MAIL 30.7.26

Mr. A. W. Piper, K.C.

Mr. A. W. Piper, K.C., one of the leaders of the South Australian Bar, will celebrate his sixty-first birthday on Monday. He is the oldest son of Rev. Thomas Piper, and was born at Faversham Kent, England. He was educated at Prince Alfred College, called to the Bar when he was 21, and took silk 15 years ago. Legal practice has engaged his chief attention, but he has found time to devote to activities and institutions outside his profession. For instance, he was president

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of the South Australian Literary Societies' Union from 1907 to 1909. Years ago he took a keen interest in the study of Shakespeare's works, and doubtless does so still. For three years he was president of the South Australian branch of the Royal Geographical Society of Australasia, and from 1916 to 1919 he was president of the Liberal Union. Mr. Piper has been president of the Law Society, and is Immediate Past Grand Master of the Grand Lodge of Freemasons of South Australia.

ADV. 7.7.26

CHARACTERISTICS OF STARS.

UNIVERSITY EXTENSION LECTURE.

STARS MORE POWERFUL THAN THE SUN.

The second of three extension lectures on "The new physics and the new astronomy" was delivered at the Prince of Wales Theatre, University of Adelaide, on Tuesday night by Professor Kerr Grant. He dealt with the characteristics of the stars in an able and interesting manner, and illustrated his subject with a number of excellent slides. Professor Darnley Naylor presided over a good attendance.

Professor Kerr Grant said, taking the sun as a standard of comparison, it might be asked if the stars were as big or bigger in mass and volume. What was their range in mass and volume? Did they radiate more or less light and heat? What were they made of, and in what state did this matter exist? What was the degree of vehemence of their heat, both on the outside and in their interior? Could the stars be classified, and, if so, were the differences between them of degree or of kind? It was obvious that in the time allotted he could only answer the questions in the briefest way. It appeared that the sun was of medium luminosity—there were many much more powerful and roughly as many less so. Thus, Canopus radiated 10,000 times as much light as the sun, whereas other stars did not radiate one-hundredth as much. Of course, if dark stars existed, the range might go down practically to zero. Among other stars of very large absolute magnitude were Antares, Betelgeuse, Aldebaran, and Arcturus. The first three were red stars, and presumably their surface was only at a red heat, yet they ranked in brilliancy with stars at a white heat, and consequently far greater emissive power, area for area. From this circumstance, it was argued long ago that these very bright red stars must be of enormous size to compensate for their lower temperature. If, in fact, the red stars in the sky were arranged in their order of absolute magnitude, the striking fact emerged that they separated into two great classes of very high and very low luminosity respectively. There were no stars of intermediate brilliancy. These two classes were termed giant and dwarf stars. The same division existed also for orange yellow and even white stars, but with a much less decided gap. From the intrinsic brightness of a star, which could be estimated from its color, and from its total light emission, the angular area of its surface could be calculated with tolerable accuracy. Eddington made the angular diameters to be as follows:—Betelgeuse .051, Antares .043, Arcturus .020 (in seconds of arc.).

Measuring Luminous Objects.

A possible method of measuring the apparent size of very small luminous objects has been proposed by the American physicist, Michelson, in 1890, and actually applied by him with success to the measurement of the diameters of the moons of Jupiter. The method depended upon the fact that if a narrow beam of light from a luminous source was in any way divided into two beams, and these were then brought together again a set of interference fringes was seen. If, however, the source was gradually enlarged, or the separation of the two beams varied, it was found that for one particular relation between size of source and amount of separation, the fringes disappeared. For objects of the angular dimensions of the stars, if Eddington were right, an enormous separation was necessary, and the difficulties of making the adjustments were increased proportionately. However, an apparatus was made and mounted on the huge 100-inch reflector at Mount Wilson, and as a test successfully applied to the measurement of the separation of the components of the double star Capella, which were too close to be separated by any telescope. Up to the present such giant stars as Betelgeuse, Antares, Aldebaran, and Arcturus had been measured. The masses of such of these giant stars as had a companion, were approximately known from the motion of the two stars round their common centre of gravity. It was tolerably certain that none of them exceeded their own sun in mass more than 20-fold, and Antares was probably not more than five times the mass of the sun. The density of its matter was consequently less than one hundred-millionth that of the sun, or less than one-one hundred thousandth that of their own atmosphere. It must consist, therefore, on the average, at least, of extremely rarefied gas. The same conclusion applied to all giant stars. Passing to the other extremes, the so-called "dark companion" of Sirius, was known long ago by its disturbing effect on the motion of the dog star. When Alvan Clarke, in 1862, furnished the construction of a big 18-inch telescope for Dearborn Observatory, he turned it first of all on Sirius to test it, and was thus the first man to see the "dark companion." It was in fact a white star, but of small diameter (1-35 solar, twelfth magnitude). But in spite of that its effect on the motion of Sirius showed it to be nearly half as massive as Sirius, or slightly less than the sun. Its volume was less than that of the sun. The density of its material was nearly 30,000 times that of the sun, or 50,000 times that of water. The heaviest substance known on earth was platinum, which was 21½ times as dense as water. Hence Sirius was over 2,000 times as dense as platinum.

