THE 25¼-KNOT CUNARD LINER "MAURETANIA."

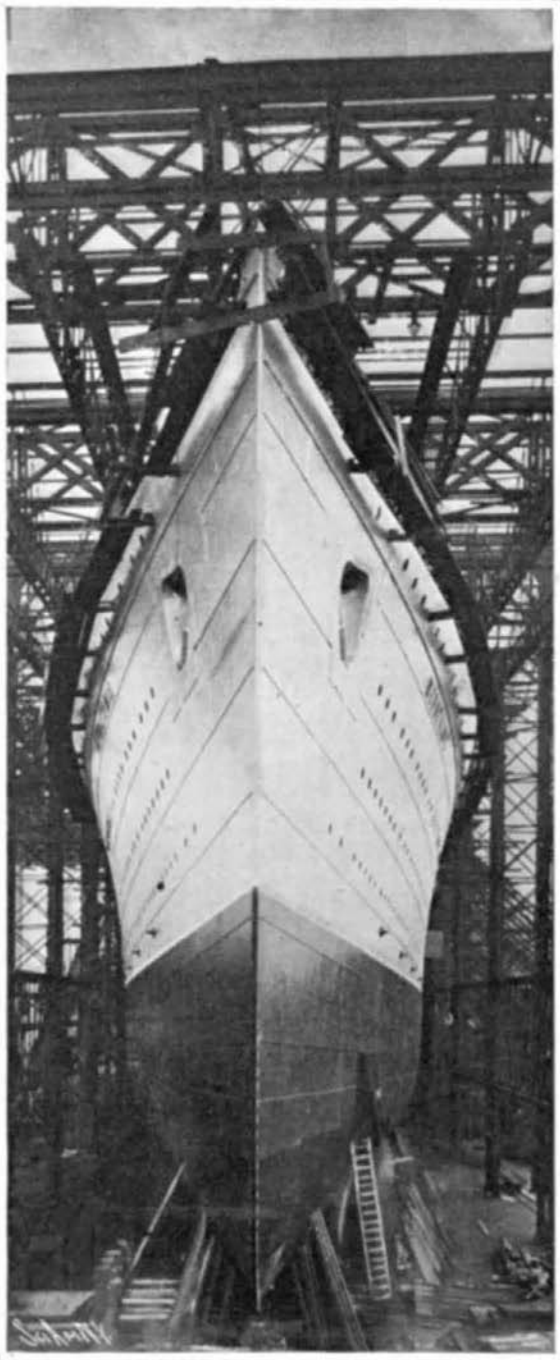
The "Mauretania," the second of the new 25-knot turbine liners which are being built for the Cunard Steamship Company, was recently successfully launched at the yards of the builders, Swan, Hunter & Wigham Richardson. The contract of the Cunard Company with the British government binds them to build two liners, to average 24¾ knots, which are to be retained at the call of the Admiralty in case of war. In return the government advances a sum of $13,000,000 for the construction of the ships at 2¾ per cent interest, and the government also makes an annual payment of $750,000 to the company. The literal terms of the contract are that the vessels shall make 25¼ knots on trial, and that within a year of taking their place in service they shall make a round trip to New York and back at 24¾ knots.

The "Mauretania" is identical with the "Lusitania" except in minor details. The form and dimensions of the ships are based upon tank experiments at the government tank at Haslar; but these experiments were supplemented by the builders, who constructed a 40-foot 6-inch launch, which was of the same general form as the big steamship; and with this, elaborate tests were made on variations in the form of the stern and in the design of the propellers. As a result of these experiments the outer propellers have been placed somewhat farther ahead of the inner propellers than in the "Lusitania," and the shape of the propeller blades is slightly modified. The dimensions of the "Mauretania" are as follows:

Length over all.................	785 feet
Length between perpendiculars..	760 feet
Beam extreme	88 feet
Depth molded	60 ft. 6 in.
Gross tonnage	33,200 tons
Net tonnage	11,900 tons
Maximum draft	37 feet
Displacement at this draft......	45,000 tons

These dimensions render these vessels by far the largest ever built or projected. They are 78 feet 6 inches longer than the swiftest of the big liners, the "Kaiser Wilhelm II.," and they are to show a speed 1¾ knots greater. They are 80 feet longer even than the "Great Eastern," and of 5 feet greater beam.

