

## REVIEWS

*An Introduction to the Study of Eclipsing Variables.*<sup>1</sup>— Since the observations of Algol made centuries ago, much information on variable stars has been obtained. This book is the first to bring together much of this information. The author enters his subject with a comprehensive, lucid, and beautifully organized discussion of methods of synthesis and analysis of light-curves, a topic which comprises half of this all-too-brief book. Geometry is then exchanged for astrophysics, and in the remainder of the book Dr. Kopal develops and expounds theories of the shape of the stellar components and the distribution of light over the apparent disks. Much of the theory was developed by Dr. Kopal himself; it consists principally of the material published by him in a series of papers during the last eight to ten years.

The reader, upon finishing the book, is beset by the feeling that its title suggests a broader approach than its contents reveal. The great field to be exploited by studies of spectrographic observations is unmentioned, and the stress laid upon different aspects of the problems of eclipsing binaries seems not always to be in proportion to their importance. Tantalizing problems such as those presented by  $\beta$  Lyrae are mentioned, but none of the modern discoveries are outlined or compared with the best theories. Near the end of the book, the reader fairly aches for some hint as to how well Dr. Kopal's theories will explain the details of some of the modern precise spectrographic and photometric observations. Several important modern observational developments, such as the determination of rotation from eclipsing binaries, and the direct determination of darkening coefficients, are scarcely mentioned.

The book will be an invaluable aid to all who work in the field of binary variables, both for its contents, which bring together at last the many and complex orbital analyses available, and for its complete and excellent bibliography with comments.

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<sup>1</sup> *An Introduction to the Study of Eclipsing Variables*, by Zdenek Kopal. (Cambridge: Harvard University Press, 1946.) Harvard Observatory Monograph No. 6, 220 pages. \$4.00.

*Photometric Atlas of Stellar Spectra*.<sup>2</sup>—Photometry of the solar spectrum culminated just before the war with the publication of the *Utrecht Solar Atlas*,<sup>3</sup> which gives tracings, on a true intensity scale, of the solar spectrum between wave lengths 3332A and 8771A, with a dispersion of 2 cm/A. The high quality of this work makes possible to anyone having access to it the measurement, with considerable accuracy, of the equivalent widths of even the faintest solar lines.

The publication under review is an attempt to do for a series of stellar spectra what the *Utrecht Atlas* does for the sun. Such an endeavor, while eminently worth while, must inevitably suffer by comparison because the vastly smaller amount of light available from the stars necessitates the use of smaller dispersion and faster emulsions than can be applied to the sun. The authors have chosen for their atlas eight bright stars which are listed in the following table with their spectral types and absolute magnitudes.

Star	Type	Absolute Magnitude
$\beta$ Orionis .....	B8	-5.8
$\alpha$ Lyrae .....	A0	+0.6
$\alpha$ Can. Maj. ....	A1	+1.3
$\alpha$ Cygni .....	A2	-4.2
$\alpha$ Persei .....	F5	-1.1
$\alpha$ Can. Min. ....	F5	+2.8
$\alpha$ Boötis .....	K2 pec.	-0.1
$\alpha$ Orionis .....	M2	-4 :

Spectrograms of these stars taken with the coude spectrograph of the McDonald Observatory have been traced with the direct-intensity microphotometer of the University of Michigan. This instrument makes use of two plate carriages on one of which is the stellar spectrogram, while on the other is a linear wedge spectrogram on a plate from the same box made with the same spectrograph. The resulting tracings, reproductions of which

<sup>2</sup> *Photometric Atlas of Stellar Spectra*, by W. A. Hiltner and Robley C. Williams. (Ann Arbor: University of Michigan Press, 1946.) \$7.50.

<sup>3</sup> *Photometric Atlas of the Solar Spectrum*, by M. Minnaert, G. F. W. Mulders, and J. Houtgast. (Amsterdam: D. Schnabel, 1940.)

constitute the *Atlas*, are on a true intensity scale; hence the intensity at any point within a line, relative to that in the continuous background, may be read directly.

The *Atlas* is arranged in the form of nine booklets with a cloth case. Book I contains data on the spectrograph and spectrograms, dispersion tables, method of calibration, and a brief discussion of instrumental line broadening. Each of the other eight booklets contains the tracings for one of the series of stars. In general the tracings run from about  $\lambda$  4000 to about  $\lambda$  6000, although there is some inconsistency in the range covered; the H and K region is included for three stars and  $H\alpha$  for four. Two tracings appear on a page, the wave lengths of both ends of each tracing being indicated. Intensity scales are also provided at both ends of all tracings and are connected by horizontal lines to facilitate reading.

Since a prism spectrograph was employed in this work, the dispersion of the tracings varies from about 1A/cm at  $\lambda$  4000 to nearly 7A/cm at  $\lambda$  6000. The scale in the red is thus a little too small for accurate intensity measurements, particularly for the narrower and weaker lines. For most purposes of identification, however, the tracings seem to be adequate; a few trials on known lines, with the assumption of linear dispersion along the length of a single tracing, gave results good to two or three tenths of an angstrom.

Reference to the table of stars included in the *Atlas* shows a very decided preponderance on the side of high absolute magnitude. This unbalance is inevitable, of course, in any work which must utilize only the brighter stars. It seems unfortunate, however, that the solar spectrum was not included in the *Atlas* as a representative G-type dwarf. This would have served the double purpose of extending the range of absolute magnitudes covered and, through comparison with the *Utrecht Atlas*, of providing a means for estimating the accuracy of any measurements which might be undertaken.

The *Atlas* should prove of value for instruction to illustrate the wide variety of form exhibited by stellar absorption lines, the detailed variation of spectra with type and, to a lesser degree, with absolute magnitude. To those whose work is in the field of

stellar spectroscopy it will serve as a useful means of answering quickly some of the questions which frequently arise concerning relative intensities of lines. As a source of data for research purposes, its value is somewhat more questionable. Where the accuracy demanded is not too great, however, there can be no doubt that it contains a wealth of material which can be made available with a relatively small expenditure of effort.

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