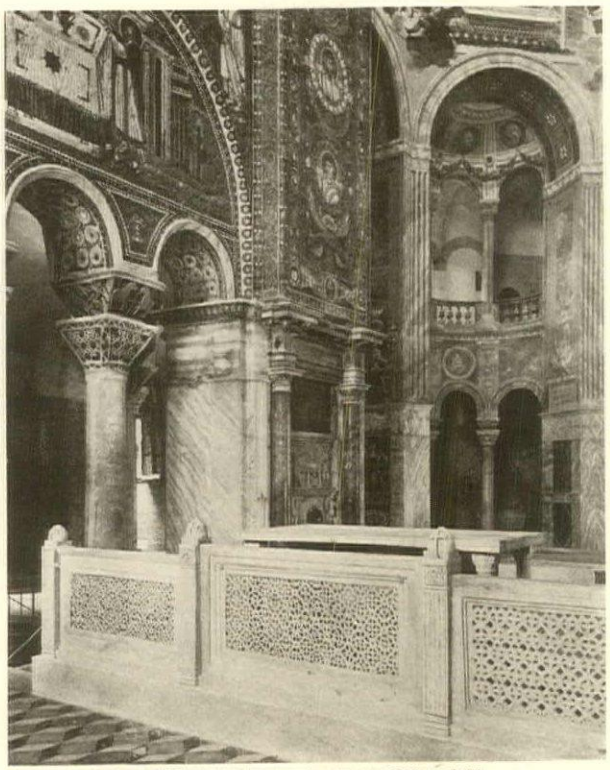
However, as the ritual became more and more elaborate and involved, so the first simple plans were necessarily changed to comply with the demands for more space. The apse was lengthened and the transepts were developed. These became more and more of architectural importance and, as it was seen that the projections formed useful breaks in the monotonous regularity of the building, it was but a logical step to their employment in the cruciform church plan. We see in England the great central tower springing from the nave and the cross walls, and requiring the abutment of the transepts to support its great weight.

The cloister is a survival of the atrium, which was suggested, probably, by the atrium of the private residences in Rome. This forecourt helped to screen the interior from the gaze of the curious, besides providing a place for the worshipers who were not yet fully qualified to partake of the services within. The two ambos have been converted into the modern reading desk and the pulpit, placed opposite each other.

There was one change which took place in the interior arrangement of these earlier basilicas as they were developed in later years. The original position of the bishop in the center of the apse, with the altar in front of him, has been changed to the side of the choir with the altar occupying the central position against the wall of the apse. In St. Peter's at Rome the old arrangement has been adhered to, with the Pope's throne high up in the middle of the apse.



Cloister of St. Paul's-Outside-the-Walls. These marble columns are of onyx from Egypt.



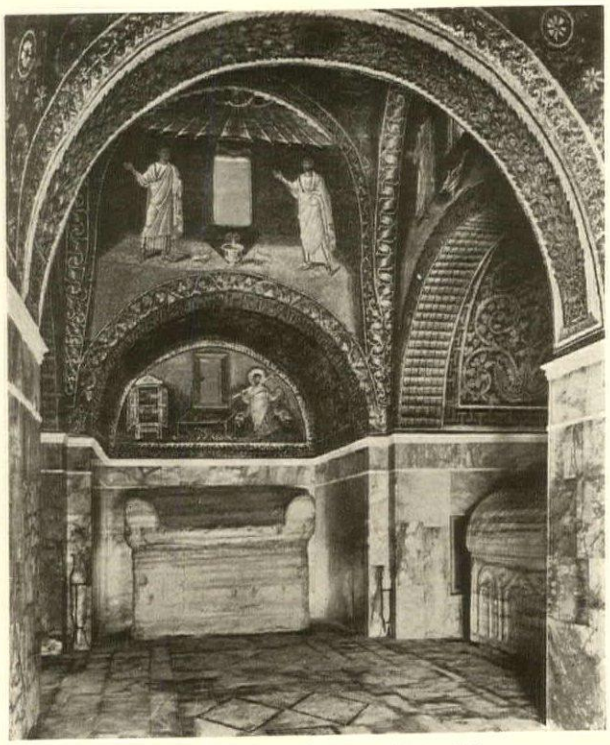
Photograph from Thos. G. Machen, Architect, Balto., Md.

Interior of St. Vitale, at Ravenna, built in the sixth century. The screen is marble, as are the walls, floors, columns and much of the decoration. Notice the dosserets.

Many of these early churches were dedicated to patron saints, and we find great reverence paid to them. Usually a circular or many-sided building adjoined the basilica, which contained the shrine of the saint. This was the baptistry of the church. Later the shrine was placed under the altar in the apse and finally secondary altars were built in honor of subsidiary saints, and it was necessary to build apsidal recesses for their accommodation. These were placed at first on the sides of the central recess, but as the main apse developed into the choir and occupied the full width of the building, the shrines were placed in the transepts or in the main central apse. French cathedrals were distinguished by this last arrangement.

Another type of Christian church that we find during the years that followed Constantine is the round or polygonal type, symmetrical around a geometric center. They are in great variety, from the old baptistries above mentioned to complicated systems of aisles, niches, chapels and arms radiating about a round or polygonal middle, like San Vitale at Ravenna. They were not suited to the whole ritual of the Christian church, but were a Roman form suited for monuments such as the tomb of Cecilia Metella.

In the fifth and sixth centuries, Ravenna on the Adriatic coast built many important churches. As there were few Pagan temples to supply the materials, it was necessary to work up the details for the basilicas to fit the places they were to occupy. We find, therefore, a better quality of architecture, and it differed greatly from the Roman in style. Since Ravenna was in close touch with the East and was subjugated by the Byzantine Emperor Justinian in 537, we find her adapting many features of the Orient



Photograph from Thos. G. Machen, Architect, Balto., Md.

Mausoleum of Galla Placidia, showing barrel-vaults used to form a dome.

and combining them with the classical Roman.

Constantine had transferred his seat of power to Byzantium and carried with him many of the columns and capitals of the principal Roman buildings. These were incorporated into the new buildings shortly begun by him and his successors. But, as Byzantium was in direct contact with the other nations of the East, there was quickly manifested an Oriental richness in the architecture.

While it is true that there were domed buildings erected by the Romans, such as the Pantheon; yet, because these were domes placed upon buildings which, for some special reason, were circular in form, they were not true solutions of the problem of

Photograph from Thos. G. Machen, Architect, Balto., Md.

Byzantine capital, with its massive pyramidal form, and carved with incised basket-work. The impost block was placed directly upon the capital.

Photograph from Thos. G. Machen, Architect, Balto., Md.

