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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.

THE MANHATTAN BRIDGE FIASCO.

In our issue of July 16 we presented a *résume* of the history of the city's abortive attempt to build a suspension bridge across the East River, at a point adjacent to the present Brooklyn Bridge; and we think that the average citizen of New York would have found that story positively entertaining, had it not been so completely humiliating to his civic pride. In the article in question, which is accompanied with illustrations of the substitute plans which are proposed by the present Bridge Commissioner, no attempt was made to criticize the engineering features of these plans, and this, not for the reason that they were by any means beyond criticism, but because we felt that the time was not then ripe for such discussion.

Judged purely from the æsthetic standpoint, the new design, if we except the anchorages, is pleasing, particularly as compared with the recently completed Williamsburg Bridge. The improvement is due to the very shallow depth of the stiffening truss, which runs at the floor level from end to end of the structure. Unfortunately for the design, what it gains in appearance from this shallow truss, it loses in structural efficiency. The object of such a truss is to prevent local sagging of the cables under a concentration of load at any point in the bridge where it may occur; but the ability of a truss to resist this bending is proportionate to its stiffness, and its stiffness is directly proportionate to the cube of its depth. Hence, other things being equal, the shallow truss, such as here proposed, will be a weak truss, unless, indeed, it be made extraordinarily heavy and an immense amount of steel material be massed into the upper and lower lines of the trusses, or what are technically known as the top and bottom chords. But if such a massing of material be made in order to compensate for weakness due to shallow depth, the truss becomes inordinately heavy, and an additional amount of material must be put into the steel cables to carry the increased weight of the trusses; consequently the bridge becomes proportionately heavy and costly.

Now this decreased strength and stiffness, or greatly increased weight and cost, as the case may be, does not appear in such a dainty little drawing of the bridge as was shown in our issue of July 16. It does not appear in the elaborately-shaded plans that were submitted to the Municipal Art Commission. All that is seen in those plans is a pretty picture of a rather graceful-looking structure. Such a drawing gives no information whatever as to the strength, the weight, the rigidity, the ease of erection, the cost of erection, and the thousand and one other items which must be carefully considered by the expert engineer before it can be said whether such a design is a practicable and useful one. It may be pretty—it is pretty. But before the city embarks on an expenditure of twenty million dollars for a public utility, it wants something more than a fanciful sketch, hastily drawn up by a newly-installed Bridge Commission.

Let us briefly state what are the indispensable requirements for the bridge in question. First, in view of the frightful conditions of congestion on the present Brooklyn Bridge, the new design should be of such a character as to admit of the most speedy erection. Secondly, in view of the astonishing rate at which travel between New York and Brooklyn increases, and the absolute certainty that big and wide as the bridge is being made, it will, before many generations have passed, be called upon to carry even more than its estimated load, it is imperative that the structure should be made exceptionally rigid and strong. Thirdly, it should have as great architectural or æsthetic beauty as is consistent with the requirements above stated. Now, comparing the two designs, the one accepted by the Municipal Art Commission was provided with eye-bar cables with a view to speedy erection, and it is certain that it can be constructed under contract in from three and a half to four years. It is equally certain that the new design with wire cables would take from one and a half to two years longer to construct, for the new Williamsburg Bridge, built generally upon the same lines and with wire cables, consumed over seven years in construction. As regards the comparative rigidity, the design accepted by the Municipal Art Commission embodies stiffening trusses that have a maximum height of 58 feet, whereas the new design gains its architectural appearance by cutting down this height from 58 to 24 feet, which is 16 feet less than the height of the trusses in the existing Williamsburg Bridge. We venture to say there is not a single competent bridge engineer in the world who, when first looking at this design, did not feel astonished to see that the designers should have returned, in a bridge of this stupendous magnitude, to principles of construction in the way of shallow stiffening trusses that were condemned and abandoned forty years ago. This very element of shallowness in the trusses condemns the design from an engineering point of view at the very first glance.

There is one more point of comparison of the two bridges which is perhaps the most important of all, and that is that whereas the design accepted by the Municipal Art Commission, prior to its acceptance, was submitted by the Mayor to the most eminent board of bridge experts that could be gotten together in this country, and was cordially indorsed by them, the new design, which was drawn up by one of the subordinates of the engineer who designed the first bridge, has never been submitted to any board of experts, and therefore has nothing back of it, in an engineering sense, more than the individual opinion of the engineer and his associates. The Municipal Art Commission can pass upon the æsthetic elements of the new design; but until this design has been submitted to an expert board, the Art Commission finds itself at a great disadvantage in making any comparison of the comparative engineering value of the two designs. For reasons best known to himself, the present commissioner appears unwilling to have any expert commissioner pass upon his plans; although if those plans are in complete shape it would not take more than a month's time to secure a report upon them. Why is the present bridge commissioner unwilling to submit these plans to the same expert investigation which passed upon the plans that he had rejected?

PERILS OF THE SUBMARINE.

