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NEW YORK, SATURDAY, NOVEMBER 2, 1901.

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.

RAPID CONSTRUCTION OF THE RAPID TRANSIT SUBWAY.

Our congratulations are extended to the engineers, the construction company and the contractor of the New York Rapid Transit Subway, on the great skill and unprecedented dispatch with which they are prosecuting a work, which may justly be considered as being at once the largest and most difficult of its kind ever undertaken. Although this is not the first time that an underground system has been built in a metropolitan city under cast-iron conditions as to non-interference with the regular flow of traffic, it must be remembered that the tunnels constructed in London and Paris did not compare in magnitude with the New York system, and that many of them have been built at a depth below the surface which carried them clear of all surface pipes and drainage, and avoided altogether the difficult problem of providing for the ceaseless flow of traffic at the surface. For it must be borne in mind that the Rapid Transit Subway starts at the very busiest center of traffic in the whole city and runs for a considerable part of its total length of 20 miles beneath some of the most important thoroughfares of New York. Moreover, except for a few short stretches, it lies in close proximity to the surface, with little more than the depth of its steel-and-concrete roof intervening between the top of its cars and the wheels of the traffic above. Hence it has been necessary, before a stroke of work could be done upon the actual excavating of the tunnel itself, to provide an elaborate and massive system of falsework to hold the surface of the street temporarily in place. Add to this the fact that over the greater part of the route the contractors have had to make special provision for holding up the massive roadbed of a double-track underground trolley road, to say nothing of a perfect network of gas and water mains, and electric cable conduits, and it becomes evident, even to the lay mind, that the construction of this tunnel was an engineering problem of far greater proportions than can be expressed in mere statements of length and quantities.

In drawing up the contract, the Rapid Transit Commissioners set the date of completion at August 21, 1904, or four and a half years from the date, February 21, 1900, on which the contract was signed. Having in view what we might call the incidental difficulties of construction as mentioned above, to which, by the way, must be added the necessity of diverting and lowering some of the largest elements in the sewerage system of the city, it would not have been surprising if it had become evident, as the work developed, that an extension of time would be necessary. At any rate, it must be confessed that the history of earlier contracts of the kind rendered such a delay a decided probability. It is extremely gratifying, therefore, to learn that the work has been handled with such skill and pushed through with so much energy that to-day the contractors are several months ahead of their time, as will be seen from the following figures: Out of a total estimated earth excavation of 1,700,000 cubic yards, 800,000 cubic yards has been taken out, leaving only a little more than one-half of the total to be removed. Out of 1,300,000 cubic yards of rock, including both rock taken out in open cut and that removed in tunnel excavation, 366,000 cubic yards have been removed, or 28 per cent of the whole. On November 1 of this year $9,700,000 had been expended out of the total contract price of $35,000,000. As the amount paid out for work done is about the fairest way of estimating the rate of progress it may be said that about 28 per cent of the tunnel is completed. The fact that the amount paid out every month for work done is steadily increasing augurs exceedingly well for the early completion of the contract. In August of last year the total monthly payment amounted to $265,000, whereas in August of this year it had risen to $900,000, and there is a probability that it will increase as the months pass by. Bearing this in mind, then, we think that the engineers and contractors are perfectly justified in assuming that the subway will be completed by Christmas of the year 1903. In agreement with this estimate the contract for the power plant names January 1, 1904, as the date on which the whole of the installation of boilers, engines and generators is to be delivered. The power station is to be located at Fifty-ninth Street and the Hudson River, and the contractors, having an eye to the future probable extensions of the subway, have secured a plot of ground which will enable large additions to the plant to be made as required. The power station will be larger than the Metropolitan Street Railway Company's plant of 70,000 aggregate horse power, and larger even than the huge power station of 100,000 horse power which is now nearing completion for the Manhattan Elevated system.

PAINTING OF BIG BRIDGES.

The New York public has had the question of the painting of large bridges brought very forcibly and somewhat painfully to mind, of late, by the extraordinary disclosures of the report of the expert commission appointed by the District Attorney to examine the Brooklyn Bridge. In this connection a few facts regarding the system of painting adopted in the case of the largest and most important bridge in the world, the Forth Bridge in Scotland, will be of interest.

It seems that ever since this structure was opened for traffic, eleven years ago, the work of painting it has gone on without any interruption. A staff of about thirty-five men is employed on the work. They commence painting at the southern end of the structure (which, by the way, comprises two main spans of 1,710 feet and two shore spans of 700 feet), and the work proceeds daily, except on Sundays and in unusually stormy weather, until the northern end of the structure is reached. It takes three years to cover the full length of the bridge, which, in the cantilever portions alone, is about one mile in length. Hence it will be seen that this period of thirty-six months represents the useful life of the paint, since one coating is no sooner completed than the work is begun again. Already the huge structure is receiving its fourth coat. To enable the painters to conveniently reach every part of the structure, the engineer in charge has devised a system of ladders and steam hoists. Where possible, ladders attached to the great struts and ties are made use of, but for reaching the loftiest portions of the cantilevers, which rise to a height of 360 feet above the piers, a series of permanent elevators have been installed. These are operated by means of steam winches which are placed a little below the level of the roadway. In proximity to each elevator there is erected a house in which the paint is mixed. For painting the under side of the roadway permanent wire ropes are stretched along each side of the structure, from which the painters' platforms are suspended in such a way that they can be drawn along the rope very much after the manner of a cableway. Evidences of the thoroughness with which the work is done is seen in the fact that, so far, no portion of the bridge has shown any signs of decay or need for renewal.