Entrance to the Basilica of St. Mark at Venice. Notice the picturesque but wholly unstructural use of columns, the wooden cupolas over the five domes and the pointed arches. These are deviations from the Byzantine dating from later times.

placing circular domes over square plans; consequently, we cannot rightly classify Roman architecture as among the domed styles of the world. There was a crude effort made at Ravenna, as shown in the Tomb of Galla Placidia (about 440 A.D.), to secure the effect of a pendentive dome; but it was in reality only four barrel-vaults on four sides of a square.

Photograph from Thos. G. Machen, Architect, Balto., Md.

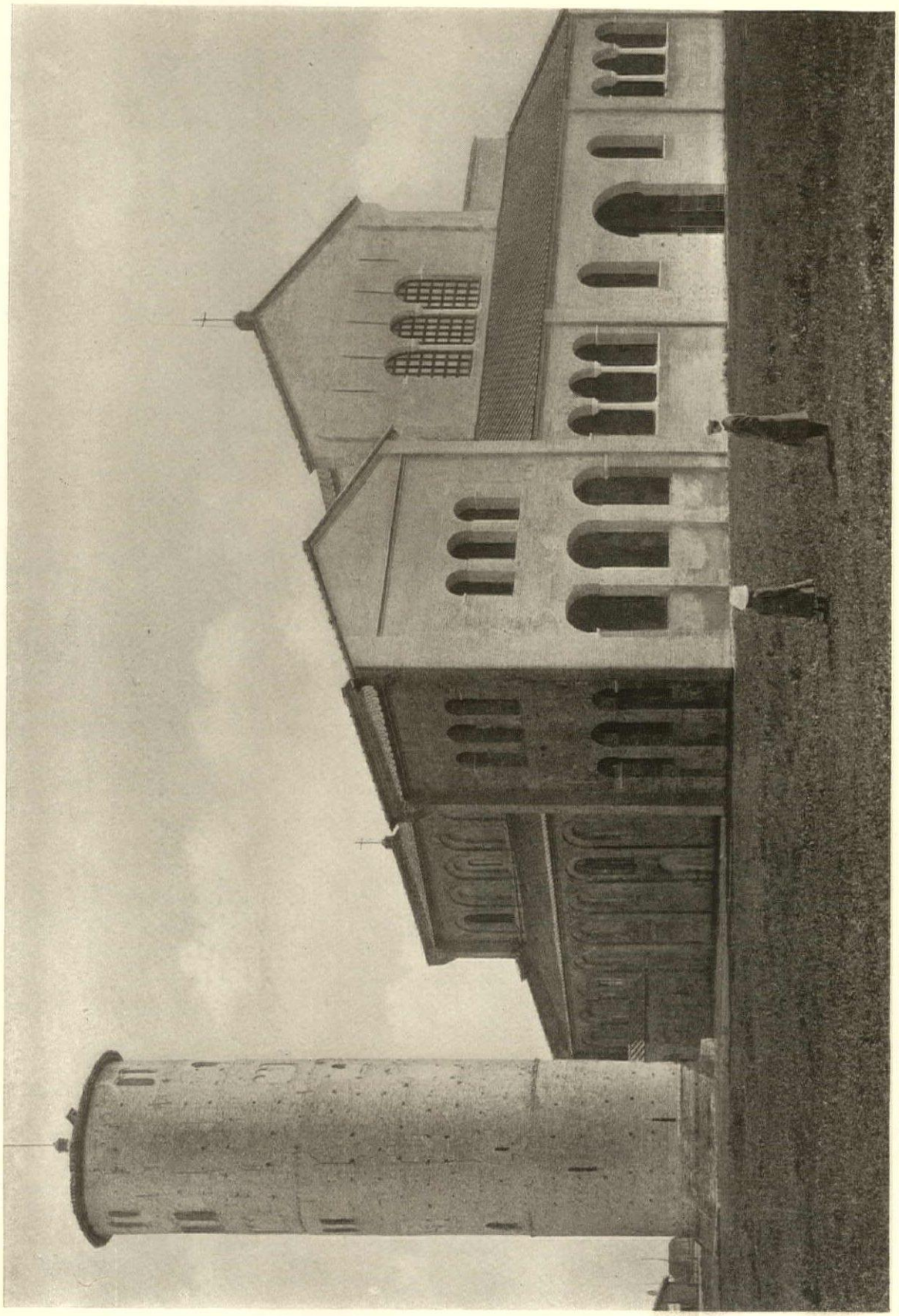
Interior of the church of St Apollinare Nuovo, at Ravenna, showing the side wall of the nave, the clerestory windows, the impost blocks above the capitals and the side aisle with its lower roof.

The true dome, as exemplified in the mosque of St. Sophia in Constantinople, and the brilliant interior decorations, were the two distinguishing features of the Byzantine. The dosseret or impost block was one of the minor details. This was usually shaped like an inverted pyramid and was placed between the capital proper and the springing of the arch.

The influence of the Byzantine style upon the architecture of Western Europe was slight. The church of St. Mark at Venice is perhaps the most brilliant example of this style. The original church was destroyed by fire and the present building was begun in 977 A.D. It was probably erected by builders from Byzantium; for, if we except minor details of later date, it is purely Byzantine in character. The churches of San Lorenzo, at Milan, and the cathedrals of Torcello and Monreale show Byzantine detail.

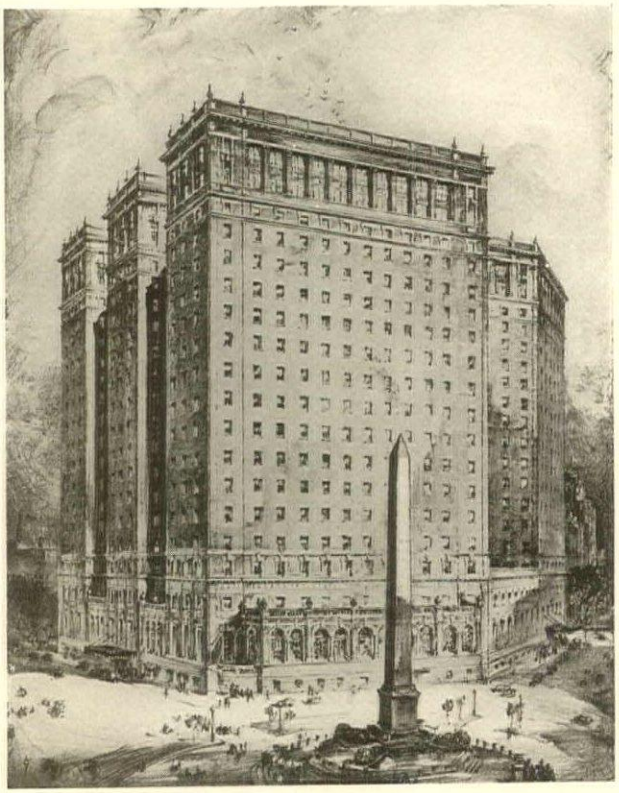
Among the basilican churches at Ravenna which show the influence of Byzantium are two that have been preserved in fair condition. These are the St. Apollinare Nuovo (A.D. 525) and St. Apollinare in Classe (A.D. 549). This latter is about three miles from the city, in what was formerly the port. The ancient Cathedral of Ravenna, by all accounts the most remarkable structure in the city, was destroyed by fire in the last century. It contains examples of the "wind-blown" capitals, in which the leafage is carved as if blown by the wind, and which are also found in St. Sophia and St. Mark's in Venice.