The "Mauretania" has nine decks—the lower orlop, the orlop, the lower, the main, the upper, the shelter, the promenade, the boat, and the sun deck. The motive power, including engines, boilers, and coal bunkers, occupies 420 feet of the mid-length of the vessel from the main deck to the hold, and therefore it can be readily understood that there is practically no space for cargo, the vessel being purely a mail and passenger ship. The passenger accommodation is provided on the six decks above the water line, from the main deck upward. The shelter deck is given up to the officers and crew, the latter being forward and aft. On this deck also are specially isolated hospitals. A feature which will be greatly appreciated by invalids and those who may be temporarily indisposed, is the provision of two electric passenger elevators at the center of the ship, with landings at each of the six passenger decks, an innovation first proposed by the



Bow View, Showing the Very Fine Entrance and Lofty Freeboard.

Scientific American for these vessels. The ship will carry 560 first-class, 500 second-class, and 1,200 third-class passengers, and a crew of 810, making a total number of souls on board of 3,070. In general the staterooms will be 9 feet in clear height and in the saloons the height will be about 10 feet 6 inches. Another novelty in the "Mauretania" is that the promenade and boat decks overhang the shelter deck by 21 inches on each side of the ship, this being done to bring up the width of the promenades on each side of these decks to 18 feet. The boat deck is 33 feet above load water line. The top of the wheel house is 63 feet, and the funnels are 115 feet above the same level.

The hull is divided by fifteen transverse bulkheads and the coal bunkers are themselves water-tight and divided by bulkheads. The subdivision is such that these ships could not be sunk by a single collision. Every door of the compartments can be closed, in the event of collision, by the Stone-Lloyd hydraulic system; and this can be done by the officer on the bridge, or from any one of several positions throughout the ship.

The flat keel is built up of plating varying in thickness from 1 inch to 1¼ inch. In all plating the holes were electrically drilled, and the riveting was done by hydraulic power. The ship has a complete double bottom throughout her length, the depth between the outer and inner bottom being 5 feet. The bilge is well rounded and the entrance lines, as is evident from the accompanying view of the vessel bow on, are exceedingly fine.

It is needless to say that the framing of the ship is exceptionally deep and stiff. Amidships it consists of channel bars, with deep web frames at intervals. These heavy frames are grouped where the stresses will be greatest, notably in the wake of the machinery spaces. The channel bars extend from the double bottom (which, by the way, is carried well up into the bilge) to the shelter deck, which is 60 feet 6 inches above the keel. The plating of the hull is unusually heavy, each plate weighing from 2½ to 3 tons. At the turn of the bilge and on the sheer strakes they are made much heavier and weigh from 4 to 5 tons apiece. Here, also, the plating is doubled, and steel of higher tensile quality is used, the object being to give the sides of the ship additional girder strength by increasing the weight of the material along the top and bottom chords.

The weights and sizes of the various parts are necessarily very large, the stern frame and brackets, for instance, weighing altogether 150 tons. The rudder head is of steel, 25 inches in diameter. There is one gudgeon only on the stern framing, and the pintle is of immense size, weighing over 1¼ tons.

