THE WHITE STAR LINER "CELTIC."

Of late years the development of the transatlantic liner has proceeded along somewhat divergent lines, and has resulted in two distinct types, of which the "Deutschland," of the Hamburg-American Line, and the new "Celtic," of the White Star Line, may be taken as the most recent representatives. At one time the transatlantic merchant steamers were divided sharply into two classes—one intended primarily for the carriage of passengers and mails, and the other for carrying freight only. The demand of late years for passenger accommodation that should be cheaper and not so luxurious as that of the mail steamers led the companies to provide, on the faster of the freight steamers, a certain amount of passenger accommodation; and the new departure has proved so successful that an entirely new type of steamer has been produced, of which such ships as the "Pennsylvania," "Cymric," "Ivurnia," and now the "Celtic," are the largest and most popular representatives. Although these vessels are primarily to be considered as freighters, the extent and quality of their passenger accommodation, and the high average sea speed of from 14 to 16 knots of which they are capable, renders them scarcely less valuable to the owners and to the traveling public as passenger ships.

The element of bigness enters so largely, in these days, into the notoriety of ocean steamers, that the advent of the "Celtic" to the port of New York must be reckoned one of the most notable events in the history of transatlantic navigation; and since the "Great Eastern" is the invariable basis of comparison, we may state at once that the new vessel is 9 feet longer than that ship, about 1 foot deeper from the same deck, and of 10,700 tons more displacement. Another vessel with which the "Celtic" may be compared is her predecessor, the "Oceanic." The "Oceanic" is 4 feet longer and of the same depth, but her other dimensions are considerably less than those of the new boat. The accompanying table will enable the reader to compare the new vessels with other notable liners that are at present in service:

Name of Ship.	Date.	Length over all.	Beam.	Depth.	Displacement.	Gross Tonnage.	Speed.
		Feet.	Feet.	Feet.	Tons.	Tons.	Kn'ts.
Great Eastern........	1858	692	83	57½	27,000	18,915	14½
Paris................	1888	560	63	42	15,000	10,500	20
Teutonic.............	1890	585	57½	42	13,800	9,984	20
St. Paul...........	1895	554	63	42	16,000	11,600	21
Lucania............	1893	625	65	41½	19,000	12,950	22
Kaiser Wilhelm.......	1897	649	66	43	21,000	14,349	22.8
Oceanic.........	1899	705	68	49	32,500	17,274	21
Deutschland.........	1900	686	67	40½	23,500	15,500	23.5
Celtic...............	1901	700	75	49	37,700	20,880	16

The "Celtic" is 700 feet long over all, has 75 feet of beam and 49 feet of depth, measured from the keel to the promenade deck, the plating of the vessel being carried up to this deck continuously throughout the whole length of the vessel. At present her maximum draft will be about 31 feet, this being the limit imposed by the present depth of water at the entrance of New York Harbor; but she has been designed with a view to the larger accommodation which will be afforded by the 40-foot channels which are now being dredged by the United States Government. When these are completed, the "Celtic" will load to her maximum designed draft of 36 feet 6 inches, and at this draft she will displace the enormous amount of 37,700 tons. Displacement, or the total dead-weight of ship and load together, is of course the truest test of a vessel's size. Just how big this new marine giant is may be judged from the fact that at 37,700 tons displacement she will weigh in the water just double as much as the largest battleship now built or under construction. She will, as we have said, exceed the "Great Eastern" by 10,300 tons, and she will even exceed the great "Oceanic," at the maximum designed displacement of that vessel, by 5,200 tons. At the present writing there is lying in the adjoining dock of the White Star Company, at New York, the company's steamer "Germanic"—a mighty ship in her day. It would take four and one-half times the total displacement of the "Germanic" to equal that of the "Celtic."