While the Byzantine style had no great effect upon Western Europe, it became the recognized form for the buildings of the Greek Church and it exerted a considerable influence upon the form of the Mohammedan mosques. It is still the style practiced in the religious art of the Balkan States and of present-day Russia. At its best, it is a remarkable combination of Greek details and Oriental warmth and color. Only in its treatment of mosaics can it be called barbaric.



Photograph from Thos. G. Machen, Architect, Balto., Md.

Exterior of St. Apollinare in Classe. The use of external arcading to give some slight adornment to the walls and the round bell-tower of brick is the first step towards the development of the "wall-veil" and the campaniles of later centuries.



The vast new hostelry recently opened in the city of Buffalo.

# BUFFALO'S MAMMOTH NEW HOTEL

**The Statler, Largest Hostelry Between New York and Chicago, makes extensive use of Marble for Interior**

IN upper New York State there ran, in 1795, an old post road, winding past a dozen scattered houses. One of these was a tavern operated by a man named Skinner, of whom the Duke de la Rochefoucauld said: "If he kept a tavern, he kept nothing else; neither furniture, rooms, kettles nor milk." Judging from the Duke's comment, the tavern was not especially palatial. It was, however, the center of the crude social life of the neighborhood, and the cluster of homes later became a thriving village. This village was eventually named Buffalo.

From Buffalo's first tavern to its latest and largest is a long step, but in this step is the evolution of the modern hotel. The new Statler, which opened its doors to a throng of two thousand invited and pleased guests on May 19th of this year, is the most imposing figure on the city's sky-line. It looms up nineteen stories high and spreads over a block of ground. It fronts on five of Buffalo's main streets. Its location, opposite Niagara Square, upon the site of two previous hotels, the Castle Inn and the Hotel Fillmore, is very happily chosen.

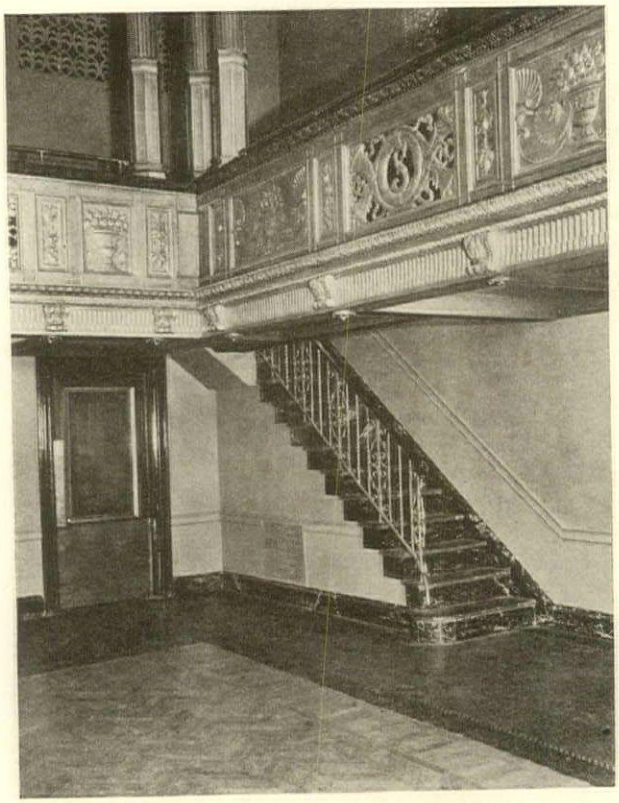
The exterior is in the style of the English

Georgian, especially suitable for a structure of this character. Upon a foundation of concrete-filled steel piles driven forty feet into the ground to bed rock, the frame of steel girders rests solidly. The main entrance is on Delaware Avenue. This, as well as the three other entrances, are each protected by an artistic marquise.

The Delaware Avenue entrance is outlined in its entirety in black and gold marble of exquisite veining, the polished slabs most excellently matched. In the huge solid block over the center is carved the name Statler. The spacious vestibule leads into the main lobby, with its vaulted ceiling in the style of the Italian Renaissance. The walls, twenty-eight feet high, are lined completely with Botticino marble imported from Italy, with bases of darker-veined black and gold. The colors of the Ispahan rugs combine with the walnut furnishings in the Italian style, with their richly colored mohairs, velvets and tapestries, to add beauty to the handsome marble walls and columns.

To the left, up a short flight of marble steps, through an entrance-way supported by marble columns of the Ionic order, leads a foyer giving access to the ballroom. Oriental rugs similar in pattern to those of the lobby carpet the floors. The furniture

Entrance to Ballroom foyer. The walls are of Botticino marble; the steps are of black and gold.



Corner of Ballroom in the Hotel Statler, Buffalo. Marble is effectively used to enrich the gold decoration.

here is upholstered with fine silk and metal velvets.

The ballroom is a spacious Italian apartment, with a balcony on three sides ornamented in antique gold. The walls are Pavanazzo, with a base of marble of a darker color. The ceiling is painted to simulate a sunny blue sky with large fleecy clouds drifting by. It is recorded that a dozen artists worked continuously eighteen hours to achieve the proper effect.

A concealed concert-organ is installed in one end of the room with the console in the balcony. Opposite is a raised stage, equipped for theatrical presentations, with dressing-rooms for the performers. A curtain of rose satin similar to the window hangings closes the stage opening, and matches the rose coverings of the walnut furniture, and the Italian black and rose pattern of the carpet. A fireproof booth in the rear of the console organ contains apparatus for the projection of motion pictures.

To the right of the main entrance, in the lobby, is the entrance to the palm room. Three marble steps lead to a slightly higher level, and here, beneath the flat arches of the roof, surrounded by the growing greenery, the guest may enjoy the exotic beauty of the palm room. The walls of Botticino marble reflect the shimmering lights, and the two wonderful antique tapestry panels blend with the greenish-blue pepper-and-salt rugs.

