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NEW YORK, SATURDAY, FEBRUARY 10, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

STATE COMMISSION ON NEW YORK WATER SUPPLY.

According to its first annual report to the Legislature, the New York State Water Supply Commission has been occupied chiefly in considering the needs of New York city for an increased water supply. The application for permission to establish a water system in the Catskill region at a cost of $160,000,000 is the most important problem of its kind yet proposed in this country. The report says that, judging from the statement of eminent engineers, it seems altogether probable that New York city must eventually utilize the waters of the Hudson River, either directly from its source in the Adirondacks, or possibly at less cost near Poughkeepsie, at a point on the Hudson about 75 miles distant from the city. Attention is drawn to the movement for the purification and protection of streams and rivers, which has been carried out with such success in Europe, that it seems likely to have the ultimate beneficial result of abolishing the barbarous plan of making scavengers of fresh-water streams.

The plan for establishing a water system in the Catskill regions has provoked the inevitable opposition, which occurs when any inhabited, and more or less cultivated, watershed is appropriated for city water supply. The formation of the extensive reservoirs will mean the absolute flooding out of inhabited districts, and the removal of buildings and abolition of farms from a belt of land bordering on each side of the tributaries to the main reservoir. That the occupation of a watershed in this way works positive hardship upon the population cannot be disputed, although we understand that it is the sincere purpose of the Commission to make adequate compensation to the residents and owners who will be affected. To many of these, no doubt, the loss of their ancestral homes, and the wiping out of all the associations with which the locality is enriched, will mean a sentimental loss that monetary compensation cannot meet. The case thus becomes one of conflicting interests; and if, in the present instance, the Catskill watershed is the only one that can properly meet the pressing needs of New York city, stern necessity will compel the sacrifice of the minority to the imperative needs of New York city's many million inhabitants.

Although the Catskill scheme has been recommended as, all things considered, presenting the best solution of the problem, it is not by any means the only one that has been under discussion, or has received eminent professional indorsement. As the report of the State Commission suggests, New York city must ultimately be driven to the Hudson River as its main source of water supply. One Engineering Commission has suggested that the Hudson River water should be used in preference to that of the Catskills, either by bringing it direct from its sources in an aqueduct, or by building a pumping plant on the river, and raising the water to a system of filtering beds, located on the hills back of the river, whence it would flow by gravity to the reservoirs within the city limits.

In this connection we publish on another page a letter from a correspondent, who offers the very novel and striking proposal to impound the waters of the Hudson River in various reservoirs located near its sources; build at each site a hydraulic-electric plant; and transmit the current to an electrical pumping station at Poughkeepsie, where the Hudson River water would be raised to the filtration beds and reservoirs on the hills above. The scheme, if based on the Burr, Hering, Freeman estimate, would involve the raising of 500,000,000 gallons daily through a vertical height of 400 feet. Our correspondent believes that his project could be carried through with a saving of thirty per cent, as compared with the scheme of providing a dam at Ashokan and an aqueduct for conveying the water from the dam to a reservoir on the Poughkeepsie side of the river. As regards the project suggested by our correspondent, it must be remembered that for the performance of this work by the hydraulic-electric method, there must be provided, at the many power plants scattered through the Adirondacks, the energy represented by the fall of 500,000,000 gallons daily through a height of 400 feet, plus the power necessary to overcome the resistance in the pipe lines, in the turbines, in the generators, and in the step-up transformers. To this must be added the energy necessary to overcome the resistance in the hundreds of miles of transmission line between the Adirondack power stations and the pumping plant at Poughkeepsie, and also the resistance in the pumping plant itself due to the step-down transformers, the rotary converters, the motors, the pumps, and the pipe lines, from the intake at the Hudson to the outlet at the reservoir on the hills above. It would be an interesting problem, when the location of the power plants was established, to determine how many hundreds of millions of gallons must be delivered daily to the turbines, to cover the above-enumerated sources of loss, and still suffice for the stupendous and unending effort of lifting the 500,000,000 gallons daily to a height of 400 feet—this height being necessary to secure a flow to the high-level reservoirs within the city limit. The most sanguine estimate would demand, surely, that not less than 800,000,000 gallons daily should be available at the distant power plants. Yet we are informed by the Water Supply Department that a study of the flow of the Hudson in the driest seasons on record shows that it has fallen at Poughkeepsie as low as about 900,000,000 gallons per day. With all due recognition of the ingenuity of Mr. Parrott's proposal, we think that, if the Hudson water were used, considerations of security and permanence would lead to the selection of a steam pumping plant rather than one depending upon the variable flow of the upper Hudson.

