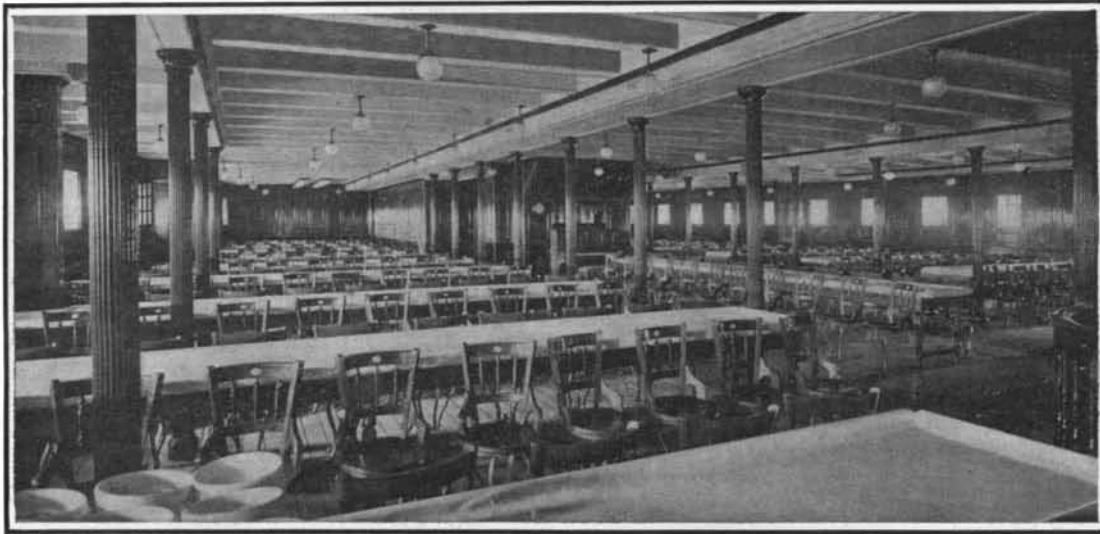


THE NEW TURBINE LINER "LUSITANIA."

By the time this issue is in the hands of our readers the "Lusitania," the first of the two express turbine liners which have been built by the Cunard Company, will have completed her first trip to New York.

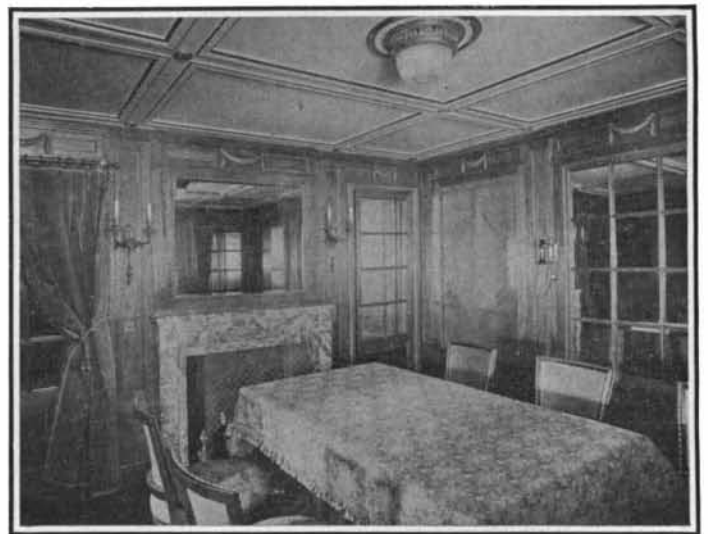
she is 1 foot longer, being 706 feet as against the 705 feet of the "Oceanic." The "Lusitania" is 760 feet between perpendiculars, 785 feet on deck, 88 feet broad, and of 38,000 tons displacement. The greater displacement of the "Oceanic" as compared with the

will displace 45,000 tons. In regard to horse-power and speed, the figures are also full of interest. The combined horse-power of the paddle-wheel and screw engines of the "Great Eastern" was 7,650, and her best speed was 14.5 knots. The "City of Rome," which



Note provision for individual comfort as compared with former steerage conditions.

The Spacious Third-Class Dining Saloon.



Note the large square-headed windows.

Private Dining Room in Regal Suite.

This magnificent vessel is so much larger and faster than her predecessors, and possesses so many features of novelty in her construction and motive power, as to place her in a class by herself; and in the romantic history of the development of the transatlantic steamship she will always clearly mark the beginning of a new epoch, as being the first high-speed liner to adopt the steam turbine in place of the reciprocating engine. She embodies a far greater advance in speed, size, and spacious accommodations than has ever before been recorded in any one ship. It is true that the use of turbines was anticipated in the "Carmania" of the same company; but as she belongs rather to the intermediate type of moderate-speed boats, she is in a distinctly different class; moreover, the adoption of turbines in the "Carmania" really formed a part of the costly experimental work which was undertaken to obtain the necessary data for the design of the larger and faster ship.

