[For the Scientific American.]

DECAY OF STONE AND BRICK.

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The rapid disintegration or decay of the brown stone, so generally employed in the construction of New York houses, leads naturally to the consideration of the causes producing this decay, and also to the examination of other building materials, and the discussion of their merits or demerits as compared with brown stone.

The chief causes of disintegration of stone and brick are:
1st. Roughness of surface, favoring the deposition of dust.
2d. Vegetable growths, favored by dust and moisture.
3d. Percolation of water through interstices and fissures.
4th. Action of frost.
5th. Action of acid vapors in the air.

In the experiments we propose to relate, the materials employed were the same as those mentioned in a previous paper, namely, brown stone, Nova Scotia stone, red brick, and white brick. Submitting these to a microscopic examination under a power of twenty-five or thirty diameters, a very instructive lesson regarding the structure of these materials is obtained. The stone is seen to be composed of various sized particles loosely aggregated together, and presenting a very rough surface; the red brick is smooth, the fracture showing interstices of considerable size, while the white brick is not only smooth, but also dense, the interstices being very small; and every here and there minute spheres of molten glassy material are discoverable, showing the intense heat to which the brick has been subjected. Such a microscopic examination affords, to the architect and engineer, indications regarding the probable weathering power, which should never be overlooked in the selection of building material to be used in exposed locations, for the rough imperfectly cemented material not only favors the deposition of dust, which, being chiefly organic, furnishes a suitable nidus for vegetable growths, but it is also, by virtue of its structure, more friable, and therefore easily disintegrated by the forces to be considered hereafter.

The vegetable growth, of which we have spoken above, is a minute lichen, known as *Lepra antiquitatis*, and it grows with remarkable freedom on such hygroscopic rocks as the sandstones, as any one may satisfy himself on examining the houses on the cross, or east and west, streets of our city.

The percolation or passage of water takes place even in the densest rocks, as trap and basalt, for, in the interior of even the most compact specimens of these rocks, spots of moisture are often found on breaking them, and Bischoff states that these are always connected with minute fissures, the edges of which often show effervescence when they are touched with acid, thereby demonstrating that water may convey into, or produce, carbonates, even in these dense rocks, and thereby alter their structure. This being the case with compact rock, we can form some idea of the manner in which percolating water acts on such loosely cemented material as the different kinds of sandstone.

Of the agents engaged in the disintegration of rock, one of the most efficient is frost. In its action, two elements are involved, namely, the friability of the material and its hygroscopic power. The difficulty attending the direct application of cold in the examination of the action of frost, has led to the use of other and similar means. Among these none is better adapted for the purpose in view than that of dipping the material to be examined in a saturated solution of sulphate of soda, and allowing the salt to crystallize when the specimen has been thoroughly saturated with the saline solution. The crystallization of the sulphate of soda, on and in the substance, brings to bear upon its particles the same kind of force as that produced in the crystallization or freezing of water, and particles are torn off or separated exactly as in the latter operation. In employing this test I soaked the rock in the solution for about four hours, and let it dry and crystallize for twenty hours. The loosened material was washed off by a fine jet of water from a washing bottle, the sample redipped for four hours, and again set to crystallize. This was repeated eight times, the experiment extending over a period of eight days, with the following results:

TABLE I.

Brown stone	10,000 parts, lost	191 of substance.
Nova Scotia stone	" "	441 "
Red brick	" "	74 "
White brick	" "	24 "

The disintegration is very nearly in the ratio of 1 for the white brick, 3 for the red, 3 for the brown stone, and 18 for the Nova Scotia stone, a result which furnishes information of the greatest value from an economic point of view, and which cannot be too strongly insisted upon in a country where so little attention is paid to the durability of public and private edifices.

The long periods of time, required for the performance of the crystallization test, led me to make a series of experiments to find a quicker method for arriving at a reliable determination of the friability of these substances. The plan I endeavored to apply was to heat the specimens to a temperature of about 600° Fah., and then quench them while hot in cold water. The sudden chill and formation of steam on the surface of the masses caused them to disintegrate superficially, the amount of material removed, after the repetitions of the chill, being:

TABLE II.

Brown stone	10,000 parts, lost	202 parts of substance.
Nova Scotia stone	" " "	597 " "
Red brick	" " "	82 " "
White brick	" " "	43 " "

which gives a ratio of 1 for the white brick, 2 for the red, 5 for the brown stone, and 14 for the Nova Scotia. These results do not agree exactly with those given by the sulphate of soda test, but they approach them more closely than could have been expected considering the different character of the force applied.