THE DELAY OF THE MANHATTAN BRIDGE.

It will be within the memory of our readers that our last article on the Manhattan Bridge controversy was intended to close the discussion, as far as the columns of the Scientific American are concerned; but we have since received several letters from Mr. Hildenbrand, requesting us to re-open the subject to the extent of assuring the public that our criticism of his published letters was not intended to cast any doubt on his professional ability. We cheerfully comply, if only because of the opportunity it affords us to state, once and for all, the position of the Scientific American with reference to this matter. The point of view of this journal is that of the individual citizen, who, first and last, is the one that suffers from the inconvenience caused by the delay—the absolutely unnecessary delay as it seems to us—in the construction of this bridge. So long as the Manhattan Bridge be well designed and speedily built, the Scientific American cares not one iota what engineer writes his name at the bottom of the plans. Our strong advocacy of the design of the former Bridge Commissioner has been absolutely impersonal, and based entirely upon the merits of the case. The Editor formed a favorable impression, from the very first, of the plans for a chain-cable bridge—an impression which was deepened by the indorsement which these plans received from the Board of Engineers appointed by the Mayor to pass upon them.

That Mr. Hildenbrand's name appeared in the columns of the Scientific American was due entirely to his own act in sending us his letters for publication. We did not approve of his method of argument, and said so. We do not approve of it now. But he is quite in error if he thinks that our criticism was prompted by any motive of disparaging his professional ability. Mr. Hildenbrand may well be content to let his reputation stand upon the fact that he was mainly responsible (if we are not mistaken) for the design of the Brooklyn Bridge. His strong advocacy of the wire cable is consistent, and, we have no doubt, sincere; but in the present controversy we think that he has unwittingly allowed his zeal to get the better of his logic.

It seems to us that what is needed in a discussion of this matter is a broader point of view. Would it not be well for everyone concerned in the agitation that has already deprived New York city of this greatly-needed improvement for a period of nearly three years, to try to look at the question more from the standpoint of the good of the public, and less from the standpoint of personal predilection for any particular type of bridge. We seriously doubt if any of the engineers who opposed the design for a chain bridge believed that it would have failed, if built, to prove perfectly serviceable and safe. Even Mr. Hildenbrand, in his letter published in the Scientific American of November 4, 1905, says: "They" (the Board of Engineers that approved the rejected design) "were merely engaged for giving their opinion whether the design submitted to them was practical, whether the bridge, after being finished, would be fireproof, durable, and serviceable, and whether it would have sufficient capacity and strength. These questions were answered with 'Yes,' and if I had been a member of the committee, I would, with strict adherence to the same questions, have given the same verdict." Now, that the bridge would have been heavier than a wire bridge (with all that this involves) no one has ever disputed; yet, in their strong preference for the construction of a wire bridge, the Bridge Department, in spite of the delay which a change necessarily involved, threw aside the plans for a chain bridge, which Mr. Hildenbrand himself believes would have been, though heavier, "serviceable," and of "sufficient capacity and strength," and thereby subjected the city to the present intolerable delay, the extent of which no one can foretell. Herein lies the true burden of responsibility. The result of the agitation against the chain-bridge design has been to cause the city of New York enormous inconvenience, by delaying a most urgently-needed link in its system of transportation.