This method of painting certainly has its advantages over a system in which the repainting is only done as various parts of the structure seem to call for it; since it precludes the possibility of any detail being overlooked for any considerable period of time. An ideal system would be that which combines a periodic painting of the whole structure with a special coating, in the interim, for such parts as are particularly exposed to the action of the elements or traffic, such, for instance, as, in the case of the Forth Bridge, the first 20 or 30 feet of the steel towers above the salt waters of the Firth of Forth, or in the case of the Brooklyn Bridge, the articulated portions of the structure which are subject to movement and those portions of the floor system in which mud and water are liable to collect and set up a rapid oxidation.

ANNUAL REPORT OF THE BUREAU OF ORDNANCE.

In the annual report of Rear-Admiral O'Neil, Chief of the Bureau of Ordnance, it is stated that increased efficiency for the larger naval guns must be looked for, not in the direction of larger size and weight of the guns themselves, but rather in increasing the weight of the projectile and in improving the smokeless powder; in other words, we must endeavor to increase the striking energy of the shell per ton weight of the gun. The latest types of guns, of both large and small calibers, are so heavy and large, that any further increase of weight or length will seriously hamper the design of warships, by making a too large demand upon displacement. The report states that the ordnance equipment for American naval vessels is up to the highest standard attained in foreign navies for vessels of corresponding date and class. Rear-Admiral O'Neil says that he knows of no guns afloat, or shortly to be put afloat, that will equal in energy those which are being built for the United States navy. It is gratifying to know that the manufacture of guns and other ordnance fittings is well in hand, and that the outfits will probably be completed when the vessels are ready to receive them. During the last fiscal year 143 naval guns were completed, and 256 are at present under construction. We are also pleased to learn that there is a steady improvement in naval smokeless powder, that of to-day being considerably superior to the grade manufactured twelve months ago.

Speaking on the subject of submarine boats, Rear-Admiral O'Neil is of the opinion that this type is receiving undue prominence; an opinion in which we heartily concur. He states that if these craft are to have any permanent value, it will be as an adjunct to a system of coast defense. They are, as yet, purely in the experimental stage, and he believes that they will never take the place of ships of the regular type, or render a reduction in the fleets of the world possible. We are pleased to learn from the report that the latest armor contracts are extremely advantageous to the government, the price being lower than that paid abroad, and the armor the best that can be procured.

Interesting light is thrown upon the present controversy which is raging in naval circles over the designs for our new battleships and cruisers. We had thought that the point at issue was that of the double versus the single turret; but Rear-Admiral O'Neil, who is president of the Board, states that the issue is as to the relative merits of the new 7-inch gun as against the 8-inch and 6-inch guns, he himself being a strong advocate of the lighter piece. The arguments in favor of the 7-inch gun were given in our issue of August 10, 1901, when firing diagrams, showing the concentration and total energy of the gun fire obtained with two types of ship, one carrying the 7-inch gun and the other the 8-inch and 6-inch guns, were given. We hope in a later issue to take up this question in fuller detail.

IMPORTANT APPLICATION OF ELECTRIC POWER IN RAILROADING.

President James J. Hill, of the Great Northern Railway, is preparing to operate a 66-mile section of that railroad through the Cascade Mountains with electricity instead of steam. If the project proves successful it is proposed to operate an entire division from tide-water at Everett to Wenatchee on the Columbia River, a distance of 141 miles, with electric motors. This accomplishment, railroad men believe, will be but the beginning of the equipment of the entire main line with electricity. The plan of substituting electricity for steam, which has been forced upon Mr. Hill by his long tunnel and peculiar conditions, was first proposed to the railway world, as applied to long distance, by Henry Villard nearly ten years ago. Mr. Villard was at that time in control of the Northern Pacific Railroad and had become greatly impressed with the possibilities of electricity through his association in a business way with Thomas A. Edison. Early in 1892 Mr. Villard gave instructions for George W. Dickinson, then assistant general superintendent of the Northern Pacific at Tacoma, and one or two high officers of the engineering department, to meet him in New York, whence they were taken to the works of the General Electric Company for a conference with Mr. Edison and other electrical engineers regarding the feasibility of introducing electricity on the Northern Pacific. To these officers Mr. Villard unfolded a plan which he had partially matured for operating first a broad-gage electric railroad between Milwaukee and Chicago. He had under consideration either the building of an entirely new line between those cities or the substitution of electricity on that portion of the Wisconsin Central which was then controlled by the Northern Pacific. Mr. Villard figured that the line could be placed in operation by the summer of 1893 and could thus be used by thousands of visitors to the Columbian Exposition at Chicago. The consummation of this plan was prevented by the gradual tightening of the money market which preceded the stringency of 1893, and in consequence of the receivership which followed, the Northern Pacific passed out of Mr. Villard's hands.

The investigations on the same subject by the Great Northern cover a period of over three years and have been under the direction of J. N. Hill, the eldest son of President J. J. Hill. The matter was first brought to the elder Hill's attention by the reports of his civil engineers to the effect that it might be found impracticable to operate trains through his two-mile Cascade tunnel by means of coal-burning locomotives, on account of its extreme length and the fact that there would be no means of effectively ventilating the tunnel when finished without going to the expense of installing and permanently operating compressed-air motors. The investigations which followed have convinced the officers of the road that a great saving can be made by operating trains by water power con-