The Solar Chromosphere *

THE spectrum of the solar chromosphere may be observed at a time of total eclipse by various methods. Frequently the thin crescent of the solar gases is photographed through a prismatic camera, the crescent itself acting as slit. In 1898, Dr. W. W. Campbell devised an important modification of this method of observing the flash spectrum. It consisted in the introduction of two new features, (1) a wide slit in the focal plane of the camera perpendicular to the dispersion and so to the monochromatic image-crescents, (2) a moving photographic plate moved during the exposure in its own plane in a direction perpendicular to the slit. The slit permits a short length (of the order of $\frac{1}{32}$-inch) of the central portion of each crescent to fall on the plate.

In the resulting photograph each bright line in the usual flash spectrum appears as a longer or shorter bright line, straight and normal to the dispersion, terminating at one end at a point corresponding to the instant at which the whole radiation from the still uncovered chromosphere is insufficient to affect the plate. In the other direction each bright line ultimately 'fades' into the corresponding Fraunhofer absorption line.

The intenser the radiation from the chromosphere for a given distribution of intensity with height, the longer the line outside the apparent limb-level; and similarly the less rapidly the intensity decreases with height, the longer the line. The apparent limb-level is well marked in the photographs, and it is possible to analyse the spectrum from the moving-plate spectrogram at any assigned 'height' on the plate, but it must be remembered that the 'intensity' at any given 'height' on the plate is a function not of the chromospheric radiation at that height but of the integrated chromospheric radiation for all levels above that height. Thus the spectrograms are not what they appear to be at first sight, and some mental effort is required to keep the true interpretation vividly in mind.

The method was successfully employed by Campbell at the eclipses of 1898, 1900, 1905, 1908. Though these results were described in brief immediately after each eclipse, full details waited until the present. We now have, in this splendid volume from the Lick Observatory, the complete analysis of the chromosphere results by the moving-plate method and a series of reproductions of the spectrograms. The work has been carried out by Dr. Donald H. Menzel, and he is to be congratulated on the service he has rendered to solar physics.

In the introduction, Dr. Campbell defends the moving-plate method against criticism, and points out its advantages as a *continuous* record of the changes in the flash spectrum as the chromosphere is gradually covered or uncovered by the moon. Approximately two-thirds of the volume is occupied by spectroscopic tables, computed by Menzel. These tables give possibly the most complete information on the flash-spectrum yet published. The whole of the measures are arranged twice over, once according to wave-length and then again arranged according to element, the full multiplet designation being given for each line, together with estimates of its 'intensity' at various 'heights' as measured by microphotometer tracings. The labour of compilation must have been immense, and the double tabulation will enormously smooth the paths for future workers.

Dr. Menzel reaches the surprising conclusion that the contours of all chromospheric lines at any given level are essentially the same curve, the vertical scale only being different; and further, that the contours are broader and more flattened at the higher levels. As Menzel says, this is the reverse of what would be expected. Insufficient information is given about the apparatus employed, etc., to form a judgment whether the effect is real or simply a photographic effect. The reproduction of a few microphotometer tracings would have been of interest.

The remaining one-third of the volume is a valuable digest of current theories of contours of spectral lines in stellar atmospheres, degrees of ionisation, etc., together with various applications to the results of the chromospheric observations. It is extremely useful to have a consistent treatment of the whole problem; and Dr. Menzel's analysis is in many places original. His final conclusion (stated with critical reservations) is that the chromosphere is probably in a state of turbulence in which radiation pressure plays a part. He criticises the attribution to the chromosphere of a static form of equilibrium under radiation pressure, but it may be noted that he ultimately shows (p. 286) that Minnaert's observed value of the residual central intensity in the ionised calcium lines is consistent with an almost 'fully-supported' chromosphere. Dr. Menzel's analysis is throughout directed towards an attempt to infer what is the actual state of the chromosphere as implied by observation; he is not in general concerned with the more fundamental problem of why the chromosphere comes to have its particular state. Some of the theories of chromospheric equilibrium which he views unfavourably owed their origin to an attempt to see in what ways it is possible for a stellar atmosphere to thin out into space, how radiation pressure rises into importance as collisions become rarer, and similar problems, rather than to impose a particular theoretical constitution on the solar layers. But Dr. Menzel's whole outlook is stimulating, and his volume will be a rich treasure-house, of both observation and theory, to all future workers on the subject. E. A. M.

* Publications of the Lick Observatory, Vol. 17. Part 1: A Study of the Solar Chromosphere based upon the Photographs of the Flash Spectrum taken by Dr. William Wallace Campbell, Director of the Lick Observatory, at the Total Eclipses of the Sun in 1898, 1900, 1905 and 1908, by Donald H. Menzel. Pp. v+vi+303+9 plates. (Berkeley, Calif.: University of California Press, 1931.)

Resuscitation in Asphyxia

THE recovery of persons in whom breathing has ceased following the inhalation of water or a noxious gas is attempted by artificial respiration, the method most generally adopted being the Schäfer prone pressure method. In certain cases, however, this method may not be suitable, or it may be inadequate to restore the normal respiratory movements. In collapse on the operating table under an anæsthetic, the cessation of breathing is sometimes quickly followed by stoppage of the heart: recovery may follow artificial respiration alone, or after cardiac massage or the injection of adrenaline into the heart in addition.

An experimental basis for the use of adrenaline is given by the results obtained in a recent investigation by Sir E. Sharpey-Schafer and W. A. Bain (*Proc. Roy. Soc. Edin.*, vol. 52, p. 139; 1932). Cats anæsthetised