THE CHICAGO WATER WORKS AS THEY APPEARED BEFORE THE LATE FIRE.

This building, which was, before its destruction, entitled to be considered one of the representative buildings of Chicago, has acquired renewed interest from its connection with the recent catastrophe, and we herewith append an engraving of it.

As our readers are aware, the city supply of water was drawn through a conduit from the lake, the water being taken two miles from the shore. Previous to the construction of these works, the water supply had been of inferior quality. Their completion furnished an abundance of pure, wholesome water to all parts of the city.

In all their appointments these works were as complete as any in existence, and were the pride of the city.

THE LAKE TUNNEL.

The plan of tunneling two miles under the bed of the lake was proposed by E. F. Chesbrough, Esq., the city engineer, and was executed under his superintendence. It is one of the most novel, successful, and economically executed engineering enterprises of the time.

THE PROGRESS OF THE WORK.

Ground was first broken for the work on the 17th of March, 1864, when the construction formally commenced. The iron cylinders, which had been ordered to protect the land shaft against the intlux of the very wet sand and gravel known to overlie the clay for about twenty feet, did not arrive till after two months of detention. The progress at first was much slower than was anticipated, owing to the troublesome nature of the sand and gravel; but the hard clay was reached about the first of April, and the iron cylinders had been sunk through the sand. No serious difficulty afterward arose in the prosecution of the land shaft and shore end of the work. At the end of the year the tunnel had been finished from the land shaft out under the lake 2,139 feet, and July 10, 1865, it had reached 3,023 feet, and was extending outward at the rate of about twelve feet per day. August 25 it had reached a distance of 3,505 feet, and the masonry was about twenty-five feet behind the face. In some places an average rate of progress of fourteen feet per day was made for a week at a time, but for the whole period this average was considerably less, owing to occasional interruptions from the breakage of machinery, strikes among the workmen, the meeting with and occasional explosion of gas, and other causes. The average for the year ending April 1, 1865, was thereby reduced to nine and one tenth feet per day.

The back filling between the regular brick work and the irregular surface of the excavation of the tunnel, which was originally intended to be of well packed earth, was made of masonry, because it was found very difficult to get the puddled clay used, faithfully packed into the spaces. The ground generally was so uniform and favorable for excavation that the tunnel was cut with great precision, and an average of one inch thickness of cement mortar between the bricks and the clay walls was all that was required.

A tendency in the clay to swell was found at an early stage of the work, but the masonry resisted it perfectly. It, however, gave some trouble in the grading, for one portion would swell more than another. In order to facilitate the work, chambers and turn tables were placed at intervals of one thousand feet. These were used for the storage of materials and for mixing cement, and for turn-out tracks for the cars. As the work progressed iron rails were substituted for wood in the tram ways, and small mules were used to draw the cars instead of men. By all these facilities the economy and rapidity of execution of the work were increased.

VENTILATION.

The ventilation of the first half mile of the tunnel was effected by drawing the vitiated air out through a pipe connected with the chimney of the boiler furnace, but toward the last this method was found to be so ineffectual and unreliable that it was abandoned, and one of Alden's blowers was used with complete success.

PLACING THE CRIB.

The crib through which access was to be obtained to the bed of the lake for the excavation of the tunnel from that point shoreward, simultaneously with the progress of the shore end, was not placed in position before the 25th of July, 1865, when it was launched and towed out to its place in the lake. The work of sinking was delayed somewhat, in consequence of defective arrangement of and accidents to the anchors. Just as it reached the bottom a storm came on, and as the crib was not sufficiently loaded to rest firmly upon the bottom, it was filled with water, by means of a wrecking pump. After the storm had subsided, it was found that the crib had moved thirteen feet north of its true position, and that it had become firmly imbedded in the clay of the bottom of the lake. It was therefore deemed best not to disturb it, as the variation from the exact position was of no practical importance, and it was immediately filled with stone. It was afterward built up three feet higher, so as to be secure from the wash of the waves, and it was covered in by a building to serve for the protection of the workmen, the materials, and machinery. The seven iron cylinders making the iron part of the shaft, and sixty three feet of it in hight, were connected together, one by one, and lowered inside of the crib, to the bottom of the lake, within the thirty feet wide open space in the centre of the crib. The gates or valves, by which the water of the lake is admitted to these cylinders, are placed near to their upper end.

