

wide range in size and price, and many object-glasses, eye-pieces, and other accessories are also listed. Surveying instruments, particularly theodolites and levels, are well represented. In the section devoted to telescopes, a number of second-hand instruments, both reflectors and refractors, on equatorial and altazimuth mounts, are offered for sale. The list includes a 12-in. reflector and a 12-in. and a 7½-in. refractor, as well as several smaller instruments, object-glasses, eye-pieces, sidereal clocks, and other astronomical apparatus. A series of lantern-slides has been prepared to show the appearance of the bright line spectra between the limits 4000–7000 Å.U. of the commoner elements with normal dispersion. Slides of twenty-seven elements are now available; they should be of considerable service to science teachers. Other features of the catalogue are the sections dealing with cameras and other photographic apparatus and books; the latter contains, among a number of useful text-books

and series of scientific periodicals, vols. 28 to 104 of NATURE.

THE Cambridge University Press is publishing the three following books in the autumn:—"New Mathematical Problems," by Major P. A. MacMahon; "Series Spectra," by Dr. Norman R. Campbell; and "Weather Prediction by Numerical Process," by L. F. Richardson. The first-named will be problems based on the permutations and combinations of elementary geometrical shapes; the second will be the first of the supplementary chapters to the author's "Modern Electrical Theory," to which allusion has already been made in NATURE (February 24, p. 842); and the third embodies a scheme of weather prediction, resembling the process employed in the production of the *Nautical Almanack*. At the close of the present year the same publishers will issue "Alternating Currents," in two parts, by C. G. Lamb. It is intended as a guide to the student attending a three-term course on the subject.

### Our Astronomical Column.

SEPTEMBER METEORS.—Mr. W. F. Denning writes:—"An excellent series of abundant observations were obtained during the first ten days of the present month by Miss A. Grace Cook and Mr. J. P. M. Prentice at Stowmarket, and several hundred meteor paths were carefully recorded, from which a number of interesting radiant points were derived. These include various systems which have been well observed in past years, and several which apparently represent new showers.

"An active radiant of Orionids from  $91\frac{1}{2}^{\circ}+8\frac{1}{2}^{\circ}$  was detected on September 1–3, which seems to have escaped previous observation; and among the old streams we observed were the  $\epsilon$  Arietids,  $\alpha$  Casiopeids,  $\alpha$ - $\beta$  Perseids, and  $\iota$  Aurigids.

"Fireballs are usually very frequent in September, and the present month has proved no exception. Several brilliant meteors from Capricornus were observed on September 6, 7, and 14. On September 7 and 8 large meteors were seen from a radiant in Auriga, and on September 10 two brilliant objects were recorded, possibly from a radiant near  $\alpha$  Cygni. The times of the two latter were at 9.10 and 11.40 G.M.T., and further observations of these various objects would be valuable. This display of Cygnids is a long-continued one, and was noted as specially active on September 12, 1918, as seen from Bristol."

IONISATION IN STELLAR ATMOSPHERES.—Dr. M. N. Saha has published an important series of papers on this subject in *Phil. Mag.* (vols. 40 and 41) and in *Proc. Roy. Soc.*, 99 A (1921). A useful summary and critique of these is given by Mr. E. A. Milne in *Observatory* for September. The work consists of two parts: the study of the conditions of ionisation by the formulæ of physical chemistry, and an endeavour to explain some of the features of solar and stellar spectra in the light of the results. Taking calcium as an example, the percentage of ionisation at different temperatures and pressures is tabulated; the table indicates that at the surface of the sun both normal and ionised atoms of calcium should be plentiful, and, in fact, the  $g$ ,  $H$ ,  $K$  lines are all present. On the other hand, at great heights above the photosphere the pressure is small and ionisation almost complete; accordingly, only the enhanced lines  $H$ ,  $K$  are visible here,  $g$  not being traced beyond a height of 5000 km. Analogous results are given for several other elements, and hope is held out that the method

may eventually afford an indication of the pressure at various heights above the photosphere.

Lessons are also deduced from the progressive appearance and disappearance of certain lines as we pass along the series of stellar spectra from  $M$  to  $O$ . Dr. Saha determines the temperature of each type, his values ranging from  $23,000^{\circ}$   $Oa$ ,  $18,000^{\circ}$   $Bo$ , to  $5000^{\circ}$   $Ma$ , and  $4000^{\circ}$   $Md$ . These are in fair accord with those of Russell, Wilsing, and Scheiner, but slightly higher on the average.

It will be remembered that several astronomers have suggested that, the supply of gravitational energy being insufficient to maintain their output, the stars are drawing on the energy of the atom. It is likely, therefore, that atomic chemistry will play an important part in the astronomy of the future.

VARIABLE STARS.—Observations of seventy-two well-known variable stars, the R.A.'s of which range from 5h. 21m. to 24h., were made by Prof. Vojtěch Šafařík at Prague between the years 1877 and 1894. They are reproduced in great detail by Prof. Ladislav Pračka in a publication recently received ("Untersuchungen über den Lichtwechsel Älterer Veränderlicher Sterne. Nach den Beobachtungen von Prof. Dr. Vojtěch Šafařík." Vol. 2, pp. iii+180. Prag: Fr. Růvňáč, 1916). The magnitudes of the comparison stars are discussed and compared with all available authorities; the differences of magnitude between them and the variables are given in full, and the nature of the light curve, with the dates of maximum and minimum, is discussed in all cases where the observations suffice for the purpose. There are also many estimates of colour, on Schmidt's numerical scale, which represents white by 0, yellow by 4, orange by 7, red by 9 to 10. The long-period variables in this volume are without exception orange or red; eleven of them have colour-estimates extending beyond 9, and one star,  $S$  Cephei, has a colour-estimate of 10.

The following stars have especially long and full series of observations:  $R$  Leonis,  $R$  Camelopardi,  $R$  Draconis,  $R$  Aquilæ,  $U$  Cygni,  $V$  Cygni,  $S$  Cephei. Observations of two novæ are included in the volume. Nova Aurigæ fell from 5m. to 11m. in a few weeks early in 1892, then revived to 9.2m. early in 1893, being 9.9m. at the end of that year. Nova  $T$  Coronæ appeared to remain steady at 9.2m. during the years 1886 to 1894.