

Preface

Research on planetary nebulae (PNe), a subject with over one hundred years of history, has undergone a vigorous growth in recent years. Observations from space (*IUE*, *IRAS*, *ROSAT*, *HST*, *ISO*, etc.) have revealed these objects to be more complex and physically interesting than had previously been suspected. PNe are active in all spectral regions from the X-ray to the radio, radiating by a rich variety of physical mechanisms. Since the last symposium in 1996, infrared spectroscopic observations by *ISO* have identified many new molecular and solid state species with significant implications on our understanding of interstellar chemistry and grain formation and evolution. High resolution optical observations by the *HST* have revealed the existence of micro-structures and jet-like structures which were not previously known and are not presently fully understood. At the time of the current symposium, new data from *FUSE*, *Chandra* and *XMM* have just become available. *FUSE* has provided high spectral resolution observations of the stellar winds from the central stars, and gives abundance information on atoms and ions for which the strongest lines are in the ultraviolet. *Chandra* and *XMM* have detected X-ray emission from the coronae of the central stars and the shock-excited “hot bubbles”, giving us important clues on the nature of the mass-loss processes and on the dynamical evolution of the nebula. Finally, data from specialised new instruments mounted on the new-generation large optical telescopes provided sensitive surveys of the extremely faint PNe in galaxies and the local universe, giving new insights into galactic evolution and the missing mass problem.

Studies of PNe are crucial for better understanding of late stages of stellar evolution. PNe are a short-lived transition phase between the AGB stars and the white dwarfs. Their investigation provides important constraints on a variety of physical processes that play a crucial role in the late stages of stellar evolution, such as mass loss, convection, mixing, and nucleosynthesis.

PNe represent the best-studied example of the interactions (radiative, mechanical and chemical) between stars and their interstellar medium. Lessons that we learned in PNe can also be extended to the study of other astrophysical objects such as young stellar objects (YSOs) and supernovae. PNe and YSOs share many similar characteristics: infrared excesses, circumstellar “disks”, bipolar morphologies, and even microstructures such as jets and knots.

Perhaps one of most rapidly advancing fields of PNe research is the study of PNe in external galaxies beyond the local group. With the new 8m-class telescopes now coming on line, and with new specialist instrumentation, these can be found in large numbers against the background stars thanks to their strong monochromatic emission. PNe have been successfully used as standard candles to measure the size of the universe, and provide perhaps the best tracers we have of dark matter in galactic halos, and of the intra-cluster medium. Spectrophotometric studies reveal the abundances of lighter elements such as N, O, Ne and S in the intermediate and old stellar populations, and galactic formation and chemical evolution can thereby be better understood.

The planetary nebulae community has had a history of very successful IAU symposia, beginning with IAU Symp. 34 in Tatranska Lomnica, Czechoslovakia in 1967, followed by IAU Symp. 76 in Ithaca, N.Y., U.S.A. in 1976, IAU

Symp. 103 in London, England in 1982, IAU Symp. 131 in Mexico City, Mexico in 1987, IAU Symp. 155 in Innsbruck, Austria in 1992, and IAU Symp. 180 in Groningen, Holland in 1996. The number of people attending and papers presented has grown with every symposium. It was unfortunate that the events of September 11, 2001 in New York and Washington, D.C., had unfavorably impacted our attendance, in particular on scientists from the United States. Nevertheless, 27 countries were represented in the symposium, including Armenia, Australia, Austria, Belgium, Brasil, Canada, Chile, China, France, Germany, India, Indonesia, Israel, Italy, Japan, Korea, Mexico, Netherlands, Taiwan, New Zealand, Poland, Russia, South Africa, Spain, United Kingdom, Ukraine, and the United States of America.

At the meeting of the IAU Planetary Nebulae Working Group during the XXIII IAU general assembly in Kyoto, the participants voted in favor of Canberra, Australia as the site of the next IAU Symposium on PNe. This recognizes the significant contributions made by Australian astronomers to the field of PNe research and the role that PNe in the Magellanic Clouds play in our understanding of the PNe phenomenon. This proposal was approved by the IAU Executive Committee in May, 2000.

The conference was held in the Dome of the Academy of Sciences, surrounded by gardens, adjacent to the campus of the Australian National University, and overlooking Lake Burley Griffin in the heart of Australia's "bush capital". There was a rich social program including visits to the Tidbinbilla Nature Park, the Bungendore historic village, and wine tasting at the Red Belly Black Cafe at Mount Stromlo Observatory. The conference dinner was held in the magnificent great hall of the University House. The weather during those November days was beautiful, with many flowers and the summer wattles blooming. On the morning of the first day of the symposium, many of the delegates rose early to look for the Leonids shower, which maximum was expected at 4:24 AM. Unfortunately the sky over Canberra was cloudy at that hour.

The program was carefully put together by the Scientific Organizing Committee, whose members are A. Acker (France), M. Arnaboldi (Italy), B. Balick (U.S.A.), M. Barlow (U.K.), M. Dopita (Australia, co-chair), S. Deguchi (Japan), G. Jacoby (U.S.A.), S. Kwok (Canada, co-chair), W.J. Maciel (Brazil), A. Manchado (Spain), M. Perinotto (Italy), S.R. Pottasch (The Netherlands), D. Schönberner (Germany), Y. Terzian (U.S.A.), S. Torres-Peimbert (Mexico), R. Tytenda (Poland), and P.R. Wood (Australia).

We are grateful to the members of our very enthusiastic local organizing committee, whose hard work helped so much to make this meeting the success it was, namely Michael Dopita (chair), Carole Jackson, Peter McGregor, Maartje Sevenster, Ralph Sutherland and Peter Wood. Many staff members of the RSAA helped out during the conference, for which we thank them here collectively. We are particularly indebted to Peter Wood, who handled many correspondences with participants and the allocation of travel grants. The financial support from the International Astronomical Union is gratefully acknowledged.

At the IAU Planetary Nebulae Working Group meeting held during the symposium, Hawaii, U.S.A. was chosen as the site of the next symposium. In a few years, when we gather again in Hawaii to discuss and debate, we hope

that we will look back to the Canberra symposium as a milestone of research in planetary nebulae.

This book is dedicated to Prof. Lawrence H. Aller, whose work on planetary nebulae has been instrumental in the development of this field. His scientific insight has been an inspiration to many of us. He will always be in our memory.

The Editors