Overlooking the palm room is a balcony with double arches supported by square columns with Corinthian capitals. The openings are filled at the bottom with boxes of vari-colored ferns. Handsome vases upon carved stands suitably placed around the floors contain luxuriant and massive palms.

Beyond the palm room is the entrance to

Palm Room, with the entrance to the main Dining-Room at the rear.

Section of the main Dining-Room, with terrace showing through the arches on the left. The walls are of Botticino, and the columns of Cipollino marble.

the main dining-room. Here the walls of Botticino marble contrast with the monolithic columns of Cipollino, with its greenish tones and wavy bands. A terrace at each end is separated from the main room by gilded wrought-iron balustrades. On the east end is a huge organ with only the console showing. Opposite is a monstrous tapestry, considerably the largest in the building. The furniture is walnut, the chairs after a pattern found in a medieval castle in a remote part of Italy, being upholstered in a soft bluish-green.

A black Axminster carpet covers the floor. This was copied from a rather ancient Italian print found in a document. The lighting fixtures comprise both suspended polychrome ceiling clusters and wall lamps with decorated parchment shades.

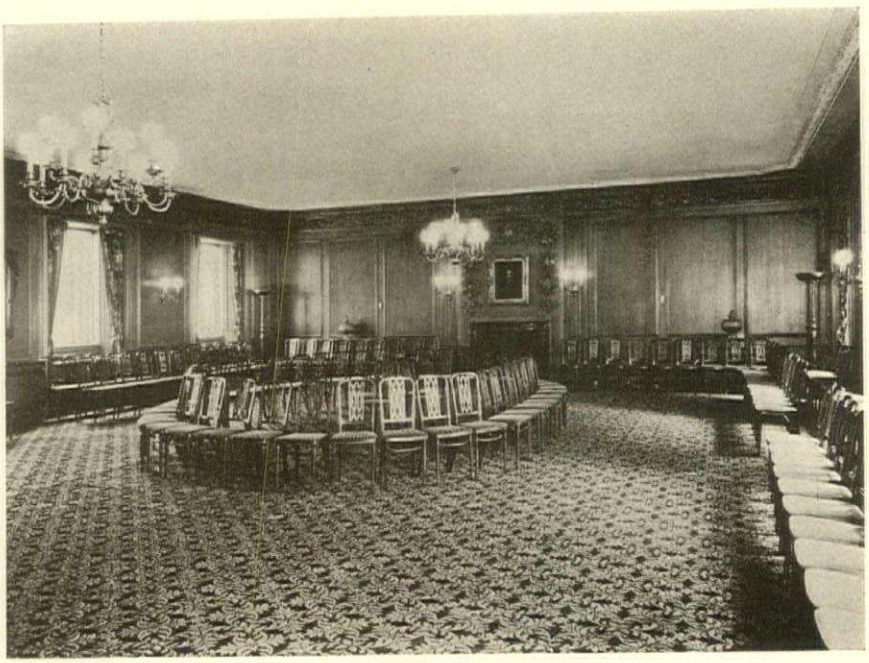
On the Niagara Square side of the dining-

room is a raised terrace or loggia, where the diners may have an unobstructed view of the Square. There the ceiling is done in a foliage and trellis design after a masterpiece in the Villa of Papa Giulio in Rome.

Marble is used extensively in many other parts of the building. The men's cafe has its columns, door and window trim of Travertino, with flooring of tesellated Terrazzo. Bases and fireplaces of different marbles are used in the Georgian dining-room, the library, the Chinese room and in many other rooms of the hotel.

The Chinese Room, one of the private dining-rooms. This is finished with highly artistic lacquers.

The variation in the floor levels is a noticeable feature in the Statler, and the usual monotony of great floor spaces is completely eliminated. Besides enhancing the effects of the decorations, it lends intimacy to the rooms and furnishes pleasing contrasts.



The Georgian Room, another of the private dining-rooms. Notice the marble fireplace. Marble is freely used throughout the Statler.

Throughout the guestroom floors but three color schemes are used—rose, fawn and blue—and on any one floor one color always predominates. There are 79 guestrooms to each floor, and 14 floors, and all but two of these have both tub and shower baths. There are at present over 1100 guestrooms, but provision has been made for the addition of 500 rooms in another wing when the necessity arises. A novel feature is a radio station on the top floor.

# A HANDBOOK ON MARBLE

*It is the purpose of the National Association of Marble Dealers, to publish as soon as possible, a handbook on marble. The material contained in this book will be contributed by those best qualified to speak in an authoritative manner on the various matters treated. This is the fourth installment and contains part of the second chapter, written by John Stephen Sewell, President of the Alabama Marble Company. These extracts will probably undergo some slight changes before appearing later in book form.*

## CHAPTER II—The Production of Marble (*Continued*)

TRUE Marble deposits nearly always retain some trace of the laminated structure common in sedimentary rocks, but rarely the open beds often found in Limestones. The thin seams of mud or clay that are the apparent cause of the open beds, are metamorphosed into Schist and incorporated as a vein in the Marble, in the process of metamorphosis: but they may subsequently become open again, if one part of the Marble deposit is made to slide relative to another part. Schist veins are weaker than the Marble; and may yield to such stresses, at a stage in their history when conditions do not admit of reconsolidation by plasticity, recrystallization, etc. Under these conditions, the Schist may be deeply weathered, making a real open mud seam, to a considerable distance from the outcrop.

While Marble deposits do not occur usually in layers physically separated by open beds, they are nearly always separable into layers, by variations—sometimes by abrupt changes—in such characteristics as the tone (and sometimes the texture) of the ground mass; amount, character and disposition of the color, etc., etc. Usually these "layers" are parallel with the original bedding planes, and the character of the stone varies less rapidly from point to point in a given layer than it does from layer to layer. Yet there are local exceptions to this rule. However, if a given layer is full of "flint balls," or Pyrites, or Quartz crystals at one place, it is likely to retain these undersirable features over areas much greater than those covered by the average Quarry opening.

### COLOR VARIATIONS IN ONE LAYER

Variations in the tone of the ground mass from white to blue and back again, and in the amount of "color," may be expected in any one layer within distances of a few feet. This is especially true of white Marbles, though similar variations are not uncommon in other Marbles.

The scientist has discovered by means of the microscope and chemical analysis, many impurities not mentioned above, but those not mentioned are rarely the source of trouble to the Quarryman, and their study is too intricate a subject for discussion here. Some of them which give to the "fancy" or variegated Marbles their peculiar beauty and value will be noted later.