After the cylinders had been placed in the right position, they were forced downward into the clay some twenty-five feet, the water being wholly excluded. The masonry was then commenced. In the meantime the engine for hoisting, and the necessary machinery, were made ready, and the bricks, cement, and other materials and supplies were collected and stored in the building, upon the top of the crib. For all these preparations a much longer time was consumed than was anticipated, and the work upon the tunnel at the end did not commence before the first of January, 1866, after which the work steadily progressed.

In commencing the lake shaft end of the tunnel, it was excavated for about sixty feet, to the eastward, in order to facilitate the alignment. The ground at the lake end was found to be very similar to that at the other, but more liable to cave in, and consequently, rather more difficult and expensive to work.

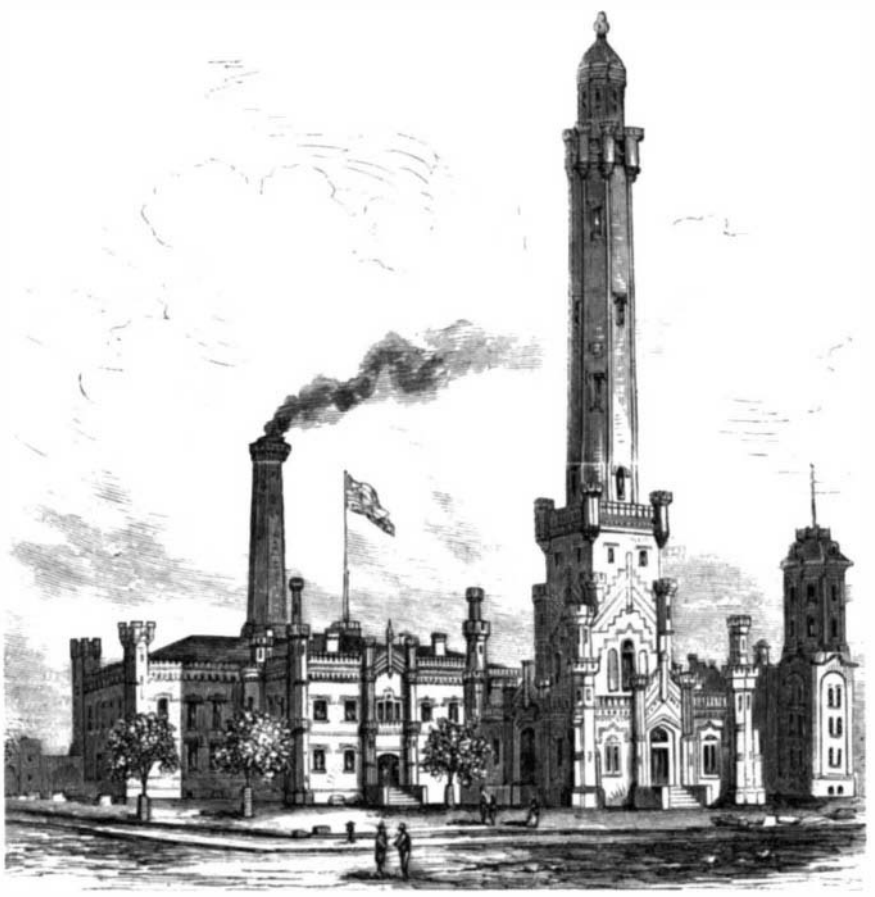
The masonry uniting the two parts of the tunnel was formally closed up December 6, 1866, by his honor Mayor Rice, and the citizens were permitted to inspect the work. There then remained the side chambers to be filled up, and the entire tunnel to be cleaned out. This was all carefully done, and the water was first let into the tunnel, from the lake, on the 8th day of March, 1867, and on the 11th it was filled to the level of the lake. The water was then pumped out sufficiently to allow a boat to pass upward of half way from the crib to the land shaft. Not a brick was found to be displaced, and it could not be perceived that the slightest fracture had anywhere taken place by the pressure to which the masonry had been subjected. As it was very desirable to use the tunnel as soon as possible, it was thought unnecessary to pump out the whole of the water, and the tunnel was again filled. The formal and public opening took place on the 25th of the month, and since that time Chicago has been free from the annoyances of impure and fetid water. The buildings for the pumping engines and water columnwere unusually commodious and beautiful, and were constructed of stone in the castellated style, from designs by W. W. Boyington, architect.

