

PREFACE

The formative ideas for this symposium originated in 1978 at the IAU Symposium No. 83 on "Mass Loss and Evolution of O-type Stars" held at Qualicum Beach, Vancouver Island, Canada - WR stars generally figure prominently in O-star meetings and vice versa! Following general approval by the IAU Executive Committee the initial ideas were cemented at a subsequent meeting, IAU Colloquium No. 59 on "The Effects of Mass Loss on Stellar Evolution", held at Miramare, Trieste, Italy in 1980, which was attended by the majority of the present Scientific Organising Committee and at which meeting the outline programme for this symposium was formulated. 1981 was considered an appropriate year in which to hold a meeting on WR stars, since the last IAU Symposium devoted to this stellar class had been held a decade earlier, in Buenos Aires (IAU Symposium No. 49), and during this intervening period a wealth of new observational material had been obtained for WR stars together with significant advances on the theoretical front. The venue for this symposium was chosen from the requirement, which can be inferred from the above, that a meeting on 'hot' stars take place in an appropriate, sunny climate and followed upon the excellent suggestion of Dr. C. Firmari to hold the symposium in Mexico. The aim of this meeting was to bring together both observers and theoreticians working in the WR and related fields, to present and discuss recent results in order to see what consensus exists as to the physical and chemical properties of the WR stars, their evolutionary status and their links with other stellar classes.

On the observational front, the comparatively recent advent of sophisticated space instrumentation such as the IUE and Einstein satellites, have enabled the first detailed observations of many stars to be made at ultraviolet and X-ray wavelengths, whilst improved ground-based techniques and new telescopes have extended our knowledge of the stellar wind Infrared and Radio emissions as well as bringing many WR stars in the Magellanic Clouds under detailed scrutiny. These observational advances have been accompanied, and often stimulated, significant advances in the theoretical interpretation of WR spectra and theoretical studies of the evolution of massive single stars and binary systems in which mass loss and/or mass exchange plays a significant role.

Following an opening session dealing with the general properties and deduced physical conditions of Pop I WR stars, Session 2 addressed the long-standing question of their chemical composition; a topic of much uncertainty and controversy throughout the history of WR studies. Recent attempts to quantitatively analyse both optical and ultraviolet spectra conclude that the WR stars are very hydrogen deficient (although a very recent result is that there is no one-to-one relation between H/He and WN subtype) and have He/C/N ratios that are broadly consistent with those expected theoretically to occur through the exposition of nuclear processed material at various stages of late H-burning (WN stars)

and early He-burning (WC stars). However alternative views were also expressed and will be found in these proceedings.

The Mass Loss properties of the WR stars formed the basis of Session 3. As a result of the recent acquisition of Infrared and Radio data on the free-free emission emanating from their stellar winds which can be well modelled for mass loss rates, there appears almost complete consensus that both WN and WC stars exhibit similar, very high, rates of mass loss, $\sim 3 \times 10^{-5} M_{\odot} \text{ yr}^{-1}$, with a surprisingly small dispersion about this figure of only a factor of two or so. The reason for such a small spread amongst stars which can show radically different spectra is not yet clear. Moreover these mass loss rates appear much larger than can be accommodated by single scattering radiation pressure driven winds. Whether or not multiple scattering is the answer, or another as yet unknown mass loss mechanism is needed is currently an open question and much further work is required here.

Session 4 deals with WR stars in binary systems. Recent statistical results indicate that about 50 percent of Pop I WR stars are in WR+OB systems. New mass determinations deduced from binary studies yield results which show that a much higher dispersion in WR masses is present than thought hitherto. Some have the 'canonical' value near $10 M_{\odot}$ but other can be much more massive - the record so far is $67 M_{\odot}$! The reality of the recently observationally proposed WR+compact object systems (a prediction of stellar evolutionary theory for massive binary systems) was the subject of much discussion. At present the data on these systems, previously identified as single stars, seems open to ambiguous interpretation and there is need for much more observational material. The apparent lack of high levels of X-ray emission from these proposed WR+compact object poses a real problem if they are in fact true systems. By analogy with classical massive X-ray binary systems (OB+compact object) we would expect to observe high X-ray luminosities which are not observed. Whether or not such X-ray emission can be absorbed sufficiently in the WR stellar wind and thus mask its observation, or for some reason the production of X-ray emission is suppressed will be topics for future work.

