"A Study of Practical Problems for the Marble Industry"

By D. W. Kessler

(Published by permission of the Director, United States Bureau of Standards)

Stone

Vol. XLVI, No. 8, August 1925, pp. 479-481

The article begins:

> "The United States Bureau of Standards has undertaken a line of research for the purpose of solving some practical problems which have from time to time perplexed the producers of marble as well as those intrusted with its care in buildings. These problems relate mainly to the proper installation of interior marble and methods of keeping it in its original state of beauty…."

Note: On the last page of this document, you will find the article and photo graph from, "Cathedral Group in Stone" about the St. Mary's Cathedral group of buildings at Wichita, Kansas.

Peggy B. Perazzo
Email: pbperazzo@comcast.net
April 2016

A Study of Practical Problems for the Marble Industry

By D. W. Kessler

Published by permission of the Director, United States Bureau of Standards.

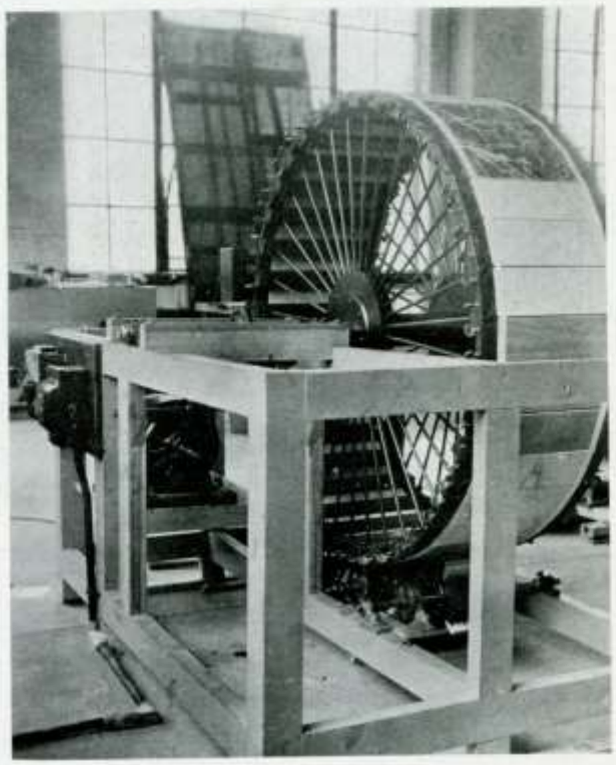
THE United States Bureau of Standards has undertaken a line of research for the purpose of solving some practical problems which have from time to time perplexed the producers of marble as well as those intrusted with its care in buildings. These problems relate mainly to the proper installation of interior marble and methods of keeping it in its original state of beauty.

Occasionally confronted with the question as to the cause of discolorations on interior marble the producer is apt to suggest that the staining matter came through from the brickwork or concrete wall to which the marble is attached. While this statement seems to be perfectly justifiable and is probably true, it is seldom possible to definitely attach the responsibility to any particular material. Chemical analyses on most marbles reveal the fact that they are nearly pure calcium carbonate or a combination of same with magnesium carbonate. Both of these compounds are naturally white and afford a good background for the small amounts of impurities giving rise to the veining and cloud effects which furnish the real distinguishing marks of the different commercial types. The snow-white background tends to magnify the appearance of any stain that may reach the finished surface of the marble, hence it is important to prevent the penetration of extraneous matter from the walls of the building as well as the absorption of stains at the exposed surface.

The different phases of the study will be as follows:

- (a) The relative discoloring effects of different materials in the walls to which the marble is attached.
- (b) The value of different waterproofing processes in preventing discolorations.
- (c) The removal of different kinds of stains from the exposed face of the marble.
- (d) The cause and prevention of decay of interior marble.
- (e) Cleaning processes, with particular reference to their harmful effects on the marble.