The statement that the "Lusitania" stands in a class by herself will be borne out by a study of the accompanying table showing the development of the transatlantic liner during the past half century; or in the period intervening between the "Great Eastern" of 1858 and the "Lusitania" of 1907. The "Great Eastern" was built very much before her time; and it was not until the "Oceanic" made her maiden trip to New York in 1898, that any ship was seen in this port that was comparable with her. The "Great Eastern" was 680 feet long measured on deck, 83 feet broad, and of 27,000 tons displacement. The "Oceanic" is 685 feet long between perpendiculars, 68 feet 5 inches broad, and of 28,500 tons displacement. Next to the "Oceanic" in point of size came the "Kaiser Wilhelm II.," 678 feet between perpendiculars, 72 feet broad, and of 26,000 tons displacement; but over all

"Kaiser Wilhelm II." is due to her greater draft and fuller lines, her draft being 32 feet 6 inches as against 29 feet of the "Kaiser Wilhelm II.," and so also the vast increase in the displacement of the "Lusitania"

came out in 1881, may be called the pioneer of the modern liners of great length and size, for she measured 543 feet between perpendiculars, and displaced 11,230 tons. With an indicated horse-power of 11,900,

COMPARISON OF TRANSATLANTIC STEAMERS.

| Name. | Date. | Dimensions. | | | Draft. | Displacement. | Cylinders. | | Boilers. | | | Indicated Horse-Power. | Speed on Trial. | |
|--------------------------------|-------|--------------------|----------|----------|--------|---------------|-----------------------------------------------------------------|---------|------------------|-------------|----------------|------------------------|-----------------|---------------|
| | | Length bet. perps. | Breadth. | Depth. | | | Diameter in Inches. | Stroke. | Heating Surface. | Grate Area. | Working Press. | | | |
| Great Eastern..... | 1858 | 680 | 83 0 | 57 6 | 25 6 | 27,000 | Screw, four 84-in.; paddle, four 74-in. | 60 | 48 | ..... | ..... | 30 | 7,650 | 14.5 |
| Britannic..... | 1874 | 455 | 45 0 | 36 0 | 23 6 | 8,500 | Two 48-in., two 83-in. | 60 | ..... | ..... | ..... | 70 | 5,500 | 16 |
| City of Rome..... | 1881 | 543 | 52 0 | 38 9 | 22 0 | 11,230 | Three 46-in., three 86-in. | 72 | 29,286 | 1398 | ..... | 90 | 11,900 | 18.23 |
| Umbria..... | 1885 | 500 | 57 0 | 40 0 | 22 6 | 10,500 | One 71-in., two 105-in. | 72 | 38,817 | 1606 | ..... | 110 | 14,321 | 20.18 |
| Paris..... | 1888 | 528 | 63 0 | 41 10 | 23 0 | 13,000 | Two 45-in., two 71-in. and two 113 in. | 60 | 50,265 | 1293 | ..... | 150 | 20,000 | 21.8 |
| Teutonic... .. | 1890 | 565 | 57 6 | 42 2 | 22 0 | 12,000 | Two 43-in., two 68-in. and two 110-in. | 60 | 40,072 | 1154 | ..... | 180 | 19,500 | 21 |
| Campania .. | 1893 | 600 | 65 0 | 41 6 | 23 0 | 18,000 | Four 37-in., two 79-in., and four 98-in. | 60 | 82,000 | 2330 | ..... | 165 | 80,000 | 22.01 |
| St. Louis..... | 1895 | 536 | 63 0 | 42 0 | 26 0 | 16,000 | Four 28-in., two 55-in., two 77-in., four 77-in. | 60 | 40,320 | 1144 | ..... | 200 | 18,000 | 21.08 |
| Kaiser Wilhelm der Grosse..... | 1897 | 625 | 66 0 | 43 0 | 28 0 | 20,880 | Two 52-in., two 89-in., and four 96.4-in. | 68.8 | 84,285 | 2618 | ..... | 178 | 30,000 | 22.5 to 23 |
| Oceanic..... | 1899 | 685 | 68 5 | 49 0 | 32 6 | 28,500 | Two 47.5-in., two 79-in., four 93-in. | 72 | 74,686 | 1962 | ..... | 192 | 27,000 | 20.72 |
| Deutschland. | 1900 | 662.9 | 67 0 | 44 0 | 29 0 | 23,620 | Four 36.61-in., two 73.6-in., two 103.9-in., and four 106.3-in. | 72.8 | 85,468 | 2188 | ..... | 220 | 36,000 | 23.25 to 23.5 |
| Kronprinz Wilhelm... | 1901 | 663 | 66 0 | 43 0 | 29 0 | 21,300 | Four 34.2-in., two 68.8-in., two 98.4-in., and four 102.3-in. | 70.8 | 93,685 | 2702 | ..... | 213 | 36,000 | 23.25 to 23.5 |
| Kaiser Wilhelm II.... | 1903 | 678 | 72 0 | 52 6 | 29 0 | 26,000 | Four 37.4-in., four 49.2-in., four 74.8-in., and four 112.2-in. | 70.86 | 107,643 | 3121 | ..... | 225 | 38,000 | 23.5 |
| La Provence. | 1906 | 597 ft. 1 1/2 in. | 64 7 1/2 | 41 8 | 26 9 | 19,160 | Two 47.2-in., two 76.2-in., four 88.18-in. Turbines. | 66.9 | 58,342 | 1571 | ..... | 200 | 30,000 | 22.5 |
| Lusitania.... | 1907 | 760 | 88 0 | 60 4 1/2 | 33 6 | 38,000 |  | .... | 158,350 | 4048 | ..... | 195 | 68,000 | 25.5 |

