A PRELIMINARY COLOR-MAGNITUDE DIAGRAM FOR LATE-TYPE STARS IN THE SOLAR NEIGHBORHOOD

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Modern photoelectric techniques yield magnitudes and colors of stars with accuracies of the order of a few thousandths and a few hundredths of a magnitude respectively. Hence for star clusters it is possible to derive highly accurate color-magnitude arrays since all of the members of a cluster may be considered to be at the same distance from the observer. It is much more difficult to do this for the nearby stars where all of the objects concerned are at different, and often poorly determined, distances. If one depends upon trigonometric parallaxes, the bulk of the reliable individual values will refer to main sequence stars, and while the mean luminosities of brighter stars are given reasonably well by this method, the scatter introduced into a color-magnitude array by using individual trigonometrically determined luminosities could obscure important features. Somewhat similar objections could be raised against the use of the usual spectroscopic parallaxes which also should be quite good for the main sequence but undoubtedly exhibit appreciable scatter for some, at least, of the brighter stars.

Recently a method for obtaining the luminosities of late-type stars by measuring the widths of the bright reversals in the H and K lines of Ca II has been developed [1]. This method must be calibrated and, at present, the sun together with the four yellow giants in the Hyades are used for this purpose. (Details will be given elsewhere.) Critical tests of the procedure are difficult to make, but the indications are that two good spectrograms of 10A/mm dispersion should yield a luminosity to within about $\pm$ 0.4 mag or perhaps better.

Such spectrograms have been taken of many of the late-type stars in the published lists of magnitudes and colors [2, 3, 4, 5]. A plot of the absolute visual magnitudes derived from the K-line widths against the quantity (B-V) is shown in Figure 1 where the curves for M67 [6] and M3 [7, 8] are included for comparison, and the lower diagonal curve is the standard main sequence. Solid and open circles are H and K observations of higher and lower weight respectively. For stars with trigonometric parallaxes greater than 0''050, the trigonometric values of M_v have been used and these stars are represented by crosses in the diagram. This has been done to indicate roughly the agreement between the two methods and to illustrate the dearth of larger parallaxes among the intrinsically brighter stars.

Since unknown selection factors have influenced the available data, the diagram cannot be used to make deductions about the relative densities of population in various regions of the M_v — (B-V) plane. Perhaps the two most important results are the sharp right-hand boundary of the distribution, which must mark a well-defined limit of possible configurations, and the existence of a group of stars near B-V = 1 mag which extend well below the M67 curve. The significance of the latter objects is not yet clear. According to current evolutionary thinking they might be much older stars than those of M67. It is also conceivable that they could be on an evolutionary track which breaks away from the main sequence at nearly the same place as does that of M67 but which, for some reason, possibly a difference in chemical composition, falls much below the M67 curve before rising to the giant region.

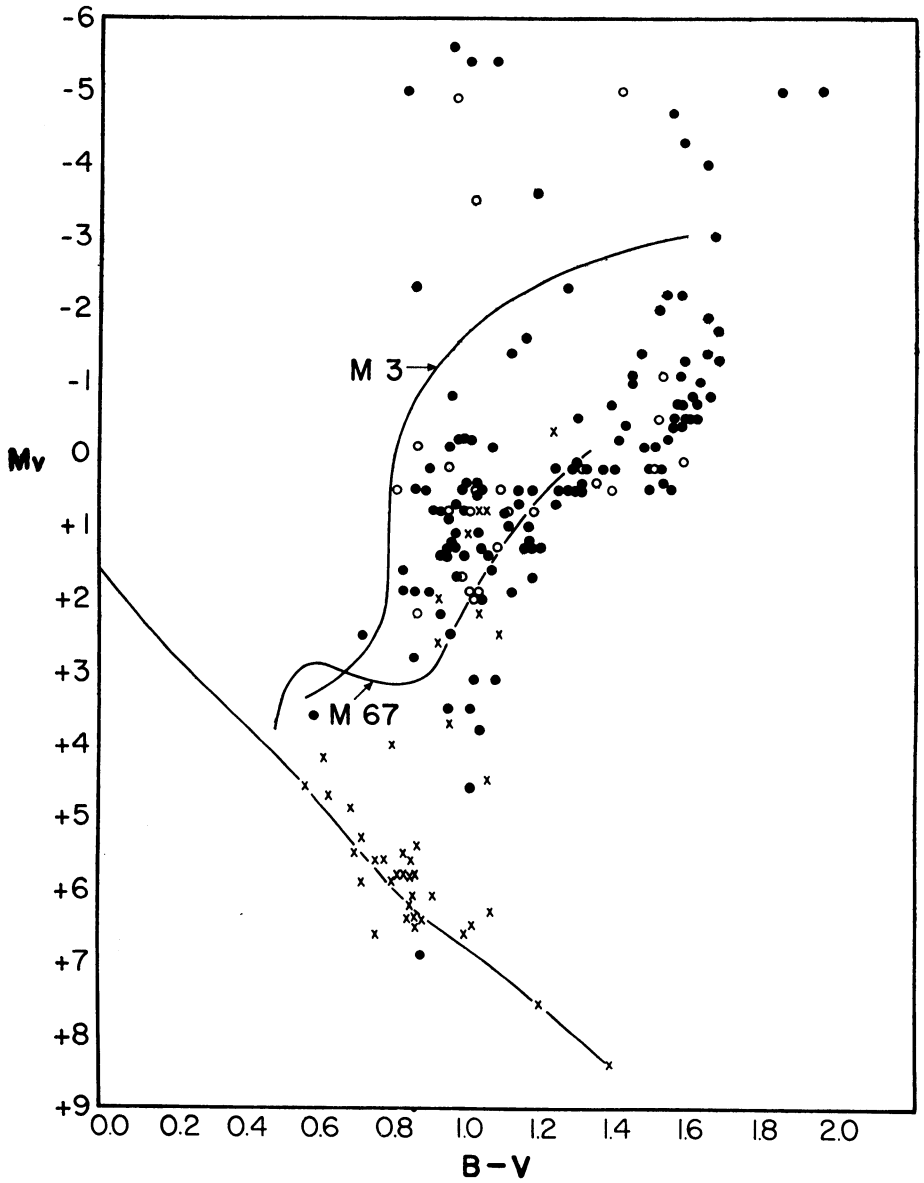

FIGURE 1. — The luminosities of the late-type stars, as estimated from the Ca II line widths, as a function of B-Vphotoelectric colors.

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