Mr. Hildenbrand claims that the responsibility for delay dates back to 1902, when the original design for a wire-cable bridge was thrown out. We believe, however, that the original design was both incomplete and inadequate to the increasing traffic, and that, whether a wire-cable or a chain-cable were used, new plans were in any case necessary. We may be wrong; but even if it be granted that the delay in 1902 was unnecessary, that is no justification for the further delay in 1904. Two blacks never yet made a white.

In the present dilemma the Merchants' Association of this city has made to the Mayor a recommendation which we cordially indorse. As matters now stand there are, in the Bridge Department, two complete sets of plans for the Manhattan Bridge. One of these, calling for a chain cable, has been passed upon and approved by a Board of Engineers; the other, which has never been offered for approval by an independent board, has been bid upon, but the bids have been thrown out by the courts. The Merchants' Association suggests that, as the Department is now in possession of two sets of plans, they should both be submitted to an independent board of engineers, and that fresh bids should be asked upon the plans which this board may approve. We sincerely hope that the Mayor will adopt a suggestion which is so sensible, and offers such a simple and quick way out of the present deadlock.

ON A TOUR OF THE SHOPS.

Shop methods have changed greatly in recent years, and school and college trained mechanics are making their influence felt more and more, but the old-time mechanic, with a mind accustomed to dealing with emergencies and able to turn his hand to almost anything, still survives in many of the shops. His training is very different from the younger generation. He knows less about mathematics and accurate drawing to scale, but his intimate knowledge of the practical working of machinery makes him an invaluable factor in every shop. He knows his machinery by heart, and any heart throb that is not natural attracts his attention. He can usually tell by the "feel" what ails a complaining machine. He knows every "cranky" engine or machine in the shop, and he understands how to favor each one to get the greatest amount of work out of it.

But it is in the repairing of machinery that the old-time shop hand is at his best. Here he is in his element. He was brought up in the school which made every machine shop an independent entity. It was impossible in those early days to order duplicates of machinery by telegraph, and expect them to be delivered within twenty-four hours. Consequently, every shop had its resourceful mechanics, who were capable of repairing any machine so that it could continue its work for several weeks until the new parts could be forged or made in some distant factory. It was this very training which made the old-time mechanics such men of inventive genius. If an engine rod broke or a steam box fractured, the mechanic of the shop could repair it so that work would not have to be shut down for long. The breaking of a huge flywheel only meant temporary delay. An old-time shop mechanic recently told me how he had rigged up a wooden flywheel within twenty-four hours after an iron one had broken, and the temporary one worked successfully until the order for a permanent wheel could be filled.

In the modern, up-to-date shop, where nearly every part of the machinery is supplied in duplicate, so that the breaking of any piece merely causes a little shut-down, the tendency has in recent years been to depend less and less upon the old-time all-round, ingenious shop mechanic. The feeling has grown that the human element will be more and more eliminated from the shop as an important skilled factor. It is the machinery which holds sway, and which does the work, and the man who operates it merely holds an inferior position. Yet there are some shops which take the opposite view of this. A visit to one of them a short time ago revealed quite a unique condition of affairs. It was filled with old-time mechanics and shop workers. Very few of the new school were present. Was this an accident or intentional?

"Partly both," replied the superintendent. "I brought most of these men back with me from Mexico, and I shall keep them as long as they care to stay here. I went down there five years ago to install and run for a year a new railway shop in the city of Mexico. I knew I could not depend upon native labor, and so I selected my men in this country and took them with me. I was warned before I left that there was no possible way of getting duplicate parts of machinery in that part of the country inside of a month or two. It all had to be shipped by train from this country. Therefore it was quite essential that I should take with me men mentally equipped to tackle emergency jobs. I chose the old-time practical shop men, those who had been accustomed to the old methods of independent work. I was not disappointed. Down there we met some pretty ugly propositions in mechanics, for the railroad company was poorly equipped with repairing machinery. But we surmounted every difficulty. Every time we ran up against a hard thing, we held a council of war. Every man had a right to state his way of making the repairs, and then we selected from the list the most serviceable. Well, it would have surprised you to see some of the ingenious and practical methods proposed by those old mechanics. They could have given your new school-trained shop man a mile ahead start and beat him out. They gave me pointers which I haven't exhausted to-day. I shall continue working on them for years to come. When we got through with that Mexican job, I brought the men home, and I consider we have the best set of mechanics in any shop of the country. There is a feeling of responsibility among the men which is difficult to get in a mixed lot.

