the size, model, and necessary horse-power of the new ships. An elaborate series of tests was made in the Admiralty tanks and by the two shipbuilding firms, with the result that it was found necessary to build ships of unprecedented dimensions and power, the required length being nearly 800 feet, the beam 88 feet, and the draft from 33½ to 37½ feet, with an estimated horse-power in turbine equipment of 68,000. The contract called for a trial speed of 25¼ knots, and an average sea speed for the round trip across the Atlantic of 24½ knots. In the recent trials of the "Lusitania" the contract was very largely exceeded, a maximum speed of 26½ knots being obtained on the shorter courses, and of 25.4 knots on a long cruise of 1,200 knots.

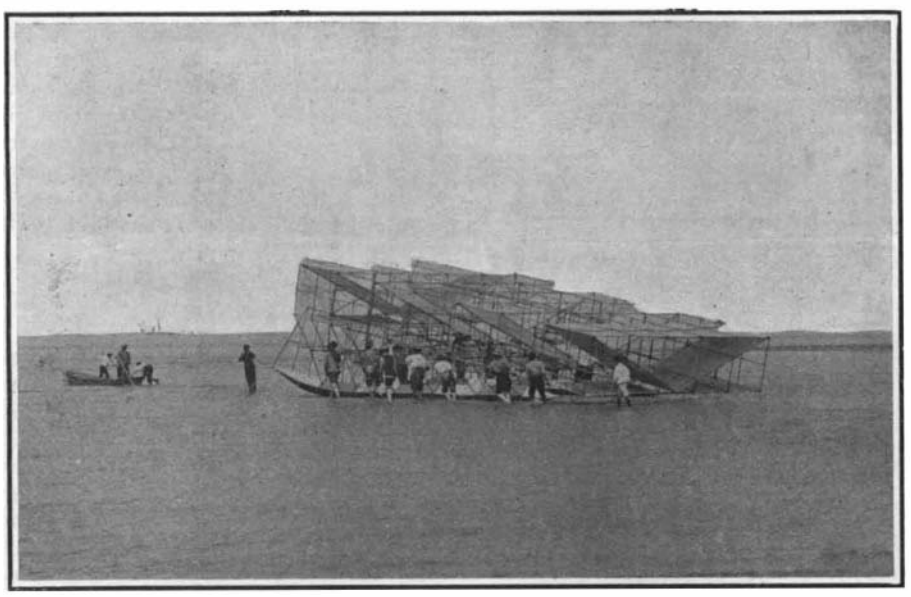
The model of the "Lusitania" shows the finest and sweetest lines of any of the existing transatlantic steamships. Unlike any of her predecessors, the form of the "Lusitania" runs in a continuous curve (without any of the customary straight section amidship) from stem to stern, and the correctness of the design is shown in the remarkably small wave-making which occurs even when the vessels are driven at their highest speed. In an investigation made many years ago by the SCIENTIFIC AMERICAN to determine some of the leading characteristics of a four-day liner, it was pointed out that the length of such a ship was so great as to call for special stiffening to enable her to withstand the great bending stresses to which she would be subjected when steaming across the seas; and it was suggested that double-plating should be worked into the vessel amidships along the top strakes and at the turn of the bilges; and also it was deemed desirable to work a longitudinal bulkhead down the center of the ship. In the design of the new Cunarders this feature has been given special consideration, and the upper strakes of the side plating have been built of a special steel, of high tensile strength, the plating being doubled for a considerable length amidships, and extra plating being worked continuously along the shelter and upper decks for the same purpose. Considerable longitudinal stiffness is also afforded by the vertical plating that forms the inner wall of the coal bunkers. The arrangement of this high-tensile steel plating is shown in the accompanying diagram, for which and the table of transatlantic ships we are indebted to our esteemed contemporary Engineering.