The discolorations and causes of decay will be studied first by means of specially built marble-faced walls which can be kept damp and made to dry out through the marble face, and second, by means of marble vats filled with water and fragments of various materials which are frequently used in the walls of buildings. The object in view will be to determine if certain marbles are more susceptible to discoloration or decay than others when employed under unfavorable conditions as well as to determine the effects on the marble from various backing materials. Both tests are primarily leaching tests in which the soluble matter from the materials commonly employed in the walls of buildings will be carried to the surface of the marble and deposited there. The most comprehensive part of this test will be with the vats since the simplicity of this process will enable one to test the effects of a great range of materials. The walls are mainly for the purpose of connecting up the results of the vat tests with the actual conditions.

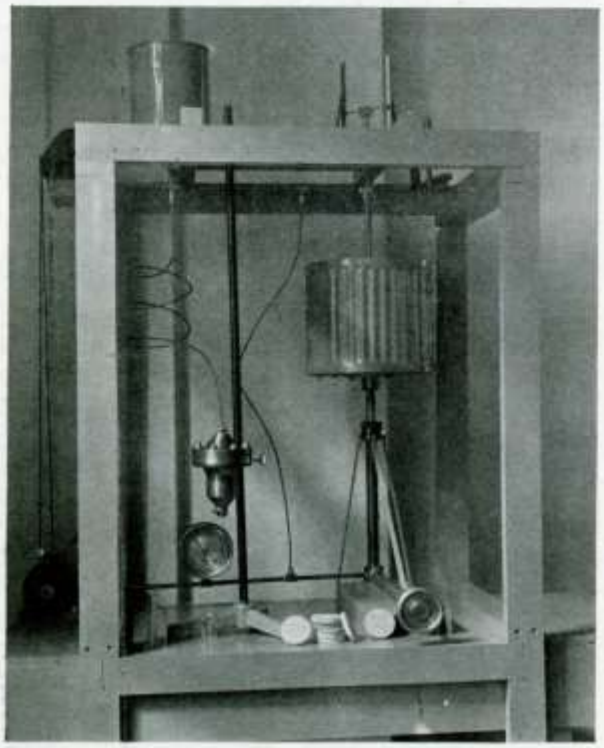


Apparatus Designed and Set Up by the Bureau of Standards for Long Period Scrubbing Tests on Marble.

It is very seldom that interior marble gives trouble from disintegration. This is of such seldom occurrence that only a few cases have been noted. We are accustomed to thinking of the disintegration of stone as taking place only when it is exposed to the weather and being due to frost action or chemical solution. However, it has been established by actual cases of interior masonry disintegration and it can be proven by artificial means in the laboratory, that the action of frost is

(photo caption) "Apparatus designed and set up by the Bureau of Standards for long period scrubbing tests on marble."

not a necessary agency to bring about decay of stone. The crystallization of soluble salts in the pores of stone produces a more severe action than frost. The writer has noted several cases where building stones of established reputation as to durability were disintegrating in buildings only a few years old. This kind of disintegration is more apt to manifest itself in the more sheltered parts of buildings as beneath balconies, window sills, cornices, etc. The reason for this is evidently because the water from rains soaks into the masonry on



Testing Apparatus Used by the Bureau of Standards for Determining the Permeability of Stone. Water Pressure Can Be Maintained at Any Desired Point Up to 300 Pounds Per Square Inch.

horizontally exposed surfaces, leaches downward carrying with it a small amount of soluble matter which it has dissolved from the masonry. This water finally comes to the surface at some point below and is evaporated. The dissolved matter does not pass off into the air with the water which carried it to the surface but is deposited on the surface and in the pores of the stone where evaporation occurs. This deposit of dissolved matter which collects on the surface is often referred to as efflorescence. The surface deposit may be partly carried away by rains but the portion which collects in the pores of the stone grows into crystals and finally exerts an expansive action similar to that of frost which results in surface scaling or frequently deep disintegration. The severity of this action is so great that any type of stone, no matter how strong or how dense, is apt to be defaced by it. Granite, which has the reputation of being the strongest and one of the densest of our commonly employed building stones is not immune from destruction by this process. A careful inspection of almost any stone building after a few decades of service will usually reveal decayed portions and the most common places for such are the lower surfaces of projecting courses. A good example of the decay of interior stone work will be found in the New York State Capitol building. In the portion occupied by the famous million dollar stairway the walls are tiled with red sandstone from Scotland. At the top landing an examination of these walls will show several conspicuous patches of efflorescence accompanied by pronounced exfoliation of the stone. This is not an isolated case but is cited because of the prominence of the building and because it proves that enough water can leach through the granite masonry on the outside and cause sufficient crystallization on the interior to disintegrate the stone.

