Neubauer, F. J. Lick Observatory program of radial velocities for the fainter B stars.

A great portion of the observing time at the Lick Observatory has been devoted in the past to the determination of radial velocities. Since early 1933 two long-term programs have been followed. In the first, the Mills spectrograph has been used for the observation of the brighter stars for which variable velocities were found at Lick, but for which either no periods, or only tentative periods, were established. The second program, for which the author has been responsible, consists of the determination of the radial velocities of all stars listed in the *Henry Draper Catalogue*, and its *Extension*, of classes Oe5 to B5 for which no radial velocities hitherto have been announced. This program was undertaken in collaboration with the Dominion Astrophysical Observatory at Victoria. The Lick observations have been completed in two zones of declination, from -23° to 0° , and from 0° to $+20^\circ$. For the southern zone, the observations and results were published in 1943, while for the northern, about 50 per cent of the 1200 spectrograms remain to be measured. It is hoped that the measures will be completed and the results published within this year (1946). In order to complete the B star program in the northern sky, further observations need to be made in the Cygnus region. The additional work involves observing some 200 stars of this class, and its undertaking is being considered at Victoria and at Mount Hamilton. Since the number is not large, this portion of the program may be completed within a reasonable time.

There is a great need for observations of the fainter B stars in the remainder of the southern hemisphere. Some 400 stars, ranging in magnitude from 6.5 to the limit in the *Henry Draper Catalogue* (about 11.0), have not yet been observed. In order to complete the general radial velocity program for all the catalogued B stars, an appeal is therefore made to southern observatories, for it is only through their cooperation that the concluding data may be obtained.

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Petrie, R. M. The rapid determination of radial velocities by a new projection method.

This paper describes the construction and operation of a machine designed to shorten the time required to measure and reduce a stellar spectrogram for radial velocity. The spectrum is projected under high magnification (about 70

diameters) upon a viewing screen upon which are ruled the positions of the comparison lines and the zero-velocity positions of the stellar lines. By mechanical and optical means it is then possible to eliminate the measurement of the comparison lines and almost all of the process of "reduction."

As a test of the new method some forty-five single-prism spectra have been measured by the two methods. Comparison of results leads to the following conclusions regarding the projection comparator:

(a) the mean difference in velocity, New minus Old, from all plates is $+0.2$ km/sec with a probable error ± 0.4 , so that no important systematic errors are introduced;

(b) the average probable error of a single plate, from internal agreement, is about 10 per cent greater in measures with the new machine;

(c) the time required to measure and reduce a spectrogram with the new machine is reduced to about one-half that necessary by the ordinary measuring micrometer.

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Stebbins, Joel and A. E. Whitford. The relation between color and absolute magnitude in G- and K-type stars.

It is well known that in the spectral types from G to M the dwarf stars are definitely bluer than the giants. The present study of the relation between color and absolute magnitude is an extension of similar work by John S. Hall some ten years ago. Our photocell with the violet and infrared filters used in six-color photometry gives color indices with wave lengths at 4220 Å and 10,300 Å, with a scale from 6 to 9 times that of Hall, depending apparently upon the stars used, and about $2\frac{1}{2}$ times the international scale. The increased leverage is not all gain, for the effects of atmospheric extinction and the dispersion of the colors in stars of the same spectrum increase somewhat in proportion, but there is an advantage in having the observational errors small in comparison with the quantities to be studied.

In agreement with previous observers the difference in color between dwarfs and giants begins between F5 and G0, reaches a maximum near K0, and is then much smaller in the M stars. Also in this interval from G to M the colors of normal giants and subgiants are uniformly between those of the dwarfs and supergiants. Since the greater redness of the supergiants might also be caused by selective space absorption, only

stars in high galactic latitude or at distances less than 100 parsecs are used.

