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AMERICAN ENGINEERING COMPETITION.

British manufacturers are indebted to The London Times for a remarkable series of letters on the subject of American engineering competition, which have lately been communicated to that journal. Previously to writing these articles, the author made a tour through the chief manufacturing States of the Union, for the purpose of personally examining the plant, management, local conditions and transportation facilities, of the leading industries and gather all other information necessary for a comprehensive and intelligent discussion of the subject. It is evident that he is technically qualified for the task, and the series forms such a valuable compendium on the subject that we have concluded to publish it in consecutive issues of the SCIENTIFIC AMERICAN SUPPLEMENT.

The introductory letter, which will be found in the current issue of the SUPPLEMENT, naturally opens with a reference to the statistics of imports and exports of Great Britain and the United States, the figures being taken respectively from the British Board of Trade and from the United States Bureau of Statistics. Statements of imports and exports afford the most reliable evidence of the strength of American competition and of the relative progress of the two countries in the world's trade; although, as the writer reminds his readers, Sir Robert Giffen, in a recent lecture before the Royal Statistical Society, has warned the British public against being too easily alarmed by an excess of imports over exports, pointing out that Great Britain has a fruitful source of income in the return upon the enormous British capital invested in railways, public works, etc., in different foreign countries. While the force of this suggestion is not disputed, it is pointed out by the correspondent to The Times that for a country to carry on an export trade is an indication that it can meet and beat other nations in competition, while the falling off in American imports, though it may be caused by a protective tariff, is an evidence of the nation's greater ability to manufacture for its own needs, and for the consumer to pay the price demanded by the producer.

The introductory statistical comparison is based upon the changes which have taken place in the two countries during the decade from 1888 to 1898. The total exports of the United States were, in 1888, $695,954,507, while the imports were $723,957,114, which gives an excess of over $28,000,000 of imports over exports. In 1898 American exports had risen to $1,231,482,330, while the imports had fallen to $616,049,654, which shows that instead of buying more than we were selling, as at the beginning of the decade, we were selling more than we were buying by an enormous margin. The statistics of English trade show that in 1888 the total exports were $1,492,887,705, or over double those of the United States in that year. The imports were $1,938,178,715, the excess of imports over exports, therefore, being about $445,000,000. Eleven years ago Great Britain and the United States imported more than they exported; by 1898 British exports had fallen to $1,470,069,940, while the imports had risen to $2,351,892,914, showing that the excess of imports over exports had risen to over $881,000,000, the excess being about double what it was at the beginning of the decade. Comparing these results we find that, whereas in 1898 Great Britain bought about $881,000,000 worth more than she sold, the United States sold about $640,000,000 worth more than they bought.

Speaking of the natural advantages enjoyed by the engineering trade in the United States due to the vast extent, richness and accessibility of the ore, and the fortunate geographical distribution of the raw material for the steel industries, The Times correspondent shows that whereas the Lake Superior ores contain from 59 per cent. to 65 per cent. of iron, as against 57·6 per cent. of iron in the so-called rich Cumberland and Lancashire ores, in the Cleveland ironstone the percentage is very much less. A further natural advantage is due to the fact that coal is being worked very much nearer the surface in the United States than in England, and that in cases where long distances have to be covered, to gather the raw materials at the blast furnace, the improved methods of transportation peculiarly characteristic of the United States have gone far to neutralize the disadvantage. Moreover, it seems that so far from the coal, ironstone and flux lying geographically close together in Great Britain, the ore used in the manufacture of Bessemer steel has to be brought a thousand of miles by sea from the Spanish mines. Thus, in 1898, when Great Britain produced 8,631,151 tons of pig iron, she imported nearly five and a half million tons of ore, chiefly from Spain.