A mere statement of dimensions conveys only an inadequate idea of the proportion of these vessels. Their size can best be appreciated when it is compared with some object with which the public is generally familiar, and to this end we have chosen the Capitol at Washington. On reference to our front-page engraving, in which the "Lusitania" is combined in a shadow picture with a photograph of the Capitol, both on exactly the same scale, it will be seen how in a front elevation this vessel exceeds the Capitol on every point of comparison except that of the height of the dome. If the keel of the ship were resting at the ground level at the Capitol, several of its upper decks would project above the top of the balustrade of the main building, which is exactly 69 feet 6 inches above the ground. Thus, the boat deck of the "Lusitania" would be 78 feet, the top of the boat deck cabins would be 89 feet, and the top of the captain's cabin 100 feet above the ground. The top of the smokestacks would reach nearly to the springing of the dome, this point of the ship being 155 feet above the ground, or twice the height of the main building. The diameter of all the smokestacks is 25 feet. In length the "Lusitania" would considerably exceed the main building, which latter measures 751 feet, as compared with the "Lusitania's" over-all length of 785 feet.

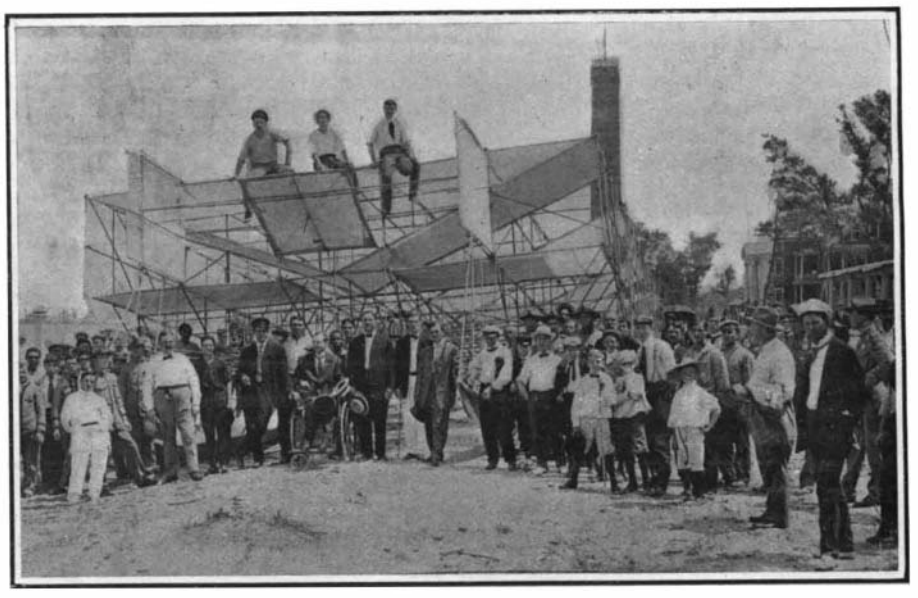
Again, if the keel of the "Lusitania" rested upon the street surface of Broadway, and one side of her was placed against the face of the buildings on one side of this thoroughfare, the other side of the ship would extend 28 feet into the buildings on the opposite side, and the roof of the cabins on her topmost deck would be level with the coping of an ordinary six-story building.

It can be readily understood that to drive the huge bulk of such a ship through the water at a speed of about thirty miles an hour requires enormous power; and the tank investigations showed that to exert the necessary thrust calls for about 68,000 horse-power. This total thrust has been divided between four propellers, actuated by four turbines, there being a high-pressure turbine on each outer shaft and a low-pressure turbine on each inner shaft; a pair of go-astern turbines being carried also upon the inside shafts.

Limitations of space prevent any extended reference to the passenger accommodation, the sumptuous character of which is well shown by the accompanying illustrations. The most noticeable improvement is the fact that, because of the great beam of the ship, the average cabin possesses fifty per cent more space than is to be found in similar cabins on any previous steamship. The decorations, although rich, are simple and marked by great refinement. A feature which will meet with general approval is the double passenger elevators, which are arranged with the main stairway around them, with landings on each deck of the vessel. The suggestion to install these was made to the Cunard Company several years ago, when these ships were first proposed, and plans were made to incorporate them long before their adoption by any other steamship. The "Lusitania" will accommodate 540 first-class, 460 second-class, and 1,200 third-class passengers; and as her crew will number 800, the full complement of the ship will be some three thousand souls. If the "Lusitania" does as well in regular service as she did on trial, she should make the trip in four and a half days, and to drive her at this speed will call for the consumption of about 1,100 tons of coal per day—a huge amount in the total it is true, but not unusually large in proportion to the size of the ship, the number of passengers carried, the very superior accommodations provided, and the reduction of the time of passage by half a day.



SIDE VIEW OF LUDLOW'S NEW AEROPLANE, SHOWING IT MOUNTED ON PONTOONS FOR TOWING ON THE WATER.



