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 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.

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

THE CREATION OF A STAR.

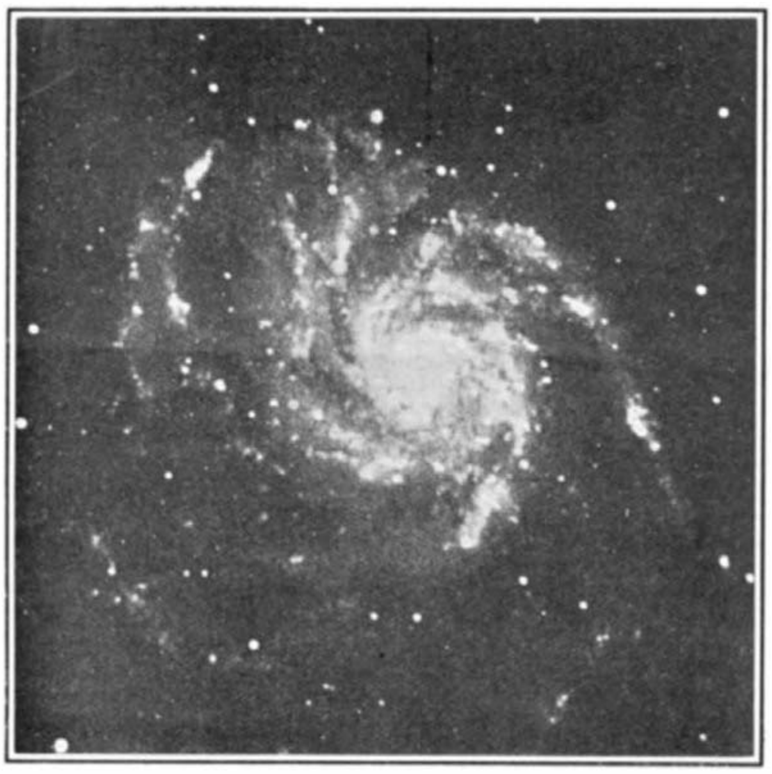
Fortunately, we have at hand in the spectroscope an instrument more exquisite in its refinement—an instrument which enables us to analyze the elements of a remote blazing luminary with startling precision.

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 fossils of the heavens. He has thus succeeded in divining, with marvelous accuracy, the probable career of a planet, such as our earth, from the day when the first sphere congealed from the original glowing nebulous mass.

He has succeeded, for instance, in demonstrating that a body which has just condensed from the original mist, has a spectrum that differs widely from that of a star millions of years older; and further, he has succeeded in proving that the older sphere is spectroscopically quite different from an orb still more aged. The color or groups of colors and lines which constitute the spectroscopic picture of a star can be arranged in a chronological series quite as orderly as the equine skeletons that have preceded the modern one-toed horse.



The Spiral Nebula in Ursa Major.

Only within recent years have spiral nebulæ been discovered in sufficient numbers to be regarded as type-objects of the heavens.

Thus it has been deduced that the stuff of which stars were originally made, in other words the glowing mist, are those fire-like masses which astronomers call nebulæ—masses which will eventually be condensed into a planet. Indeed, so far has congelation progressed in some cases, that certain nebulæ are even called "planetary nebulæ." We find in the constellation of Orion a planetary nebula that bears unmistakable evidence of the process of condensation which it is undergoing. Within Orion may be seen a dazzling spot, composed in reality of four stars, all of them suns probably as large as the center of our solar system, perhaps larger. That these four suns constitute a system of their own, can hardly be questioned. Undoubtedly they were formed by the draining of the primeval mist about them, if we may judge by the surrounding empty blackness. Spectroscopically considered, this nebula of Orion is nothing but a gigantic mass of glowing hydrogen, nitrogen, and an unknown gas, in which gaseous mixture stars are plunged. That the four stars to which we have referred formed part of the nebula at some remote period, is evidenced by the fact that their gaseous composition is exactly similar to that of the uncondensed nebula about them.

This wonderful use which has been made of the spectroscope, we owe to the brilliant work of Sir William and Lady Huggins. Before they began their epoch-making investigations, astronomers supposed that nebulæ were merely clusters of stars so closely packed together that even the most powerful telescope could not disintegrate them. This supposition had for its basis the circumstance that many a star cluster which to the naked eye appears but a blur of light in a black sky, is seen through the telescope as a multitude of white points. The spectroscope has definitely settled, however, which aggregations may be considered nebulæ and which stars, and has revealed cosmic secrets that the astronomer of half a century ago despaired of fathoming. The composition of a star cluster is as different from the composition of a nebula as water from steel.

