The World's Greatest Ship—The 'Olympic'—a 60,000-ton Vessel

The new White Star liner "Olympic" which was launched from the famous yard of Harland & Wolff at Belfast in October last is far and away the largest vessel ever built, her gross tonnage being half as much again (32,500 tons) as that of the "Mauretania" or the "Lusitania," which until now have held the record for size. Her dimensions are: Length, 888½ feet; beam, 92½ feet; depth (from keel to main deck rail), 62 feet; and her tonnage displacement is 60,000. Her huge hull, divided into thirty water-tight compartments, contains nine steel decks, and provides accommodation for 2,500 passengers, besides a crew of 860. She is a triple-screw boat and her engines of 45,000 horse-power will propel her at a speed of 21 knots. In equipment also she will surpass anything afloat as can be seen from this diagrammatic picture of her interior. The "Titanic," her sister ship, will be launched early this year. Each vessel, when completed, will have cost \$7,300,000.

From the Graphic.

THE WORLD'S GREATEST SHIP.

The launching of the White Star liner "Olympic" at Belfast on October 20th, marked a new advance in naval architecture. Not only is the "Olympic" the largest vessel that has ever been built, but her propelling machinery is of a type that has never been installed on a vessel of such dimensions. After the success of combined turbine and reciprocating machinery in the "Laurentic," it was decided to equip the new steamer with both types of engines and with triple screws.

The "Olympic" outwardly resembles the "Mauretania" of the Cunard Line. She has four elliptical funnels, each 28 feet in diameter. Her length is 888½ feet; her breadth over all, 92½ feet; her breadth over boat-deck, 97 feet; her height from the bottom of her keel to top of her captain's house, 105½ feet, and to the top of the funnels, 175 feet; her freeboard is somewhat greater than the "Mauretania's," being about 52 feet at the top, 45 feet to the level of the main deck, 62 feet to the boat-deck amidships, and 42 feet at the stern. She may be distinguished from other four-funnel ships on the high seas by a single pole-mast forward of the bridge. The "Olympic" has a maximum draft of 37½ feet, on which she displaces about 60,000 tons, as against a displacement of 45,000 on the same draft for the "Mauretania."

Despite her size, her engines will develop 45,000 horse-power, sufficient to maintain the minimum speed of twenty-one knots, for which she has been designed. The combined reciprocating and turbine engines are so planned that two reciprocating engines will drive the wing propellers, the exhaust passing into a low-pressure turbine driving the center propeller.

The launching weight of the "Olympic," about 27,000 tons, was the heaviest weight ever transferred from land to water; and this operation, always a matter of anxiety to those in charge, was naturally, in the case of so huge a vessel, an undertaking of unusual importance. The method of launching was very simple. The vessel was held on the ways by hydraulic triggers, which were released by the mere opening of a valve, in order that the vast structure might glide into the water.

Some idea of the enormity of the "Olympic" may be obtained when we consider the size and quantity of some of the parts that entered into her construction. Her rudder alone weighs 100 tons, and the weight of the castings comprising the stern frame, rudder, and brackets amounts to 280 tons, or 60 tons more than those of any other steamer. They were manufactured at Darlington, and special arrangements had to be made for their conveyance to Hartlepool, whence they

were shipped to Belfast. The largest beam weighs four tons and measures 92 feet; the longest steel plates are 36 feet. There are 2,500,000 rivets in the ship. Each engine crank-shaft weighs 118 tons; each bed-plate, 195 tons; each column, 21 tons; and the heaviest cylinder with its liner, 50 tons; the wing propeller, 38 tons. The weight of the casting for the turbine cylinder is 167 tons, and of one of the solid bronze propellers, 22 tons. The anchors are 19 feet in length and over 15 tons in weight, and each link of their chains weighs several hundredweight. Twelve horses were required to drag one of the anchors to the Naval Exposition at Olympia.

The equipment and furnishings of the vessel have likewise driven home the gigantic size of her hull. Besides the usual dining rooms, lounges, saloons, drawing and smoking rooms, restaurants, and verandas and cafes, all beautifully decorated, the "Olympia" will be provided with a complete and well-equipped Turkish bath, a spacious swimming bath; a full-sized squash and racquet court, with a gallery for the use of spectators of the game, electrical bath establishments, sun parlors, sport decks, palm courts, lifts, gymnasiums, etc. These accommodations are provided for 2,500 passengers. The crew will number 860.