The decay of interior marble work appears to be confined chiefly to cases where walls below grade are faced with marble without providing a waterproof membrane or an air space in the wall to take care of the ground moisture. In such cases there is little wonder that trouble occurs. The warm air inside the building rapidly evaporates the moisture from the face of the marble as it comes through from the damp walls, and the crystals of dissolved matter grow in the pores of the marble until the surface is scaled off.

It is planned to determine the effectiveness of waterproofing materials in preventing the penetration of stains into the marble and also their effectiveness in reducing the permeability to water under pressure. The first case will apply particularly to colorless waterproofings on the exposed face of the marble, while the second case will apply to waterproof coatings which are applied to the backs of marble slabs before they are set in place. The permeability will be determined by means of an apparatus designed by the writer for testing the permeability of granite. A disc of the stone 3 inches in diameter by ½ inch thick is placed in a compartment of the apparatus in which water under pressure is brought in contact with the upper side of the specimen. Any pressure may be used up to 500 lbs. per sq. in., which is obtained and kept constant by means of an accumulator. A cup-shaped vessel having a sharp-edged top which is 2 inches in diameter is screwed into the lower part of the apparatus until it makes contact with the lower side of the specimen. The portion of the water which comes through the specimen and collects in the cup is drawn off and measured at intervals during the test and represents the amount which flows through a definite area of the stone under a certain pressure. In order to determine accurately the amount of percolation through very dense stones it is necessary to absorb the water which penetrates in some desiccative material like anhydrous calcium chloride which is placed, inside the cup. The amount is then determined by the increase in weight of the desiccant. This process will, no doubt, be necessary in the case of marble.

The study of cleaning compounds for marble will be

(photo caption) "Testing apparatus used by the Bureau of Standards for determining the permeability of stone. Water pressure can be maintained at any desired point up to 300 pounds per square inch."

