Einstein cosmology and has prophesied not only measurable but conspicuous deviations from classical theory for measurements dealing with distances as great as those of the remote stars and nebulae.

The third lecture dealt with Dr. Silberstein's own investigations based upon the spacetime theory of de Sitter. Attention was confined to a discussion of Radial Velocity. This velocity in the line of sight is measured by the Doppler effect, that is to say, by the displacement of a spectral line in the spectral photograph of a star relative to the position of that line in the spectrum of a similar source of light on the earth.

Both de Sitter and Weyl showed theoretically that the greater the distance of the star from the observer, the greater would be the shift of the spectral line; but their theories only allowed for a shift towards the red end of the spectrum. In the case of de Sitter, this was because he limited himself to the perfectly artificial assumption of the star fixed relative to the observer; and in the case of Weyl because he introduced the quite gratuitous assumption that the world lines of all the stars belong to a unique pencil of geodesics diverging into the future. Observation, however, shows that not all the stars are receding, a considerable proportion having motions towards the solar system, while of the 42 spiral nebulae whose velocities have been measured four are approaching and likewise a large proportion of the globular clusters. Thus the spectral shift equations of de Sitter and Weyl are untenable; first, because they are theoretically unsatisfactory, being based on a gratuitous or a narrow assumption and, secondly, because they are flatly contradicted by many of the most remote celestial objects.

Dr. Silberstein has taken up the problem without introducing any limitation whatever into de Sitter's spacetime theory, thus entirely abandoning the prejudice of the universal scattering of matter. He treats the observing station and the star as two free particles and integrates the equations in their full generality. This leads him to a formula for the complete spectral displacement, a general Doppler formula containing two terms due to (1) an individual characteristic of the star considered, namely, the radial velocity which it would have at its closest approach to the observer, whether that position occurred in the past, or would occur in the future, and (2) the ratio of the distance of the star from the observer to the radius of curvature of spacetime. Although these two factors are inseparably amalgamated, yet the first dominates the result for stars near the sun, while the second far outweighs the first for stars near the boundary of our galaxy or for the spiral nebulae which are themselves probably small galaxies lying far out beyond the confines of our galaxy.

Dr. Silberstein has collected all the numerical results which are available—namely, Shapley's observational data—with regard to the Doppler displacements and distances of globular clusters and the Magellanic Clouds, and inserting these values in the equation embodying the relations above described he solves for the only unknown—the radius of curvature of spacetime. The results are so consistent from the clusters, whether approaching or receding, and from the two Magellanic Clouds, that it is impossible not to attach a tremendous importance to this achievement of Dr. Silberstein's. Thus, an intrinsic feature of the universe, the radius of curvature of four-dimensional spacetime, having a clear mathematical significance but utterly impossible of visualization in the ordinary sense of three-dimensional realization, has been evaluated numerically with a precision and weight never before approached. The consistency of the nine values obtained gives rise to a law which can be enunciated in terms of physical observable things, thus: the product of the Doppler displacement and the parallax is a constant, and this constant has the simple physical meaning of the smallest possible parallax in such a spacetime, namely, the ratio of the earth's distance from the sun to the radius of curvature of spacetime.

The figures given by Dr. Silberstein as the measure of this radius of curvature are as follows: The mean of determinations from seven globular clusters is 6.0 multiplied by 10 to the power twelve in astronomical units, and the mean value of these seven clusters, together with the Greater and Lesser Magellanic Clouds, is 6.07 multiplied by 10 to the power of twelve.

Gigantic though this figure may be, it yet implies a finite volume of the elliptical space as a section of spacetime, and the thought of "a closed elliptic cage" would be intolerable to the undaunted imagination of Dr. Silberstein, were it not relieved by this inherent property of the spacetime, strangely stimulating to what Clifford termed "cosmic emotion," that a light signal from a star near the observer's polar (the polar is a sphere around the observer of the greatest possible radius in that space) would take an almost infinite time to reach the observer, while from a star actually on the polar the signal would come—never.

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SCIENTIFIC EVENTS

THE MASSES AND LUMINOSITIES OF THE STARS[1]

AN important paper on this subject was read by Professor A. S. Eddington at the meeting of the

[1] From *Nature*.