Among all the statistics bearing upon the engineering trade of the two countries, none are more significant than those of the production of pig iron, for, whereas in 1884 7,811,727 tons of pig iron were produced in Great Britain as against 4,097,869 tons in the United States, in 1890, when the total production for Great Britain was about the same, that of the United States had more than doubled, having risen to 9,202,703 tons and thereby giving to this country, for the first time, the foremost position among the iron-producing countries of the world. The estimated production for 1899 is for Great Britain 9,500,000 tons and for the United States 14,000,000 tons, an excess over Great Britain of 4,500,000 tons. The letter concludes with the statement that during the tour through the United States, made in the interest of the series of articles referred to, the writer found everywhere the same state of booming prosperity; works of all kinds full of orders for a year and more ahead, old works being enlarged and new works started.

OUR BATTLESHIPS IN THE LIGHT OF THE "BELLEISLE" EXPERIMENT.

The very remarkable test of the "Belleisle" recently carried out by the British Admiralty is particularly gratifying to naval experts in this country, for it goes to prove that the principles upon which the ships of the United States navy have been designed in regard of their defensive qualities are thoroughly sound; in other words, that the emplacement of guns and the distribution of armor is better suited to resist the attack of modern high-power guns than that adopted by those navies which must be regarded as possible antagonists. The principle underlying the defensive arrangements of our vessels is that the best protection against shell-fire is the provision of a continuous, vertical wall of armor from below the water-line up to and embracing the gun-emplacement. Thus, in the battleships of the "Alabama" type, we have from 9½ to 16½ inches of armor extending from below the water-line to several feet above it; then the 15-inch wall of barbette armor, and above this the 14-inch protection of the turrets; while for the 6-inch guns of the intermediate battery we have 6 inches of armor from the belt to the deck upon which these guns are carried, and 5½ inches of protection in front of the guns themselves. Now 6 inches of armor will, in almost every case, burst a shell on its outer surface, or at least before it can effect an entrance within the vessel.

Turning now to the account of the damage done by the guns of the "Majestic" upon the "Belleisle," as recorded on another page, it will be noticed that the 6-inch shells which struck the armored portions of the vessel failed entirely to penetrate, the lyddite shell being in this respect as helpless as the common shell. On the other hand, whenever they struck the unarmored portions of the ship, they passed through and burst the between decks, with the result, in the case of lyddite, that the deck was lifted over a wide area, and that portion immediately over the explosion completely blown away. Now, it has always been contended by Sir William White, the very able Chief Constructor of the British Navy, that high explosive shells which burst between decks would act exactly in this manner, and that it was absolutely imperative to provide a complete wall of side armor, of sufficient thickness to keep out a high explosive shell, which should cover each gun-emplacement and extend without a break from the gun-platform down to and below the water-line. This principle has been faithfully followed in all the battleships and armored cruisers of the modern British navy, and, with the exception of the "Maine" and the "Texas," the same principle has governed the construction of the battleships of our own navy.

To appreciate the value of a continuous wall of vertical armor from water-line to gun-emplacement, we have but to look at some of the most notable of the German and French designs: such, for instance, as the three French battleships of the "Charlemagne" class, and the four German battleships of the "Kaiser Friedrich III." class. In every one of these seven first-class battleships, there is a wide gap, extending over a height of two decks, say about 15 or 16 feet, and reaching horizontally the whole length of the vessel, upon which there is not an inch of armor protection. In the case of the "Charlemagne," although the eight rapid-fire guns on the main deck are protected by 3 inches of armor in front, they have nothing but the thin shell of the vessel to prevent high-explosive shells from being burst within the vessel immediately below the deck on which they are mounted. This shell plating would serve simply to give the shock necessary to explode the shell at the point where it would do most damage. The way in which the decks of the "Belleisle" were blown to pieces suggests that in a duel at moderate range between the "Charlemagne" and, say, our own "Alabama," the seven 6-inch rapid-fire guns which the latter would be able to bring to bear, to say nothing of the 12-inch rifles, would, if firing high-explosive shells, very quickly put the whole of the rapid-fire battery of the "Charlemagne" out of action. This will be readily understood by referring to the armor diagram of the "Charlemagne," published in our article on the French Navy (SCIENTIFIC AMERICAN, January 28, 1899).