Although we have given the depth of the "Celtic" as 49 feet, as a matter of fact the topmost deck of the ship will be just 100 feet above the keel; that is to say, when the vessel is loaded to say 30 feet, the captain will stand on the bridge at an elevation of 70 feet above the sea level. Reckoning from the keel, we have first the floor of the vessel, which forms the inner bottom of the cellular "double-bottom" of the vessel. Next above this is the lower orlop deck; then in succession follow the upper orlop, the 'tween deck, the main, upper promenade, bridge, upper bridge, and the sun deck, the last-named being at the same level as the captain's bridge, or 100 feet above the keel. The first six decks to the promenade deck are continuous throughout the vessel. The bridge deck above this is broken in places for convenience in reaching hatchways. The upper bridge, boat deck and the sun deck extend for about one-third of the length of the vessel amidships, and on these decks is located most of the cabin passenger accommodation.

In the construction of a ship of this great length and carrying capacity, extra provision had to be made for longitudinal strains, to secure her against the alternate hogging and sagging stresses to which she is subjected. Among other provisions for strength is the doubling of the bilge strake amidships, while the sheer strake and the next but one below it are also doubled. The upper deck stringers have been doubled, except at the extreme ends of the vessel. Fore-and-aft strength is secured also by six longitudinal members, worked three on each side of the keel, intercostally. There are also two intercostal keelsons. As a further provision for strength there is a beam at the decks to every frame of the vessel. There were used in plating the ship 1,392 plates, which averaged 5 feet in width by about 30 feet in length. They were as much as an inch and a quarter in thickness, and weighed in some cases four tons apiece. In riveting up the structure, close upon 2,000,000 rivets were employed. The engines are of the Harland & Wolff's quadruple-expansion, balanced type, the cylinders being 33, 47½, 68½ and 98 inches in diameter, with a common stroke of 5 feet 3 inches. Steam is supplied by eight double-ended boilers, each 15 feet 9 inches by 19 feet 6 inches, and the trial speed, when the engines are working up to the full horse power is 17 knots per hour. The sea speed of the vessel will average something over 16 knots an hour.

In spite of the fact that the "Celtic" can stow away 18,500 tons of cargo, including 2,400 tons of coal, passenger accommodation of an exceptionally spacious character is provided for 2,859 passengers. Of these, 347 will be first-class, 160 second-class, and 2,352 third-class. The last-named will be accommodated on the upper, main, and 'tween decks—some of these in separate staterooms and others in open berths. The officers, as is customary in White Star liners, will be housed on the upper bridge deck. There will be a deck crew of 64, an engine-room and stoke-hold staff of 92, and 179 stewards, making a total crew of 335. Adding this to the number of passengers, we find that the total number of souls aboard the "Celtic," with a full passenger list, will be 3,194.

An interesting comparison of the "Celtic" and the "Oceanic" is that based on the coal consumption as compared with the passenger accommodation. The "Oceanic" carries 1,284 fewer passengers, and, as we have said, her maximum displacement is smaller than that of the "Celtic" by 5,200 tons. Yet, to secure her additional speed of four knots an hour she burns double the amount of coal and requires 115 more men in her crew.

Our illustrations of the vessel speak for themselves. We draw particular attention to the bow and stern views, taken when the mammoth ship was in drydock, which afford a most vivid impression of her vast height and bulk. The interior view of the front cabin dining saloon, which is 75 feet in width, shows that in spaciousness and comfort the "Celtic" compares favorably with costlier vessels.

Electrical Fire-Damp Indicator.

A novel fire-damp indicator, based upon the method of electrical resistance, has been devised by M. G Léon. The indicators in use at present are based upon the halo given by a flame in the air containing fire-damp. Ordinary oil safety-lamps will only indicate down to 2 per cent, but M. Pieler, using the larger flame of alcohol, has brought the limit down to 2 or 3 thousandths. M. Chesneau dissolves nitrate of copper and bichloride of ethylene in the alcohol and gives a blue flame to the Pieler lamp, which reveals as low as one thousandth part of fire-damp. Mr. Livéing, an English engineer, has devised an electric indicator based on the difference in redness of two platinum wires heated by the same current and placed in pure and in contaminated air. This method will show about one-half per cent. In the present method M. Léon uses instead the difference of electric resistance of two platinum wires heated to about 1,000 deg. C. by the same current. One of the wires is stretched in a sealed glass tube, and the other (for the fire-damp) placed in a wire-gauze case. The two wires form the two branches of a Wheatstone bridge, the other two branches being formed of suitable resistance wires, in this case of 1.3 ohms each. For the galvanometer of the bridge a Chauvin & Arnoux instrument was used, giving a deflection of 100 divisions for 50 milliamperes. Two cells of accumulator give the current, and the resistances are adjusted till the needle remains at zero when both wires are in pure air. When the air contains fire-damp the galvanometer is deflected 2 divisions for one-thousandth part of fire-damp. These deviations are about proportional to the quantity of gas. The author concludes that with this indicator the proportion of fire-damp in a mine may be determined at any instant, and that it will even be possible to establish fire-damp observing stations, and thus contribute greatly to the scientific study of the subject.