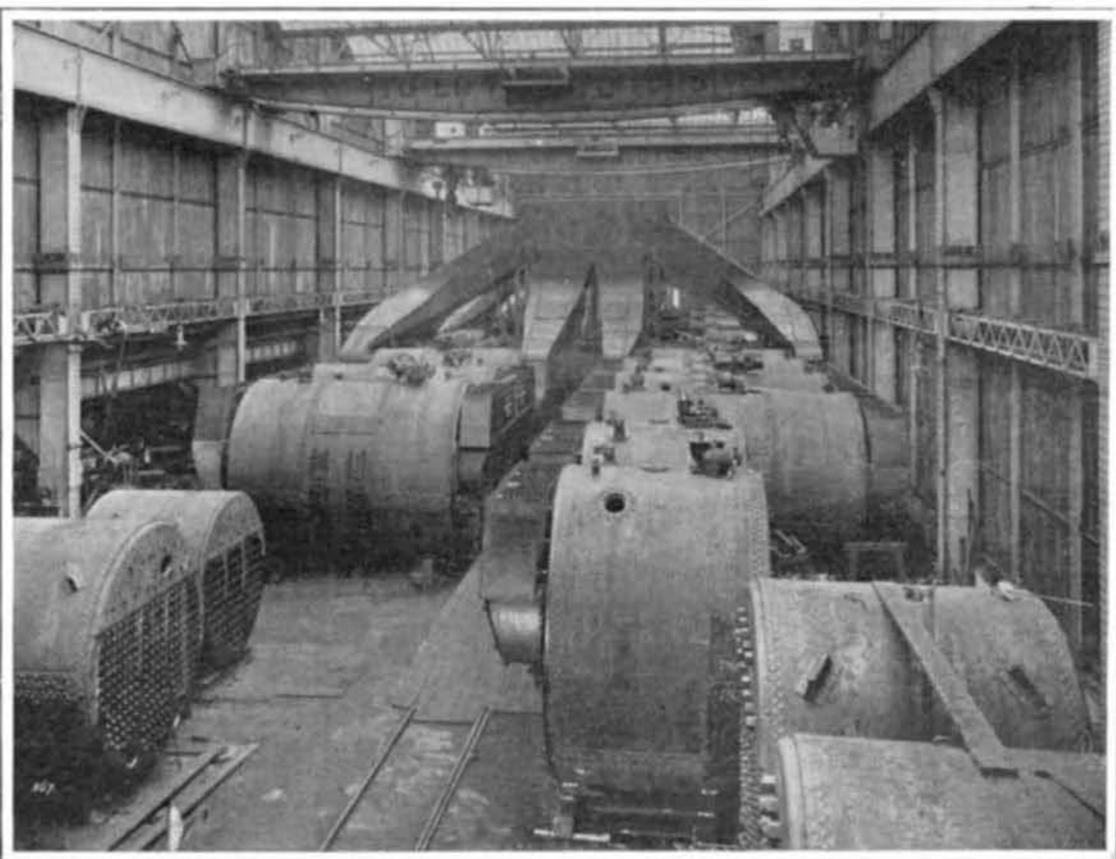
Perhaps the greatest interest attaching to the "Mauretania" centers in her turbines, which are being constructed by the Wallsend Slipway and Engineering Company. The motive power, it will be remembered, is developed on four shafts, each carrying one propeller. The two outer shafts are driven by two high-pressure turbines and the two inner shafts by two low-pressure turbines. At the after ends of the low-pressure turbines, and on the same shafts, are located the turbines for driving the ship astern. The inner shafts turn outward and the outer shafts inward. The total contract power is 68,000 divided equally upon the four shafts. The speed of revolution is to be about 200.

We direct attention to the very interesting photographs of the turbine plant, which give an impressive idea of its vast proportions. Thus the high-pressure turbine has an internal diameter of 10 feet and is over 25 feet in length, while the total length from the forward end of the low-pressure turbine to the after end

(*Continued on page 323.*)

Stern View, Showing Two of the Four Propellers.

Note the fine lines of the afterbody.



The Boiler Equipment, Consisting of 25 Cylindrical Boilers 17 Feet 3 Inches Diameter by 21 Feet Long.

They contain 192 furnaces, 160,000 sq. ft. of heating surface. Upon their 4,000 square feet of grate over 1,000 tons of coal will be burned daily.