Though the chilling test described above may be objected to as not meeting the conditions prevailing during the action of frost, but being rather the opposite, on account of the employment of heat in place of cold, it gives results which are very significant when viewed in relation to the power of brick and stone to resist the destroying action of great conflagrations. The conditions of the experiment are almost identical with those presented by a building on fire, for in each case the substance is alternately heated by the flames and chilled by the water thrown to quench them. The table therefor gives a very fair estimate of the relative powers of the materials in question to resist such destructive action.

The chemical ingredients of the air that act on building materials are carbonic, nitric, sulphuric, and sulphurous acids. The first of these is always present as the product of combustion, and, when dissolved in rain water, forms a solution which readily dissolves marble and other limestones, and even acts on dense granite and other rocks. Sulphuric and sulphurous acids are both found in appreciable quantity in the air of all localities where coal is used as fuel. Nitric acid is, in its turn, at times an ingredient of the air, especially after great displays of lightning; it also is produced under certain conditions during the decomposition of organic matter containing nitrogen. To determine the action of these acids on the materials with which I was experimenting, I placed portions of them in dilute nitric acid, and left them in contact with the liquid for two weeks. I then kept them in water for ten days, changing the water every day to insure the removal of all soluble material; they were then dried, and being weighed, gave the following results:

TABLE III.

Brown stone	10,000 parts, lost	214 parts of ssubstance.
Nova Scotia stone	" " "	66 " "
Red brick	" " "	33 " "
White brick	" " "	7 " "

In which the ratio of disintegration is 1 for the white brick, 5 for the red, 9 for the Nova Scotia stone, and 30 for the brown stone. From this it would appear that the reason the brown stone disintegrates so rapidly in our city is its greater susceptibility to the action of the acid products of organic decomposition and combustion, where the cementing material is dissolved or weakened, and pores and fissures in the rock being opened, it is less able to resist the attack of frost. The Nova Scotia stone, on the contrary, is a more friable material than the brown stone; yet being less acted upon by the acid waters, it resists the process of decay better. The superiority of the white over the red brick, in this respect, is even more marked than under the other tests, and, taken with them, gives unquestionable evidence of the weather resisting power of this hard burned compact brick.

[NOTE.—In our article on this subject last week, an error appeared in Table I., in part of our impression only. The loss of moisture of Nova Scotia stone should have been printed as 426, instead of 260.—EDS.]

OCCASIONAL NOTES.

BY G. E. H.

Amsterdam, 1871.

THE GREAT SHIP CANALS OF HOLLAND.

Previous to the completion of the great North Holland Canal, the larger vessels of the Amsterdam trade were obliged to discharge their cargoes outside of the Amsterdam harbor, and were themselves lifted over the bar, at the mouth of the Ij, by means of large "camels," first sunk on either side of the ship, and then rendered buoyant by pumping the water from them by hand pumps; but, in 1825, the opening of the canal, and the improvements of the harbor, afforded a safe sea channel for the largest East Indiaman, avoiding both the delays at the bar, and the difficult and dangerous navigation of the Zuider Zee.

The harbor then was reclaimed from the south bank of the Ij, and consists of two immense dykes or dams, nearly parallel with the quay front, which likewise serves the additional purpose of protecting the town from inundation. Between the two dykes extend two rows of immense piles, with openings left at intervals between them, to allow the passage of ships, which openings are uniformly closed at sundown by large booms.

To reach the North Sea, vessels pass westerly along the channel of the Ij into the Wyker Meer, and thence through the canal proper to the Helder, a distance of 51 miles.

The engineering of this wonderful work of utility, which is 124 feet wide at its surface, and 21 feet deep, overcame enormous difficulties in its construction through the low swamps and loose sands of North Holland; while to secure a safe foundation for the locks, (which are the largest known) excavations, 43 feet below the present surface of the sand, were necessary. This work occupied Blanken, the engineer, six years, and had cost, when opened, $7,500,000.

Still more to facilitate her commercial relations, Amsterdam is at present constructing a new and more direct route to the sea, which shall not only shorten the distance by 35 miles, but also add to the many acres already reclaimed from watery dominion. This work, to be called the Great North Sea Canal and Harbor of Refuge, is under the direction of Mr. Hawkshaw and Mynheer Dyrks, and was commenced in 1867, with the then expectancy of completing it in 1876. To Mr. Hutton, the resident engineer, our thanks are due for his kind attentions and information concerning its details.

The scheme commences by throwing an immense dam across the harbor, at the junction of the Pampas with the Ij, founded in a lake of mud on 10,000 of the longest piles. This dam, provided with immense sluices to pass vessels and keep out the Zuider Zee, was formally opened some ten days previous to this writing.