Compressed Air for Pumping Oil Wells.

One of the latest and most novel uses to which compressed air has been put is the pumping of oil wells. California has oil fields throughout its entire length, but of these what is known as the Bakersfield or Kern River District, situate about the middle of the state, is head and shoulders above all the others, both as to present production and possible developments. In this district the formation lies almost horizontal and, with the exception of a sticky clay and heaving sand, is just hard enough to drill rapidly, but the heaving sand has been so difficult to overcome that in many cases wells that, from their surroundings were absolutely sure of oil, have, after months of constant effort, been abandoned on account of the heaving sand. It certainly requires courage and persistence in the drillers, after working for days and perhaps only gaining ten or fifteen feet, or possibly nothing at all, to run his tools into the hole and find that they will not go down within one, two or possibly three hundred feet of what they had gone but a few minutes before; and to have this experience day after day and week after week will test every virtue a man may possess, including his pocketbook.

Every expedient known in other fields has been tried here, but with only moderate success. The formation being loose and open allows the water to run away so fast that the rotary hydraulic rig is a failure, though where the sand heaves *inside* the casing a column of water is used with good effect to aid in holding it back. Even after the oil sand has been reached and the pump put in, the troubles have only begun, as the pressure outside of the casing forces the sand through the perforations and the well has to be shut down at short intervals to remove the accumulated sand and clear the working barrel, necessitating an engine and rig at each well and also the retaining of a "pulling crew" of at least three men.

To overcome these conditions a great deal of expensive experimental work has been done by various companies, and at this time compressed air gives promise of solving the problem. The air is piped from the air compressor (too well known to need any description) to the well, a 1-inch pipe run down into the well and connected with a 3-inch tubing near the bottom by a U joint, though in some cases two or three pipes are connected, one at the bottom of the tubing, one at about three-quarters distance down and one about one-half the distance. In starting the well pumping they are all turned on together until the column of oil is started, when the intermediate connections are shut off and the lower one will do all the work, usually requiring about 120 pounds pressure in an 850-foot well, 14 gravity oil. By this method everything above the connections is carried out of the tubing and the deeper they are submerged the better the results. In this way the sand, which has been the source of so much trouble, is not allowed to accumulate, but is carried out with the oil, and by gradually lowering the tubing the well is cleared of whatever sand may have accumulated in it. In one instance which has come under our observation the well, after being completed, had filled up 180 feet with sand which, working day and night for nearly six weeks with the tools, failed to lower. As an experiment and last resource compressed air was introduced with the result that in four days, besides getting the benefit of the entire production of the well, the sand had been removed and the tubing lowered to the bottom of the hole and the well has since produced steadily.

Briefly, the advantages of the new method are as follows: One man to attend to the compressor plant and one man to attend to all of the wells being pumped, instead of one man to every well and a pulling crew in addition.

The compressor plant being the only machinery required, instead of an engine and rig to every well, wells can be operated at a long distance from the compressing plant with practically no loss of power. Last, but possibly most important, the wells produce for thirty days in the month instead of about fifteen days, as heretofore.

Dome of St. Paul's Cathedral Damaged.

