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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.

AMERICAN LOCOMOTIVES ABROAD.

The American engines which were purchased by the Midland Railway Company of England in 1899 have at last been heard from officially. Mr. Johnson, Superintendent of Locomotives, states that the company put into operation thirty Baldwin and ten Schenectady engines, the builders having been given a free hand in the matter of design and pattern. The result of a six months' trial in 1900 showed, according to the report, that the cost of operation of the American locomotives exceeded that of the English engines by the following percentages: Repairs, 60 per cent; oil, 50 per cent; fuel, from 20 to 25 per cent. These figures are certainly surprising, and they are by no means offset by the fact that these engines cost each $2,000 less than English engines of the same size and power. It is impossible to draw any conclusions from this official statement until full details of the circumstances under which the comparison was made are known. Of course there have been the usual hints and suggestions that the imported engines were not given fair play; but to anyone who is acquainted with the working of at least the official side of the English railroads it is certain that every effort would be made to obtain reliable data where such an interesting and unusual opportunity as this was offered for comparing the two types of engine under similar conditions. It is possible, of course, that the American locomotives may have suffered in the comparison from the fact that the engineers and firemen were familiar with their own engines, and necessarily found the American machines somewhat strange. Ideal conditions would be those in which each type was operated by engineers and firemen of its own nationality, if we may so speak. It is reasonable to expect that of two locomotives, one which costs $2,000 more to build would prove more economical in operation. Part of this increased cost of operation might be due to the use of the copper fireboxes which are common in English practice; for it is not denied that this device is a great saver in the matter of repairs, the fireboxes in many of the English locomotives outlasting the engines. There is also a slight saving in fuel due to the superior conductivity of the copper over the steel—though this is so small as to be almost negligible.

After making all allowances of this kind, we fail to understand how such a great difference in repairs and oil could occur; and one is forced to the conclusion that the English engines must, as far as the engineers and firemen are concerned, have received more careful handling than the foreign-made locomotives. Possibly, also, the American locomotive may have suffered from the fact that it is built for harder service than its English competitor, and that it was hauling loads much below its maximum capacity. The American boiler is built to be forced, and the exhaust is harsher with a view to a fiercer draught. The exhaust is softer in the English locomotive and the boiler is not usually forced as it is in American service. It can readily be understood that if the American locomotives were not being worked up to their full capacity, they would show less fuel economy per load hauled than engines which were designed and built for the conditions of the test.

PROTECTION OF IRON STRUCTURES.

The complete revolution which has been effected in the field of industry by the introduction of iron and steel has brought the world face to face with a problem which, if it be not successfully solved, is likely to put a definite limit on the useful life of all structures that are built of these materials. Corrosion of such structures is a certainty if they be not absolutely protected from the oxidizing influences of the elements. They will lose steadily in weight and thereby in strength—a consideration which should modify somewhat our self-congratulations, when we point with pride to our towering, skeleton-steel, buildings and far-reaching bridges on shore, or to our fleets of giant steamships afloat. Although it has been understood from the very first that the life of iron and steel structures was, other things being equal, proportionate to the efficiency of the means used to prevent corrosion, it is nevertheless a fact that our knowledge of the best means to prevent their decay has by no means kept pace with our skill in the design and erection of metallic structures. This most vital subject is treated exhaustively in a paper presented by M. P. Wood, of New York, at the May meeting of the American Society of Mechanical Engineers, which contains a vast amount of data bearing upon the question of the relative value of the different systems of protection by painting.

The paper will be given in full in the SUPPLEMENT, commencing with the current issue, and without attempting to review it at any length, we would refer to three widely known structures, which are mentioned in the article as showing the destructive effects of corrosion, in spite of the fact that they are extensively painted at regular intervals. Thus, we learn that advices as to the condition of the great cantilever bridge over the Firth of Forth, Scotland, finished less than ten years ago, show that corrosion is widely established over the entire structure; and this in spite of the fact that a corps of painters is continuously employed upon it, and that the structure is practically repainted every three years, and in many places yearly. It seems that the lower sections, for 20 feet or more in height above the masonry piers, are particularly subject to attack by the salt spray which is blown from the Firth during the prevalence of high gales. Yet this structure received two coats of boiled oil at the shop before erection, and then two coats of iron oxide paint, the last two coats together calling for not less than 180 tons of paint. Another case in point is the tubular railway bridge over the St. Lawrence River at Montreal, where the destructive action of the elements was intensified by the hot gases and steam from the locomotives. The elevated railway system in this city is also quoted as affording an instance of the rapidity with which deterioration is taking place under our very eyes.

A valuable opportunity was offered to test the relative value of the various paints by an experiment which was carried out, or rather commenced and never completed, on the viaduct over the Harlem station of the New York Elevated Railway at 155th Street. Here the lattice work, floor beams and buckle plates are subject to attack by the gases of the elevated locomotives, and the structure is well suited to an investigation of this kind. The metal work was first carefully cleaned by the sand-blast, and then seventeen panels were painted with as many different grades of paint, some of the panels receiving two and some three coats. Every possible condition was brought to bear to make the test one of a practical, commercial nature, as well as to give it true scientific value. After an exposure of about nine months, a thorough examination of the condition of each panel was made by a prominent engineer, acting under orders of the Board of Public Works of New York city. The report was based upon a rating of 100 as representing a perfect condition of the coating. The freedom from rust varied from a maximum percentage of 99 to a minimum of 25. The 99 per cent of freedom from rust was shown by a paint known as Nobrac, and the 25 per cent freedom from rust was shown by a paint known as Red Lead Axtonide. A 97 per cent efficiency was shown by a lead graphite and lucol oil paint, and 92 per cent by a carbon paint. Then followed a carbon black paint with a record of 85 per cent and an amorphous graphite paint showed an efficiency of 80 per cent. It should be mentioned that the 99 and 97 per cent results were gained on panels which had received three coats of paint, while most of the other panels received only two coats; and it should further be noted that although there was little appearance of rust upon the panels securing a high percentage, the paints showed a tendency to crumble in places as though being rotten—a condition which would suggest inability to resist corrosion had the tests been continued for a greater length of time.