Session 5 is primarily concerned with progress that has been made in building stellar evolution models for both single stars and massive binary systems in which extensive mass loss and/or mass exchange is taken into account. Although much further work was identified at the meeting, present results indicate that given sufficient levels of mass removal it is possible to sufficiently 'peel down a star' and generate an object at advanced stages of evolution with at least some WR characteristics, particularly in chemical abundances which are similar to those inferred from spectra. However the models give uncomfortably large values of T_{eff} and there may be a major problem in reconciling the predicted nitrogen abundance in He-burning models with that inferred for WC stars.

Session 6 deals with low mass objects which exhibit WR-like spectra and thus addresses the occurrence of a 'WR phenomenon' over several regions of the HR diagram. Also discussed were new observations of ring nebulae around WR stars, where new searches have shown that such nebulae are not confined to WN stars but are found around some WC stars as well.

The final two sessions covered recent work on WR stars in the Magellanic Clouds as well as the report of the first detection of this stellar class in M31. The central object of 30 Doradus in the LMC received much attention, being 'billed' as the most supermassive star currently known. One of the highlights of the meeting was the presentation of the first Einstein X-ray data for a number of WR stars. The results show X-ray luminosities of the same order of magnitude as for single O-type stars, and as referred to above, surprisingly small levels of X-ray emission from objects purported to be WR+compact object binary systems. However, most of the stars surveyed were at or near the sensitivity limit of the Einstein detectors, and clearly longer exposures and the extension to higher X-ray energies with future satellite instrumentation can be expected to yield important new results.

An important aspect of all symposia are the discussions which follow individual papers and sessions, and the editors have attempted to faithfully record in these proceedings the content of the discussions. Participants were asked to write down their comments and answers during the sessions and in addition the discussions were taped. The collection and collating of the numerous written sheets were capably handled at the meeting by the several assistants to the Local Organising Committee, and their help is greatly appreciated. Typed versions of all the discussions were generated at the Astrophysical Institute of the VUB, Brussels, and in all cases were sent to the contributors for final corrections and if required additions. Broadly speaking, A.J. Willis was responsible for the preparation of the first half of these Proceedings and C. de Loore for the second part. At the Astrophysical Institute of the Vrije Universiteit Brussel, the preparation and typing of the discussion sessions was carried out by Ms. Michiels whose hard work and assistance is greatly appreciated. The International Astronomical Union provided generous financial assistance to the Scientific Organising Committee, and these funds were used to enable several participants to attend the meeting. The Local Organising Committee received generous help from the Universidad Nacional Autonoma de Mexico and Consejo Nacional de Ciencia y Tecnologia, and it was most gratifying to see a substantial contingent of young Mexican astronomers at the symposium. The untiring efforts of Ms. Laura Martinez in assisting participants and their guests with local matters was a great help to all. The Scientific Organising Committee is greatly indebted to Drs. C. Firmani and G.F. Bisiacchi for dealing with local organisation aspects prior to and at the meeting and to making everyone who attended feel so welcome. The symposium was held in very pleasant surroundings

on Cozumel Island, just off the north coast of the Yucatán peninsula, Mexico. The magnificent swimming conditions enabled participants to recover, as necessary, from the hurly-burly of the scientific sessions, by bringing their thoughts down from the stars above to the observation of the greatly varied and colourful coral and fish found in the beautiful crystal-clear caribbean waters around the island. A select and careful compilation made by Prof. Lucrecia Maupomé as well as the one made by Dr. Laura Saver, introduced the participants to some of the most important texts on ancient American cultures. On several evenings the participants were treated to very enjoyable and instructive lectures from Dr. Laura Saver and Prof. Alfredo Barrera Rubio concerning the history of the ancient Mayan civilisation and these talks were warmly appreciated. Finally the editors note that at the ancient historical site of Copan, Honduras, there is a stone relief dating from about 776 A.D. which illustrates one of the first recorded meetings at which scientific papers were 'exchanged' between participants. We hope that history will judge that the papers presented at this symposium are just as worthy as those presented at that earlier epoch.

The Editors