When the colors are plotted against absolute magnitude for a given spectral type like Ko, the difference between intrinsically bright and faint giants is greater than the difference between faint giants and dwarfs. At Ko a change of 1.0 in absolute magnitude corresponds to more than 0.10 mag. in international color index. Between individual stars a range from -2.3 to $+1.3$ in M gives a variation of 0.6 mag. in international C.I. On the relative temperature scale, the corresponding values are $T = 3600^\circ$ to 4700° for these giants, while the average dwarf Ko has $T = 5300^\circ$. In statistical studies of large numbers of stars, the relatively few supergiants and subgiants may have little effect upon the mean color of a spectral type, but for individual stars the color of a giant is a definite function of its absolute magnitude.

Of the three quantities, spectral type, absolute magnitude, and color, it is the type which needs to be better determined than now, to get absolute magnitudes from colors. For instance, with the color fixed, a variation in classification from gKo to gK1 corresponds to a change of 0.5 mag. in M , while in the supergiants the effect would be perhaps 0.75 mag. in M .

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van Dijke, Suzanne E. A. A comparative study of α Bootis and 70 Ophiuchi A.

The weaker lines in the spectra of α Bootis and 70 Ophiuchi A have been compared visually and photometrically on high dispersion plates in the wave-length region $\lambda 3800$ to $\lambda 4800$. Curves of growth were obtained for neutral iron, and the observed velocity of the atoms and the damping factor are 3.25 km/sec and 0.8×10^{-6} , respectively. The solar values were assumed for the dwarf. Relative abundances of the various atoms at different energy levels were found and departure from equilibrium is evident in the giant. Temperatures for the various atoms were obtained with mean values of 3160° and 4170° for the giant and dwarf, respectively. By means of the ionization equation, the logarithms of the relative electron pressures are approximated as -3.74 for the giant, and -1.10 for the dwarf. The effect of absolute magnitude is apparent in the weakening of the sodium and neutral calcium lines, the strengthening of the singly ionized rare

earths and lanthanum, and the great strengthening of strontium and barium in the giant. In general, all lines of excitation potential less than 3.1 volts are enhanced in the giant and beyond this they are enhanced in the dwarf. The CH band at $\lambda 4300$ is weakened in the giant while the $\lambda 4216$ band of CN is strengthened. The band at $\lambda 3883$ of CN is stronger in the dwarf. This is quite unexpected and puzzling. The suggestion is made of a stratification of elements in the atmosphere of the giant star similar to that found in the sun.

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van Dijke, Suzanne E. A. and Helen W. Dodson. A stylized sequence of behavior for excited solar areas.

The following solar phenomena were taken as representing a sequence of increasing excitation: the undisturbed solar disc, weak to strong bright hydrogen flocculi, chromospheric eruptions of importance 1, 2, and 3. A survey of solar observations made primarily at the Whittin Observatory between 1938 and 1942 shows that hydrogen and helium lines, especially $H\alpha$ and $\lambda 5876$, undergo marked variations in intensity and contour throughout the excitation sequence.

With increasing excitation, the *residual* central intensity for $H\alpha$ increases until, for an eruption of importance 2, it is usually equal to that of the continuous spectrum. In eruptions of importance 2+ or 3, $H\alpha$ is ordinarily brighter than the continuous spectrum and may show a very pronounced symmetrical widening. The helium line $\lambda 5876$ is not visible over the undisturbed disc. In the region of a bright flocculus or "plage" it can be seen as a very faint, wide, diffuse absorption line. With increasing excitation, up to that of an eruption of importance 2, the helium absorption increases and the line apparently narrows. This change in the contour of $\lambda 5876$ may be a true narrowing of the line or may be due to the superposition of a fairly sharp central absorption on a weaker, but still present, diffuse absorption. For eruptions of importance 2 or greater, a reverse trend sets in. The residual intensity in $\lambda 5876$ begins to increase; it may become equal to that of the continuous spectrum and thus "disappear" or the line may appear in bright emission.

Although many lines are affected in intensity by a chromospheric eruption without accompanying positional displacements, detailed study of the spectrum variations of hydrogen and helium