is due to beam and draft, the beam having gone up to 88 feet, or 5 feet greater than that of the "Great Eastern," and the draft to 33 feet 6 inches. At her maximum draft of 37 feet 6 inches the "Lusitania"

her best speed was 18.23 knots. In the "Umbria," 1887, 500 feet between perpendiculars and of 10,500 tons displacement, the Cunard Company had the satisfaction of producing the first vessel to maintain a



Upper and Lower First-Class Dining Saloons, Seating 500.



Lower First-Class Dining Saloon, Seating 350.

THE NEW 25 1/2-KNOT CUNARD TURBINE LINER "LUSITANIA."

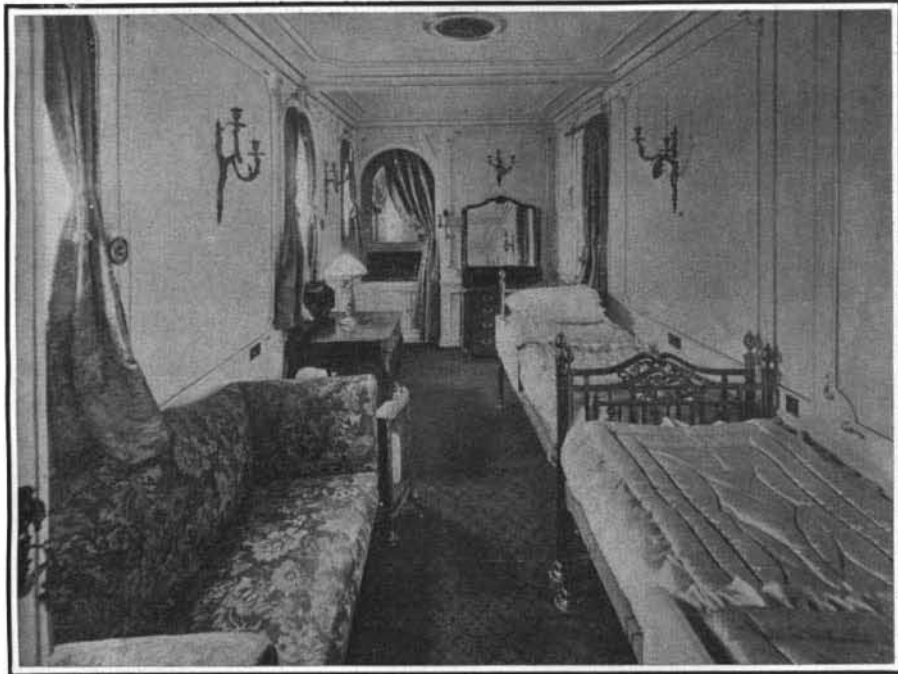
speed of over 20 knots an hour across the Atlantic, her best record being 20.18 knots for the whole trip. Then came the "Paris" in 1888, the first of the twin-screw vessels, whose best record was 21.8 knots, which was obtained with the development of 20,000 horse-

power. The next record-breaker was the "Campania" of the Cunard Company, the first ship to reach the length between perpendiculars of 600 feet. She was of 18,000 tons displacement, and with 30,000 horse-power she maintained an average speed of 22.01 knots across the Atlantic. In 1897 the North German Lloyd Company entered the competition with that most successful ship "Kaiser Wilhelm der Grosse," 625 feet between perpendiculars. She was of 20,880 tons displacement, and with 30,000 horse-power she raised the record to an average speed of 22.5 knots. From her the record was taken by the "Deutschland," of the Hamburg-American Line, a vessel 663 feet between perpendiculars and of 23,620 tons displacement, which, with a development of 38,000 horse-power, moved the record up to 23.5 knots. This was equaled, and indeed slightly surpassed, by the "Kaiser Wilhelm II.," which with 40,000 horse-power averaged a fraction over 23.5 knots. The "Lusitania" on her trial trip averaged over a 1,200-mile course 25.4 knots, at which mark the record is likely to stand for many years to come. In doing this her engines averaged the enormous figure of 65,000 horse-power.

