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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.

AN 18-000-TON BATTLESHIP.

Despite the storm of criticism with which it has been assailed, the large-displacement battleship continues to grow both in size and in favor. Proof of this is to be found in the huge 18,000-ton ships which are to form the most important feature of the new building programme of the British navy. In 1882, six battleships were included in the British naval construction estimates, each of 10,600 tons. In 1892, the displacement had risen to 14,150 tons, which was the size of the "Royal Sovereign" class. Then followed the "Majestic" class of 14,000 tons; the "Formidable" class of 15,000 tons, and the "King Edward" class of 16,350 tons; while to-day the designs for 18,000-ton battleships will soon be in the builders' hands. The policy of building battleships of large size is favored in our own navy, the "Connecticut" and "Louisiana" having a displacement of 16,000 tons.

In other respects than that of size, there is a tendency on the part of American and British designers to reach a common type, with certain clearly-marked characteristics. This is particularly noticeable in a comparison of the new 18,000-ton ships with our own 16,000-ton vessels; for it must be confessed that in these last ships the British designers have shown a desire to follow our lead in the make-up and disposition of the armament, as will be seen from the following description:

The main armament of the new ships will consist of four 12-inch guns, located in two barbette turrets, forward and aft, and eight 9.2-inch guns, mounted in four barbette turrets, one at each corner of a central citadel, within which will be carried ten 6-inch rapid-fire guns. This armament will be more powerful than that of the "King Edward" class by four 9.2-inch guns. As compared with the "Connecticut," it will be seen that the armament will be about the same in power; for while the eight 9.2-inch guns constitute a much more powerful battery than the eight 8-inch guns of the "Connecticut," this preponderance is largely offset by the fact that the "Connecticut" carries twelve 7-inch guns as against the ten 6-inch guns of the British vessel. The 8-inch gun is very popular with the officers of our navy, and it is amply sufficient for the attack of armor covering the secondary batteries of the latest foreign vessels. On the other hand, the 9.2-inch is a much more powerful piece: it throws a 380-pound projectile with a muzzle velocity of 2,900 feet per second, and a muzzle energy of 22,160 foot-tons. Our new naval 8-inch piece of 45 calibers throws a 250-pound shell with a velocity of 2,800 feet per second, and an energy at the muzzle of 13,602 foot-tons. The lower power of our piece would be compensated for somewhat by the greater rapidity with which it can be handled; on the other hand, the 9.2-inch gun can pierce any waterline armor afloat at ordinary fighting range. The total muzzle energy of a single round from the main batteries would be 409,552 foot-tons for the "Connecticut" and 417,680 tons for the 18,000-ton ships.

It is chiefly to the increase of its defensive qualities that the extra 2,000 tons displacement of the British ship has been devoted, the protection being of quite an exceptional nature. In addition to the protection of 9 inches of Krupp steel from stem to stern at the waterline, this 9-inch armor covers the whole side of the vessel to the upper deck, giving the equivalent of waterline protection to the whole of the 6-inch battery, the bases of the 9.2-inch and 12-inch gun barbettes, and to the ammunition hoists and the bases of the smokestacks. The whole of the personnel will therefore fight the ship from behind not less than 9 inches of Krupp steel. The speed of these huge vessels is to be 19 knots, and they will each cost $7,000,000 to build and equip.

THE NEW COKE INDUSTRY.

In the past quarter of a century coke has become one of the most important factors in our iron and steel manufacturing interests, and its value for other purposes where a smokeless fire is required has appreciably increased with its extended use. As a statistical factor it was of little more importance than charcoal prior to 1880; but in 1901 nearly 20,000,000 tons of coke were produced in this country. The present demand is even greater, and the production and consumption for the current statistical year will probably exceed anything heretofore noted in our industrial history.

The coke furnaces of the country have an estimated capacity of production for the current year of 25,000,000 tons, and if this sells at the average rate of $2.50 per ton, as it did in 1902, the total output will represent $62,500,000. But coke, like coal, has increased rapidly in value in the past few months, and to-day it is hard to get it at $3 and $4 per ton for furnace coke, and $5 to $12 for foundry coke. These abnormal prices, however, are not likely to continue long. The chief difficulty in the coke industry has been the shortage of railroad cars to move the material to the furnaces for manufacturing, and then delivering the finished product to the consumers. So greatly handicapped have the coke furnaces been in this respect, that nearly half a million tons of coke are held up in the yards for lack of transportation facilities.

Poor transportation facilities affect the coke makers more than almost any other class of manufacturers, for besides requiring cars to carry the finished product to the consumer, the raw materials must be brought to the furnaces over the same lines of traffic. The hauling of coke to the iron and steel mills must necessarily determine to a large extent the cost of smelting. This has in the past year been out of all proportion to the actual conditions which prevail in normal times.

The future requirements of coke can be partly measured by the unparalleled development of our iron and steel trade. It takes on an average about one ton of coke to make each ton of pig iron. In the last statistical year—that of 1901—the total pig-iron product of the country was 15,878,354 long tons. Not all of this, however, was smelted with coke. Some of it was made with anthracite coal, charcoal, bituminous coal, and charcoal and coke mixtures. But the excess of coke produced over pig iron represents to a large extent the actual demand for coke in other lines of work. The conditions of the iron and steel industries in this country at the beginning of the year were never so promising, with the exception of the high cost of coal and coke. While the maximum capacity of the pig-iron plants of the country for 1902 was about 350,000 tons per week, that of 1903 will be much greater, owing to the completion of some twenty-five new blast furnaces, with an estimated capacity of 2,500,000 tons of pig iron a year.