The dome of St. Paul's Cathedral is badly cracked and the damage is serious. The immense weight resting upon the eight piers upholding the dome has caused the foundations under the dome to settle more than elsewhere. This has broken eight arches and the windows of the clerestory over them in the nave of the choir, and in the north and south transepts where they abut on the dome piers. The great weight of the western towers has caused them to sink, and in sinking they have cracked the west front vertically through the great door, the window above and the vaulted ceiling and portico. Minor cracks have been noticed. The architect in charge of the edifice is of the opinion that the damage was caused by the settlement induced by the building of two underground railways and a large sewer. The vibration of the trains is considered particularly harmful.

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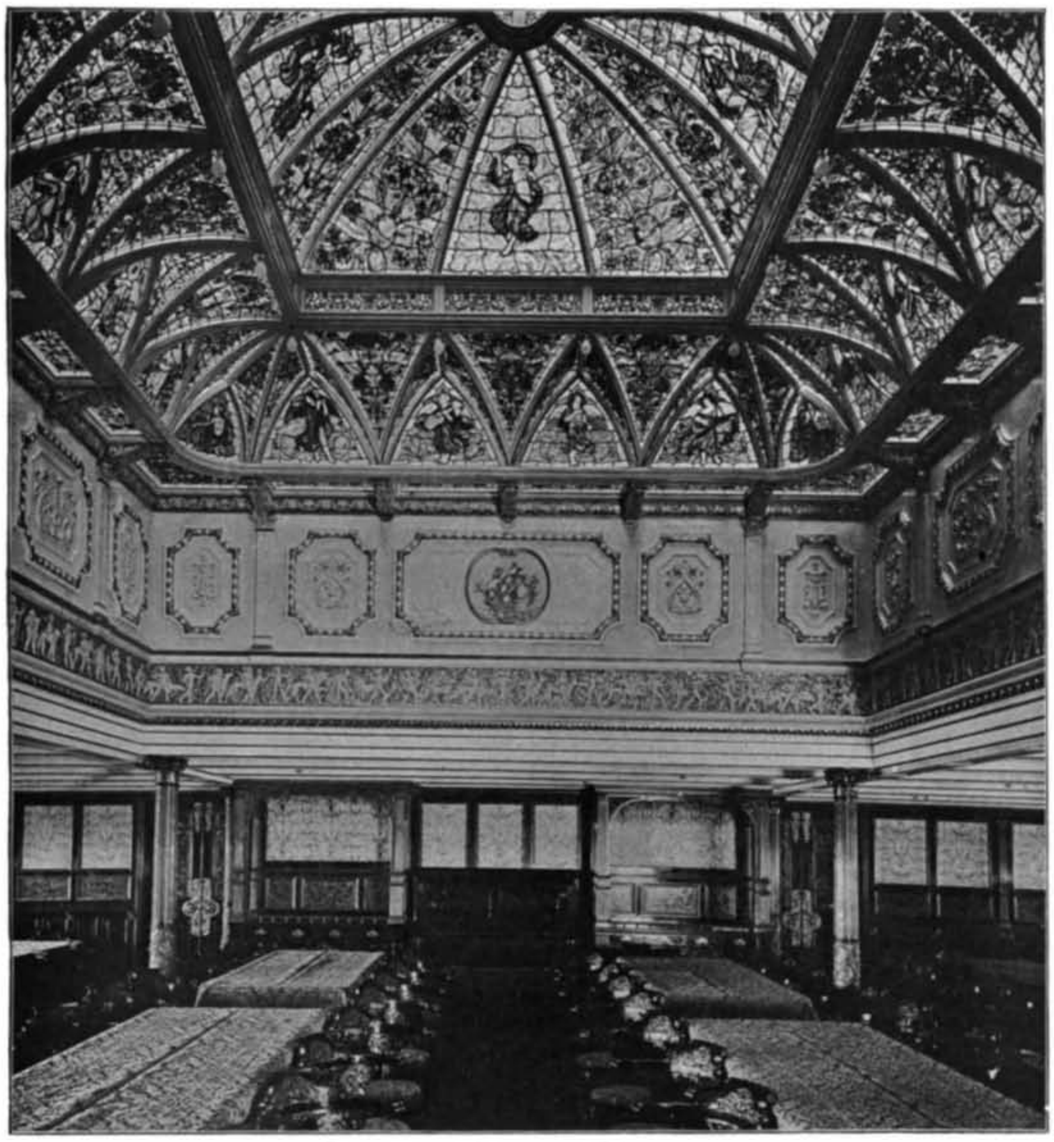
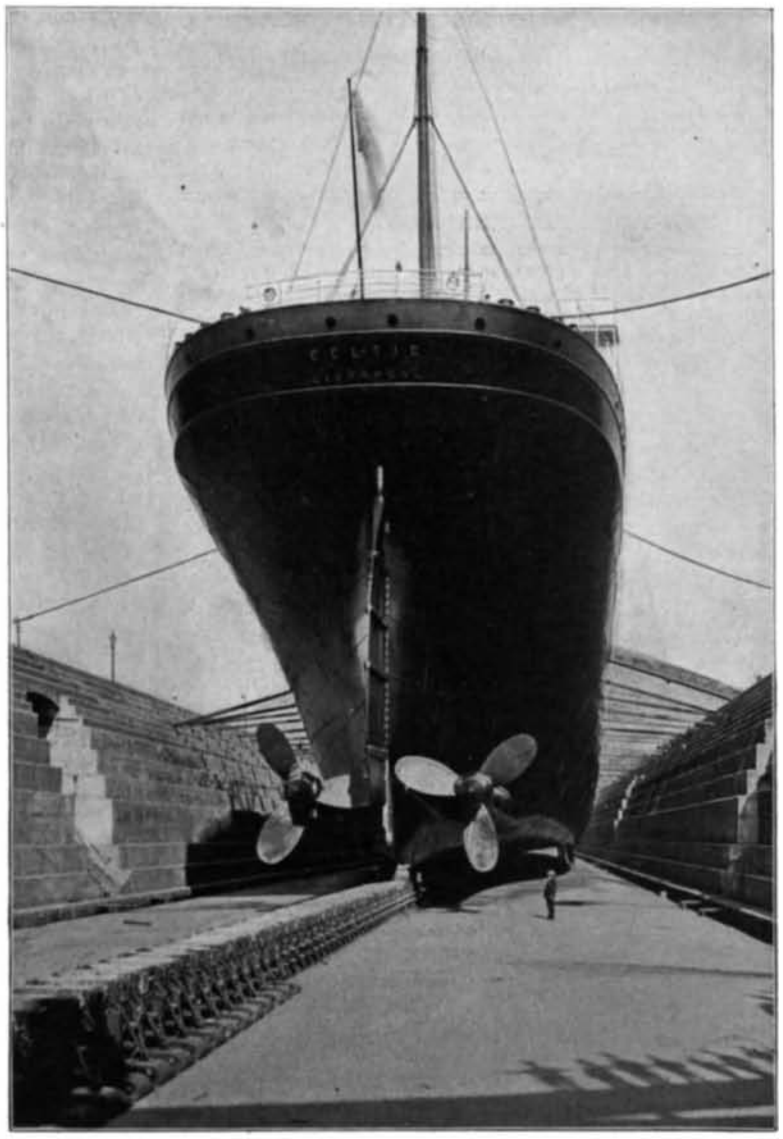


