INTERPRETATION OF CARBON STARS*

(Abstract)

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This communication aims at presenting the results of a research, whose purposes are to gain some insight into the evolutionary state of C stars, when the assumption is made that the main features of their spectra are due to mixing of the envelope with thermonuclear processed layers. Approximate indications concerning their population type and their mass range have been derived by:

– the study of the galactic distribution of several phenomenological groups of C stars;

– mass evaluation for some C stars belonging to binary systems or to clusters.

From the whole analysis three groups have been identified:

(i) a Population I group in the mass range (5–15 $M_\odot$) mostly constituted of constant, irregular or semiregular N stars;

(ii) an old disk Population group with masses between one and two $M_\odot$, formed by R stars and long period variables;

(iii) a group of halo stars.

The data concerning chemical abundances for these stars have been collected: they are rather scanty except for the determination of the C_{13}/C_{12} ratio. From them, it is tentatively surmised that abundances for the large mass star group are compatible with the assumption that mixing at the surface has occurred with CNO cycle processed layers; while, for the low mass star group, data are insufficient to allow one to decide whether mixing was due to CNO or 3α processed layers.

The theoretical analysis based on the evolutionary tracks of different groups shows that for the large mass group, mixing with CNO processed layers may have occurred at the reaching of the Hayashi border line. However, the amount of material brought to the surface would be insufficient to obtain the appearance of a C spectrum unless mass loss of the envelope has occurred during the He-burning phase. It is shown that mass loss rates of the order of 10^{-6} to 10^{-5} $M_\odot$ yr^{-1}, quite compatible with the experimental observation are sufficient to reach the desired effect. However, it may be suspected that only for the larger mass stars > 10 $M_\odot$, the total mass loss would not be too large to allow them to preserve the red supergiant configuration.

For the low mass star group, the analysis of the available tracks leads in all cases to the interpretation that mixing may have occurred with the 3α processed material during the flash either of the He core or of the He shell.

These predictions could be checked by the C/N and C/H abundance determinations both for the large mass and low mass groups, which should be rather different in the two cases.

* This paper was presented by C. Barbaro.

Tayler (ed.), Late Stages of Stellar Evolution, 127.