Since the advent of the "Great Eastern" in 1858, no vessel, except the "Mauretania" and "Lusitania," has created such a vast amount of comment as the "Olympic," not only on account of her enormous size, but also because she represents a new type in naval architecture. In our issue of June 19th, 1903, we published an article on the "Development of the Transatlantic Steamship," in which we traced the evolution of the modern liner from the old "Britannia," which was the first vessel that ever crossed the Atlantic on a regular schedule, to the present-day "Olympic." We pointed out, at the time, that between the "Britannia," with her length of 215 feet and her speed of 8.5 knots, and the "Olympic," with her enormous length of nearly 900 feet and her minimum speed of 21 knots, the changes in construction and in propelling machinery have been remarkable. The two decades that followed the advent of the "Britannia" saw the advent of the "Asia" in 1850, a vessel with a length of 275 feet and a speed of 12.5 knots, and the "Persia," an iron steamship built in 1855, with a length of 385 feet and a speed of 13.8 knots. Then came the "Great Eastern," Brunel's naval masterpiece, a ship so far in advance of her time that she proved a commercial failure, but nevertheless a harbinger of the development which has

given us the "Olympic." The "Great Eastern" with a length of 692 feet and a displacement of 28,000 tons was not exceeded until the "Oceanic" made her appearance in 1899 with a length of 705 feet, a maximum displacement of 32,500 tons, and a speed of 20.7 knots.

The "Great Eastern" marked the transition from the paddle to the screw; for she was equipped with both. The "China," built in 1862, a ship of 337 feet in length with a speed of 14 knots, was propelled by a single screw only. After that the screw propeller completely displaced the paddle wheel. Up to the time of the "City of Paris" and the "City of New York," practically all of the vessels were driven by single screws, a method of propulsion which reached its highest development in the "Umbria" and "Etruria," 525 feet in length, and 19.6 knots of speed, with engines of 14,500 horse-power. With the "City of Paris" and the "City of New York," began a new period of twin-screw ships driven by triple-expansion engines. When they went into service in 1889, they were by far the finest ships afloat, as well as the largest. They were 560 feet in length, and had a displacement of 16,000 tons.

The "City of Paris" and the "City of New York" were steady and very much along the same lines. The

"Lucania," the "Kaiser Wilhelm der Grosse," the "Deutschland," etc., were built in more or less rapid succession, and exceeded their predecessors in size and in speed.

With the building of the "Lusitania" and the "Mauretania," turbine engines permanently entered the field of transatlantic navigation, although the two Cunarders were not by any means the first vessels in which the turbine was installed. In the "Mauretania" and "Lusitania" a speed of from 25 to 26 knots is maintained steadily, but at a cost which might well give less wealthy owners pause. The White Star Line has made no effort to compete with other companies in building ships which will hold transatlantic records for speed. The "Olympic," like her predecessors, the "Celtic," "Oceanic," and "Baltic," is a comfortable ship of moderate speed, as speeds go nowadays. In the combination of reciprocating engines and turbines she represents the entrance of a new type whose performances will be watched with not a little interest.

The launching and other exterior views of the "Olympic" were illustrated in the SCIENTIFIC AMERICAN, November 12th, 1910. The present picture is taken from the *London Graphic* and it gives a sectional representation of her interior.

The Structure of Metals

By DR. ALFRED GRADENWITZ.

ONE of the most difficult tasks incumbent on the managers of machine shops, is the examination of the mechanical and electrical properties of raw materials and the utilization of the results thus obtained for their continued improvement.

In the electrical industry this task, because of the peculiar conditions of the case, becomes especially complicated. In fact, the mechanical properties (hardness, ductility, mechanical strength, etc.) being anything but parallel to the electrical properties (insulation, conductivity) two opposite tendencies have to be accounted for. This industry therefore is especially interested in availing itself of the most perfect processes of chemical and of mechanical analysis.

Whereas the chemical composition of a given material can always be ascertained by means of a more or less complicated analysis, the thermal processes (melting and annealing) and the mechanical operations (rolling, compression, drawing, etc.) undergone by the material, cannot be checked by the old methods with all the accuracy and safety required. The metallographic methods recently suggested are therefore specially useful in this case.

The Cable Works of the A. E. G. of Berlin has been among the first to adopt this method. The following examples, two of which are illustrated herewith by microphotographs for which we are indebted to the courtesy of the directors of the works, will give a striking idea of the many advantages afforded by a microscopic examination of polished cross-sections.

The first example is a microphotographic picture representing a brand of cast copper as obtained from wire refuse in the refining furnace: The copper (Cu) having absorbed in melting, large amounts of oxygen (O), has united with this element in the shape of red oxide of copper (Cu₂O) incorporated with the copper under the shape of a fine powder, up to a

certain density corresponding to saturation. By an examination of the microscopic cross-section, the crystals of pure copper (1) are seen suspended in a saturated solution (2) of copper-red oxide of copper.