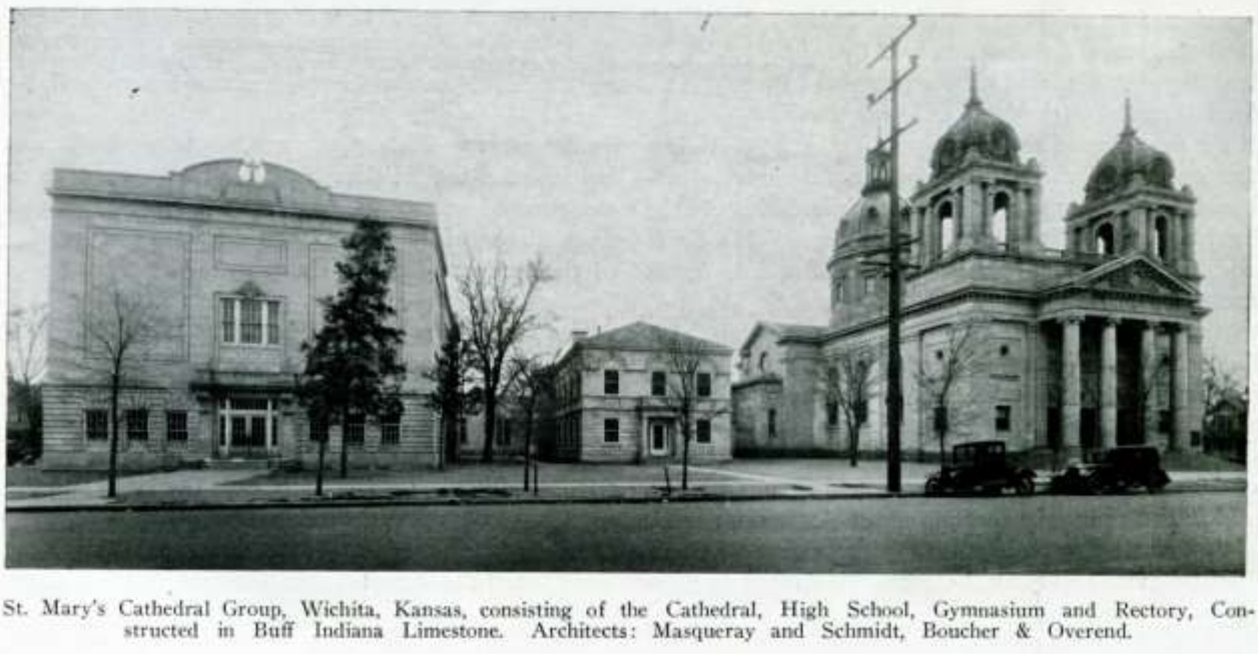
undertaken mainly with a view of determining the ultimate effect of different compounds which are commonly used for this purpose. This will involve the study of the chemical as well as the physical effects of the various ingredients of the compounds on the marble through a long series of applications. In this part of the work it is proposed to mount a large series of marble slabs around the periphery of a broad faced wheel which will be revolved at a very slow rate. Below this wheel a smaller one carrying brushes or felt mops, will revolve so that the brushes or mops at the lower side of their axle will dip into the cleaning solution and, in turning, will scrub the marble slab at the lowest point on the large wheel. A little farther around the large wheel another set of brushes or mops will make contact with the marble for the purpose of drying the surface. A warm blast of air will also be blown on the marble slabs to draw out the moisture absorbed from the scrubbing process so the routine of scrubbing, surface drying and finally internal drying will be imitated. This apparatus will carry 36 slabs of marble chosen to represent the entire range of compositions and accessory minerals all of which will be subjected to a period of scrubbing with some particular cleaning compound. This will be continued for several weeks or for a sufficient period to represent 50 or 100 years of actual service conditions. After the period of scrubbing, the slabs will be removed from their mounting and examined for surface effects then tested for transverse strength and elasticity. The results of these tests will be compared with the same properties of a duplicate set of slabs which have not been subjected to the scrubbing process.

Another phase of this work will be concerned with the study of actual cases of discoloration or decay of marble in buildings. This will afford data for coupling up the results of tests with the actual conditions and may also lead to a better understanding of the structural conditions which should be avoided.

It is proposed to inspect and carefully study all the actual instances of marble trouble that can be located and anyone who is familiar with instances of this kind can materially aid in this work by pointing them out. This may be done by writing either to the National Association of Marble Dealers at Cleveland, Ohio, or the United States Bureau of Standards, Washington, D. C.

Cathedral Group in Stone

A building programme covering a period of more than fifteen years, during which time both diocese authorities and architects have never deviated from the original plan calling for the use of a particular variety and grade of stone, has resulted in the completion of the St. Mary's Cathedral Group of buildings at Wichita, Kansas. The group consists of the Cathedral, a structure 76 feet wide and 165 feet long, ornamented with twin towers and dome, with a columned entrance. This building erected in 1910 is of Buff Indiana Limestone exterior. The design by Masqueray is Italian. A high school building was next erected. It is 60 by 125 feet and like the Cathedral is of Buff Indiana Limestone exterior. It was completed in 1918. The gymnasium, a building 70 by 150 feet was constructed of the same stone and includes besides the gymnasium a kitchen, community room and lodge hall. The rectory, containing the offices of the diocese and the residence of the cathedral priests, is "L" shaped, 94 by 65 by 39 feet. It was erected in 1923-24. The Buff Indiana Limestone for the rectory was furnished by the Cuthbert Cut Stone Company of Wichita. The architects for the high school, the gymnasium and the rectory buildings were Schmidt, Boucher & Overend of Wichita.



St. Mary's Cathedral Group, Wichita, Kansas, consisting of the Cathedral, High School, Gymnasium and Rectory, Constructed in Buff Indiana Limestone. Architects: Masqueray and Schmidt, Boucher & Overend.