"We still hold our meetings to consider the best method of proceeding when anything happens, and the men put in their solutions for the trouble just as they did down in Mexico. At these meetings we get an exchange of views that is worth a good deal. For instance, the other day we found it necessary to make repairs to a warped bed on which some heavy machinery stood. The question was raised as to whether we should have a new bed on new foundations, repair the old, or design something of our own. Here is the proposition one of the oldest mechanics and engineers in the shop made: Tear up the old bed and foundation; cut down to hard pan in the soil in a space one foot wider than that required for the machine, and then build up a firm foundation of coarse stones laid in cement, and finish off the top with good concrete. This latter is brought up a few inches below the level for the bed. While the top course of concrete is soft, heavy three-inch oak plank is buried in it, the ends and sides being completely covered with the cement. When the cement hardens, the plank is firmly embedded. On top of this wooden bed fastened into the cement oak planks are screwed firmly, and to the wooden floor thus laid directly on and into the concrete foundations the legs of the machine are screwed. A perfectly level floor bed is thus obtained, and there is absolutely no vibration. When the floor gets warped or worn, the top planks can be taken up and new ones put down.

"This suggestion proved so novel and promising that we have made an experiment with it. We shall lay it under a heavy engine lathe, and if it proves all that is desired, we may repeat it under other machines. Like most shops, we have experienced a good deal of trouble with beds for heavy machinery. They get warped or uneven in a short time where the weight of the machinery is unevenly distributed, and particularly where the pounding of the machinery is over one part. The question of building absolutely firm beds which will neither warp nor drop on one end is a nice one in many shops. The constant raising of ends and putting chips under them to secure a perfect level can hardly be called good workmanship, and yet in many shops this is just what is being done. Beds which will not warp or change the level are greatly to be desired."

It is a fact that in a good many machine, repair, and construction shops, ideas and suggestions are made by the men which are not always received in the right spirit. The tendency to consider a poor mechanic of little account, except in his special line of work, is fatal to the highest efficiency of any single crew of men. Superintendents, foremen, and master mechanics are often so jealous of their own positions, that they resent any suggestions from those below them. Yet it has been the writer's fortune to run up against a number of cases where the most useful inventions in use in the shops came through the suggestions of the men who held inferior positions. They had the knack of seeing how things should be done to save time and labor, and their practical knowledge made their suggestions invaluable.

In a good many shops where devices of a novel nature are in use no drawings whatever exist, or if crude ones were made they have been destroyed. In many cases the men had the designs made according to the suggestions of subordinate mechanics. Frequently such crude devices have saved thousands of dollars to the shops, either through increasing the output or decreasing cost of production. As these devices are not patented they are not put on the market, and other shops are not benefited thereby. One shop is not inclined to throw open its secrets to another, but where devices are not considered important enough to patent, little harm can be done by an exchange of visits between master mechanics and foremen of shops. New descriptions of shop methods and labor-saving devices would furnish a great amount of data for shop foremen and superintendents to study, and in the aggregate they would greatly raise the general standard of appreciation of the subordinates who work in the various machine, repair, and construction shops of the country. A. S. ATKINSON.

PROPOSED DAM FOR LAKE ERIE.

BY ALTON D. ADAMS.

Niagara Falls may be given a more constant volume of water by the erection of a dam at the foot of Lake Erie. Such a dam would be of great benefit to the electric power plants about the Falls, and an important aid to commerce moving between the four upper lakes and the St. Lawrence River. These results would follow the erection of a dam at the outlet of Erie because that lake is subject to great fluctuations in level, while Niagara Gorge is only one-fifth to one-tenth as wide as the river above the Falls.