THE 25¼-KNOT, 45,000-TON TURBINE CUNARDER "MAURETANIA."

THE 25¼-KNOT CUNARD LINER "MAURETANIA."

(*Continued from page 320.*)

of the astern turbine, which is placed immediately after the low-pressure, is not far short of 100 feet. The low-pressure turbine casing is a truly enormous piece of work, having an internal diameter of 16 feet 6 inches. This, be it noted, is slightly larger than the diameter of the Rapid Transit tunnel tube below the East River. It is estimated that the weight of the rotating parts of the low-pressure and astern turbines combined is more than 200 tons, and yet so accurately is the work being done that the methods of lining up adopted provide for an adjustment of this 200 tons of about 1-3,000 of an inch. Moreover, although the circumferential speed will be about 11,500 feet per minute, there will have to be a minimum clearance in the high-pressure of 0.1 inch between the blades and the surface of the casing. All the casings of the turbines are of cast iron, while the rotors and dummies are made of Whitworth fluid-pressed steel, as are also the disk wheels of the rotors. The low-pressure rotor is 12 feet in diameter. The casings are fixed to the bedplate at one end, but the other end is free to slide longitudinally in slipper guides under expansion and contraction. Other dimensions showing the great size of the turbines are those of the exhaust ports from the low-pressure casing to the condenser, which measure 11 feet by 16 feet in the opening. The blades of the turbines vary from a few inches in length at the admission end of the high-pressure turbine up to a maximum length of 22½ inches at the exhaust end of the low-pressure turbine. The high-pressure turbine shafting is 27 inches and the low-pressure 33 inches in diameter.

One of the most striking of our engravings is that showing the twenty-five cylindrical boilers which are necessary to supply steam to the above-described turbines. Twenty-three of these boilers are double-ended and two are single-ended, and between them they carry 192 furnaces. The double-ended boilers are 17 feet 3 inches in diameter, and 21 feet long. They are to work under the Howden forced-draft system. Between them they will have 160,000 square feet of heating surface and nearly 4,000 square feet of grate area. The pressure at the boilers will be 180 pounds and at the turbines 160 pounds. The boilers will be in four separate stoke holes with seven boilers in the forward stoke hole and six in each of the others. In our illustration the boilers are shown arranged in the erecting shop exactly as they will stand when looking athwart the ship. For each group of six boilers there will be a smokestack which will extend to a height of 152 feet above the keel of the ship, and these smokestacks, which are elliptical in section, measure 17 feet 6 inches by 23 feet 6 inches.

The launching weight of the "Mauretania" was 16,500 tons. When loaded to her maximum draft of 37 feet, she will weigh about 45,000 tons. She will be ready for her steam trials in the summer of 1907, when, as we have said, she must make 25¼ knots. That she will do so is rendered probable by the successful performance of the turbines of the "Dreadnought" which are similar in design, and went 5,000 horse-power above the contract.

The "Ville de Paris"—A New French Airship.

Among the recent airships which are being constructed in the vicinity of Paris we may mention the "Ville de Paris," which will no doubt soon be ready to enter the field. M. Henry Deutsch, senator and well known for the aeronautic prizes he founded in France, is having the new airship built by Surcouf, and it has been in construction for some time past. Some of the main features are as follows: The dirigible is 62 meters (203.42 feet) long, and its largest diameter is 10½ meters (34.45 feet). Its capacity is 3,200 cubic meters (113,800 cubic feet). Built of double rubber-coated tissue with an interior protecting coating, the balloon ends in a balancing tail, designed according to the plans furnished by Col. Renard, and the aeronaut Henri Hervé. This part will be one of the original features of the new balloon, and is intended to give it steadiness as well as a good steering. It is made up of a set of eight canvas tubes filled with hydrogen and attached behind the main body. Col. Renard's method is used for building the main part of the balloon, according to his recent theories. This is formed of a middle cylindrical part, with a conical cap at each end. The whole is designed so that the pieces of tissue are joined together without having any longitudinal seams, and in such manner that the seams are relieved of heavy strains. As to the nacelle, which is suspended below the balloon, it is formed of a framework 105 feet long and carries an Argus 4-cylinder gasoline motor, giving 70 horse-power at 900 R. P. M. A reducing gear having a gear ratio of 5 to 1 connects the engine to the propeller shaft. The propeller is placed at the front end of the framework. This propeller is entirely new, and is constructed after the technical conceptions of Col. Renard. It has two blades, which are set in the hub in such a manner that they can be freely turned. The setting of the blades to the proper pitch is accomplished automatically, and is dependent upon the thrust. In other words, it is an automatically variable propeller. The tests of this propeller by different engineers have led them to hope for excellent results.

