DISTANCE OF THE ORION NEBULA.—An interesting estimate of the distance of the Orion nebula has been made by Prof. W. H. Pickering (Harvard Circular No. 205). From a consideration of the brightnesses and distribution of the stars in the nebula and in the surrounding region, it is concluded that practically all the stars within the nebula are of type B, and that there are no stars in the nebula fainter than fifteenth magnitude. Since we are looking very nearly along the axis of the great spiral nebula which stretches over nearly the whole length of Orion, and is connected with the great nebula, all the stars associated with it must be at approximately the same distance from us. Russell has shown that only very massive stars can attain the colour of type B; and assuming 10·5 as the mean magnitude of the stars within the nebula, while the average absolute magnitude of such stars may be taken as −1·0, it follows that the distance of the nebula is 6520 light-years, or that the parallax is 0·0005″. Among the interesting results which follow, the mean diameter of the brilliant Huygenian region is found to be 6·3 light-years, and the distance between the extreme stars of the trapezium 0·68 light-year. It is also calculated that Rigel is 2,100,000 times as bright as the sun, thus far exceeding Canopus, for which Walkey estimated a brightness of 50,000 times that of the sun.

## TERRESTRIAL MAGNETIC OSCILLATIONS.

THE paper referred to below[1] is an important contribution to our knowledge of oscillations in the magnetic elements, especially those of shorter period termed "pulsations" by van Bemmelen. The records were obtained in an underground chamber near the Marine Biological Laboratory at Misaki, between 1910 and April, 1914, with a special set of very sensitive magnetographs, designed by Prof. Tanakadate. The magnetographs, which recorded the north (N), west (W), and vertical (V) components, show several original features. The V instrument, which worked very satisfactorily, had the magnet carried by horizontal quartz fibres. The sensitiveness of the instruments was about 0·15 γ per 1 mm., and the time-scale about 3½ mm. to the minute.

The original object was to ascertain whether seismic movements were accompanied by magnetic waves. No certain connection was established, but many interesting records of pulsations were obtained. The distribution of pulsations throughout the twenty-four hours varied markedly with the period, waves with periods less than seventy seconds having their maximum frequency during the day, and those with periods longer than ninety seconds having their maximum during the night. Periods shorter than thirty seconds were rare. Pulsations in V were almost facsimiles of those in N, except that they were of smaller amplitude and had a retardation of phase. As the period became longer, the ratio borne by the amplitude of the V to that of the N pulsation increased, while the difference in phase diminished. The hour of the day seemed without direct influence on the value of the ratio. The relation between the pulsations in N and W, on the other hand, depended largely on the hour of the day. Regarding north and west as the positive directions in the two cases, it was found that agreement in phase between N and W pulsations was most frequent in the early morning, whilst direct opposition in phase was most frequent in the evening. Cases in which the N pulsation was largely dominant were most frequent near noon and near midnight.

Generally there was a marked tendency in the vector in the horizontal plane to rotate, after the fashion first described by R. B. Sangster for longer-period movements. According to the author, in pulsations at Misaki, clock-wise rotation is most frequent between sunrise and noon, and again between sunset and midnight, anti-clock-wise rotation predominating in the intermediate hours. One interesting feature, which the author thinks may possess considerable significance, is a tendency when pulsations start abruptly for N to show a rapid rise. He is disposed to attribute pulsations to fluctuations in the electrical currents in the upper atmosphere, to which the regular diurnal magnetic variation is now generally ascribed. If, as he thinks most likely, pulsations arise simultaneously and not successively at different stations, the currents in the upper atmosphere probably fluctuate in intensity as well as in position. This might, he thinks, arise from vertical oscillations in limited portions of the upper atmosphere. A variety of mathematical problems relating to oscillating linear electric currents are worked out. The plates at the end contain numerous interesting examples of pulsations.

C. CHREE.

[1] "On Rapid Periodic Variations of Terrestrial Magnetism." By Torahiko Terada. Journal of the College of Science, Imperial University of Tokyo, vol. xxxvii., 1917, Art. 9. Pp. 85+5 plates.

## GLOBULAR STAR CLUSTERS.

MR. HARLOW SHAPLEY'S preliminary work on the distances of the globular clusters attracted much attention two years ago. He has since then diligently pursued the subject, and gives an interesting summary of the progress of his researches in Pubns. Astr. Soc. Pac., February, 1918.

His methods are:—(1) To determine the photographic and photo-visual magnitudes of the cluster stars by photographs on ordinary and panchromatic plates. The colour-indices of the stars are thus determined and their spectral types inferred. The fact that stars are found in the clusters quite as blue as the B stars in our neighbourhood leads to the assumption that light absorption is negligible. The distances can then be inferred, making assumptions on the absolute magnitudes of stars of different spectral types

(2) The work of Miss Leavitt, Hertzsprung, and Shapley shows that the absolute magnitude of Cepheid variables is a function of the period of light variation. A curve is given in the article, from which the following values have been measured:—

| Period (days) | Abs. mag. | Period (days) | Abs. mag. |
|---|---|---|---|
| 63 | −6 | 4·9 | −2 |
| 33 | −5 | 1·7 | −1 |
| 17 | −4 | 0·85 | −0·5 |
| 9·2 | −3 | 0·7 (and under) | −0·3 |

Since the cluster variables conform mainly to the Cepheid type, this affords a very accurate means of obtaining the distances of clusters. Mr. Shapley notes that the long-period Cepheids are the most luminous of all stars. The longest observed period is about 130 days, absolute magnitude −6·8 (indicating about 50,000 times the luminosity of the sun). Cepheid variables are also notable for their rapid motion, which appears to average more than 100 km./sec.

(3) By the above methods the average absolute magnitude (photographic) of the brighter stars of the different clusters (twenty-five stars selected from each cluster, rejecting the five brightest) is found to be −1·5. Making this assumption for other clusters, we can estimate their distance without waiting for more detailed researches.

(4) There is found to be a fairly close correlation between distance and apparent diameter, indicating that the linear diameter of a cluster is a function of its distance. With diameter 1·4′ corresponds distance