Of the four upper lakes, Erie is much the smallest in area, and its greatest depth is only 84 feet, while that of lakes Michigan and Huron is 1,000 feet, and that of Lake Superior 1,030 feet. Niagara River is the final outlet of the four upper lakes, but the great storage capacity of lakes Superior, Michigan, and Huron is not directly available to maintain its rate of discharge. This is due to the fact that Erie is lower than the three Great Lakes to the west, and connects with them only through the comparatively narrow and shallow channel of the St. Clair River. While the three higher and greater lakes thus supply much the larger part of the water that annually flows down the bed of the Niagara River, its hourly and daily rates of discharge depend mainly on the level of Lake Erie at its lower end. East and west along the length of Lake Erie the winds sweep a course of 290 miles, and pile up its waters at either end. The rise of water level due to wind action is particularly notable at the eastern end of Lake Erie, because it gradually narrows from its full width of 65 miles to the head of Niagara River, where the width is less than one-half mile. A strong wind from the west raises the water level at the foot of the lake, and largely increases the discharge rate of Niagara River, while an east wind has the contrary effect. By the action of wind alone the water level at the head of the Niagara River is varied as much as seven feet either way from the normal. Other causes produce a maximum change in Erie level of as much as four feet. When both the wind and other factors operate together it thus seems that the water level at the foot of Lake Erie may vary as much as nine feet from the normal. At the inlet of Niagara River the greatest depth of water is about twenty feet at normal lake level, and a change of seven feet, or about one-third of this depth, must obviously have a large effect on the rate of discharge. According to the report of the Secretary of War, a rise of Lake Erie level from 570.25 feet above mean low tide, in November, 1899, to 573.12 feet, in June, 1900, increased the discharge rate of Niagara River from 165,340 to 231,350 cubic feet per second. If this rise of 2.87 feet in the level of Lake Erie was followed by an increase of 40 per cent in the rate of Niagara discharge, how great must be the change in discharge rate that follows a variation of seven to nine feet in the lake level? In view of these figures, it is not hard to believe the story that the cliff which carries the American Falls was laid bare some years ago, after a strong east wind had been blowing for some days. The American Falls show the effect of low lake levels much more than do the Horseshoe, because the crest of the former is about seven feet higher than that of the latter. At Port Day, about one mile above the Falls, and where Niagara River is nearly a mile wide, records of the water level have been kept since 1886. In January, 1893, the river level at Port Day was down to 557.4 feet above mean low tide, and in January, 1899, the water level at the same point was up to 565 feet, a rise of 7.6 feet.

Such changes of the river level above the Falls work large variations in the heads of water on wheels in the power plants there, because Niagara Gorge is so much narrower than the river above. For each foot of rise in the river level above the Falls, the rise in the Gorge below is close to five feet. A rise of seven feet in the upper river thus brings about a rise of 35 feet in the Gorge, and the power plants at the Falls are exposed to a net change of as much as 28 feet in the heads on their turbine wheels. This change of head, besides directly affecting the available amount of power, makes the problem of speed regulation much more difficult.