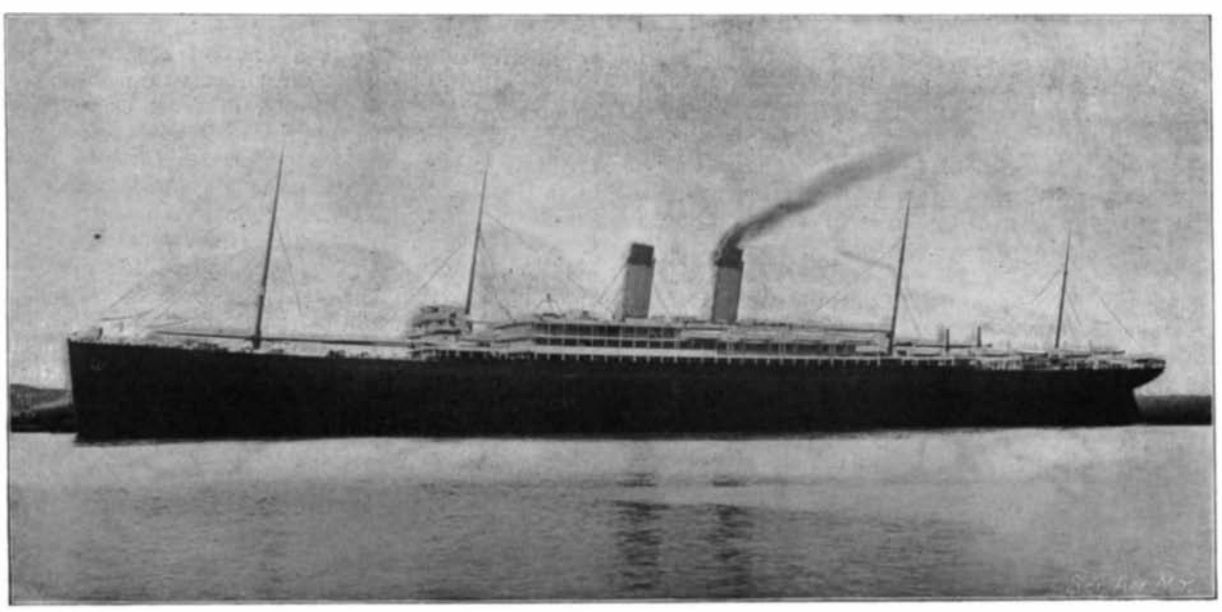
View Beneath Dome of Dining Saloon.