By far the greater portion of the Marbles used in the United States, both for building and interior finish, belong to the classes known to the trade as white Marbles (nearly all more or less veined and clouded), Monotones (like Botticino, Tavernelle, Tennessee and Missouri Marbles), and Verde-Antiques. The white Marbles are usually thoroughly metamorphosed and all trace of any fossils they may have contained is destroyed. The Monotones are highly crystalline or semi-crystalline, but generally retain more or less evidence of fossil remains. The Verde-Antiques, derived from igneous rocks, are, of course, devoid of fossils.

Any discussion of the subject-matter of this chapter must be made with these three general classes of Marbles chiefly in mind. What has been said so far is intended to lead up to such discussion, even though much of it may seem like a series of digressions.

### FOLDING AND CRUMPLING

It remains to point out certain large scale structural features induced in Marble deposits by earth movements and stresses, and the effects of these agencies, combined with the subsequent one of erosion, upon the present attitude of the deposits and the distribution of their outcrops. Opinions differ as to the ultimate causes of earth movements and stresses, but there is no doubt of their existence. Whatever causes them, can safely be called dynamic agencies—and the Geologist refers to their activities as "Diastrophism." They have caused large areas of the superficial outer part of the earth's body—involving a thickness, sometimes, of miles—to crumple and fold up into mountain chains, with resulting metamorphosis, more or less complete, of the rocks involved. Subsequent erosion by the weather has exposed masses of rocks that must have been deeply buried when the crumpling began. This is inferred from the fact that we find them folded and distorted without fracture, in a manner that can be duplicated by artificial means only under great pressure, or under high temperatures, or under both conditions at once. A small amount of moisture, such as must always exist in the natural rocks, seems to facilitate these processes. It is found that cracks or joints also exist in these folded and crumpled rocks, but under such conditions that they must be due either to shrinkage or to other stresses applied after the folding and crumpling had taken place, and when the conditions no longer permitted the rocks to yield and flow like plastic bodies. Of course, intermediate conditions are found, where the rocks yielded partly by folding or flowing and partly by fracture.

Marble deposits of some thickness are sometimes found folded, in both anticlines and synclines, so sharply that the folds have completely closed up, so that the layers are repeated in the same order, going out or in, or up or down, from the line where the two branches of the folds were pressed together. (See Bulletin 521, U. S. Geological Survey, Fig. 11, p. 79.)

Often where a deposit is sharply folded, it is quite sound, and yet the same deposit may be quite unsound a short distance away, where no folding is apparent.

It is a fair inference that the unsoundness was due to a stress subsequent to and probably less severe than that which caused the folding, and occurred after the Marble was so nearly exposed by erosion of overlying materials, that the conditions for plasticity no longer existed.

Sometimes it is apparent that Marble beds have been subjected to stresses tending to cause a shearing stress more or less parallel with the beds; that is, tending to cause the upper parts of the beds to slide relatively to the lower parts. If there were veins of "color" parallel to the beds, and if the stress resulted in actual sliding, not only will the Marble have a strongly marked "grain" in the direction of the slide, with crystals elongated in that direction, but the "color" will often be distributed throughout the thickness of the layer, by a process called "drag folding." If this process is carried very far, it may result in a uniform distribution of "color," which shows the same or similar characteristics on a sawn face, no matter how the block is sawed. But it usually results in diagonal streaks, which may be broad and wavy when the block is sawed

in one direction, narrow and straight when sawed in another and narrow and wavy in the third direction. In such cases, "matching" is difficult and such half-finished "drag folding" may be a serious handicap. For a full discussion of this subject, reference is made especially to LEITH'S STRUCTURAL GEOLOGY, listed in Chapter I. At least one case is known where a Quarry was opened on a deposit of white Marble with viens of undesirable Schist running through it at intervals of from eighteen inches to five or six feet. The marble between the Schist beds (they are sometimes a foot or more thick) is a very desirable grade of white marble, which is extensively used for interior purposes. The deposit everywhere shows evidence of the differential sliding above described, with some tendency to the formation of "drag folds"; but generally the blocks can be taken from the Quarry by splitting the Schist beds, and the good marble, free of Schist veins, sawed out from between the streaks of Schist. But the Quarry above mentioned was opened at a point where the dynamic agencies—or the diastrophism—had been locally much intensified. "Drag folding" had occurred in two directions, apparently, and the result was to convert the entire mass of marble into a series of moderate sized lenses of beautiful material separated from each other, on all sides, by material too full of Schist to be of any use. Unless these conditions change with further development, it will be impossible to make a success of this Quarry, for every slab of any size will have one or more of its corners cut off by a loose and open streak of soft, greenish gray Schist. The slab will come apart along these streaks, the Schist will not polish, and the purity of the remaining material makes the contrast with these irregular and muddy streaks so disagreeable, that no architect would willingly accept the material, even if the Schist streaks were tight and would polish. It may be stated here that "unsoundness" of any kind in a piece of white marble is a disqualifying defect. No patching or filling is allowed.

In the light of experience, it is easy to see that the cores and the initial exposures of the rock in the Quarry above mentioned carried plain indications of the unfortunate state of affairs. But no one except a skilled Marble man with a fair knowledge of "drag folding" as a geological phenomenon, would have been able to interpret the signs. At that time, at any rate, there was probably no such person. The property had been thoroughly prospected and highly recommended by a reputable firm of mining engineers. They are not to be blamed. They were confronted by conditions undoubtedly without precedent in their experience, and no drill ever produced any more beautiful cores from a marble deposit than those produced from this one.

### CHANGES DUE TO METAMORPHISM

It is manifest that the dynamic agencies involved in metamorphism may change what were originally more or less straight veins of color into crinkly wavy lines, still approximately parallel. They may give to the marble a well-defined "grain" in the direction of thrusts; they may distribute the color by "drag folding," so that it is no longer even approximately parallel with the beds; they may mix it so thoroughly with the ground mass as to give a close uniform distribution of clouding or veining practically alike in all directions, as in the ordinary grades of white Italian Marble; they may break an entire deposit into irregular fragments, which may be later consolidated by pressure, by heat, by both together, by cementation due to infiltrating waters, or by all of these agencies combined; or finally,

they may fold, rupture and tilt the entire mass in a very complicated fashion, often breaking it into fault blocks and separating surfaces once in contact, by distances of thousands of feet, or even miles. They may raise the marble and thrust it over on top of younger rocks, or they may raise older rocks and thrust them over on the marble. The thickness of the strata involved, and the extent of overthrust, are sometimes incredible; but the facts are plainly evident and cannot be denied. Fundamentally, it is to these agencies of "diastrophism" that we owe the existence of Marble; at least the more valuable deposits. But Nature is no respecter of materials and does not cease to operate on a rock when it has reached that physical condition that men would regard as the most desirable. So, a continuation of the same activities may, for the purposes of the Marble man, undo much of the good that may have been accomplished in past ages. Everybody—producers, manufacturers, and users—must accept Marble as Nature left it, make the most of its qualities, and eliminate, as far as possible, its defects. Possibly the fact that the material always suggests an ideal which, while unattainable, may be closely approached, is one of the fundamental reasons why it is highly prized. It certainly affords unlimited scope to ability in design and execution, and fully responds to the highest degree of mechanical artistic skill.