These large changes of water elevation in the Gorge sometimes occur within very short periods. Thus, on November 2, 1897, the water level at the "Maid of the Mist" landing below the Falls was 334 feet above tide, but on November 6 the river surface had risen 27.7 feet, or to elevation 361.7, at the same point. Just above Goat Island, Niagara River is a mile wide. Between Prospect Point and the Canadian bank, below the Falls, the width is no more than 1,000 feet, and after the railway bridges are reached there is a stretch along the Whirlpool Rapids where the width is only 400 feet. The channel in the Gorge for a mile below the Falls is thus no more than one-fifth as wide as the river above Goat Island, and this goes far to account for the fact that changes of water level are five times as great below as they are above the Falls. Navigation by way of the Welland or the Erie Canal is much interfered with by changes of 7 to 9 feet in the water level at the eastern end of the lake, because the regular depth of the former canal is but 14, and of the latter 7 feet. A dam at the head of Niagara River would prevent an excessive discharge of water when the level was exceptionally high at the eastern end of the lake, and would maintain the water surface at a more nearly constant elevation. With no dam at the outlet of Erie, high water there produces an abnormal rate of discharge, much greater than the inflow from the St. Clair River. The consequence is that when the temporary high water at the foot of the lake subsides, its entire level sinks below the normal until the discharge from Lake Huron brings it up. To dam Lake Erie presents no great difficulties from an engineering point of view, apart from the mere magnitude of the work. For a length of one-half mile just below the outlet of Lake Erie, Niagara River is no more than three-eighths of a mile wide between Buffalo and Fort Erie, Ontario, and its greatest depth of water is about 20 feet. A low dam at this point would accomplish the purposes named above.

PRIZE FOR ELECTRIC DEVICE.

A prize contest has been organized by the Hydraulic Power Syndicate of Grenoble, France, relating to a much-needed device for use in electric light or power stations. On the system of wiring which distributes current to the subscribers, each of the branch circuits is established so as to provide for a certain power whose maximum is determined in advance, and the arrangement is made with the subscriber either by contract or meter. It often happens that the maximum of current is exceeded for more or less time, and this causes trouble upon the whole system which the station supplies. It will be of value to have a method which will allow of notifying the subscriber in the first place, and if he pays no attention, of obliging him to return to the conditions of his contract, this without annoying surveillance on the part of the central station. The proposed current-limiting device is to work at a higher power than 5,000 watts and on all kinds of current. It is to give a signal as long as possible before it commences to operate; then it limits automatically the current on the branch line, working every time the proper current is exceeded. It can be set back again, but leaves each time an indication of the resetting. A complete description is to be sent before April 1, 1906, to the Siège Social du Syndicat des Forces Hydrauliques, 63 Boulevard Haussmann, Paris, also (if accepted) two apparatus, which are to be tested on the line and in the laboratory. A prize of 2,000 francs ($500) is to be awarded for the best device.

OFFICIAL METEOROLOGICAL SUMMARY, NEW YORK, N. Y., JANUARY, 1906.

Atmospheric pressure: Mean, 30.13; highest, 30.72; lowest, 29.25. Temperature: Highest, 63; date, 29th; lowest, 13; date 10th; mean of warmest day, 54; date, 23d; coldest day, 20; date, 9th; mean of maximum for the month, 42.8; mean of minimum, 31.8; absolute mean, 37.3; normal, 30.4; average daily excess compared with mean of 36 years, +6.9. Warmest mean temperature for January, 40, in 1880 and 1890; coldest mean, 23, in 1893. Absolute maximum and minimum for this month for 36 years, 67, and —6. Precipitation: 2.98; greatest in 24 hours, 1.63; date, 3d and 4th; average for this month for 36 years, 3.78; deficiency, —0.80; greatest precipitation 6.15, in 1882; least, 1.15, in 1871. Snow: 3.0. Wind: Prevailing direction, west; total movement, 10,451 miles; average hourly velocity, 14.0 miles; maximum velocity, 61 miles per hour. Weather: Clear days, 8; partly cloudy, 9; cloudy, 14. Sleet, 13th, 14th, 20th; fog, 4th, 12th, 16th, 21st, 22d, 31st. Thunder storms, 4th.

Hydrodynamics, elasticity, optics, electricity and magnetism, though originally based on molecular hypotheses and the idea of central forces, in the course of their development found themselves more or less independent of these notions. In all of them the important common feature is the propagation of actions through a medium which can be regarded, at least in first approximation, as continuous. In hydrodynamics and in the theory of elasticity this medium is that unknown something which we call matter; in optics, and later in the theory of electricity and magnetism, it was found necessary to postulate the existence of another medium, the ether.