The same serious defect exists in that otherwise admirable ship, the "Kaiser Friedrich III," in which, the guns although emplaced in separate turrets, and well protected from what we might call lateral or horizontal attack, have no protection against the bursting of high-explosive shell beneath them, other than is afforded by a small armored ammunition tube extending from the base of the gun to the protective deck some 15 or 16 feet below. Well-directed shell would pass through the unarmored sides above the water-line belt, and could be burst in great numbers beneath the floor of the turrets. In the "Kaiser Friedrich III." this is true, not only of the rapid-fire battery, but of the two turrets containing the main armament of four 9½-inch guns. A diagram of the "Kaiser Friedrich III." appears in the article upon the German Navy, SCIENTIFIC AMERICAN, April 22, 1899. If the diagrams of these German and French ships, be compared with those of such vessels as the "Oregon," "Kearsarge," "Alabama," and the "Maine," it will be seen at a glance how vastly better equipped for defense are the American ships than those of France and Germany.

Upon the other hand, it is only fair to state that the continental navies, notably the French navy, have shown their farsightedness in adhering to the continuous, as against the partial belt, at the water-line. Both the "Charlemagne" and the "Kaiser Friedrich III." have a belt extending practically throughout the length of the vessel; whereas the "Oregon" and her class, like the "Royal Sovereign" and "Majestic" class of the British navy, have only a partial belt extending for two-thirds of the length of the vessel amidship. Judging from the "Belleisle" results, shell fire would tear these unarmored ends to pieces, admitting water and injuring the stability of the vessels. Our later ships, however, of the classes named above, are to have a practically continuous belt, and will be in this respect a great improvement over the "Oregon."

THE "DEUTSCHLAND."

There is something very impressive in the ease with which each of the successive giant vessels of the Atlantic fleet that has been started on its westward voyage has attained the speed for which it was designed. The contract for the construction of the "Deutschland" called for a sea speed of 23 knots an hour. It usually requires three or four voyages to bring the engines down to their bearings, and no attempt is made to push the vessel to its highest capacity on the first few trips; certainly not on the maiden trip. Hence, the record of the "Deutschland," which ran from Plymouth to New York at an average speed of 22·42 knots an hour, is particularly meritorious, and makes it reasonable to expect that this fine vessel will ultimately make an average speed of 23¼ and possibly 23½ knots an hour for the whole distance. The "Deutschland's" speed is greater than that achieved by the "Kaiser Wilhelm" on the maiden voyage of this vessel from Southampton to New York, which was made at an average speed of 21·39 knots per hour; but it is not quite so fast as the highest average of the "Kaiser Wilhelm," on its fastest eastward trip to Plymouth, when it made the distance in five days sixteen hours and ten minutes, at an average speed of 22·63 knots an hour.

The "Deutschland," which, like her great rival, was built at the Stettin Yards, Germany, is larger than that vessel, though not so large as the "Oceanic" of the White Star Line. In external appearance there is a great likeness between the two German boats. The "Deutschland" is 686½ feet long, or 38 feet longer than the "Kaiser Wilhelm," and 7½ feet shorter than the "Oceanic," and her horse power is 35,000, or about 7,000 more than that of the other two boats. Her beam is 67½ feet, or half a foot less than that of the "Oceanic," and her displacement is about 23,000 tons, which is 5,500 tons less than the displacement of the "Oceanic," on a 32½-foot draught. She is driven by quadruple-expansion, six-cylinder engines, of 35,000 horse power, and steam is supplied from twelve double-ended and four single-ended boilers.

The brilliant success of the "Deutschland" on her maiden voyage naturally turns attention to the plans of the rival company for a new steamship which is to exceed the "Deutschland" in size, speed and equipment. Particulars of this vessel are not at present available; but it is understood that she will have a contract speed of at least a knot greater than that of the "Deutschland."