Two double acting pumps, twenty eight inches in diameter and eight foot stroke, were used. The cylinders were forty-four inches in diameter, and their stroke the same as in the pumps. They took their water from a pump, or well, lined with brick and communicating by means of a curved tunnel with the main lake tunnel through the shore end shaft.

The following description of the burning of the building is extracted from an interesting book entitled the "Great Fires of Chicago and the West," of which the reader will find a notice in another column of the present issue:

Before tracing the progress of the fire further northward, must be mentioned the burning of the water works, and the curious, or rather incomprehensible, manner in which it caught fire almost two hours before the time that the fire first reached the north division across the main branch. As stated above, the Galena Elevator, at the edge of the main branch, caught fire from the south side at about 20 minutes to 6 o'clock. At about 20 minutes before 4 o'clock a fire was discovered in the carpenter shop of Mr. Lill, built on piles above the shallow water of the lake. Standing between the burning carpenter shop and the water works, extending northwest of the shop, stood one of Mr. Lill's book keepers. Turning round toward the water works, he exclaimed, "My God, the water works are in flames!" This gentleman states positively that the flames from the water works, when he first saw them, were issuing from the western portion of the pumping works, no flames being seen from the eastern portion of the grounds, which were occupied with coal sheds etc. On the other hand, the employés at the water works say that the fire commenced about half past 3 o'clock in the morning; that it commenced in the eastern part of the water works, which took fire from the shed. Another gentleman testifies that the carpenter shop, or the cooper shop, as he called it, was burned down before the fire commenced in the water works, and that when the water works were in full flame, the main body of Lill's brewery, with the exception of the carpenter shop, was intact. The time of the commencement of the fire in Lill's carpenter shop and the water works, however, differs one hour; the last named witness asserting that the water works commenced burning at about half past 2 or 3 o'clock. But whatever may have been the origin of the fire at the water works, it is certain that when it did commence the whole building was soon in flames, and in a few minutes the engineers had to rush out of the building to save their lives. The machinery was very considerably injured. The water tower, however, to the west of the pumping works, was almost entirely uninjured.

Our readers will find, in another column, an interesting letter referring to Holly's system of fire protection and water supply, with some remarks on the water system of Chicago, which will be interesting in this connection.



CHICAGO WATERWORKS AS THEY APPEARED BEFORE THE FIRE.

Chameleon Barometer.

M. Lenoir, of Paris, an inventor as fertile as ingenious, and who is especially known by the gas engine that bears his name, and by a system of autographic telegraphy, has just introduced a kind of barometer which at least has the merit of ingenuity. It is composed of a dial, in the centre of which is traced a circle, the diameter of which is almost half that of the dial. The annular space comprised between the two circumferences is divided into four sections; on the lower one is inscribed the name of the inventor and that of the apparatus, "*baromètre caméléon*;" the compartment to the left is pink, and bears the inscription "much rain," the top one is gray, with the word "variable," and that on the right greenish blue, with the words "set fair." The paper in the center circle changes color according to the state of the atmosphere, conforming to the tint of one or other of the three colored compartments, according as it may be very damp, tolerably dry, or extremely dry. The apparatus is, in fact, more a hygrometer than a barometer. The change of color in the central papar is produced by atmospheric humidity. This sensitive paper is prepared with a mixture of chlorine of cobalt and of marine salts, added to glycerin to attract the humidity. Salts of cobalt, nickel, copper, etc., are largely employed in the production of sympathetic inks, with which writing or drawings can be made, invisible at ordinary temperatures, but which are made visible under a slight heat, and which disappear when the temperature falls.