### PRELIMINARY CONSIDERATIONS IN DEVELOPING A QUARRY

For convenience of reference, the "strike" and the "dip," and the direction of the "grain" if it is well marked, the scheme of distribution of the "color," and the directions and arrangement of the prevailing "cracks" or "unsoundness," may all be referred to as the "structural" features of a Marble deposit. Due regard to all of them is often necessary to success on any scale, and is always necessary for the best possible results. It should be the aim of the Quarryman to produce his marble in the form of rectangular blocks of sound material and of suitable dimensions. If it is to be used for interior work, in thin slabs, considerations of strength of slabs, ease in working, and freedom from breakage, demand that the greatest dimension of the block be in the direction of the "grain." This is almost always parallel to the dip of the beds, or nearly so, but there are exceptions. The distribution of the "color" nearly always bears a close relation to the "dip" and the "grain"; usually, the "color" is more controllable, "matching" easier, and the average grade of the material higher, if the length of the block is with the "dip."

As a result of the above consideration, the best result will usually follow if sound blocks can be obtained by quarrying with the "strike" and the "dip," the greatest dimension being in the direction of the "dip," unless, as occasionally happens, the thickness of a bed is greater than the length desired. The blocks should be separated parallel with the beds, at places where the character of the stone changes, and always, as far as possible, in material of the least value, for there is considerable waste involved in this operation. Even if the deposit is absolutely sound, the waste involved in quarrying cannot be kept much below 20 per cent of the volume of stone as it lies in the ground, which means 25 per cent of the volume of the blocks as measured for sale, even under the best conditions.

Unfortunately, the unsoundness does not always, nor ordinarily, parallel the "strike" and the "dip." If the cracks are close together and make a very acute angle with the "strike" and the "dip," then the blocks

should be quarried with the bedding and with the unsoundness. This will nearly always result in a less desirable distribution of "color"; but soundness is the first requisite in a block of marble if it is to be a commercial product, and the grade of the marble is of secondary importance.

### GEOLOGIST'S SERVICES DESIRABLE

There are exceptions to all rules, including those just stated; but in opening a new Quarry they cannot be safely disregarded.

If the proposed new Quarry is on a deposit on which successful Quarries are in operation—not too far away—much may be inferred as to the lithological character and marketable properties of the stone in the proposed opening, from a study of the finished product of the operating Quarries as exhibited in actual buildings, and from a comparative study of the outcrops at the actual and proposed Quarries. The latter study combined with a study of the geological reports, if any, on the given deposit, may justify inferences as to soundness, as to how the marble lies, and the amount probably present in the prospective property. Here, however, if the expectant producer is himself a skilled Quarryman, and can work with a good field Geologist in the practical details, he will find the Geologist's services worth all that they cost. If he is not a skilled Quarryman, he should seek the advice of a Geologist and a skilled Quarryman, and the two should work together. The Quarryman should be one familiar with the particular deposit, if possible, otherwise experience in a different field may actually lead him to wrong conclusions; and few people are more tenacious of their opinions than those who have acquired them slowly as the result of struggles with the uncompromising facts of Nature, in a limited sphere.

### MAKE SURE OF YOUR MARKET

If the deposit has never been developed, then the first question to be decided is whether the marble can be sold at all, and, if so, the probable extent of the market. The market for marble is by no means unlimited. It is doubtful whether the United States has ever used more than 4,000,000 or 4,500,000 cubic feet of marble, in a year, for all purposes—exterior building work, monumental work and interior finish. The last named branch of the business fluctuates less than the others, but it probably never uses more than 1,500,000 cubic feet in a year, of which about 40 per cent usually consists of imported marbles. Of these, a considerable part are highly colored fancy marbles for which there are, so far, no American equivalents, so they cannot be included in estimating the probable market for a new American Marble, unless it is of a kind not hitherto discovered.

The market will take a very limited amount of the selected grades of various kinds of marbles, at what seem to be very good prices; but it will not take any more at any price. The selected grades do not occur anywhere in large available quantities, and without the larger market for the medium grades, no large marble-producing enterprise could exist. Even here, the market is distinctly limited, though concessions in price may sometimes enlarge it to a slight extent.

The use of Marble for exterior building purposes fluctuates from almost nothing to probably 1,500,000 cubic feet per year, but the price is not high.

The monumental trade seems to fluctuate less than the exterior marble trade and more than the interior. It will pay a very fair price for selected material, but the bulk of it is of medium grade and sold at rather close prices.

The use of Marble generally is increasing with the growth of the country; but there has never been any real shortage, and only temporary urgent demand, usually due to the desire to finish some one or more large jobs in a very short time. So, a new operation, if on a large scale, must count on taking away from established concerns a part of the business they have.

On a small scale, it may find its place in supplying a part of the gradually increasing demand.

In the production of standard grades of White Marble, or of popular grades of Monotone Marble, for interior use, an annual business of 100,000 cubic feet is a large operation.

In Verde-Antique, a production of from 10,000 to 12,000 cubic feet per year is of corresponding proportions. In other less used varieties—among them some that are highly prized for special decorative effects—the possible marketable production from any one operation is much less.

The production of an exterior marble from a given Quarry is likely to vary from nothing at all to several hundred thousand feet a year.

For monumental work the possibilities are more like those of the interior business. As compared with the steel business or even with the stone business, as a whole, the marble business is one of moderate proportions. It is, however, one of great stability when once established.

### SECURE SPECIMENS FIRST

If the prospective producer is not already a Marble man, he must find out first how his marble will be classified by the trade, in case he is able to produce it. To do this with certainty, some blocks of reasonable size must be gotten out, sawed and polished. Polishing is not necessary if the stone is to be used for exterior purposes only. The blocks need not be of commercial size, but they must be large enough to afford reliable samples. Two to three feet wide, and, at least, four feet long, should be sufficient, but less than this would not.