Westerly from the city, extends the canal, which is formed, not by excavation, but by enclosing a riband of the Ij between two large parallel dykes, 250 feet apart; and founded, as the harbor dam is, upon piles driven deep into the muddy bed, near the northerly bank. Through the peninsula of Buitenhuizen, the canal is excavated, but enclosed again by dykes across the Wyker Meer, with suitable branches, to accommodate Halfweg, Haarlem, and the North Holland Canal. All of the watery space not enclosed is to be drained for agricultural purposes, and the sale of the reclaimed lands will largely provide funds toward the cost of the works.

From Velzen, the canal is being excavated directly west through the sand dunes, to the North Sea, where the Harbor of Refuge is about half completed. This is to be entirely formed by throwing out from the beach, two piers, each 5,000 feet in length, of heavy blocks of concrete. These piers, which approach each other at the sea extremity, enclose 250 acres of secure anchorage, of which area 150 will be dredged to a uniform depth of 26 feet. Half a mile inward from the beach are being finished the extensive sluices, while the intervening distance to the harbor will form a tidal basin, 26 feet deep, and 197 in surface width.

The lock foundations are formed of huge concrete blocks, similar to those employed in the piers, and are finished in Dutch brick and ashlar.

For the piers, the blocks average seven tons in weight, and are manufactured, by a system of Mr. Hutton's, at Velzen. They are transported to the harbor by rail, and transferred from the car to the sea bottom, by an ingenious steam crane, designed by the same gentleman.

Divers are employed to see that each stone is properly bedded, and they give the signals to the crane driver by means of a cord to the boat. The parapet blocks, of from 50 to 60 tons weight, are, of course, moulded *in situ*.

To get a definite idea of this vast work, one must watch the varied labors combined in the construction of this immense undertaking. He must observe the long sand trains puffing their way, from the lower excavations, at the locks, up the heavy grades toward Velzen, there to deposit their loads along the slowly forming dykes of the Wyker Meer, passing, *en route*, the little locomotives on the bank, conveying their trains of trucks, each carrying its heavy concrete block to form a unit in the long piers that stretch their protecting arms far into the stormy waters of the North Sea.

Add to this the steam mixers and transferring cranes at Velzen, the steam dredgers, and the interminable gangs of "navvies" along the canal, and the colossal nature of such an undertaking is far better understood than by the medium of a hasty pen.

Earing's Improvement in Saws.

The object of the present invention is to provide means for smoothing the sides of shingle heading or lumber as such articles are sawed. To this end the saw is supplied with cutting knives and knife sections.

The saw teeth are made thinner than the knife plates. The cutting sections consists of one or more knives which have chisel edges, and there are two knives to a section, with the edges reversed, so that they cut upon each side of the saw kerf as the saw passes through the timber, thus smoothing the sides of the articles manufactured. The upper points of the cutters are slightly below the points of the saw teeth, and the lower points are supported by shoulders. The saw teeth are set or swaged so that their points are a trifle less in thickness than the knife plates, thus giving the teeth clearance, thereby diminishing the friction. The knives and their teeth thus placed will, it is claimed, cut a less kerf than any saw now used of the same thickness of the knife plates, thereby effecting a material saving in lumber. The number of sections depends upon the diameter of the saw.

Mr. William L. Earing, of Oswego, N. Y., is the inventor of this improvement.

Tapioca Paper.

To prepare tapioca paper, says the *Engineer*, which is very useful for copying photographs by artificial light, 200 grammes of tapioca are soaked for two days in an equal weight of water; ten litres of water are added, and afterwards, for every liter of liquid, ten grammes iodide of potassium, thirty grammes chloride of potassium, one gramme bromide of potassium, are dissolved, and the whole boiled for ten minutes, allowed to stand for a day, and decanted and filtered through fine linen. The paper is immersed, twelve or twenty sheets at a time—or can be floated upon it—for fifteen to twenty minutes; it is then hung up to dry in a dark room. If it has assumed a dark color, that is of no consequence, as it disappears in the silver bath. This is to be prepared in the proportion of 1·15, and for every ounce of nitrate of silver, fifty to sixty grains of citric acid in 30 ounces of water. The time of exposure varies from ten seconds to twenty-five minutes, according to the picture to be copied and the actinic force of the light.

TO CLEAN PETROLEUM LAMPS.—Wash the vessel with thin milk of lime, which forms an emulsion with the petroleum, and removes every trace of it, and by washing a second time with milk of lime and a small quantity of chloride of lime, even the smell may be so completely removed as to render the vessel thus cleansed fit for keeping beer in. If the milk of lime be used warm, instead of cold, the operation is rendered much shorter.

A KNOWLEDGE of our weakness creates in us charity for others.