In the second example, Fig. 1 represents a micro-

FIG. 1.—A MICROPHOTOGRAPHIC PICTURE OF CAST COPPER SUPERHEATED INTENSELY
Magnified 100 times

FIG. 2.—STRUCTURE OF SAME SPECIMEN WHEN NON-MAGNETIC

photographic picture of cast copper in which the percentage of red oxide has been increased by intense superheating. Wherever the limit of saturation was exceeded, the red oxide has separated from the solution as well-defined crystal. The following three components of the metal structure are therefore observed in the microscope: Pure copper (1), copper-red oxide solution (2), pure red oxide of copper (3).

In Fig. 2 is shown the microphotographic picture of a roughly purified cast copper where the oxygen has been accumulated with a view to burn any metallic and non-metallic impurities as well as to prepare a reduction as violent as possible of the oxygen, forcing any foreign substances burnt or otherwise, to the surface of the bath by a purely mechanical process. As soon as this reduction has been affected the picture (as seen from Fig. 2) only comprises some thin threads of red oxide (2) and copper crystals (1).

Another example, finally represents a perfectly refined cast copper. As the red oxide, even in slight quantities, is detrimental to the mechanical and electrical properties of copper, the oxygen having once done its duty, should be driven out completely. The cast copper therefore is submitted once more to intense heating and to reduction, after which even the most minute metallographic observation will no longer ascertain any traces of oxide. Reduction is effected by the immersion of a birch trunk, the components of which (carbon and hydrogen) possess so strong an affinity for oxygen that this element, suddenly leaving the copper in great amounts, combines with the reductive elements, while the melt undergoes a violent seething.

Similar sets of metallographic pictures are prepared at the Cable Works of the A. E. G. for any operation of some importance, three chemists being intrusted with the checking of materials by comparing these pictures with those of typical standard. After having enriched to a surprising extent our

knowledge of living organisms, the microscope thus promises to render an equally efficient assistance to the engineer engaged in industrial pursuits.

The City Water Sterilizing Process Used at Marseilles

By the Paris Correspondent of the SCIENTIFIC AMERICAN.

THE fact that city water can be sterilized on a large scale by the use of ultra-violet rays has been well brought out in a series of tests which were made at Marseilles not long since. Owing to the knowledge that the Durance River contains a large amount of bacteria, the municipality felt the need of providing a suitable method for sterilizing the water and one which should allow of a large delivery at the same time. The results of the tests seem to show that the ultra-violet-ray method is by far the best for sterilizing, and is at the same time easy to carry out with a rapid delivery and takes but a small amount of current, hence the cost is low. We wish to describe the new apparatus for city water use which is designed by Messrs. Henri, Helbronner, and De Recklinghausen, and it is gratifying to observe that the experiments carried out by V. Henri at the Paris University are now taking a practical shape. There seems to be a great future in store for the new method, seeing that it has none of the drawbacks which are found with the other processes when it comes to using it on a large scale.

In the sand-filtering method, for instance, the filters occupy a large surface of the plant, and when not properly operated the results are very imperfect. Besides, the first cost of installing the filtering plant is high. Chemical products added to the water for sterilizing have the disadvantage of giving a bad taste to the water, and the method is not much favored for that reason. One of the best methods for municipal plants has been the ozone process, and

FIG. 2.—SECTIONAL VIEW OF APPARATUS FOR STERILIZING CITY WATER

FIG. 1.—APPARATUS USED FOR STERILIZING CITY WATER BY EMPLOYING ULTRA-VIOLET RAYS

it has been used in some large cities. However, it gives a certain taste to the water which disappears but slowly, and on the other hand there must be great care taken in the ozone production in order to avoid forming any nitrogenous products, which would vitiate the water. Hence the process is somewhat difficult to carry out, or at least needs great care and attention.

In order to find the best solution of the problem, the municipal council of Marseilles organized a course of sterilizing apparatus. Such a plant was required to deliver 200 cubic meters (261.5 cubic yards) of water per 24 hours, and was to be run continuously for one month. The inspection committee included some of the leading specialists in hygiene, mining and civil engineers, and professors of universities. The results of the tests showed that the ultra-violet-ray process was undoubtedly the best for municipal use, as it has none of the defects which we mentioned above. It uses a small amount of current, and this has now been lowered in the new apparatus. Neither taste nor smell is given to the water, and the sterilizing is very effective. At the same time the process is easy to carry out and the apparatus needs but little attention. The first cost of the plant is low, and it occupies but a small space.

The ultra-violet-ray apparatus was used in connection with a Puech-Chabal filter in order to act upon clear water, and this was necessary from the fact that the Duvarne water is very heavily charged with impurities which render it turbid. After leaving the filter it passes at a continuous rate through the ultra-violet-ray apparatus.

Fig. 1 of our engravings shows the appearance of the Marseilles apparatus and Fig. 2 the sectional view. In the former apparatus, the lamps were placed above the surface of the water upon floats, so that all of the radiation from the lamp could not be used, and in fact there was only one-third of the rays actually employed for the sterilizing. The authors sought for a means of utilizing a greater proportion