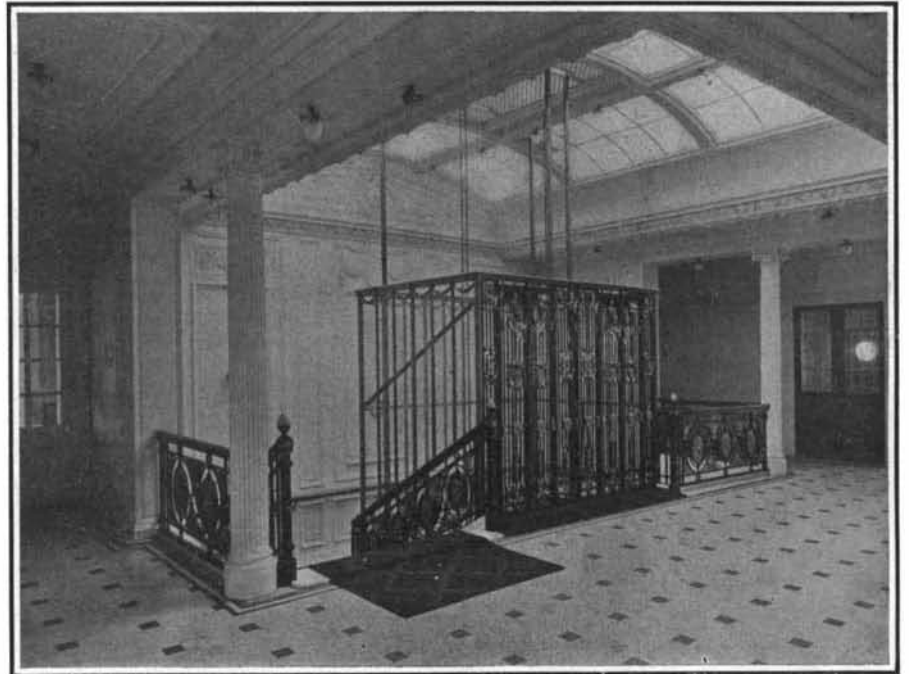
The "Lusitania" and her sister ship the "Mauretania" were built for the distinct purpose, among

other things, of winning back the "blue ribbon" of the Atlantic, which had been taken from the British lines and held for a period of ten years by the splendid German liners. If these ships live up to the preliminary promise of the "Lusitania," they should easily

amount of protection is afforded to the motive power by the fact that it also is located entirely below the waterline, and that there will be about 12 feet of coal in the bunkers extending the full length of the engine and boiler rooms to resist the entrance of explosive



Note the unusual height, 11 feet, of ceiling.
Bedroom in the Regal Suite.



Adopted at the suggestion of the SCIENTIFIC AMERICAN before they had been proposed for any other ship.
The Two Passenger Elevators.

accomplish this; for if the latter vessel can maintain the speed which she showed on her trial trip, she should have a margin of at least two knots to her credit, and should bring the transatlantic record down to about four and a half days. The two ships were built with the assistance, both professional and financial, of the British Admiralty, the government advancing the necessary sum of about \$13,000,000 for the construction of the two ships, and guaranteeing the

shells. The vessels are provided with twelve platforms for the mounting of as many 50-caliber rapid-fire 6-inch guns, each with a velocity of 3,000 feet per second, and a muzzle energy of about 6,000 foot-tons. With such protection and armament, and their ability to maintain a sea speed of say 24½ to 25½ knots an hour, these vessels should be capable of overtaking and capturing any of the fast scouts, and a large proportion of the fast protected cruisers and commerce destroyers, of any possible enemy. For scouting purposes, also, they should prove of the greatest value.

When it was decided to build two ships of 25 knots speed, it was realized that they would necessarily have to be of exceptional size and great refinement of form, and that unless serious problems connected with the forging of shafting of the necessary size were to be encountered, some other type of motive power than the reciprocating engine would have to be employed. Attention was naturally directed to the then somewhat experimental steam turbine, and the joint efforts of the technical staff of the Admiralty, of the Cunard Company, and of the two large shipbuilding firms, Swan & Hunter on the Tyne and John Brown & Co. on the Clyde, united in working out the problem of

