PREFACE

This volume contains papers presented at IAU **Colloquium** No. 90, at the Crimean Astrophysical Observatory in May of 1985. A few additional contributions are included from authors who for various reasons were unable to attend the meeting.

Four years have passed since the last major international conference on chemically peculiar stars of the upper main sequence was held in Liège, Belgium in 1981. Previous conferences were held in 1975 (Vienna, Austria) and in 1965 (Greenbelt, Maryland, USA). As the proceedings of this Colloquium show, the recent availability of ultraviolet spectra of large numbers of normal and chemically peculiar A and B stars is having a major impact on the way we study these objects, and has led to many new, exciting and unanticipated results. Simultaneously, the more traditional study of optical spectra has been advanced through the increasing use of very high spectral resolution with high signal-to-noise detectors.

The chemically peculiar (CP) stars on the upper main sequence belong in the standard framework within which we understand stellar evolution and the history of matter. Recent work has made it clear that the unusual chemistry and magnetic structure of these objects is of relevance across the broad domain of stellar astronomy, from the upper main sequence to horizontal branch stars and white dwarfs. Metal poor (λ Boo) as well as metal rich (Ap, Am) stars are an integral part of the picture. We do not know the fraction of A and B stars with significant (> 0.3 dex) abundance anomalies. It is surely much larger than the fraction (~0.1) of *classified* peculiar stars. It may well be that the majority of A and B (and other?) stars have non-solar abundances for some elements. The Am's are recognized at classification dispersion because modest (~0.3 dex) deficiencies in calcium happen to be readily detectable in the K line. Much larger anomalies in yttrium or zirconium, for example, are known from high dispersion work, but they cannot be seen at survey dispersions. Chemically peculiar lower main sequence dwarfs have been recognized, but the relation to their upper main sequence congeners is unclear. Powerful observational selection effects prevent the ready detection of predicted mild abundance anomalies in stars slightly hotter than the sun.

Much of the chemistry of the classical Ap and Am stars is explicable in terms of diffusive fractionation. But it has become clear that the chemistry of neither the upper nor the lower main sequence can be understood without a consideration of a wide variety of hydrodynamic or hydromagnetic processes. For example, high mass loss rates are capable of explaining the λ Boo stars, while somewhat lower rates may control the magnitude of the anomalies that appear in Am stars. Additional factors that influence surficial abundances are meridional circulation, magnetic fields, and turbulence. Turbulent convection determines the spectral type at which the diffusion time scales approach the main sequence lifetimes (in late F or early G stars).

The surface chemistry of certain F and hotter stars is especially sensitive to two notorious, adjustable parameters of stellar hydrodynamics: the mixing length and the microturbulence. Abundances in these stars may therefore provide important observational tests of the theory that employs these parameters. Any insight that is gained in understanding the physical basis of these quantities has immediate and broad application. We mention especially, the burgeoning field of abundance work in faint, distant stars, where workers are forced to use features whose strengths depend upon the microturbulence.

In situ differentiation is perhaps the simplest and most promising of several mechanisms that can cause abundance anomalies in main sequence stars. But the observational complexity

https://doi.org/10.1017/S0252921100091107 Published online by Cambridge University Press

of the CP stars is such that it is reasonable to consider additional processes. For example, we must learn what abundance patterns to expect in the case of mass transfer, a question involving stellar evolution in binary systems. In violent events, the system may lose mass during the transfer process in a way that would greatly change the separation of the components, and account for the dearth of close binaries among magnetic A stars. We must attempt to identify mass-transfer candidates observationally, and theoreticians must consider the subsequent fractionations of the transferred material.

A variety of questions are now under investigation concerning the theory of stellar atmospheres and their spectra, in the presence of magnetic fields. Much of this work is being done in Eastern European countries. These studies have considered the generation of magnetic fields by chemical inhomogeneities, and the nature of prominence-type activity, in addition to the global effects of the general field on model atmospheres.

We now know that stellar magnetism extends from cool dwarfs, at least into the early B stars. Theoretical discussions of stellar magnetism now often take a global approach in which fossil and dynamo-generated fields are intercompared for both upper and lower main sequence stars. There is a great deal to be learned about hydromagnetic processes that are active during star formation and pre-main sequence phases, as well as during the hydrogen-burning lifetimes. These problems are not restricted to Ap stars, and in fact the most promising mechanisms of relevance to the magnetic and related CP stars are very general ones. It is frequently true that the *effects* of these mechanisms are most easily studied in the A stars, because of the overall simplicity of their spectra. It is therefore a challenge to study these matters in the observationally approachable domain of the upper main sequence stars.

Of course, not all CP stars have strong magnetic fields. Recent advances in Zeeman effect techniques demonstrate that certain of the mercury-manganese stars have no detectable fields, even at quite small sensitivity levels. An active area of current research centers around the origin of the distinct abundance patterns that manifest themselves in magnetic and non-magnetic CP stars.

Tape recordings were made of all of the discussions which followed the review papers as well as some of the contributed papers that were presented orally. Speakers were also requested to summarize their questions and responses in written form, and the edited discussions which appear in this volume are based on both the verbatim transcript and the written records. Although minor editing has been done in the interests of brevity and grammar, the Editors feel they are otherwise an accurate reflection of what was said. We hope readers will find them interesting, fascinating, and a valuable supplement to the papers themselves.

IAU Colloquium No. 90, at the Crimean Astrophysical Observatory, brought together workers with a mutual interest in CP stars who had not had the opportunity to talk with one another. The advantages of such personal contact cannot be overestimated. We are grateful to the International Astronomical Union for its support. We thank Drs. Severny and Boyarchuk and the Observatory Staff for their hospitality and hard work which made the meeting run very smoothly. Language barriers were overcome with the help of two excellent translators, N. Kuznetsov and A. Silina. Participants greatly enjoyed an extensive tour of the observatory and coach excursions to the palace at Bakhchisaray and the Southern Crimean coast, during the Colloquium.

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