THE NEW CITY POST OFFICE.

In architectural importance this building is, perhaps, only second to the Capitol at Albany, among those now projected and in process of erection on the continent. Built of granite in the most substantial manner, it is probably one of those structures that will long rank as a prominent feature of interest in the American metropolis. Our office commands a distinct view of the building and the progress of the work; and, from the general interest manifested by those who daily visit us in the course of business, we are assured that our distant readers will be glad to see the engraving of this magnificent building as it will appear when completed.

The building stands at the south end of the City Hall Park, and fronts both Broadway and Park Row.

It is built, with some modifications, in the style of the classical Italian *Renaissance*, with French roof. Three stories, in different styles of the Doric order, are placed one above another, the ornamentation increasing in richness towards the top of the building.

In plan, the structure is that of a triangle, with the apex truncated, the narrowest frontage looking down Broadway towards the Battery. In the center there is a triangular court along the main story. There will be a sub-basement, basement, and three stories, surmounted by the roof story.

On the side fronting the City Hall, there is a wide drive way, so that the building stands, and will remain, entirely isolated from contiguous structures, and may be approached from every side. A large entrance will be left at the southwest front, communicating with an ample corridor, and surmounted with a handsome portico. There will also be two other principal entrances, one at the corner pavilion on Broadway and another at the corner pavilion on Park Row. These entrances communicate with broad elliptical stairways, leading to the upper stories. Lateral entrances will also be provided on Broadway and Park Row, and to the delivery offices on the Park front.

The sub-basement and basement extend under the entire building, central court, and sidewalks. The former is lighted and ventilated through ample areas under the sidewalks and court, and will be used for the reception of fuel, heating apparatus, boiler, and steam engine. The Post Office proper will occupy the basement and principal story. The latter in-

cludes the whole space of the building including the court. The court will be roofed with glass. The walls and partitions above this story rest on iron columns, leaving the whole space on the lower floor open for light and free communication.

A broad corridor will extend about the lower floor on the southwest, reaching to and including the central pavilions; it will surround a box and delivery screen. This corridor will be only one half story high. Above it the remainder of the story will be formed into a gallery looking inward to the delivery rooms.

Corridors encircle the building in each of the upper stories, bounded on the exterior and interior by rooms lighted from the street and central court.

The rooms of the Postmaster, Deputy Postmaster, and Cashier will be over the principal entrance at the southwest. The Park front rooms will be occupied by the United States Courts. Three court rooms will be provided, two of which will be the hight of two stories. Adjoining these rooms will be special apartments for the judges. The remainder of the second and third stories will be occupied by offices for United States Marshals and other officers, United States attorneys, clerks, and other officers connected with the courts; and the jury rooms will be in the third story.

The work has proceeded slowly owing to various obstacles, some raised by the city authorities, but it has now reached to the second story.

As our readers will see, the lower part of the building is open to the criticism that its numerous angles will form most efficient dust traps. This will inevitably impart a dingy dirty appearance, which will greatly mar the effect designed. We regret that some other design for this story, in harmony with the rest of the design, yet not liable to the objection named, was not adopted.

Barring this defect, the edifice, when completed, will present a majestic and imposing appearance.

Stone, iron, and brick are the materials used; the exterior is of granite. One hundred and fifty-nine iron columns are placed in the basement, and one hundred and seventeen to support the partition walls and floors. The foundations are of granite and concrete, and are of the most substantial character. The floors will be of brick and iron, the stairs are to be of stone and iron, the roof of iron, covered with slate and copper. The building is to be heated by four large low eprssure steam boilers.