Early Observations of the Sixth Satellite of Jupiter.

It is pointed out in one of the Harvard College Observatory Bulletins that the photographs of Jupiter will probably furnish early positions of the sixth and seventh satellites, as soon as approximate positions are computed for these dates. This has accordingly been done, by Prof. W. H. Pickering, and the positions of the sixth satellite marked upon six of the plates. The required measurements, and their reduction, were assigned to Miss Leavitt. It then appeared that in examining some of these plates, on December 10, 1904, she had already marked and measured the sixth satellite, but had concluded that it was probably an asteroid near its stationary point. On the eight plates taken from June 26 to July 1, 1899, it appeared to be moving with Jupiter, but was identified on a plate taken July 12, 1899, and found to have increased greatly in speed during twelve days. Unfortunately, Jupiter was off the edge of the plate, and it was assumed that the satellite had moved away from it, while in fact the distance between them was actually less than it was a fortnight earlier. It would appear, therefore, that had the true character of the object been recognized, the announcement made by the Lick Observatory on January 5, 1905, would have been anticipated. This statement is made as having perhaps a certain historical interest, and with no thought on Miss Leavitt's part of claiming any share in the discovery of Prof. Perrine. On the contrary, it illustrates the fact, familiar in every branch of science, that an object may frequently be seen, and yet may fail to receive that recognition of its significance which constitutes its true discovery. The sixth satellite has been found on two plates taken in 1894, and on nine taken in 1899. An excellent plate taken with the 8-inch Bache telescope on July 23, 1889, and having an exposure of 60 minutes, was also examined, but the satellite was not found, owing, probably, to the light from Jupiter, which fogged the plate, and obscures the faintest stars in the region. The faintness of the satellite, in some cases, rendered its measurement a matter of no little difficulty. On the other hand, the images of the catalogue stars, used for comparison, are very large on account of the long exposures of the plates, thus making possible appreciable errors, both systematic and accidental. For this reason, a faint star near the satellite was measured on every plate, and it may be expected that systematic errors of measurement will affect the positions of the two objects equally, if they are comparable in shape. Usually, the images of the star and the satellite do not differ greatly in character, as is shown by the description of each, written during an independent examination of the plates.

An alloy of 60 parts copper, 1 part tin and 39 parts of zinc, is found to offer great resistance to the action of sea water, and has been largely used in naval construction.

The Great Nebula in Orion. One of the First Nebulous Masses Which Were Spectroscopically Examined by Sir William Huggins.

THE CREATION OF A STAR.

THE CREATION OF A STAR.

Eras ago a great fiery mist extended into the limitless spaces of the heavens for millions and millions of miles—a mist so hot that its fierce temperature could not be measured by any human instrument and could be roughly computed only by involved mathematical processes. That mist spun with a frightful speed, and as it spun it cooled and shrank. During its contraction it spun still more swiftly—so swiftly indeed, that a moment at last came when the tremendous centrifugal force which had been developed overcame the contraction caused by cooling, and hurled off a ring from the glowing mass. With continued shrinkage, the centrifugal force increased. Other rings were flung off. These rings, still gleaming with heat, contracted about their densest portions into spheres, and these spheres in their turn hurled rings into space—rings that condensed into smaller spheres and revolved about the bodies from which they had sprung.