FRONT VIEW OF LUDLOW'S AEROPLANE, SHOWING THE ONE HORIZONTAL AND TWO VERTICAL RUDDERS.

ONE OF THE COMPETING AEROPLANES FOR THE SCIENTIFIC AMERICAN AERONAUTICAL TROPHY.

The two photographs which we reproduce above show the front and side elevation of Mr. Israel Ludlow's new aeroplane, which he has just completed at the Jamestown Exposition, with a view of entering it in the first competition for the SCIENTIFIC AMERICAN trophy. The machine is patterned largely after Ludlow's former box-kite aeroplane, which collapsed and fell with the inventor in Florida a year and a half ago, and permanently injured his spine. In place of the two compartments, Ludlow's latest aeroplane has no less than four, within each of which are placed auxiliary planes, set at a dihedral angle. The entire four compartments are mounted upon pontoons at a considerable angle with the horizontal. One horizontal and two vertical rudders are provided at the forward end. The machine is to be propelled by twin screws driven by two gasoline engines.

In constructing this large aeroplane, Mr. Ludlow believes that he has improved considerably in the design and construction of his new machine over his earlier ones, which were simply large box kites. He has been aided in building the machine by the War Department, which detailed ten soldiers to help in constructing it at the Aeronautical Building at Jamestown. After suitable tests have been made by towing the machine with a torpedo boat, for the purpose of ascertaining the pull required to fly it, and also to find out how it acts in the air with regard to stability, the motors and propellers will be quickly fitted, and it is hoped that the machine will be ready to compete for the trophy on the appointed day.

The Cement Industry of 1906.

The production of cement in 1906 amounted to the enormous total of 51,000,445 barrels, valued at $55,302,277, exceeding by 10,897,137 barrels in quantity and $19,370,744 in value the production of 1905, which had been the banner year. Classified according to character the production was as follows:

	Barrels.	Value.
Portland cement	46,463,422	$52,466,186
Natural cement	4,055,797	2,423,170
Puzzolan cement	481,224	412,921

These figures are reported by the United States Geological Survey in an advance chapter from "Mineral Resources of the United States, Calendar Year 1906," and are somewhat greater than those given in the preliminary statistics of production issued by the Survey early in the year, the difference being due to the fact that some of the returns were received too late for use in the first statement.

The most prosperous branch of the industry is, of course, the Portland cement branch, whose growth has been of the most phenomenal character. Twenty years ago, when the Portland cement output of the entire United States stood at about 250,000 barrels against nearly 7,000,000 barrels of natural cement, the first attempt was made to introduce the rotary kiln for the manufacture of Portland, the company exploiting the new process, proudly claiming the ability to produce 30,000 barrels of cement per annum, and to triple this quantity as soon as the necessary grinding machinery should be added. To-day it is not considered in the least sensational if a company announces the capacity of its plant at 3,000 to 5,000 barrels a day, while the yearly production of the large plants runs well into the millions of barrels.

The decline of the natural cement industry has been gradual, but as steady as the increase of the Portland branch. In 1906 the effect of this decline has seemed to be even more widespread than in the preceding year. The owners of many plants have allowed them to remain idle, some have turned their attention to lime-burning and kindred employments, and a few have dismantled the old plants and established buildings and machinery for making Portland cement. Since some of the lime-stone, known as "cement rock," from which the natural cement is made, forms an equally good base for Portland cement, the last course would seem to be both logical and wise.

The growth of the slag or puzzolan branch of the cement industry is interesting because of its steadiness. The advantage of the industry is that it consumes a product of steel and iron foundries which has for years been troublesome to dispose of, and has been regarded as waste. This variety of cement is not burned in rotary kilns and should not be confused with Portland cement made with slag as a basis and burned in rotaries.

Although the prices at which cement was sold in 1906 were higher than those which prevailed in 1905, they were not inflated but resulted from a normal growth in demand. The producers made no complaint of prices, but protests against the insufficient car service provided for the delivery of orders were made from every part of the United States.

The statistics of the industry have this year, as in the past, been prepared by L. L. Kimball, and the report is prefaced by a chapter on Advances in Cement Technology by Edwin C. Eckel. The pamphlet is now ready for distribution and may be obtained without cost by applying to the Director of the United States Geological Survey at Washington, D. C.