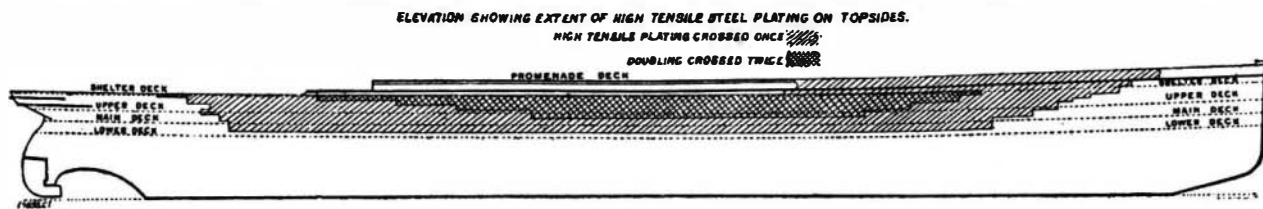
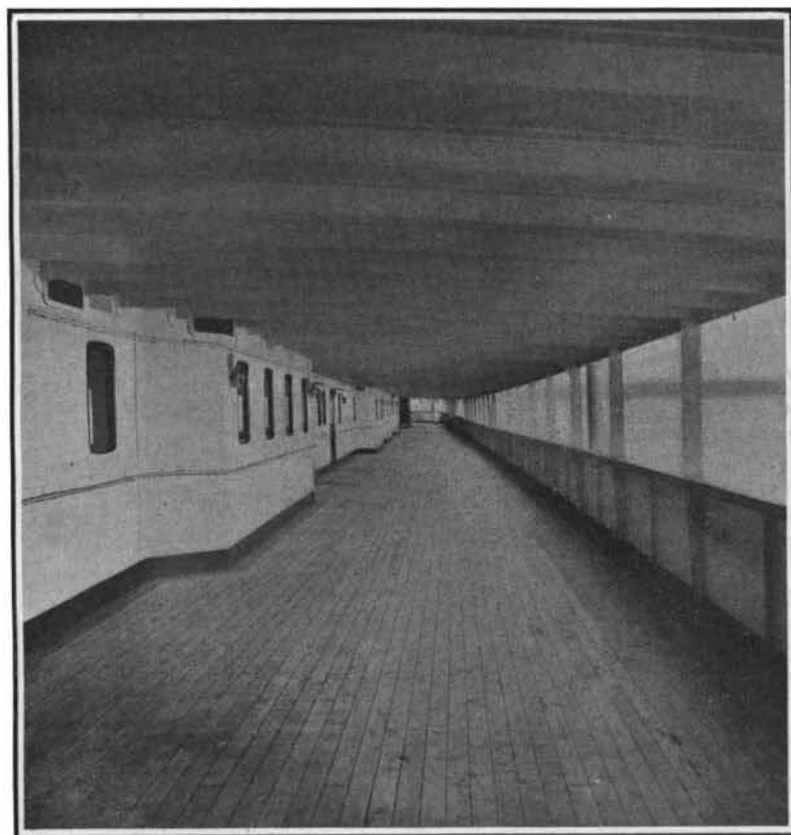


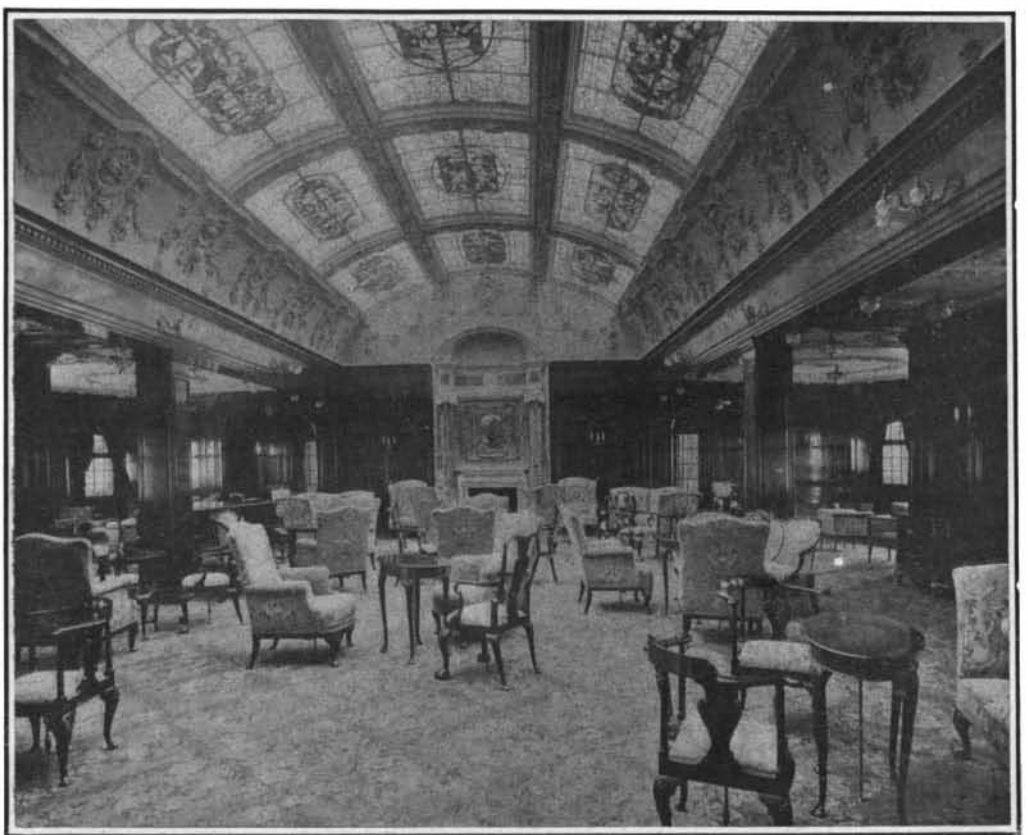
Diagram Showing the Special Plating of the Topsides to Prevent Undue Bending on the "Lusitania" When Bucking Heavy Head Seas.