A Reflecting Telescope.

The professor referred to the success of Dr. Adams, of the Mount Wilson Observatory in using the great 100-inch reflecting telescope to throw the image of the star Sirius b. on the slit, and said the result of the measurement was a triumphant vindication both of Eddington's calculation and of Einstein's relativity theory. The agreement was as exact as the uncertainty of the data on the one hand and the difficulty of the measurement on the other would permit. The density of this remarkable star was undoubtedly 50,000 times that of water. The spectra of the majority of the stars resembled that of their own sun in being of the type known as absorption spectra. There was no doubt that this type of spectrum was produced by the light of the white-hot interior of the sun shining through a relatively cool and rarefied atmosphere of gases and metallic vapors. These absorbed precisely those vibrations which they would themselves emit when in a condition to radiate and corresponding to each mode of vibration, of which a single atom might possess many; a dark line would cross the otherwise continuous bright spectrum. As they proceeded from the cooler to the hotter stars the spectral lines due to neutral atoms would steadily fall off in intensity and finally disappear, and new lines, due to the ionised atoms, would appear and steadily grow stronger. Elements easily ionised, such as calcium, would show the "enhanced" lines in stars at lower temperatures than those the atoms of which required for the detachment of the electron a more violent impulse.

Interior of the Stars.

Could they learn anything of the star's interior? Theory could penetrate where observation failed, and they owed to Professor Eddington, of Oxford, a highly valuable, if speculative, theory of the internal constitution of stars. There were three main postulates to this theory:—(1) That the whole material of the star was in a gaseous condition; (2) that the atoms were very highly dissociated; (3) that the source of the star's power of radiation was derived from the matter of the star's interior, and did not depend on any external supply. Eddington showed that the conveyance of heat from the interior to the surface from which it was radiated was effected almost entirely by radiation (not by conduction and convection), and that radiation exerted an outward pressure which was largely responsible for preventing the star from being compressed into much smaller bulk by its own gravitational force. Radiation-pressure played no appreciable part in keeping their own atmosphere expanded.

Eddington also obtained formulae from which the temperature at the centre of a giant star could be calculated, or at any rate a fair estimate made. The estimates varied somewhat widely, but all agreed in setting the temperature at millions of degrees centigrade. Russell, of Princeton, stated that all giant stars had about the same central temperature, viz., 40 million degrees centigrade. There seemed to be no doubt about it that the inside of a star was an uncomfortably hot place. Although Eddington's theory was in the first place worked out for the diffuse giant stars in the natural conviction that these only could be assumed to be gaseous, he found to his own surprise that certain of his conclusions, for example, the relation between luminosity and mass, were applicable to the dwarf stars also. The reason for this probably lay in the fact that when atoms were split up, as they were in hot stars, into the tiny nucleus of the atoms, and the equally minute electrons which ordinarily swarmed round it, they were capable of being compressed to a much higher degree without unduly interfering with each other's motion; that was to say, they continued to behave as a gas even though their density might be as high as that of a liquid. That was the explanation of the enormous density of Sirius b. It was a star with a very high internal temperature, and all its atoms were completely dissociated into nuclei and electrons. These, in virtue of their minute dimensions, came back into a space 50,000 times less than that which contained the parent atoms, just as all the bricks of which the houses in the city of Adelaide were composed could be packed within the walls of the University, although the houses themselves might well occupy 50,000 times that volume.

REG. 7.7.26

PHYSICS AND ASTRONOMY.

Lecture by Professor Kerr Grant.