The roofs of the corridor pavilions rise 107 feet above the sidewalk. The foundation of concrete is laid 35 feet below the sidewalk: the cellar is a little more than 7 feet in the clear, the basement 16 feet, the public corridor 14 feet, and the *mezzanine*, or gallery above, nearly the same. The outer circuit of the building will be over one fifth of a mile.

The granite comes from an island off the coast of Maine, where 600 men are employed in quarrying and dressing it. No stone cutting is done at the building. When the blocks arrive, they are ready to hoist into the places prepared for them. Derricks, worked by steam engines, are arranged in such a way that it requires only one man to set all the stone which 600 men are cutting.

The north front of the building will be 290 feet in length, the Broadway front 340 feet, and the Park Row front 320 feet in the clear. On each of these two fronts, however, there is an angle, which, running back some distance and then projecting, forms the entrance looking down Broadway. The entire width of this front is 130 feet. These entering angles and projecting portico will give this front a very bold and striking appearance.

The Doctrine of Metempsychosis.

At the time of the death of Mr. Louis Bonard, an ingenious mechanic of this city, we called attention to his bequest, to the Society for the Prevention of Cruelty to Animals, of $100,000. The testator's relatives are disputing the validity of the will on the ground of insanity, and rely partly upon the alleged belief of the deceased in the transmigration of souls. Dr. Clymer was examined as a witness, and, on being asked if he considered such a belief to be a mental delusion, replied:

"I will tell you in my own way. It appears that opinion was at one time a very common doctrine. In modern times we know it more as the doctrine of Pythagoras, but he got it from the Egyptians. Now, it is told, they were the first who believed in the immortality of the soul, and that this was the first expression of such belief. They held that the soul, being immortal, when it leaves the body, enters another, and never ceases to be removed from one to another. Metempsychosis implies the passage of that soul into animals successively, and, according to some who held the doctrine, again returning, after certain purifications by its progress through these animals, to the human form; and this was one of the reasons why the Egyptians preserved their mummies. This doctrine was held by the Druids of France, Britain and Germany, and is held by the Brahmins, and, in more modern times, by Fourier, and his disciples in France. Origen, one of the Fathers of the Church, held it, and some theologians endeavored to prove it as held in the New Testament, from the 9th chapter of St. John, and others say the doctrine of purgatory originated in this way. Our own Christian doctrines are held variously. What one believes, another thinks a delusion, but a medical man, finding no evidence of delusion generally, would not be warranted in saying such a person labors under mental delusion. The transmigration of souls was held by some of the first minds in ancient and modern times, and I do not consider a belief in it necessarily implies that he was laboring under delusion."

YOU may glean knowledge by reading, but you must separate the chaff from the wheat by thinking.

Correspondence.

The Editors are not responsible for the opinions expressed by their Correspondents.

Fireproof Building.---How they Build in Berlin.

To the Editor of the Scientific American:

The late Chicago fire has called public attention to the subject of fireproof building; and within the last few weeks a number of articles about this matter have already appeared in the columns of your paper. It seems to me that all endeavors to find constructions which will be really fireproof—for instance, so as to stand a fire like the one in Chicago—are useless, at least as far as the majority of our buildings are concerned, for the simple reason that even if such constructions were found, they would be too expensive for our ordinary dwellings, stores, etc. If stones, bricks, and iron are considered insufficiently fireproof, we may give up the idea of building our cities of fireproof houses. The proper remedy to prevent large conflagrations is to build all houses in a city as fireproof as can be done at a reasonable cost. If only all frame buildings, as well as the unnecessary use of wood for inside work, roofs, etc., were absolutely prohibited, and no lumber yards and the like were allowed inside of our cities, the houses need only be built substantially of stone brick, and iron, and we should have no more conflagrations of any extent. In most of our cities, however, the building laws are, or at least have been up to a recent date, of such a deplorable nature, and a mode of building has accordingly been in use, that a fire can hardly be expected to remain confined to the house in which it originates. As long as party walls are allowed, and chimneys are built without any foundation, but supported only by a couple of joists, etc., etc., our houses will always be apt to communicate a fire from one to the other, as, as soon as a whole row of houses is in flames, the heat is sufficiently intense to set fire to adjoining buildings, even if they are built independent of the former.