It is thus that Laplace conceived the origin of our solar system, and that conception, despite the modifications to which it has been subjected, is still accepted under the name of the Nebular Hypothesis by most astronomers.

The spheres first split from the glowing rings are our planets; the smaller spheres their attendant satellites. Other solar systems, probably even grander in their scope, are even now undergoing a similar process of formation in regions of the heavens unpenetrated as yet by our most powerful lenses.

How many years were consumed in the creation of our sun, our earth, the moon, and the stars, no one can even guess. That millions of years were required is at least certain. So slow is this creation of a star, that astronomers long ago fancied some evidences of its various stages might still be discovered in the sky. Naturally the rings of Saturn were first selected as one piece of evidence. But inasmuch as these very rings had suggested the Nebular Hypothesis it would clearly have been absurd to cite them as a proof of the truth of Laplace's conception. On the other hand, no change could be detected with the telescope in those stellar masses where shrinkage into a globular form might be most reasonably supposed to occur. Nor is this at all astonishing. So slowly did the original fiery mist congeal, that even in the period of ten thousand years no appreciable change would have occurred; and since telescopes have been in use for scarcely three centuries, signs of any transformation were not likely to be discovered by its means. Moreover, so enormous is the abyss that separates us from many a star that the light of the star traveling at the rate of 186,000 miles in a second reaches this earth only after the lapse of centuries. In a word, we see many stars not as they really appear, but as they were when Columbus discovered America. Clearly, the telescope can help us but little in its examination of bodies so distant.

Fortunately, we have at hand in the spectroscope an instrument more exquisite in its refinement—an instrument which enables us to analyze the elements of a remote blazing luminary with startling precision.

Everyone knows that the white light of the sun is in reality composed of many hues, some gay and others dull. By means of glass prisms or by means of diffraction gratings the sun's white glare is separated into its constituent colors and lines. Each color or each group of colors and lines is the chromatic sign manual of an incandescent chemical element. A grain of common table salt (sodium chloride) heated to incandescence in the blue flame of a Bunsen burner exhibits a spectrum in which a yellow tint is the predominant feature. That yellow tint is characteristic of the metal sodium; it always appears in the same place when seen in the spectroscope. The same yellow gleam appears in the spectrum of many stars in exactly the same position. Here we have convincing evidence that the metal sodium is contained in those stars. By means of the spectroscope the astrophysicist is enabled to determine not only the known elements of distant suns, but even elements as yet undiscovered on the earth.