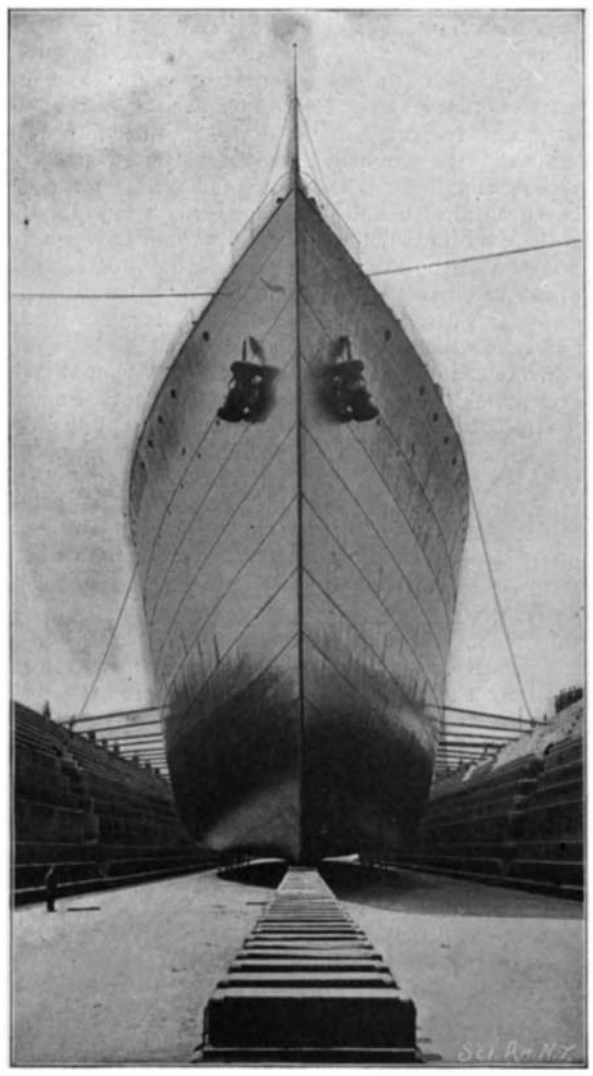
Stern View—Taffrail is 65 Feet Above Keel-Blocks.

Saloon Smoking Room.

A First-Class Stateroom.



Broadside View of the "Celtic."



Bow View in Drydock.

Length, 700 feet; Beam, 75 feet; Molded depth, 49 feet; Displacement on designed draft of 36 feet 6 inches, 37,700 tons; Sea speed, 16 knots.

NEW WHITE STAR LINER "CELTIC"; THE GREATEST SHIP EVER CONSTRUCTED.—[See page 103.]