An example that it is not necessary to build a city of fireproof buildings only, to prevent any large fires, is the city of Berlin. There has been no fire of any extent during the last ten years, the mere reason of which is an excellent building law and a strict enforcement of the same, in combination with an effective fire department.

In this country, however, even where more money is spent on a house than is necessary to construct it fireproof to a certain extent, we often find that a great deal of money is expended in such a manner as to make the building as unsafe as possible against fire. We will only allude to the "lumber piles" which are put on many houses, in the form of "French roofs." Our stores and offices are lined with neatly dressed lumber, which, to make it the more dangerous, is oiled or varnished. Is it a wonder if a safe in such an office proves insufficient to preserve its contents in case the building takes fire? Such unreasonable use of wood for the inner outfit of our houses should not be tolerated, in the same way as, in most of our cities, shingle roofs are now prohibited by law. For the majority of our buildings, lumber cannot be entirely excluded as building material, as for floors, joists, rafters, etc.; but its use should be diminished as much as possible; wooden partitions should be abandoned, and the stairways should be made either of iron or stone, and self supporting, so as to require no casing, a construction which cannot be too highly recommended.

I have been in Berlin for four years, from 1862 to 1866, and I do not recollect ever to have seen a fire there. I have often seen the engines in position, ready to go to work, but in almost all cases the fire was suppressed without bringing them into use. How does this compare with the fires in our American cities, where in one half of the cases the damage done by water is greater than that by fire?

Baltimore, Md. H. DUEBERG.

An Appeal to Dr. Vander Weyde.

To the Editor of the Scientific American:

Professor P. H. Vander Weyde, in one of his very interesting articles upon psychic force, speaks of the Davenport brothers, and how that he had performed the same wonderful feats as those jugglers. Now, as they have astonished and excited the wonder of large audiences in nearly every city in the United States, the Professor would confer a favor upon thousands, perhaps hundreds of thousands, of his fellow citizens, if he would give a clear and full *exposé* of the wonderful performances of those men while in their cabinet; such as the taking off of the coat of one of them, while securely tied, and the knots sealed with sealing wax; also the putting on of another gentleman's coat while he (the Davenport) was tied fast to a chair. Of course the light was extinguished during the performance, but not longer than it would have taken a man, not tied, to put on or take off his coat. And will the Doctor also explain the passing of the musical instruments around the hall, with phosphorus on them to enable the audience to see their movements?

Americus, Ga. J. FRICKER.

Squeaking Boots Again.

To the Editor of the Scientific American:

I have two pair of calfskin boots, both inveterate squeakers, which I have worn for a year. I tried all the known remedies, as greasing the soles, driving in pegs and nails, soaking them in water and wearing them till dry, but without success. At length a happy thought struck me. With a rag, I saturated the insoles with kerosene oil; and *Eureka et* glory! O hallelujah! the thinnest pair gave in at once, and the other pair after the second application.

Sextons and ushers will please make a note of this, and ever cherish, with grateful remembrance, the name of the discoverer, JONES.

[For the Scientific American.]

ABSORPTION OF MOISTURE BY BRICK AND STONE.

BY JOHN C. DRAPER, PROFESSOR OF CHEMISTRY UNIVERSITY MEDICAL COLLEGE, NEW YORK.

In the construction of buildings in a climate like ours, it is of tho utmost importance that the materials employed should absorb and retain as little water as possible, otherwise the buildings will be damp, and the presence of quantities of moisture in their walls will favor the formation of vegetable growths upon their surfaces, which will, together with the action of frost, aid materially in the process of disintegration.