payment of a considerable annual sum in consideration of the ships carrying the mails, being held available as cruisers in the event of war, and embodying in their construction such features as would render them quickly convertible for this purpose. For service as cruisers it is necessary that their steering gear and the propelling machinery should be fairly well protected, and that they should be strengthened in the decks for the mounting of a battery of rapid-fire guns. The steering gear is protected by being located entirely below the waterline, and a considerable

size and great refinement of form, and that unless serious problems connected with the forging of shafting of the necessary size were to be encountered, some other type of motive power than the reciprocating engine would have to be employed. Attention was naturally directed to the then somewhat experimental steam turbine, and the joint efforts of the technical staff of the Admiralty, of the Cunard Company, and of the two large shipbuilding firms, Swan & Hunter on the Tyne and John Brown & Co. on the Clyde, united in working out the problem of



The Great Beam Permits Unusual Width of Promenade.



Note the large square-headed windows.

The Spacious Drawing Room on the Top Deck.

THE NEW 25½-KNOT CUNARD TURBINE LINER "LUSITANIA."

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 $33\frac{1}{2}$ to $37\frac{1}{2}$ feet, with an estimated horse-power in turbine equipment of 68,000. The contract called for a trial speed of $25\frac{1}{4}$ knots, and an average sea speed for the round trip across the Atlantic of $24\frac{1}{2}$ knots. In the recent trials of the "Lusitania" the contract was very largely exceeded, a maximum speed of $26\frac{1}{2}$ 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

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

hoped that the machine will be ready to compete for the trophy on the appointed day.

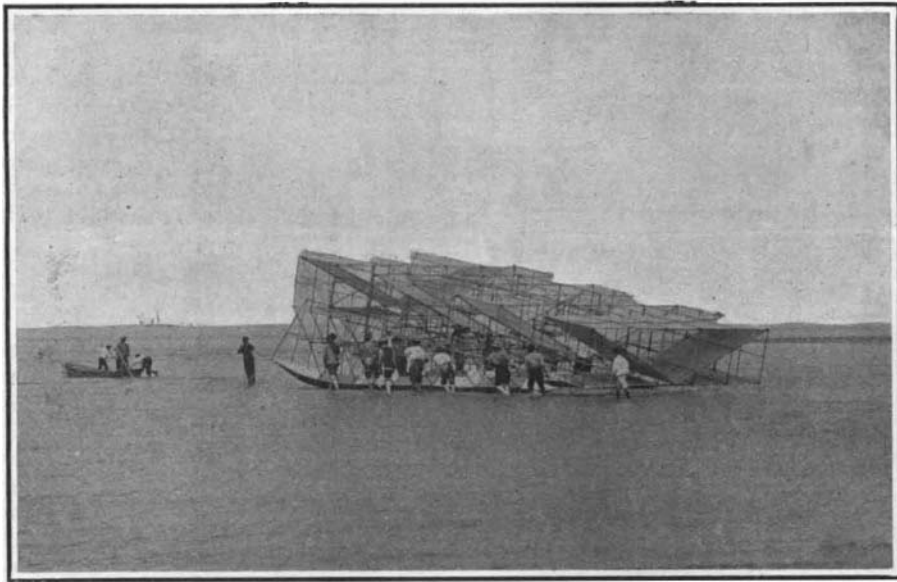
The Cement Industry of 1906.