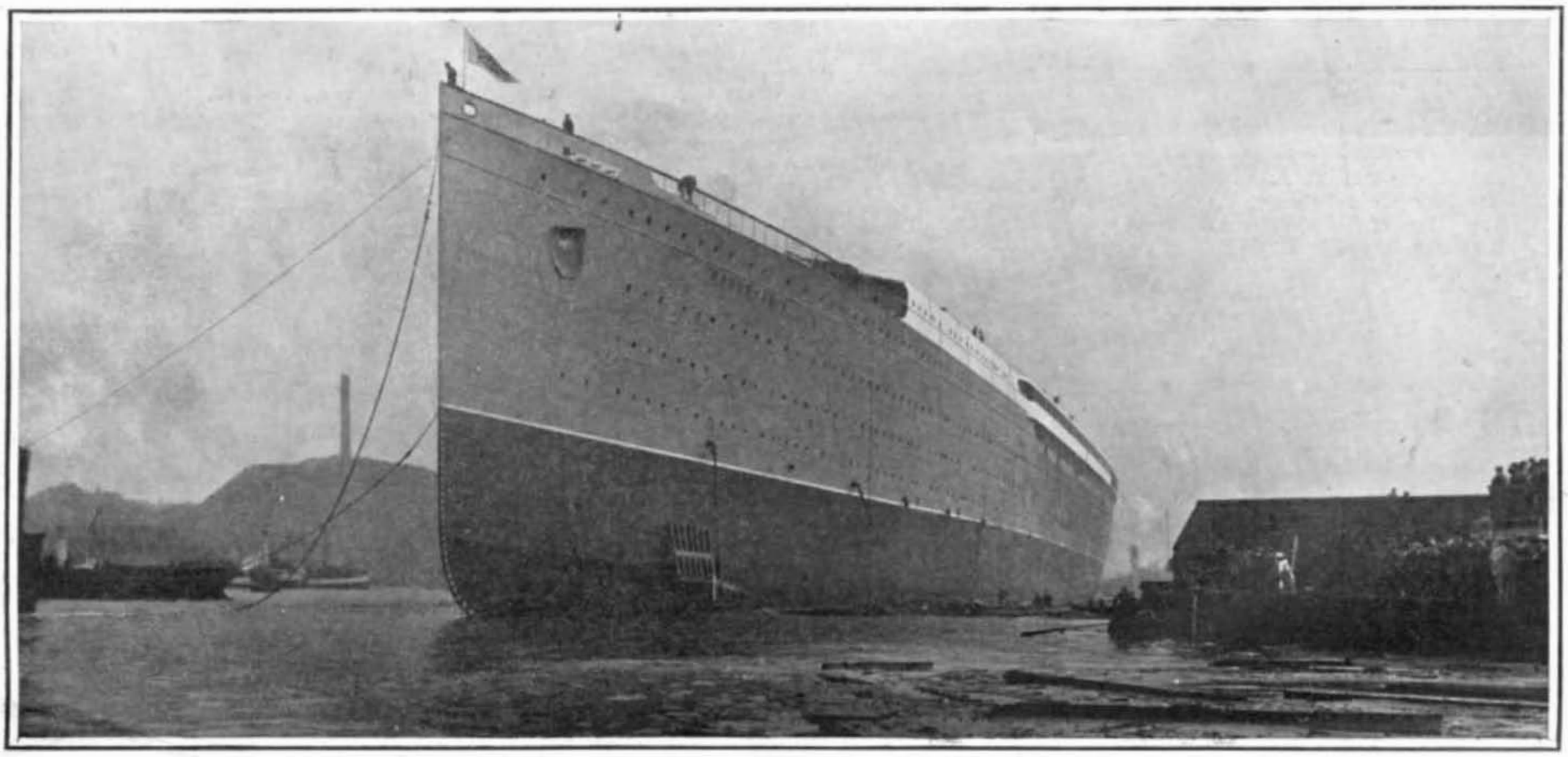
Thus the spectroscope serves to bridge chasms that may measure myriads of miles, and enables us to analyze stars almost with the same nicety as we analyze earthly compounds in our laboratories.

Spectroscopic examination of the heavens has justified the supposition that the various stages which the fiery mist undergoes in the process of star-making may still be detected. Just as the paleontologist has succeeded in tracing the descent of the modern one-toed horse from a prehistoric five-toed ancestor by the discovery of fossil equine skeletons imbedded in the earth for ages, so has it become possible for the modern astrophysicist to study what may be called the