Blocks should be secured from several different levels in the deposit. By taking advantage of existing cracks, it may be possible to detach the blocks with explosives, but great care must be used, for explosives will propagate cracks in Marble, and render it unsound for many feet, even where it was no so before. It is much better to get trial blocks by drilling and wedging, or even by setting up a small channelling machine, or by the use of a wire saw.

Samples obtained as indicated should settle the question of the class into which the marble will fall, and therefore the size of the market available. It is easy to get an exaggerated idea as to the size of the market. A manufacturer who has ever experienced any difficulty in securing marble similar to a new one, is very likely to say that there is "a very great" market for it, if it can be produced. It is well, in such cases, to find out how many cubic feet per year he himself would use, if it were available, and then do a little independent figuring.

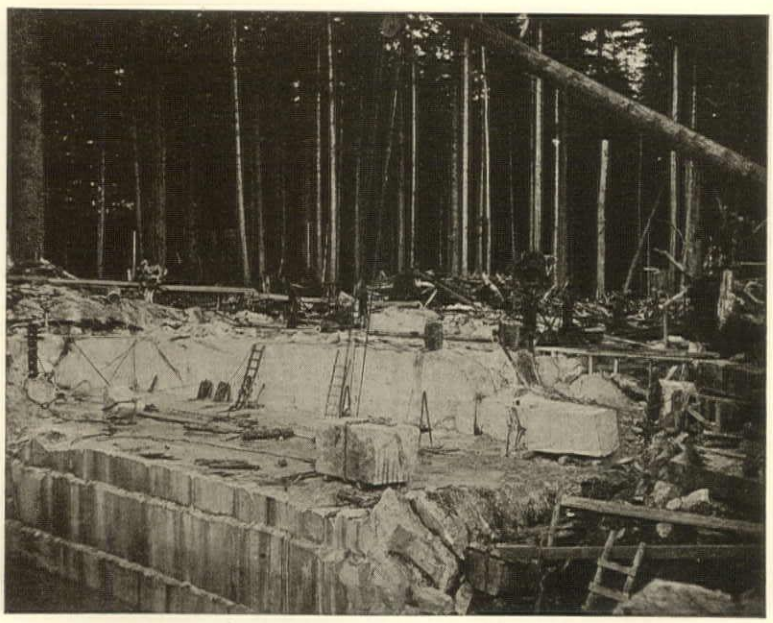
If the outcrop of the marble is covered with earth or other overburden, it will cost something to secure samples as above described, but as a first step, this will yield more information at less cost than any other.

### LOCATION OF QUARRY

Having progressed so far—having decided that there is a market for the stone, and about how much per year the market may be expected to take—the next step is to learn the extent and attitude of the deposit, and to select, as nearly as possible, the best location for a Quarry. If the marble out-

crops on a hillside, as it often does in the North, it may be easy to examine it over great distances and at frequent intervals. If it is entirely buried, recourse must be had to a drill, and even where the outcrop is accessible, the drill is needed to answer many important questions. It should be remembered, however, that a drill hole in a Quarry is just as objectionable as a crack. The drill holes should be carefully and systematically located, so as to be as few as possible, do the least possible damage, and yield the greatest possible amount of information. A preliminary survey of the deposit as a whole by a competent Geologist, and the judgment of a practical marble man are both valuable, if not necessary, in locating the holes. The information to be obtained comprises the strike and the dip, the actual thickness of the deposit, the character of each layer, the amount and direction of any change in the dip, and the condition as to soundness, so far as possible.

It is highly important that the property lines of the proposed operation shall include a large mass of the deposit, if a permanent business is to be developed. It is desirable to own or control a very considerable distance along the strike, and to locate the property so that the marble, whether constant in dip or not, shall dip under the property rather than away from it. At the same time, it is necessary to have suitable dumping grounds for overburden and waste and space for shops, etc., so located that subsequent Quarry developments will not interfere with them nor be hampered by them.



View of a surface quarry in Alaska. Marble was first produced in Alaska in 1908. Since that time, marble from this section has been used for a large number of building interiors in the far West, while considerable Alaskan marble has been installed also in the middle West; and in more limited amounts in the East.

# LIST OF QUARRIES AND MARBLE MANUFACTURERS

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| Philadelphia, Pa. | John Hegarty Marble Company | John Hegarty |
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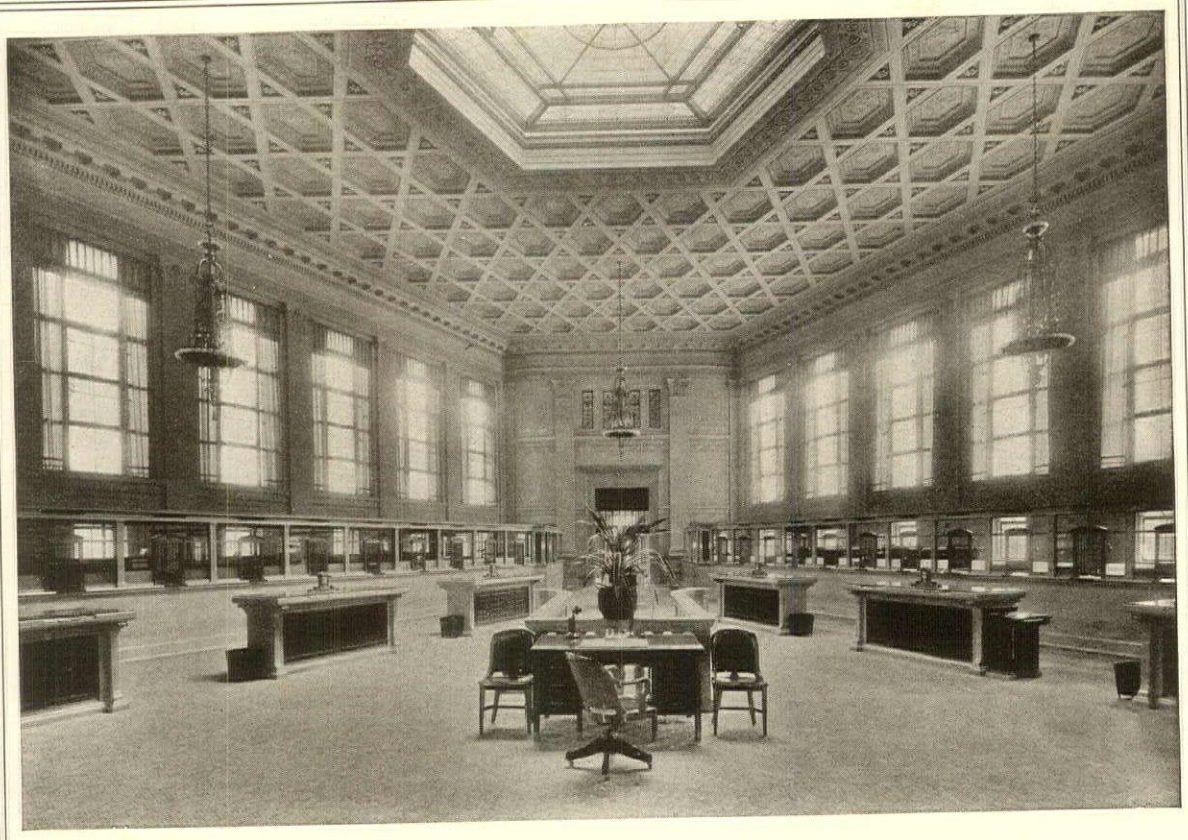