Royal Astronomical Society on March 14. He provisionally assumed that absolute magnitude could be expressed as a function of the mass plus a constant; also that absorption in the star's interior varies as density/(temperature)$^{\frac{7}{2}}$. A curve was drawn in which Capella, the mass of which is accurately known, was taken as the standard star. The masses of the highly luminous stars were taken from Professor Shapley's results for the Cepheids and Professor Plaskett's recently published results for Algol-variables in which both spectra can be photographed. The other end of the curve was filled in from the masses of the binary stars of large parallax. Professor Eddington noted that he had not expected that the results from drawf stars would fit on the curve derived from giant stars, but to his surprise they did so. He concludes that the principle, enunciated when the giant-and-dwarf theory was started, that the dwarf stars do not obey the laws of a perfect gas, is unsound; that, in fact, these laws are obeyed even for densities much greater than that of the sun. He thought that this fact might be explained by the atoms in the interior of the stars being ionized and stripped of their outer electrons. Their bulk is thereby greatly reduced, and there is room for them to move freely, even when the density is considerable. The interior of the dwarf stars continues to get hotter and hotter, but the surface cools by radiation.

Professor Eddington suggested that the small mass of the dwarfs might be due, as he had indicated some years ago, to the annihilation of matter within the star, colliding atoms destroying each other and liberating the large amount of energy locked up in them. The mass of a star would thus be less in its old age.

The results of the paper would necessitate considerable alteration in the manner of stating the giant-and-dwarf theory. Professor Eddington did not anticipate opposition from the authors of that theory (Professors Russell and Hertzsprung), as he gathered from recent communications that they were reaching conclusions similar to his own.

MORTALITY FROM DIABETES

ACCORDING to the Metropolitan Life Insurance Company one of the most encouraging items in the 1923 mortality statistics of the industrial policyholders is the drop in the diabetes death rate. The decline, it is true, was only 6.4 per cent., the death rate in 1923 being 16.1 per 100,000 as compared with 17.2 for 1922. But slight as is the drop it may have great significance; for it follows a period of three years during which time deaths from diabetes had been increasing continuously and at a considerable rate. Between 1919 and 1922 the rate rose 28 per cent. These figures for the company's industrial department relate to the great group of American and Canadian wage-earners; but there are also available from the ordinary and intermediate departments of the company (which include policyholders of a somewhat higher economic status) figures which show considerable declines in 1923 in deaths from this disease. Among the ordinary policyholders 7.8 death claims were paid in 1923 per 100,000 policies in force as compared with 10.5 claims in 1922; and in the intermediate department, 9.6 claims were paid as compared with 10.2 in 1922.

The interesting fact is, of course, that the lower diabetes death rate last year was contemporaneous with the beginning of the more or less general use of insulin to check the devastating effects of this disease. It is too early, as yet, to say finally that the sudden check in the rising mortality from diabetes is to be credited to the use of this apparently successful treatment. Before this can be done we must have figures showing declines for a series of years, and a greater rate of decrease must be shown. If the rate drops again in 1924 it will be safe to assume that there is *some* well defined cause for the reversal of the trend which was observed between 1919 and 1922. And, as there appears to be no *other* outstanding reason for the check in diabetes mortality last year, it is extremely probable, to say the least, that the increasingly successful and widespread use of insulin was the chief factor in lowering the death rate from this disease.

The mortality figure for diabetes, so far in 1924, is more than encouraging. The January death rate for the industrial policyholders was 17.2 per 100,000 as compared with 20.3 for January, 1923. Obviously, we can not guage the outcome for 1924 by what has transpired in a single month; but the change is in the right direction. If this rate of decline persists throughout the year the fall in the death rate will be more pronounced than that recorded in 1923.

OIL AND HELIUM RESERVES

A SPECIAL commission has been appointed by President Coolidge to study the problem of conserving fuel oil for the navy and providing facilities for storing fuel. The commission consists of Dr. George Otis Smith, director of the Geological Survey; Rear Admiral Hilary P. Jones, president of the General Board and commander-in-chief of the United States Fleet, and R. D. Bush, of the Bureau of Mineralogy of the State of California.

In a statement issued at the White House, Mr. Coolidge said that the commission will make a general study of the problem, but specifically it will review the situation in each one of the navy's reserves and seek to ascertain whether it will be possible to create larger or better protected reserves than those existing. The statement says: