PREFACE

Astronomers all over the world today are facing a most challenging problem: how to make others aware that man-made interference is threatening observational astronomy and that the threat is increasing rapidly.

In an effort to help build awareness, the International Astronomical Union held its Colloquium No. 112, with the topic Light Pollution, Radio Interference, and Space Debris, in Washington, DC, U.S.A., at the Omni Shoreham Hotel, from 13 to 16 August 1988. The papers presented dealt with these increasing environmental impacts on observational astronomy.

The Colloquium was sponsored by IAU Commission 50 (The Identification and Protection of Existing and Potential Observatory Sites), with the co-sponsorship of Commissions 21 (Light of the Night Sky) and 40 (Radio Astronomy). Co-sponsoring international organizations included: CIE (Commission Internationale de l'Eclairage), COSPAR (Committee on Space Research), and URSI (Union Radio Scientifique Internationale).

Man-made interference with observations is having an increasing negative impact on astronomy. Most observing sites have experienced such effects. Even observatories in space can be affected by man-made pollution. Planning for present and future observatories must take these increasingly severe adverse effects into account. We must do all we can, in and out of astronomy, to minimize future impacts. All observational astronomy is threatened.

This is also an environmental issue, affecting not only astronomy but the general public as well. Without positive and successful steps to preserve this aspect of the environment from current and future encroachment, mankind will gradually lose its view of the universe. We must preserve this spectacular and inspiring aspect of nature, both for astronomy and for mankind. *Awareness and action are needed.*

Topics discussed at the meeting included: history and status of the problem as it affects professional and amateur astronomy and the general public; reactions of those in government, the lighting, radio propagation, and business communities; predictions about the future; other aspects of the problem, such as energy and legal considerations; solutions to the problems; and recommendations, resolutions, and definition of further work needed to clarify the issues and develop and implement the solutions.

There was significant attendance from the astronomy, engineering, and other communities, thus providing a special opportunity for fruitful dialogue. The discussions were extensive and lively. There were about 120 attendees, as well as extensive coverage by the media. Most of the papers presented at the meeting are included in this volume; those for which we have abstracts only are included as some of the material is important and readers will be aware of who is active.

The severity of the world's light pollution affects all of us. Observatories around the world cannot work on the things they used to, and some have had to shut down completely. Many of the world's largest telescopes operate as if they were smaller telescopes. The view of the night sky that our grandparents had is rapidly disappearing. The Milky Way is gone from the view of much of the public, those who live in metropolitan areas. Only in a few areas can the real night sky

still be seen, and all of these locations are far from cities. A whole generation is growing up having never seen the Milky Way.

Much of the light pollution comes from street lamps, advertising signs, and other light sources that throw light up into the atmosphere where the dust and the air molecules take over, scattering the light and forming the ever-present luminous haze that can be seen over most of our cities and towns.

Optical astronomers and visual observers of the heavens are not the only ones affected by man-made sky pollution. Astronomers working with radio telescopes are faced with growing interference from microwave transmission, communications satellites, mobile telephones, and innumerable other devices, both military and civilian, all of which are impinging on the radio frequencies needed for astronomical study of the universe.

Even outer space is not safe anymore. Those involved in space exploration, and scientists using space-based telescopes, are alarmed at the runaway growth of the space debris that orbits the Earth -- over 50,000 objects measuring 1 cm or larger. Any of these can wreak significant damage to spacecraft, rendering multi-million-dollar instruments useless. The larger objects also affect ground-based astronomy by flooding delicate instruments with light, or ruining photographs or electronic images with light trails or flashes.

National and international compromises and agreements must be made to curb the detrimental trend of light pollution, radio interference, and space debris. In spite of the difficulties, efforts are underway to minimize these problems, and some significant progress is being made. Papers at the meeting discussed some of this progress, but much more remains to be done.

This meeting was a significant step in that progress, we hope. It brought together representatives from many of the various communities involved, worldwide. We expect that additional such fruitful dialogues will occur in the future. Our view of the universe, as astronomers and as the general public, depends on increasing awareness, and on successful implementation of solutions.

As Chairman of the Scientific Organizing Committee and as Editor of these proceedings, I wish to express my sincerest thanks to those who made the meeting the success I think it was: to those who attended, gave papers, and joined in the dialogues and to those of the media who came to hear of our problems and to help spread the word about the issues. Members of the SOC were most helpful, before and at the meeting. And the hardworking Local Organizing Committee, chaired by Tom Gergely, did a magnificent job in the local arrangements, doing much to insure the success of the sessions. I particularly appreciate their hardworking support, with special thanks to Tom Gergely. The LOC also organized a number of local "volunteers," all of whom did the necessary work that made the meeting flow so smoothly. I list on the following page the members of the SOC and LOC.

We also approached a number of organizations for help, fiscal and otherwise. We much appreciate the support of those who were able to contribute, and they are listed also on the next page. Without their help, we would have not had nearly the quality meeting that we had. A special thanks is due the U.S. Naval Observatory, who hosted an Open House at the observatory one of the evenings during the meeting. All attendees had a splendid time!

Dave Crawford Tucson AZ, November 1990

INTERNATIONAL ASTRONOMICAL UNION COLLOQUIUM NO. 112

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IAU RESOLUTIONS ABOUT THE ISSUES:

The International Astronomical Union held its XXth General Assembly, in Baltimore, MD, U.S.A., just before this Colloquium. During the General Assembly, the Union passed a number of Resolutions concerning critical issues, a number of which had to do with the topics of the Colloquium. We refer all interested readers to these Resolutions, copies are which are published in IAU Transactions XXB. The IAU Secretariat (98 bis Bd. Arago, F-75014 Paris, France) will be informing other scientific unions, organizations, agencies, etc. about these resolutions. Copies are available from the IAU, or from the International Dark-Sky Association (3545 N. Stewart, Tucson, AZ 85716, U.S.A).

The specific Resolutions are titled:

Resolution A2: Adverse Environmental Impacts on Astronomy

Resolution A3: Cooperation to Save Hydroxyl Bands

Resolution A6: Sharing Hydroxyl Band with Land Mobile Satellite Services

Resolution A7: Revision of Frequency Bands for Astrophysically Significant Lines.

The latter three refer to special RFI concerns in the radio astronomy community, many of which were discussed in papers presented at the Colloquium sessions. We give here the entire text of Resolution A2:

Resolution A2: Adverse Environmental Impacts on Astronomy:

The XXth General Assembly of the International Astronomical Union,

noting with grave concern the increasing impact of light pollution, radio interference, space debris, and other environmental factors that adversely affect observing conditions from the ground and in space;

reaffirms the special importance of the resolution adopted by previous General Assemblies that relate to the protection of observatories (ground-based and in space) and of observing conditions including: (1961 Resolutions No. 1 and 2, IAU XI; 1964 Resolutions No. 3 and 5, IAU XIIB; 1969 Resolution No. 2, IAU XIIIB; 1972 Resolution No. 10, IAU XIVB; 1976 Resolution No. 8 and 9, IAU XVIB; 1979 Resolution N. 3, IAU XVIIB; 1982 Resolution No. R9, IAU XVIIIB; and 1985 Resolution No. B4, B5, and B7, IAU XIX;

strongly urges

a) that all astronomers request civil authorities and others in their countries to implement solutions to preserve the quality of observing conditions,

b) that all national organizations bring these concerns to the notice of adhering organizations, space agencies, and others in their countries;

notes with special appreciation those agencies, communities, organizations, and individuals who have become aware of the issues and have begun to help; and

encourages all others, everywhere, to become aware of the need to minimize the impact on the environment of light pollution radio frequency interference, and space debris, which are causing increasingly severe impact on observing conditions for astronomy and which will compromise mankind's view of the Universe;

and requests through ICSU that SCOPE (Scientific Committee on Problems of the Environment) should study the nature and extent of this threat and advise the IAU of its findings.