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:

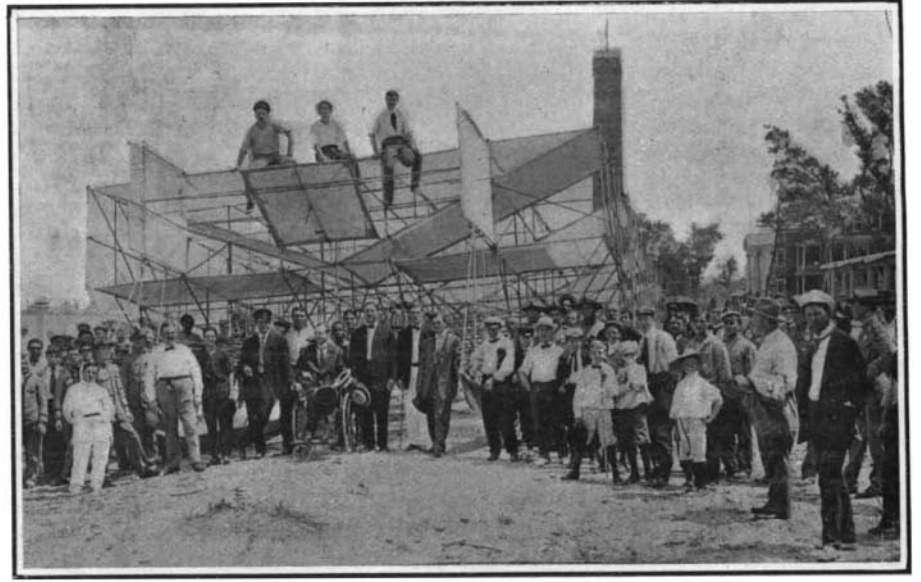
| | Barrels. | Value. |
|---------------------------|------------|--------------|
| Portland cement | 46,463,422 | \$52,466,186 |
| Natural cement | 4,055,797 | 2,423,170 |
| Puzzolan cement | 481,224 | 412,921 |

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



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.

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

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.

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

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.