The narrow escape of the crew of the submarine torpedo boat "Porpoise" from a terrible death during some recent practice off Breton's Reef, again brings forcibly to mind the great perils which attend submarine work. As far as can be learned it seems that the "Porpoise," in charge of two lieutenants and eight men, took a position off the lightship and there submerged, intending to make a run at the depth of 20 feet. The type of submarine to which the "Porpoise" belongs accomplishes its diving by maintaining a slight reserve of buoyancy, and then setting the submerging rudders so that they carry the boat beneath the water, the depth of submersion being determined by the angle at which the rudders are set. It seems that, in the present case, the rudders became jammed, so that they continued to carry the vessel down until she rested on the bottom at a depth, according to press reports, of 120 feet. To raise the vessel, an attempt was made to blow out the water-tanks; but of course, at this great depth, the water pressure tending to crush in the "Porpoise" was considerably greater than that which she was designed to stand, amounting to 52 pounds to the square inch, or about 3¾ tons to the square foot. It seems that when the valves of the trimming tanks were opened in the endeavor to expel the water from the tanks, it was found that they would not operate. Moreover, the enormous crushing pressure upon the boat started leaks, and the water began to come in through the seams of the plating and around the joints of the torpedo tube. In this emergency, which was about as terrible as could be imagined, Lieut. Nelson, who was in charge, utilized an air pump worked by hand, to expel the water, and after a long period of hard work on the part of the crew the boat slowly rose to the surface and was towed into Newport.

It is supposed that the trouble was due to the fact that the boat had not been overhauled for cleaning for nearly twelve months, and that, consequently, the sea cocks had become choked. The terrible plight in which the crew found themselves brings to mind the recent accident in the British fleet when a submarine was run down and lost with its entire crew. If the accident proves to have been due to negligence in the upkeep of the boat, of course there will be nothing in the incident to shake the faith of those who believe in the submarine as such. On the other hand, the incident serves to illustrate the special perils that attend this form of naval service, unless it be conducted with extreme caution and unremitting watchfulness.

ELECTRIC POWER FOR OIL WELLS.

M. L. Gaster, a prominent German engineer, has recently brought out some facts regarding the use of electricity in connection with petroleum production. The world's petroleum production for 1903 stands at 20,000,000 tons, and of this more than one-half is furnished by Russia, the rest coming from the United States and Canada, Roumania, and Borneo. The demand for petroleum greatly exceeds the present production. The substitution of oil for coal, in order to be advantageous, needs a better regulation of the methods of producing it and also of the price. In this connection the use of electric motors is a question of great interest. One point of superiority is the suppression of fire risks. As concerns the industrial applications, it will be remarked that in Russia oil is cheaper than coal, so that all the vessels of the Caspian Sea and Volga, as well as the locomotives of the Caucasus between Baku and Batoum, are now burning oil in preference. In England and France the question is not so far advanced and is only in the experimental stage both as regards locomotives and stationary engines. The use of current, which is generated in a large central station to operate motors for petroleum wells, is justified by the great extent of ground covered by the wells, as well as the danger from fire caused by the steam engines which operate the drills and pumps. Another reason for using such a system is the variations of load which occur at the different wells. These three points alone will therefore explain the advantages of a central station system.

The first wells to be drilled by electric motors were in Roumania, where the system was inaugurated five or six years ago. The first installation, provided with a set of motor-driven pumps, was put in by the Dutel Company. A central station was erected at a distance of 1½ miles, to supply the current. The motors are of the three-phase type, operating at 300 volts. The total capacity of the station is 200 kilowatts. Later on, the Lahmeyer Company, one of the leading German electrical firms, erected a large station for the Roumanian company Steana Romana to be used in operating a great number of wells. Hydraulic power is used here and the turbine plant can furnish 1,500 horse-power. Four dynamos of the three-phase type were installed, giving 300 volts each. A set of transformers raises the voltage to 11,000 for a high-tension line which runs for 20 miles or more to the well-district. Near the wells is a reserve station which can run in connection with the central plant. It uses three Diesel motors of 300 horse-power each. The motors use crude oil and consume 0.28 liters per horse-power-hour. A year ago there were as many as 30 electric motors in use at the wells at Campana and 27 at Bushtenari, or about 60 in all. The first cost of the plant was $2,400 per well, and the running expenses $40 per horse-power-year.

In Russia the conditions are less favorable for the use of electric power. This lies in the fact that the oil which is now consumed to furnish the power for the wells, is not subject to any tax, and therefore a very cheap supply of energy can be had, although it is wasteful and accompanied by fire risks. However, it is to be noted that there are a number of electric plants for operating the wells in the Russian district. One of these is at Balachani and it was the first to be installed. Almost at the same time a second electric station was erected in the district belonging to the Nobel Company. In the spring of 1901 a large central plant was laid out for 1,500 horse-power to supply the wells belonging to the Apcheron Company, on the Caspian. The station uses two steam engines and two dynamos of the Allgemeine (German) make. A great number of motors are used at the wells. Since then other electric plants have been installed at Balachani, Bibi-Eybat, Baku, and other localities.

THE PRODUCTION OF IRON ORES IN 1903.

Again the United States has surpassed all competitors in its yearly output of iron ores. This is the most important fact contained in the report made by Mr. John Birkinbine to the United States Geological Survey on the Production of Iron Ores in 1903. The report, which will be part of the annual volume "Mineral Resources, 1903," has just been published as a separate pamphlet and may be obtained free of charge from the Director of the Survey. Its opening paragraph declares that the quantity of iron ore produced in the United States in the year ending December 31, 1903, was 35,019,308 long tons. This means a decrease of 534,827 long tons, or about 1½ per cent, from the maximum of 35,554,135 long tons in 1902. The quantity mined in 1903 is, however, the second largest recorded and is greater than the combined totals for the year 1902 of Germany, Luxemburg, and the British Empire, which are the nearest competitors of the United States. The data for 1903 for these countries are not yet available, but the same comparison will probably prove true for this year also.

The iron ore obtained in 1903 came from 22 States and 2 Territories. Minnesota, Michigan, Alabama, and Wisconsin were the leaders in production. Nevada was added this year to the list of producing States, while Vermont and Montana reported no ore mined in 1903.

The iron ore mined was of the four general commer-