

that rainfall production is usually a complicated process.

The writer has not had enough high flying to be able to make many observations of the upper clouds, but they certainly present an interesting field of investigation well within the possibilities of aeroplanes. C. K. M. DOUGLAS.

#### PHOTOGRAPHIC DETERMINATIONS OF STELLAR PARALLAX.<sup>1</sup>

THE determination of stellar parallaxes by photography has shown a striking improvement in recent years, and the results obtained with the Yerkes refractor are of the highest order of excellence. Two of the precautions observed in this and similar series of measures are the taking of all the plates at small hour-angles, so as to minimise the effect of unequal atmospheric dispersion in the stars, and the reduction of the magnitude of the parallax star to equality with the comparison stars. This latter precaution is necessary, since any inequality in the driving will have a different effect on the images of objects that differ much in brightness. The usual way of effecting this is by rotating a screen in the form of a sector of a circle in front of the brighter image. By altering the angle of the sector, any desired diminution of light may be obtained.

This method was used for most of the parallaxes in the volume under notice, which, however, mentions an alternative plan, due to Prof. Kapteyn, that has been successfully tried at Yerkes. It consists in taking an out-of-focus photograph of the required region, which on development exhibits the stars as discs of equal size but unequal density. This negative is then used as a screen for the parallax plate. Since the density of each disc is proportional to the photographic brightness of the star that formed it, it is clear that the use of the screen will give nearly equal magnitudes for the stars on the parallax plate.

The parallax work at Yerkes Observatory was begun in 1903 by Dr. Schlesinger, who was appointed director of Allegheny Observatory in 1905; it was continued by Messrs. Slocum, Mitchell, Lee, Joy, and van Biesbroeck (of the Uccle Observatory, Belgium). Up to the end of 1915 131 parallaxes had been determined. The present volume contains the details of the last eighty-five, and a summary of the earlier results, which have already been published. The parallax stars are mainly bright ones, but nearly one-third of them are faint stars with large proper motions.

The parallax of Algol is given as  $0.02''$ ; that of  $\delta$  Cygni,  $0.27''$ ; of  $\gamma$  Ophiuchi,  $0.21''$ ; of  $\epsilon$  Lyræ (the double-double),  $0.00''$  (all four components being measured); O.A. (N.) 17,415-6,  $0.22''$ . There are six of the eighty-five parallaxes between  $0.1''$  and  $0.2''$ , three above  $0.2''$ , and seventy-six less than  $0.1''$ . Four of the stars in the trapezium

of the Orion nebula were measured, as there is little doubt that they are actually involved in the nebula. The results are negative for all four ( $-0.014''$ ,  $-0.026''$ ,  $-0.021''$ ,  $-0.023''$ ), presumably indicating that the trapezium and nebula are more remote than the comparison stars. The possibility is recognised that the latter may themselves be involved in the nebulosity, and a further investigation is suggested, using larger plates that would include stars more distant from the trapezium.

The probable errors of these parallaxes are all in the neighbourhood of  $0.01''$ . The error that is reasonably possible is, of course, two or three times as great. A good illustration of this fact is afforded by the parallaxes found for the pair of stars O.A. (S.) 14,318-20, R.A. 15h. 5m., S. decl.  $16^\circ$ . They are  $5'$  apart, magnitudes 9.6 and 9.2, spectral types  $G_5$  and  $G_4$ , P.M.s  $3.693''$  in  $195.7^\circ$  and  $3.675''$  in  $195.6^\circ$ , radial velocities  $+307$  km. and  $+295$  km. These striking facts leave no reasonable doubt that the two stars are physically connected, and have sensibly equal parallaxes. The present volume gives for the parallaxes  $+0.025'' \pm 0.008''$  and  $+0.061'' \pm 0.012''$  respectively. As Prof. H. N. Russell had previously obtained the values  $+0.014'' \pm 0.023''$ ,  $+0.045'' \pm 0.022''$ , some astronomers have adopted the view that one star is really some three times as distant as the other. But the close agreement of their abnormally large proper motions renders such a conclusion wildly improbable. In fact, the weighted mean parallax is  $0.040''$  from the Yerkes plates, and  $0.030''$  from those of Prof. Russell, a quite satisfactory accordance.

An appendix to the volume gives a detailed description of the measuring machine in use for these photographs. It was made by William Gaertner and Co., Chicago. The screw is 18 mm. in diameter, with 249 threads 1 mm. apart. The nut is 50 mm. long, and the graduated head 18 cm. in diameter, having 1000 graduations. The errors of the screw are extremely small.

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#### THE SIKKIM HIMALAYA.

NO section of the Himalaya is more fully known than Sikkim; Kashmir even has not been more assiduously investigated. The information regarding Sikkim is important for two reasons. This country, which extends, between long.  $88^\circ$  and  $89^\circ$  E., from the Bengal plain to the tableland of Tibet, is the only fully explored portion of the eastern Himalaya. Our knowledge of the more extensive territories of Nepal to the west, and of Bhutan to the east, is relatively scanty.

The pioneer explorer of this interesting land was Sir Joseph Hooker seventy years ago. Since 1848-49 many others have studied its fauna and flora, its geology and topography, its scenery and people. Explorers, surveyors, collectors, members of political missions, and expert mountaineers have found in Hooker's "Himalayan Journals," published in 1852, a pleasant companion and a

<sup>1</sup> "Stellar Parallaxes derived from Photographs made with the 40-in. Refractor." Publications of the Yerkes Observatory, vol. iv., part i.