building stood, and upon which other important and massive buildings now stand, including the massive cathedral of St. Paul's, consists of beds of brick clay of various depths under which lies a stratum of gravel also of varying thickness; and underneath this gravel lies a stratum of stiff blue clay.

The *Builder* states that "through the bed of gravel or beach, penetrated as it is everywhere by water, the engineer of the Thames Embankment has cut a broad and deep trench to the clay below. The foundations of the granite quay wall rest on this geological rock, at the depth of 32 feet 6 inches below Trinity high water mark. To excavate and to keep clear these foundations, a steam engine of fourteen-horse power was in each section constantly at work, and the chain pump which it propelled, discharged a perfect river from the subterranean source. The flow of water thus caused would not desist from exerting its own mechanical influences, out of respect for the Lord Mayor, or for any of the officers, institutions, or buildings of the city of London. What the natural effect of this mighty pumping would be in theory, we all know. Gradual loosening of the permeable stratum, displacement of the smaller particles, consequent tendency of the larger ones to come down together, disposition of the whole water supplying area to move microscopically, infinitesimally it may be, but still with mathematical certitude. As to this there could be no doubt, although we had small thanks for saying so fourteen months ago.

"One point might have been considered doubtful, and that was how far the weight of any massive building compressing and consolidating this adjacent gravel, might have prevented the mischievous action of the infiltration (or rather, if there were such a word, exfiltration) of the water. On this point we have now not only information, but a flood of light, and a very unpleasant flood into the bargain."

How far the same cause which produced the disaster alluded to will affect other more important structures remains to be shown. Certain it is that eminent architectural authorities have predicted further calamity unless the most prompt and skillful measures are applied to their prevention. The embankment has stopped where it is, and precautionary measures in the provision of tie-rods, etc., have been made to such structures as show signs of having been injured.

TEST OF TURBINE WATER WHEELS AT LOWELL, MASS.

Whether a competitive test of anything can at this day be conducted anywhere under the shadow of the wings of the American Eagle in such a manner as to enlighten the public as to the merits of the thing tested, becomes annually more and more doubtful. To implicitly cling to such a faith in the face of two events of this kind which graced, or disgraced—which you will—the year 1869, argues such a trustful spirit on the part of the possessor of such a blind faith, as must certainly render him the most unsophisticated of mankind.

The two events referred to are the tests of steam-engines at the late fair of the American Institute, and the test of turbine water wheels at Lowell, Mass. The announcement of the latter in this journal last June, aroused more attention in the American mechanical public than any other event of the year. Not only ourselves, but Mr. James Emerson, whose dynamometer was employed to test the power of the wheels, were flooded with inquiries concerning it. Mr. Emerson states that the publication of this announcement "decided two points conclusively: first, the extensive circulation of the SCIENTIFIC AMERICAN, and second, the immense interest felt throughout the country in regard to the test." He says: "I have received letters of inquiry from the most out-of-the-way, unheard-of nooks and corners, from every State and Territory in this country, also from the British Provinces."

We wish that we could now say that the test had proved something as well as the announcement. The latter it seems proved two interesting and important facts; but, so far as we can learn, the test either has proved nothing, or it has proved what the parties interested do not care to publish.

The public was invited to attend this trial, and it was generally understood that it was to be conducted in an open and fair manner, and a report made in detail describing the construction and peculiarities of each wheel; if they were made of metal, and if so what kind; if they were finished better than those ordinarily made and sold, or if taken promiscuously out of the stock of the manufacturer. In short, to render the publication of a test of this kind of any practical use or interest to the public, all the conditions under which it is conducted must be known. We have received from Mr. Emerson a report of the result obtained by each wheel, but it is very meager and not by any means complete. Simultaneously with its receipt, our editorial mouth is stopped by the receipt of letters from different exhibitors, warning us against its publication, and stating that it is unauthorized. Writing in this dilemma to Mr. H. F. Mills, of Lawrence, Mass., who conducted the tests, and has, we believe, some reputation as an hydraulic engineer, and who is stated to be the only person authorized to make a report, we learn from him that the public were only invited to witness the test of a *single wheel*, and that a full report upon all the wheels tested will not probably be given.

This being the case, we find ourselves sufficiently human to rejoice in the statement of Mr. Emerson to the effect that, before the Lowell test closed, he went West to test a new wheel, which gave better results than any wheel tested at Lowell, and which will be brought to the East next season to compete with any or all of them. We hope this may be so; but really we find it a difficult matter to believe reliable tests will be made, or that if the tests should be reliable, that the reports will be. We wait with some curiosity to see how the new-comer will come out.

BLACK RIVER FLOOD CASE.

A case of more than usual interest to civil engineers, involving important hydraulic questions, has been pending before the State Board of Canal Appraisers for several months, and is now completed, as to the testimony, and the issues of claim and defense.

In April, 1869, a large reservoir, built by the State in 1856, at the head sources of the Black River, as a feeder to the Black River Canal, was carried away during a spring freshet. A large amount of property was injured by it, along the upper portion of the river; and claims for damage have been made along its whole line, or about 100 miles. The case is tried under a special law of the last session, and involves about $750,000 aggregate damages.

The theory of the claim is, that the State has been negligent in the construction and superintendence of the reservoir, and in consequence of this negligence the damages occurred; for that portion of the damages at and below Carthage, a point about 73 miles below the reservoir, the claim identifies the reservoir rupture as the cause.

On the other hand, the Counsel for the State aver that the rupture occurred during an unprecedented flood, which no engineering skill could have provided for, and that the reservoir rupture did not have sufficient time and power to cause the damages claimed below Carthage.

The Counsel more directly engaged were the Hon. C. H. Doolittle, of Utica, with Messrs. C. A. Sherman and J. T. Starbuck, of Watertown, for the claimants; and Messrs. L. H. Brown, of Watertown, Samuel Earl, of Syracuse, and Chas. Rhodes, of Oswego, for the State. The issue having been mainly dependent upon hydraulic principles of construction and action, the expert witnesses were Hon. W. J. McAlpine and Chas. H. Haswell, Esq., associated with Samuel McElroy, Esq., by whom the case was specially investigated on the part of the claimants; and Messrs. D. Greene, and L. L. Nichols on the part of the State, the latter having been more particularly identified with the case.

As part of the testimony, Mr. McElroy submitted an elaborate analysis of the case, discussing the questions at issue as to the construction and care of the reservoir, the theory of its rupture, and the descent of its flood to Lake Ontario. In this paper the several elements which control the action of the freshet and the descending flood, the topography of the river, drainage area, history and several states of the freshets, testimony as to times and extent of damage, and principles of flood-flow are fully treated, and furnish a large amount of information on a subject not often presented.

The point, however, in the case, which is the most prominent, is the development here on a large scale, of the theory and action of the "wave of translation," which has been the subject of much elaborate investigation by scientific men, but is, so far as now known, first introduced here in a legal case, as a direct cause of serious damage. During the trial, the theory presented by Mr. McElroy and fully indorsed by his associates, was emphatically confirmed by the celebrated English engineer, J. Scott Russell, Esq., who was consulted at Paris, and who is identified with various elaborate investigations of this hydraulic law.

It appears that for nearly one third the length of the river and about its center, there exists a long, wide, deep basin, which in powerful freshets is filled to a great depth, averaging in this instance, about 24 feet, three fourths of a mile wide, and thirty miles long, on a central line.

At the head of this basin or "pool" there is a high fall, called Lyon's Falls, of 70 feet in low water, and about 54 feet in freshets; the hydraulic slope to the Carthage dam being about 26 feet, on the 30 miles.

The theory of these experts is, that the main portion of the reservoir flood plunging over this fall, into a deep basin, discharging, as estimated, about two thirds of 560,000,000 cubic feet of water in six hours, and capable, in all, of displacing about 4½ miles of the upper section, displaced at the lower end of the basin an equivalent body of water, some time before its actual particles could reach Carthage, in the time determined by the laws of the "wave of translation" or "displacement swell," as Mr. McElroy here designates it.

This analysis, in discussing the "principles of flow," shows that, while certain laws of hydraulic motion have been so thoroughly investigated, as to be "implicitly trusted," circumstances occur in flood movements which modify these laws. This general theory is then illustrated by examples from "confluent streams," "overfall weirs," and "submerged weirs," and the experience on the large aqueducts of the country. The paper then proceeds:

"In the upper valley of the Black River, we find the wave traveling with an advance 'bore,' which may or may not have been preceded by a more quiet sheet of water, the rush being distinctly marked at various points; from Dawson's to Bellingertown, and from Forestport to the Lee Bridge, the observed speed approximates to about one half the calculated central velocity; in the lower valley, similar phenomena of action were observed, the 'bore' being distinctly defined on the Carthage dam, at Rason's, Great Bend, and other points.

"In the long reaches, however, and the pool, the descending wave could not take possession of the channel, from the mass of more quiet water it successively encountered, and a different principle of relief is brought into action, by which mechanical impulse is transmitted in advance of actual molecular movement.

"The investigations of science have determined that all liquids and fluids have certain analogous laws of motion and action, and in the movement of light, sound, electrical currents, as also in water, action is frequently most perfect where actual movement of particles is impossible in the same degree. Nature has provided this wave action as a means of communication, which does not involve actual molecular delivery, in those cases where such delivery is inadmissible."

* * * * * *

Various examples are then cited; the experiments and deductions of Scott Russell are given; and the remarkable confirmations of the Hudson River and Long Island Sound tidal waves are described, with this application:

"Now this flood-wave mass was entirely able to sweep down the River Channels of Lyon's Falls, because it found a comparatively free path to travel in, and its whole body in the main, did so pass down; but when the 15,654,000 gross tuns of water, which represent it, plunged over the Lyon's Falls' dam with an impinging velocity of 58 feet per second, a comparatively quiescent body of water, more than seven times its weight, was interposed against its free progress further. According to the laws and examples we have cited, two distinct results followed: one, the displacement of a portion of the pool, equivalent to this falling body, at the other end, by the action of the "displacement swell;" and another, following as an inevitable sequence, was the increase of the former current of the pool towards Carthage."

It is then shown by applying D'Aubuisson's formula to this case, that the time of transmission of motion to Carthage through a basin of this depth is two hours, and the observed accelerated current is between six and eight miles per hour. Various phenomena which corroborate this action, are also cited.

The conclusion, identifying the reservoir flood with the progress of damages along the river, and confirming these calculations by a series of observed facts, is thus given:

"At Dexter (the river mouth), Parker, by 7 A.M., the 22d (April), records accumulated damages; at Watertown, shortly after 5 A. M., serious damages occurred; at Great Bend, by 2 A. M., there was a rise, 3 feet to 3 feet 9 inches, above level of 1862; at Carthage, about 1 A. M., the rush over the dam had swept away a stone wall, and other damages were done that night, doubtless by the same means; at Lyon's Falls, the great reservoir wave struck the pool, then at a stand, certainly by 10 P.M., with a probable advance before this; at Port Lyden (3½ miles above) the corrected testimony makes it plain that this advance may have passed at 7, that the 'bore' passed about 9, and that the full crest swept through at midnight. This forms a chain of evidence which fully accords with the deductions of science, with observations of the highest importance in other localities, and the testimony of localities all along these 70 miles, which differs only in minor details. It is impossible to escape from the conclusion which identifies these events with the same powerful cause, all the more destructive as riding down its successive descents on the fully prepared water way of a powerful freshet, without which it would have been shorn of a great part of its power and swiftness, and whose volume it gathered up and hurled along on its resistless path."

During the trial, an experiment was given by Mr. McAlpine, with a narrow trough about 8 feet long, filled with clear water, the lower part being then charged with blue coloring, and the upper part supplied with red colored water. This illustrated with great exactness, the law of displacement, long before the upper supply reached the lower ledge, and also illustrated the relation between the power of the upper supply and the lower delivery.

All the details of this case involve important principles, which will make a precedent for similar issues hereafter.

FOREMEN AND SUPERINTENDENTS.

The qualities which are essential to a good foreman or superintendent of a manufacturing establishment are rarely all combined in a single individual. When they are not naturally possessed in a high degree, they may, however, be so developed by education and self-discipline as to, in a great measure, supply natural defects. Such education and discipline, however, must, to be successful, be early commenced; and as doubtless many young mechanics who peruse these columns are aiming to qualify themselves for positions of trust and command, it may not be amiss to discuss briefly the qualifications of a first-class foreman and superintendent.

We do not regard it as absolutely essential, though, if possible, desirable, that the foreman of an establishment should be able to perform himself all the various operations, as conducted in it. It would be in many cases almost impossible that should be able to do this, but he ought to be able to determine when these operations are performed unskillfully, so that he may himself instruct, or select subordinates who are competent to instruct operatives how to do their work in the best manner.

In many large manufacturing establishments, and in all large manufactories of textile fabrics, the general supervision is vested in a manager or superintendent, while the different departments are supervised by foremen acting under, and by the authority of the general manager. It is impossible that all the operatives in such establishments should be skilled in their work. Many of them will be of necessity apprentices or learners, and as such will stand in need of direction and instruction. One of the duties of a foreman must therefore be that of an instructor, and an important and responsible duty it is, requiring for its proper execution, patience, power of imparting information with clearness, perception, not only of defects in work, but in the peculiar deficiencies of hand or mind which are primary causes of unskillfulness. And he must not only be able to detect, but to devise readily remedies for such defects where remedies are possible.

Of all the means by which instruction can be readily imparted, especially in those departments of the mechanic arts where skill is required to fashion crude materials into a great variety of forms, there is none of greater value than free-