Curiously enough, the forms of nebulæ are almost as variegated as those of plants and animals. Sometimes a nebula may assume a comet-like form, of which the nebula in Andromeda is a striking example; sometimes it may be a mere wisp of light reaching for millions of miles across the sky, as the nebula in the constellation of Cygnus in the Milky Way. Sometimes it may be ring-shaped and filled with milky light, and sometimes it may assume the form of a spiral, such as the nebulæ in Canes Venatici and in the Triangle. Latterly it has been thought that perhaps in this spiral formation we see one of the very early stages in the life of a star.

The spectroscope is not merely empowered to separate the light of a star into its constituent groups of lines; it also tells us how far condensation has progressed and how far a star has developed. The temperature of the orb is recorded in the intensity of the lines; the pressure to which it is subjected by the width and sharpness of the lines.

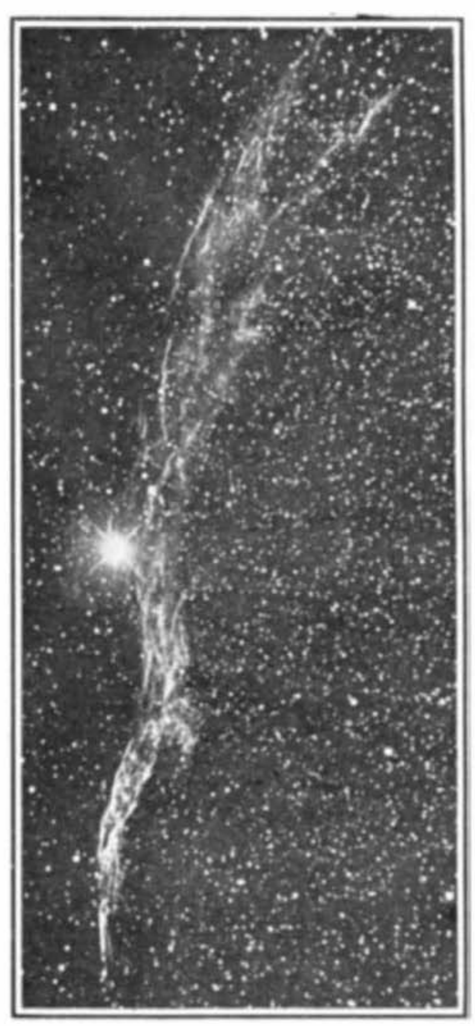
As it ages, a star spectrum changes. So does its color. Red-hot metal is not nearly so hot as white-hot metal. The metallurgist, by observing the colors of molten metal, is able to determine its approximate temperature; similarly, the astrophysicist gages the temperature and the age of a star by its color. The spectroscope, therefore, tells a modern astronomer not merely what may be the composition of a star, but also gives him some inkling of its temperature and pressure, and therefore of its age. Thus, it has been surmised that stars which are of an intensely bluish white color, resembling that of an electric arc, must be comparatively young, because they must represent a stage immediately following that of nebulæ condensation. After the bluish white stage come the yellow, orange and red stages. Up to the yellow period the star grows hotter as it contracts, after which it gradually cools. These changes of color are accompanied by changes in the spectrum as well—changes which indicate a modification in the physical structure. We find that the younger stars are composed very largely of hydrogen. As the star ages, the lines of the gases diminish and those of the metals increase in number and intensity.

The Spiral Nebula in Canes Venatici.

It is surmised that this is one of the first stages in the creation of a star.

From all that we can gather from a spectroscopic study of stars, it would seem that our sun may be regarded as the hottest type of star. After the star has passed the stage reached by our sun, the metals increase in number; next comes the red stage, when carbon is particularly prominent in its spectrum. For ages after the red stage, the star still continues to shine, but eventually, however, it degenerates into an enormous black cinder rushing through space. The next stages are represented by the planets of our solar system and by our own earth. The most pitiful period we find in our moon—frozen, desolate, arid.

The Great Nebula in Andromeda, Characterized by Its Comet-like Appearance and by Its Pronounced Nucleus Formed Probably at the Expense of the Surrounding Nebulous Mass.



For Millions of Miles a Nebulous Wisp of Light Extends Into Space in the Constellation of Cygnus.

THE CREATION OF A STAR.

Some years ago the United States Weather Bureau rerated their anemometers, and, disregarding the Smeaton rule for determining pressures, worked out a new formula. According to this, the true velocity for an indicated velocity of 80 miles is 62.2 miles, and the corresponding pressure is 15.5 pounds per square foot. Other velocities and pressures are in the same ratio.