The demand for coke by the blast furnaces for the current year will consequently be much in excess of that of any other year, and to meet this consumption coke makers have made extraordinary additions to their plants. Up to the first of 1901 there were 64,000 coke ovens in this country, with a trifle over 5,000 in the course of construction. During 1902 about 15,000 new bee-hive coke ovens were built, and several thousand more planned for 1903. These new ovens averaged 600 tons each per annum, which would increase the output of coke some 9,000,000 tons.

The by-product coke ovens have in the past few years become important factors in the situation. These ovens are peculiarly arranged and built to use coals that are not suitable for the bee-hive oven. They have been designed recently so that they can coke coals which were formerly considered of no value for this purpose. In 1901 there were 1,165 of these by-product coke ovens, with a total capacity of nearly 1,180,000 tons; but in 1903 there will be some 3,500 of the by-product ovens in operation. This will enable the makers to nearly double their output. The by-product coke output is immeasurably smaller in this country than in any of the coke-making countries of Europe, the percentage being about 5 per cent here against 40 per cent in Germany, and 20 per cent in England. This is due to the fact that the quality of the coals found in this country is relatively higher than in Europe, and the need of such ovens has not been so urgent here. It is also due largely to the fact that the question of economy in fuel has always been studied more carefully in Europe than in the United States.

Coke has found entirely new fields of use in the electrical field in recent years. In the many electrochemical industries established by the harnessing of Niagara, coke is employed for building the electrical furnaces, and for fusing with the different materials in the furnaces. In the manufacture of carborundum coke forms an important part of the mixture, and it is also used for packing the walls of the furnace. The very highest grade of coke is demanded for these electrochemical industries, and some coke ovens make a specialty of supplying products just for them. These industries include the manufacture of such commercial articles as caustic soda, sodium, aluminium, artificial graphite, zinc, and manganese. The demand for the finest coke for these practically new industries is increasing so rapidly that a number of coke ovens have been established near the scene of manufacturing.

The development of the gas engine in the past year has its bearing on the coke industry. The modern blast furnace gas engine is a marvel of modern invention and ingenuity. It takes the gas from the furnaces and utilizes it for generating power for different purposes. This gas used in the modern gas engine performs nearly or quite double the work obtained from it when used for steam heating purposes. In time the gas engine in utilizing the blast furnace gases will make the profits of pig iron production more than doubly profitable. Indeed, it is believed by some that the blast furnaces may in time be erected primarily as great gas generators, and only secondarily for making pig iron

PROPOSED REPAIRS TO THE EAST RIVER BRIDGE CABLES.

The report of the Board of Engineers appointed last November to decide what repairs should be made to the cables of the Williamsburg Bridge, which were damaged by fire, has found that the annealing of the wires by the heat of the fire left one of the cables, known as cable A, 2.5 per cent weaker than it was before the fire, while cable B was weakened by 6.5 per cent of its original strength. They suggest a method of repairs or reinforcement which will restore cable A, so that it will be only one-quarter of 1 per cent weaker than it was before the fire, while cable B will only lose 2 per cent of its original strength.

Each cable contains thirty-seven strands, and each strand is made up of 208 wires, making a total of 7,696 wires in each cable. The specifications called for an ultimate strength of 200,000 pounds or more to the square inch, but this strength actually ran much higher, being from 8 to 10 per cent greater than the specifications called for, the ultimate strength being from 216,000 to 220,000 pounds to the square inch. The result of the heating of the wires was to anneal and also to lengthen them, the heated wires, after the fire was over, being more or less bowed out from their proper position and not lying parallel with the mass of the cable. The annealing resulting from the fire reduced the strength so greatly, that, in extreme cases, the strength amounted to only 80,000 pounds to the square inch, which was about the ultimate strength at which the wires are drawn in the mill. The heat annealed the wire more or less completely for a depth of four layers. Thus specimens cut from the outer layers showed that, while the uninjured wire had a strength of 223,800 pounds to the square inch, the most injured portions of the burnt wires showed a breaking strength of only 89,900 pounds to the square inch. The reduction of strength decreased in the second, third, and fourth layers, where it fell from 234,000 pounds to the square inch to 210,500 pounds to the square inch, which, by the way, is 10,500 pounds per square inch greater than the specifications called for. A count made of the injured wires shows that 500 have been affected in cable B and 200 in cable A. The injured wires on the top of the cables where they pass over the saddles will be cut out and replaced by new wires, which will be spliced by sleeve nuts to the uninjured ends.

As the injury has taken place at the bend of the cables over the saddles, where the strength should be the greatest, it has been decided, after the wires have been spliced, to add 25 additional wires to cable A, and 200 additional wires to cable B. As the ends of these wires cannot connect with any of the wires in the cables, these being spliced to their own new sections that will be put in, it has been decided to attach these additional wires to the cables by friction. A series of steel bands will be clamped around the cables, at varying distances from the saddle, to the adjoining suspenders on either side, and a certain number of additional wires will be attached to each clamp. There will be three bands on each side of the saddle on cable A and eleven on cable B. Thus twenty wires will run to the outermost band furthest from the saddle and adjoining the first suspender; then twenty wires will be attached to the next band; twenty to the next, etc. On cable B the first band will cover 200 wires, none of which will be fastened to it; the second band will cover 180 wires, twenty of which will be fastened to it, etc. Furthermore, it has been recommended that fireproof flooring be used throughout the whole length of the bridge. It is gratifying to learn that the injury to the cables of this magnificent structure is such that it can be entirely repaired, the bridge as repaired being indeed, because of the high quality of the steel, stronger in its cables than was called for by the contract.

A HARVARD GRANT FROM THE CARNEGIE INSTITUTION.

A grant has recently been made by the Carnegie Institution, for the study of the collection of photographs at the Harvard College Observatory. For many years, two photographic doublets of similar form have been in constant use, photographing the sky night after night. The aperture of each is eight inches, and the