SCIENTIFIC AMERICAN

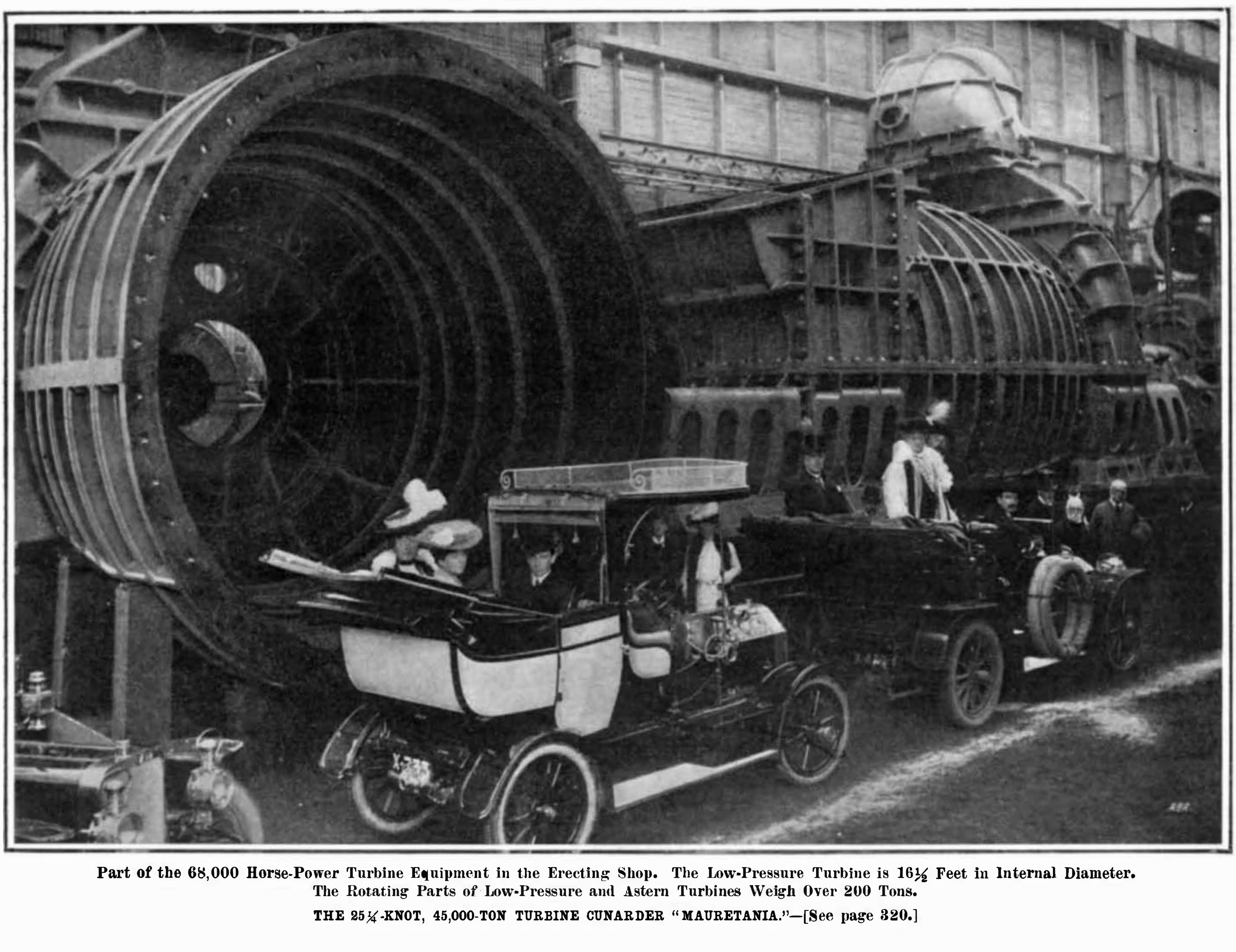
[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyright, 1906, by Munn & Co.]

Vol. XCV.—No. 18. ESTABLISHED 1845. NEW YORK, NOVEMBER 3, 1906. [10 CENTS A COPY $3.00 A YEAR.



Length, 785 feet. **Beam,** 88 feet. **Depth,** 60 feet 6 inches. **Displacement,** 45,000 tons. **Horse-Power,** 68,000. **Speed,** 25¼ knots.

The "Mauretania" Just After the Launch.



Part of the 68,000 Horse-Power Turbine Equipment in the Erecting Shop. The Low-Pressure Turbine is 16½ Feet in Internal Diameter. The Rotating Parts of Low-Pressure and Astern Turbines Weigh Over 200 Tons.

THE 25¼-KNOT, 45,000-TON TURBINE CUNARDER "MAURETANIA."—**[See page 320.]**