THE OCCURRENCE OF PECULIAR STARS IN OPEN CLUSTERS

Helmut A. Abt

Kitt Peak National Observatory

Hugo Levato

La Plata Observatory

We have classified on the MK system a total of 455 stars in 12 open clusters and associations. The classification is based on wide (1.2 mm) spectra of two reciprocal dispersions (39, 128 Å mm^{-1}) obtained with the Kitt Peak 2.1 m and 90 cm reflectors, respectively. The higher dispersion is necessary to show the subtle peculiarities found in some stars. The clusters are the Orion Nebula cluster, Orion OB1 association, Lacerta OB1 association, IC 2602, IC 4665, Pleiades, M39, M34, NGC 2516, NGC 6633, NGC 6475, and Coma; two of these were done with Morgan.

When the frequency of 13 Ap (Si) and six Ap (Hg, Mn) stars (relative to the total numbers of stars within their appropriate ranges of absolute magnitudes) are plotted against age, we see that it takes about 10^6 yr to produce Ap stars and then the number increases steadily with age. The frequency for the older clusters (10^7-5×10^8 yr) agrees well with that for field stars.

The mean rotational velocities of Ap (Si) stars decrease inversely with the square root of their age. In the magnetic Ap stars this must be due to magnetic braking but the mechanism in the Ap (Hg, Mn) stars is unknown. The rotational velocities of Am stars decreases inversely with the quarter root of their age. In the oldest clusters (10^8 yr) apparently not all the slow rotators have become Ap or Am stars. We can only speculate that the magnetic stars are gradually braked and develop peculiar abundances by diffusion while the members of close binaries are braked slowly by tidal effects and become Am stars.

A. G. Davis Philip and D. S. Hayes (eds.), The HR Diagram, 155-156 and 405.

In the Orion Nebula cluster ($10^{5.7}$ yr) half of the stars have unusually broad hydrogen line wings while in the remaining Orion association ($10^{6.7}$ yr) only 2% of the stars show that effect. This broadening is not due to rotation but to some unexplained effect in stars right on the ZAMS, according to Morgan. The effect decreases inversely with age.

We found many stars with weak shells characterized by broad helium lines but sharp lines due to Ca II, Si II, C II, Fe II, Mg II, and often Balmer line cores. One-third of the B giants among field stars show the effect. When these stars are added to more extreme shell stars (e.g. Pleione, AD 23878), we find no age dependence for shell stars, or for Be stars either.

The Am stars show no age dependence either. They occur in the youngest clusters so they are produced quickly ($<10^6$ yr). The frequency of Am stars in clusters is the same as for field stars. But there are statistically significant differences from cluster to cluster, evidently reflecting differences in frequencies of binaries.

DISCUSSION

APPENZELLER: You showed us evidence for an increase of the percentage of peculiar stars with cluster age. Is there also a correlation between the type and strength of the spectral pecularities of the individual peculiar stars and age?

ABT: Yes, the peculiarities in the younger groups are less pronounced.

McNAMARA: Why do you associate such different ages to the various subgroups in the Orion OBI association? The observed age spreads seem to be within each sub-group, and not as separate well defined age regions within the association.

ABT: We took the ages from the literature. Wayne (Warren), would you care to reply to this?

WARREN: When one compares the individual subgroups of the association, many factors indicate that they display various ages. While a unique age may not be defined for the region immediately surrounding the Orion Nebula, it is clear that the stars in this region are in general younger than stars in the Belt and Northwest subgroups.

ROSENDHAL: Would you care to comment on the implications of the existence of rapidly rotating metallic line stars on the hypothesis that diffusion in a quiescent atmosphere is responsible for the existence of the metallic-line phenomenon?

ABT: Frankly, No! Diffusion is the only viable theory that we have. So if it fails, we are up the creek!

STENCEL: How do your results on Ap stars in clusters compare with the recent work by Hartoog (1976 Astrophys. J.)?

ABT: Our material is based on two dispersions, one of which

CONTINUED ON PAGE 405

https://doi.org/10.1017/S0074180900145437 Published online by Cambridge University Press