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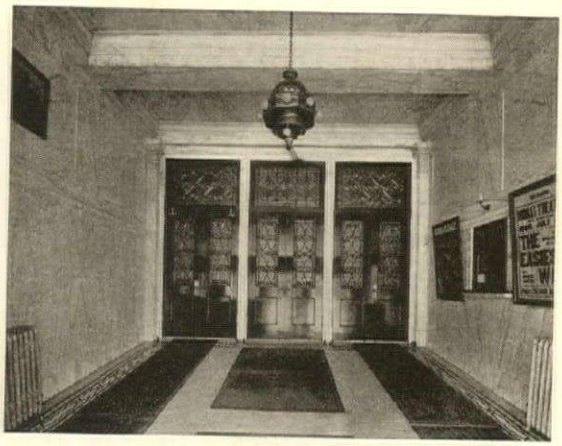

LOBBY and Theatre Entrance, Murat Temple, Mystic Shrine, Massachusetts Avenue and Michigan Street, Indianapolis, Indiana. Erected in 1910. D. A. Bohlen and Son, Indianapolis, Architects. Bedford Stone and Construction Co., Indianapolis, General Contractors. Wainscoting, panels, etc., English Vein Carrara Marble. Floors, marble mosaic.

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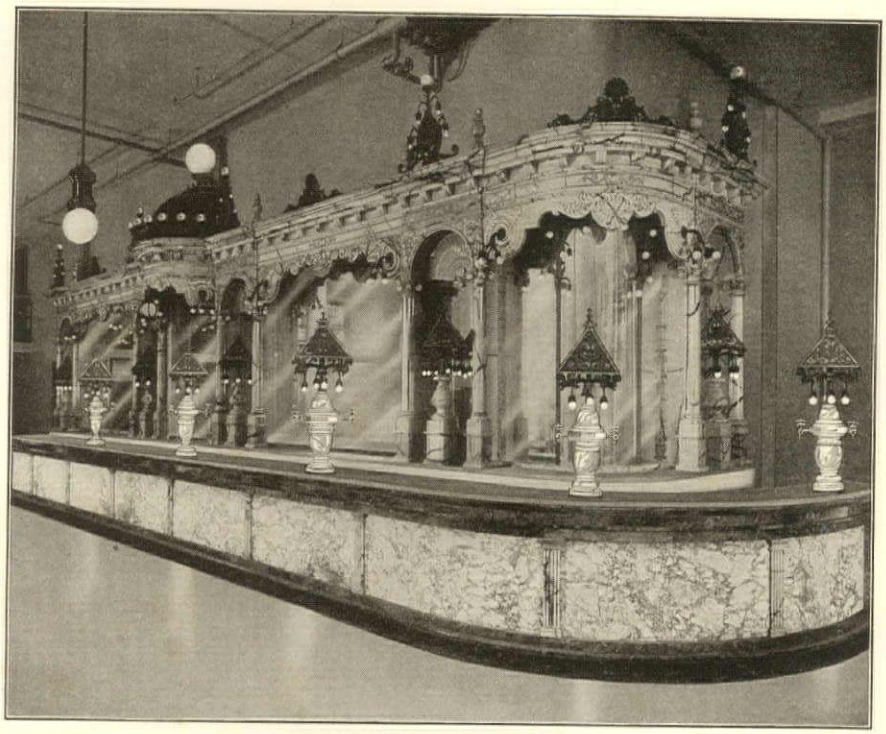

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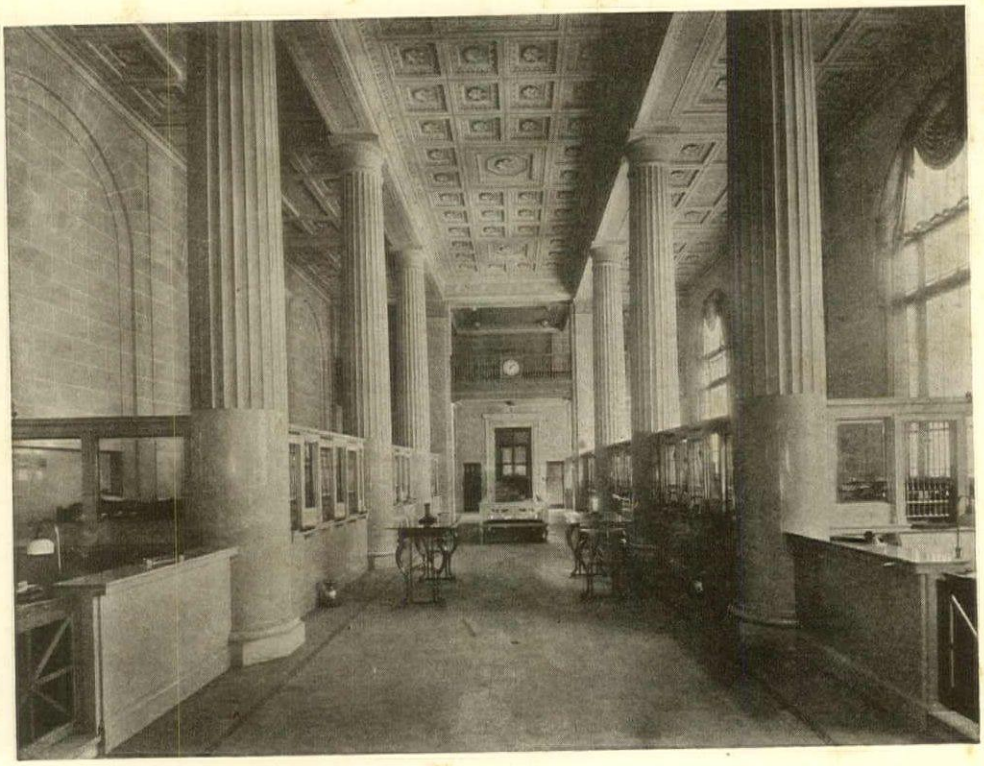

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