RED DWARF MASSES

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When a project finds enough material from the brighter stars, without high demands on instruments and observing effort, so much the better. But the very red dwarf stars certainly are not in that category. To show how limited the knowledge still is: Assume optimistically that the star count to 5 pc is complete. Extend the distance merely to 7 or 8 pc, i.e., scan a 3 or 4 times larger volume, and the present count is already short by several dozens of stars--practically the entire dM5-M8 range.

At these objects--with very little luminosity in the visible range--the observationally accessed relationship between mass and luminosity ends, and the peak in the luminosity function need not mean a peak of the mass-frequency function.

The percentage of members of double and multiple stars has, at the Brussels conference 15 years ago, been estimated at 85% (for G type and earlier stars). Subsequent researches (for instance, by Jaschek) tended to show that this assessment, if anything, was still on the conservative side. However, the better exploration of red dwarfs also brings out the lower binary abundance among dK stars now still more clearly for dM stars. A lower detection rate can hardly be the cause, as far as middle and wide separations are concerned, although nothing can yet be said about close (spectroscopic) pairs. Does the deficit among low-mass stars thus actually pertain to wide pairs only, to pairs in general, or to all objects? This open question is connected with the quite important relation (studied by Brosche) of mass vs angular momentum, of which the lower part is still unknown, and with prestellar-model calculations.

Fig. 1 shows the bottom section of the mass-luminosity diagram from present material. Though all pairs were known for over 25 yr, most of the data points have been entered or substantially revised in the last decade. There is doubtlessly a scatter of over 1 magnitude, not to be ascribed to errors in the sufficiently large parallaxes. No connection of the luminosity scatter with the presence of emission lines (probably a transient phenomenon anyway) is evident, nor was a correlation found with space velocities (as age indicators). Some additional data from a few more binaries are expected shortly.

Incidentally, the slope κ in the relationship $L \sim \mathcal{M}^{\kappa}$ has somewhat increased from 2.2 (as I computed 20 yr ago) to 2.6 from present data, or the coefficient of log mass vs M bol is now -6.6.

The rapid progress of new technologies will be the subject of detailed presentations tomorrow, and the prospects which each method may hold out to reach toward fainter stars seem especially crucial. Here are a few comments with respect to already operative techniques.

1) The significant number of very red stars not found before the Lowell proper-motion survey suggests that an additional search for proper-motion objects on infrared plates should yield a rewarding increase. Besides, the B-V color estimates cannot be reliable at such low temperatures, and an additional color would help screening the stars before spending the efforts of a parallax analysis on them.

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2) Quite weak is the radial-velocity coverage of dM stars; close pairs have had little chance of discovery. The more encouraging it is that image tube spectrographs of good resolution, high speed and--at long last--operating in the red range are coming into use.

3) Infrared photometry, particularly color excesses, may find faint red companion stars. This means of detection reaches farther than the telescopes currently used with micrometers; the excess is also a permanent feature not dependent upon the luck of finding a pair at maximum separation or radial velocity. The expectation looks now better than from the calculations of Lamla and the author 20 yr ago: It seems that photometry to the K band at 2 μ would be needed, but should also suffice, to catch a reasonable range of companion colors. Very little work at infrared instruments is currently devoted to the lower main sequence. In an infrared color diagram the intrinsic scatter of the red main sequence may turn out to be considerable (even after sorting out T Tauri objects), and luminosity criteria for classes IV to VII may become available only through molecular lines.

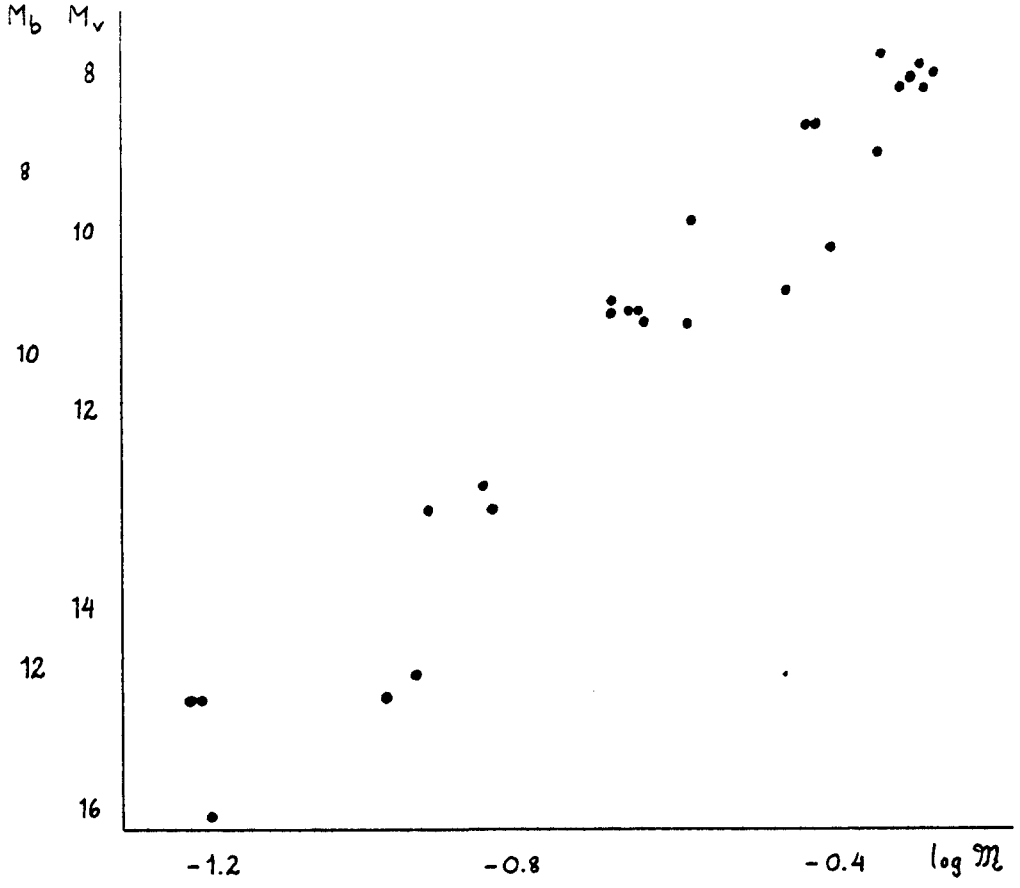

Fig. 1: The lower segment of the mass-luminosity relation.

DISCUSSION

MONET: The Hoessel et. al. (PASP 91, 94 (1979)) IVn + Wratten 88a survey of the Milky Way was begun in approximately 1977 and was finished in approximately 1979. Glass copies are available for blink searches for high motion very red stars.

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