In a recent experimental investigation of this subject, I selected the following materials, namely, brown stone and Nova Scotia stone of the best quality, fine red Philadelphia brick, and a very compact, hard burned, white brick, stamped A. Hall & Sons, Perth Amboy, N. J. Masses of equal size of each were placed in water for twenty hours to allow them to imbibe as much of the fluid as they could take up. They were then turned about on blotting paper as long as they dampened it. The external moisture being thus removed, the masses were weighed and placed in an air bath at 212° for three hours. On being removed from the bath, they were put under a glass bell jar, and, being again weighed when cool, were found to have lost the following quantities of moisture.

TABLE I.

Brown stone	10,000	parts, lost	260 of moisture.
Nova Scotia stone	"	"	426 "
Red brick	"	"	1,179 "
White brick	"	"	525 "

The masses were then placed in the warm air bath again, and kept at 212° for four hours. On being cooled with the same precautions as before they showed the following losses:

TABLE II.

Brown stone	10,000	parts, lost	8	parts of moisture.
Nova Scotia stone	"	"	8	" "
Red brick	"	"	0	" "
White brick	"	"	0	" "

The masses were then placed on an iron plate, which was heated to a dull red heat and covered with a hood of tin to cut off currents of air. They were consequently exposed to a uniform temperature, which was sufficiently high to scorch paper when it was laid on their upper surfaces. The last traces of water were thus expelled, the quantities being as follows:

TABLE III.

Brown stone	10,000	parts, lost	17	parts of moisture.
Nova Scotia stone	"	"	35	" "
Red brick	"	"	a trace	
White brick	"	"	a trace	

The conditions, to which the substances were submitted at the commencement of these experiments on drying, may be regarded as representing their state after a prolonged storm of rain in which they had been drenched and soaked with water for many hours, and Table I. demonstrates that while the brick absorbed more moisture than the stone, the white brick imbibed less than half that taken up by the red, and the brown stone a little more than half that taken up by the Nova Scotia stone.

Table II. in its turn shows that stone is far more retentive of its moisture than brick, for, while the former lost eight parts, the latter lost none. In Table III. the same fact is still more conclusively demonstrated, for against an almost imperceptible loss on the part of the brick, the brown stone lost seventeen parts, and the Nova Scotia stone, thirty five. We are therefore justified in concluding that though brick absorbs a larger quantity of moisture than stone, it is to be preferred as a building material, since it parts with the imbibed water with greater facility; and, comparing the two kinds of brick together, the white hard burned brick is superior to the red, since it absorbs only half as much water.

Passing from the consideration of the power of retention to that of absorption, I found that, on submitting the thoroughly dried masses of the last detailed experiment to the action of an atmosphere saturated with moisture at 70° Fahr. for six days, the following results were obtained:

TABLE IV.

Brown stone,	10,000	parts, absorb	at 70°,	52	of moisture.
Nova Scotia stone,	"	"	"	45	"
Red brick,	"	"	"	3	"
White brick,	"	"	"	3	"

The conditions prevailing in this experiment may be regarded as being similar to those existing on an ordinary midsummer day when the dew point stands at 70°; and on inspecting the table we find that, while the brick absorbs but little moisture, the stone is very hygroscopic, the brown stone possessing this property in a more marked degree than the Nova Scotia. Since warmth and moisture, taken together, are peculiarly favorable to the production of vegetable growths, it follows that brown stone is, by virtue of the larger amount of water it absorbs, more liable to disintegration from this cause than the other substances submitted to experiment. In the case of the bricks the absorptive power is, as the table shows, equal, and very slight or slow in its action. They are therefore superior to stone in this respect.

To determine the absorptive power when exposed to conditions similar to those prevailing during a fog, I caused steam from a free opening to play upon them for three hours. After cooling for twenty hours, they were weighed with the following result:

TABLE V.

Brown stone,	10,000	parts, absorbed	147	parts of moisture.
Nova Scotia stone.	"	"	110	" "
Red brick	"	"	127	" "
White brick	"	"	106	" "

Which demonstrates that under such circumstances brown stone is more hygroscopic than Nova Scotia stone, and there