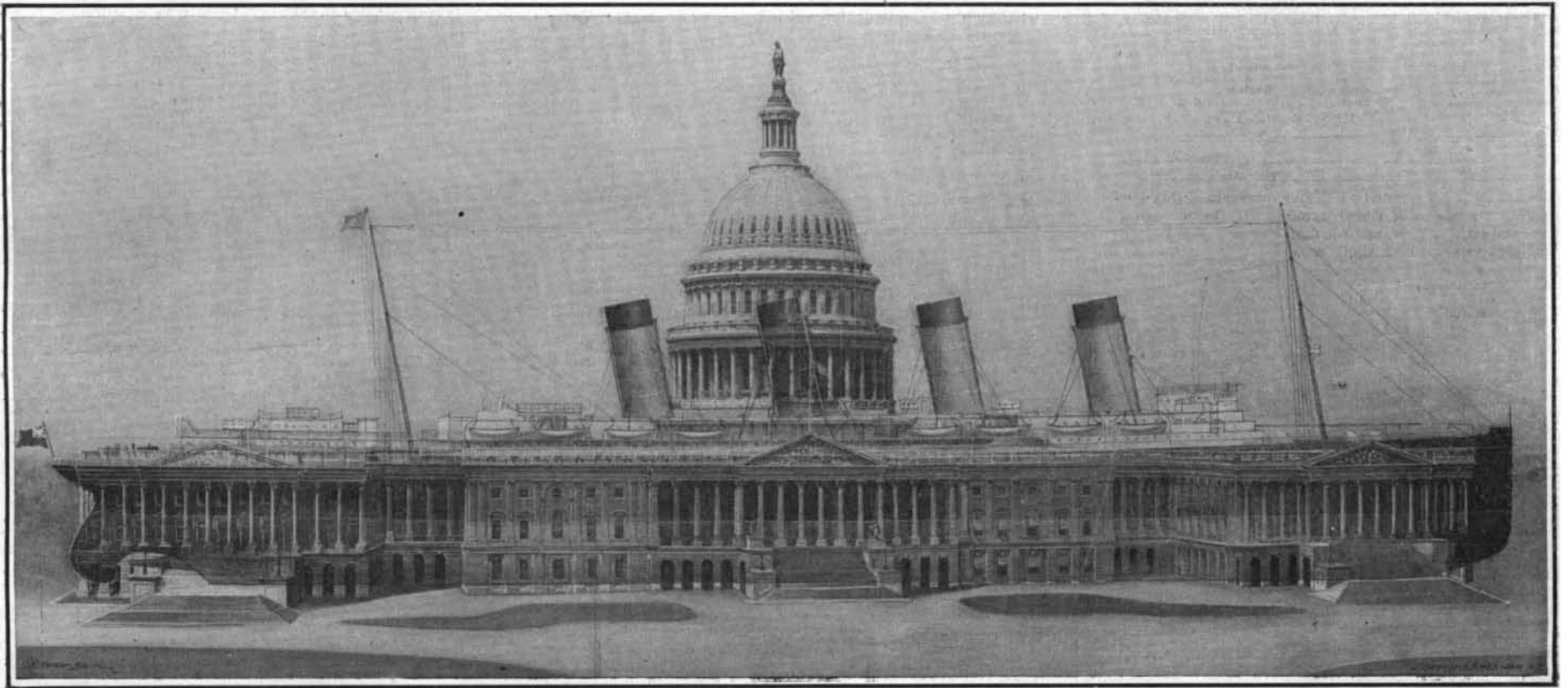
SCIENTIFIC AMERICAN

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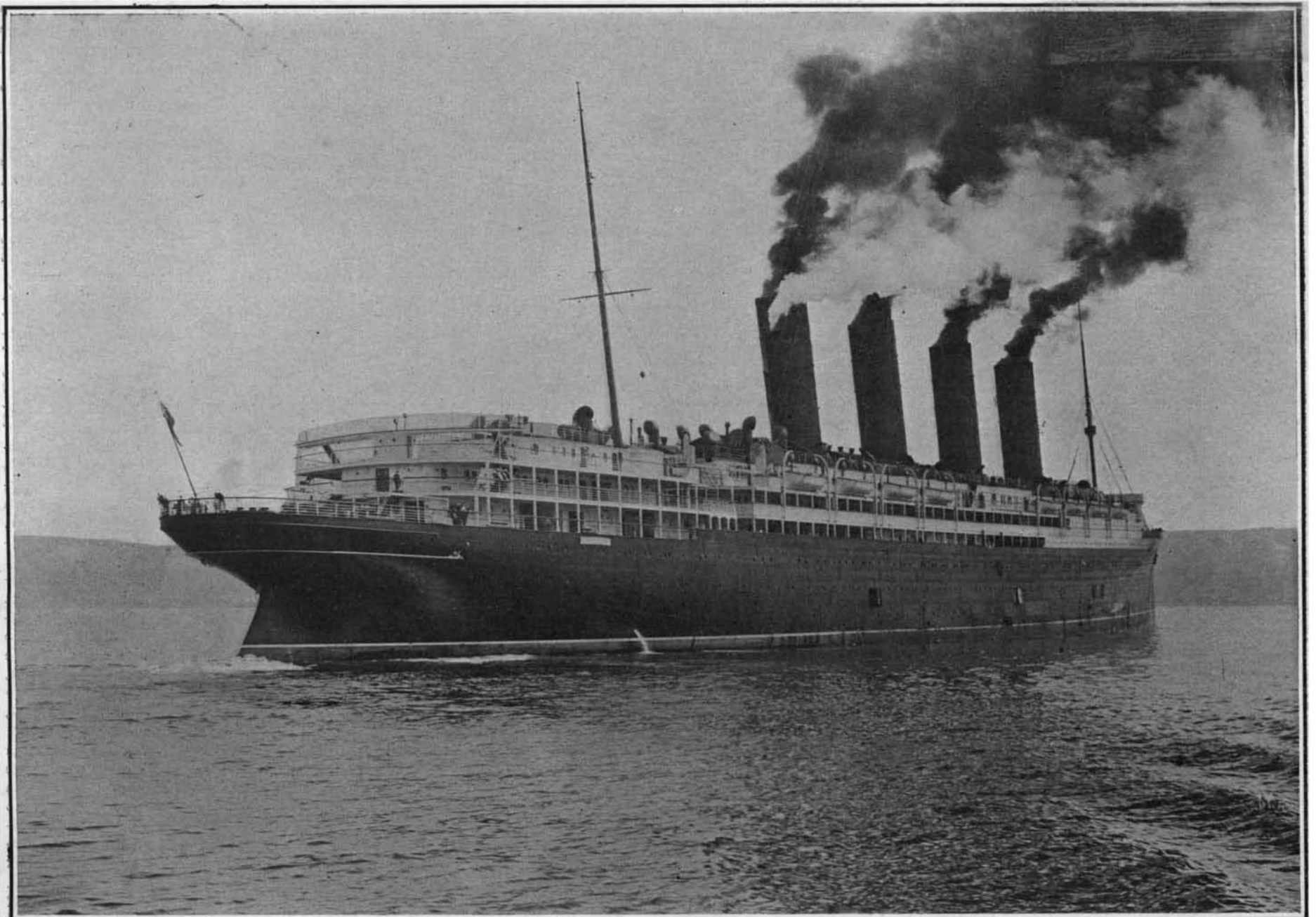
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NEW YORK, SEPTEMBER 14, 1907.

[10 CENTS A COPY
\$3.00 A YEAR.]



If the "Lusitania" Were Placed Alongside the Capitol at Washington, She Would Exceed Main Building in Length by 34 Feet and in Height by 80 Feet.



Length, 785 Feet. Beam, 88 Feet. Depth, 60 Feet. Draft (Fully Loaded) $37\frac{1}{2}$ Feet. Displacement, 45,000 Tons. Horse-Power, 68,000. Speed (Maximum) $26\frac{1}{2}$ Knots. Speed for 1,200 Knots, 25.4 Knots.

THE NEW $25\frac{1}{2}$ -KNOT CUNARD TURBINE LINER "LUSITANIA."—[See page 188.]