Unfortunately this important test was not continued. It is probable that the poor results obtained with many of the specimens offered were such that the makers were only too glad to have these telltale experiments brought to a speedy close. In view of the fact that New York has now under construction no less than three bridges which will rank among the largest in the world, and a rapid transit tunnel which will be framed from end to end with steel and will be associated with many miles of steel viaduct, we think the officials, both of the Tunnel and Bridge Commissions, should inaugurate a further series of tests, to ascertain what would be beyond question the most serviceable paint to use, in protecting metallic structures whose value will amount to not far short of a hundred million dollars.

OUR FASTEST BATTLESHIP.

The greatest credit is due to the builders of the new United States battleship "Illinois" for the brilliant success achieved by this vessel in her recent official trials over the Cape Ann course, when she showed an average speed during four hours of continuous steaming at full power, of 17.31 knots an hour. This gives to the "Illinois" the distinction of being not merely the fastest battleship of her official class—the other two of the same design being the "Alabama" and "Wisconsin"—but also for the time being the fastest battleship in the United States Navy. The "Alabama," built at the Cramp shipyard, has an official speed of 17.01 knots, and the "Wisconsin," built at the Union Iron Works, has an unofficial speed of 17.12 knots, or about one-fifth of a knot less than the "Illinois."

There are certain features which lend particular interest to this achievement. In the first place the contract requirement as to speed was that the vessel should maintain a speed of 16 knots an hour when the engines were being worked at full power. The contractors have, therefore, exceeded the requirements by a knot and a third. Moreover, the trial was to take place on a mean draft of 23 feet 6 inches and a displacement of 11,565 tons, and these conditions were fully realized; sufficient ballast being taken in to bring the vessel down to 23 feet 7¼ inches and sufficient coal and water being used up during the trial to decrease this draft by about an inch and a half. The trial, therefore, was a thoroughly practical test, and except, of course, for the fact that a good quality of coal and expert stokers were employed, the conditions represented those which will exist when the ship is fully equipped, ready for sea, with all stores on board, with a normal coal supply and with a clean bottom. The trial course on the New England coast, which is made use of by the government on these occasions, is 33 knots in length; and on this occasion it was marked off by means of buoys placed 6.6 knots apart, the "Illinois" covering the course twice during her four-hour trial. Near each buoy was anchored a naval vessel whose duty it was to take observations of the tide and of the time of the ship on passing these points. The fastest speed between any two buoys made by the vessel was 17.84 knots, and the slowest 16.97 knots. The engines were run at a mean speed of 118 revolutions per minute, and the boilers carried an average pressure of 180 pounds to the square inch.

The next fastest first-class battleship in the navy to the "Illinois" and her sisters is the "Iowa," which has an official speed of 17.09 knots. Then follow the sister ships "Kentucky," of 16.89 knots, and "Kearsarge," of 16.81 knots speed. Next in point of speed are the three vessels of the "Oregon" type, the fastest of which is the "Oregon," of 16.79 knots, while the "Massachusetts" has a speed of 16.21 knots and the "Indiana" one of 15.55 knots. Although the "Illinois" has exceeded her contract speed by 1.31 knots, this is not the greatest amount by which any battleship in our navy has shown herself superior to contract stipulations, the credit for this being due to the "Oregon," which exceeded her contract speed of 15 knots by 1.79 knots per hour. Against this, however, must be put the fact that it takes proportionately more engine power to make a gain in speed above 16 knots than it does above 15 knots, and this on account of the well-known rule that the necessary horse power to drive a vessel increases as the cube of the speed.

The "Illinois" and her sisters may be called the prototypes of the form of battleship which is destined to become permanent in the United States Navy. They are marked by a high freeboard and generous accommodation for officers and crew, being in this respect a decided improvement on our first battleships of the "Oregon" class. She is 368 feet on the water line; 72 feet 2½ inches in beam, and displaces 11,565 tons on a draft of 23 feet 6 inches; the normal coal supply is 800 tons and her full bunker capacity 1,440 tons. She carries a complement of 40 officers and 453 men. The main battery consists of four 13-inch rifles in balanced turrets, carrying armor 17 to 15 inches in thickness, and fourteen 6-inch rapid-fire guns, of which ten are on the main deck within a casement of 5½-inch armor, and four are on the upper deck with similar protection. There are sixteen 6-pounder rapid-fire guns in the secondary battery and four 1-pounders, besides two Colts and two field guns. The "Illinois" is also provided with four torpedo tubes. The armor belt, which extends from abaft the after turret to the stem, is 16½ inches in thickness at the top edge and 9½ inches at the bottom. It tapers in thickness toward the stem, where it is reduced to 4 inches. Diagonal 12-inch armor connects this belt armor with the barbettes, which are themselves protected by 15 inches of steel armor. Forward the vessel has a freeboard of 20 feet and aft of 13 feet. Altogether we must confess to a liking for the "Illinois" and her sisters. Her speed, it is true, is not up to the latest standard of 19 knots which has been accepted by our own and most foreign navies as sufficient; but she is an exceedingly powerful vessel for attack, and would stand the hardest kind of hammering in a sea fight without risk of serious disablement.