The second of a course of three University extension lectures by Professor Kerr Grant on "The new physics and the new astronomy," illustrated with experiments and lantern slides, was given in the Prince of Wales Theatre, Adelaide University, on Tuesday evening. Dealing particularly with characteristics of the stars, he said that, taking the sun as a standard of comparison, they might ask were the stars as big or bigger (a) in mass or (b) in volume, what was their range in mass and volume, did they radiate more or less light and heat, what were they made of, and in what state did that matter exist, what was the degree of vehemence of their heat (both on the outside and in their interior), and could the stars be classified, and if so were the differences between them of degree or of kind? They knew, of course, that there were conspicuous differences betwen the stars in respect of their apparent brightness and also in colour, but they could not tell whether the difference of magnitude was due to a real or absolute difference in the amount of light radiated unless they knew the distance of the star. The distances of several thousand stars, including practically all up to the third magnitude, had been ascertained either by the parallactic or some other method, and hence the absolute magnitudes of those stars were known. The best way of stating the result was to give the amount of light radiated by a few stars as compared with that emitted by the sun. It appeared that the sun was a star of medium luminosity. There were many much more powerful and roughly as many less so. Thus, Canopus radiated 10,000 times as much light as the sun, while other stars did not radiate one-hundredth as much, and, of course, if dark stars existed, the range might go down practically to zero. Among other stars of very large absolute magnitude, were Antares, Betelgeuse, Aldebaran, and Arcturus. From the intrinsic brightness of a star—which could be estimated from its colour—and from its total light emission, the angular area of its surface could be calculated with tolerable accuracy. Neither by visual, nor by photographic method of observation was there any hope of accomplishing that, because to the eye, all stars were merely points of light, while the size of the telescopic image depended upon the aperture of the object-glass to say nothing of its imperfections—and upon time of exposure in the photographic method. A possible method of measuring the apparent size of very small luminous objects had, however, been proposed by an American physicist, in 1890, and applied by him then with success to the measurement of the diameters of the moons of Jupiter.

Giant Star Diameters.

Up to the present the following giant star diameters had been measured:—Betelguese, Antares, Aldebaran, and Arcturus. The masses of such of those giant stars as had a companion were approximately known from the motion of the two stars around their common centre of gravity. It was tolerably certain that very few of them exceeded the sun in mass more than fiftyfold, and Antares was probably not more than five times the mass of the sun. The density of its matter was consequently less than one hundred-millionth that of the sun, or less than 1-1,000,000 that of the world's atmosphere. It consisted on the average, at least, of extremely rarefied gas. The same conclusion applied to all giant stars. Passing to the other extreme, the so-called "dark companion" of Sirius, was known long ago by its disturbing effect on the motion of the dog-star. It was, in fact, a white star, but of small diameter, and in spite of that, its effect on the motion of Sirius showed it to be nearly half as massive as Sirius, or slightly greater than the sun. Its volume was less than 1-40,000 that of the sun. Consequently, the density of its material was about 50,000 times that of the sun. That was a most astonishing result. The heaviest substance they knew on earth was platinum, which was 21½ times as dense as water. Hence Sirius b. was over 2,000 times as dense as platinum. Were there, then, substances of a totally different nature in that star? One of the most notable fruits of the tree of the new physics in the astronomical orchard was that it had recently been found possible not only to confirm by a direct method Eddington's indirectly deduced value of the density, but to give a satisfactory explanation of its cause. Strenuous attempts had been made by several competent observers at observatories in Germany, in India, and in America, to test the prediction of Einstien by comparison of of the position of lines in the gravitational field with their normal position as produced in the terrestrial laboratory. The skill of Dr. Adams, of the Mount Wilson Observatory, using the great 100-in. reflecting telescope, gave a result of measurement which was a triumphant vindidication, both of Eddington's calculation, and of Einstein's relativity theory. The agreement was as exact as the uncertainty of the data on the one hand, and the difficulty of the measurement on the other would permit. The density of that remarkable star was undoubtedly 50,000 times that of water.

About Spectra.

The spectra of the majority of stars resembled that of the sun in being of the type known as absorption spectra. There was no doubt that that type of spectrum was produced by the light of the white hot interior of the sun shining through a relatively cool and rarefied atmosphere of gases and metallic vapours. By comparison of those absorption spectra with the spectra of the light emitted by substances made luminous by heat or electric discharge or otherwise, the presence or absence of terrestrial elements and compounds in the sun or any star could be tested. Tens of thousands of stars had thus been chemically analysed. Could they learn anything of a star's interior? Theory could penetrate where observation failed, and they owed to Professor Eddington, of Oxford, a highly valuable, if speculative, theory of the internal constitution of stars. Although his theory was in the first place worked out for the diffuse giant stars in the natural conviction that those only could be assumed to be gaseous, he found to his own surprise that certain of his conclusions—for example, the relation between luminosity and mass—were applicable to the dwarf stars also. Sirius b. was a star with a very high internal temperature, and all its atoms were completely dissociated into nuclei and electrons. Those, in virtue of their minute dimensions, came back into a space 50,000 times less than that which contained the parent atoms.

NEWS. 8.7.26

Dr. L. O. Betts has been given an honorary commission by the Government to enquire into and report upon the care and treatment of crippled children and modern orthopaedic work generally in Britain, the Continent, and the United States of America.

NEWS. 8.7.26

In Executive Council today Mr. J. M. Hague, LL.B. (judges' first associate) was appointed to be also clerk of arraigns in the Supreme Court Department in place of Mr. L. V. Pellew, who has resigned.