The dependence of the stellar rate of mass loss on effective temperature and velocity

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From the existing literature data have been collected on the stellar rate of mass loss for 189 stars with known or derived values of the effective temperature T_{eff} and luminosity L. It appears that $\dot{M}$ depends only on T_{eff} and L for the O- through M-type stars brighter that about 3 x 10^3 $L_\odot$. This is shown in Figure 1, where we have plotted for each star the value of $-\log(-\dot{M})$ with $\dot{M}$ expressed in solar masses per year. An interpolation formula has been derived for the $\dot{M}(T_{eff}, L)$ dependence. If we define $X = \log T_{eff}-4$, and $Y = \log(L/L_\odot)-5$, then

$$-\log(-\dot{M}) = a_1 + a_2X + a_3X^2 + a_4X^3 + a_5Y + a_6Y^2 + a_7Y^3 + a_8XY + a_9X^2Y + a_{10}XY^2 \quad (1).$$

Values for a_1 through a_{10} are given in De Jager et al. (1985). A histogram of the deviations of $-\log(-\dot{M})_{obs}$ with respect to the values calculated with Equation (1) is shown in the insert to Figure 1. It yields a sigma value of 0.53, part of which is probably of cosmic origin. It appears that the Of stars are not deviating from Equation (1). Some groups of stars do not fit to our interpolation formula. These are the Wolf-Rayet and the C-stars. Figure 2 shows the rates of mass loss for WR stars, the C and S star, the Be stars and the nuclei of planetary nebulae. The histograms of deviations of $-\log(-\dot{M})$ with respect to Equation (1) are given in the insert to Figure 2 for the WR and the C-stars. For these we found:

WR-stars: $-\log(-\dot{M})_{observed} + \log(-\dot{M})_{calc} = 1.12 \pm 0.03$
C-stars : $= 1.24 \pm 0.03$

Their rate of mass loss is, hence, a factor of about 15 times larger than that for 'normal' stars with the same luminosity and T_{eff}. A comparison is not possible for Be-stars and nuclei of planetary nebulae because we have no reference data.

Reference:

De Jager, C., Nieuwenhuijzen, H., and van der Hucht, K.A., 1985, Astron. and Astrophys., submitted

C. W. H. De Loore et al. (eds.), Luminous Stars and Associations in Galaxies, 109–110.

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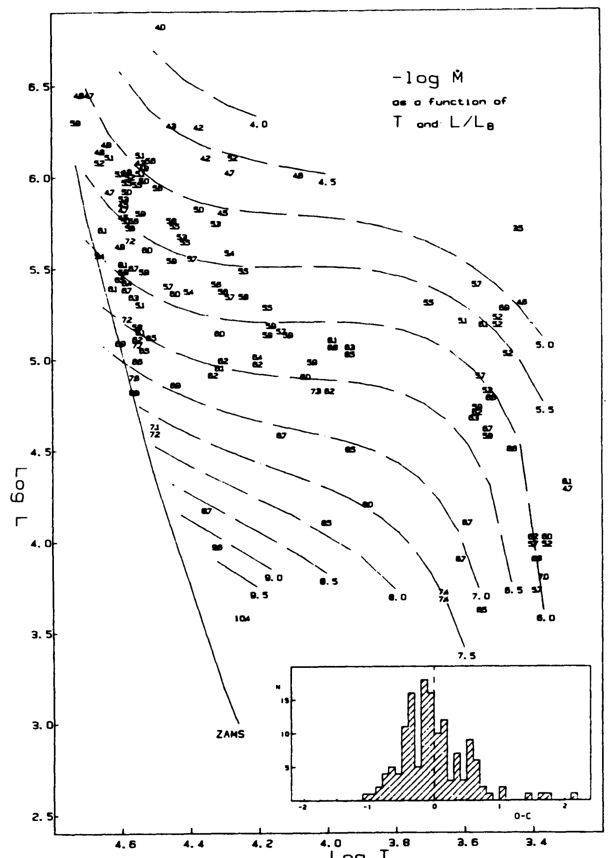

Fig. 1: logarithmic rate of mass loss for O-M stars. Lines are loci of constant mass-loss according to Equation (1). Insert: histogram of deviations.

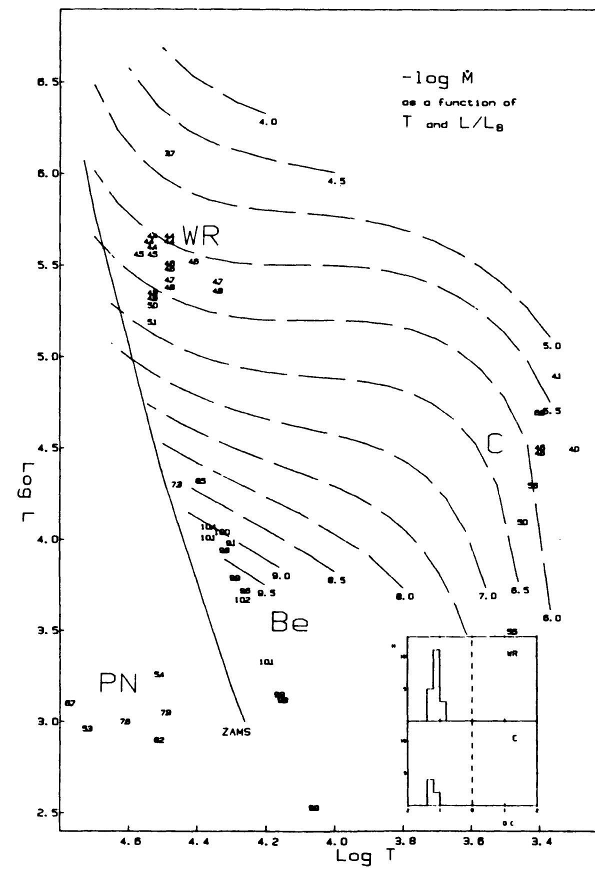

Fig. 2: as Figure 1 for WR, C, S, Be stars and nuclei of planetary nebulae. Insert: histogram of deviations for WR and C stars.

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