

etary Sciences expressed deep concern that no work was being undertaken to identify and avoid pollution problems in interplanetary space. Commission 22 set up small a working group with I P Williams as convenor. It identified several problems requiring further study and recommended further investigation.

At the 22nd General Assembly in The Hague in 1994 a formal Working Group on The Prevention of Interplanetary Pollution was set up with members from each of the Commissions in the Division of Planetary Sciences. Care was taken to include members from each of the international powers with a presence in space operations and research. Astronomers from Australia, China P R, the Czech Republic, France, Japan, the Russian Confederation and the United States of America. Largely through e-mail contact the convenor, C S L Keay, drew on the expertise among the nominated members to expand the earlier report.

The principal areas of concern dealt with by the Group are:

- * Environmentally harmful propellant residues;
- * Unconfined debris from impacting objects;
- * Pollution from explosives, particularly nuclear;
- * Radionuclide pollution from nuclear power generators;
- * Undesirable transfers of surface materials;
- * Biocontamination prevention and quarantine measures.

It was stressed that the challenge is to devise cost-effective techniques and procedures acceptable to mission planners which will prevent or at the very least minimise pollution outcomes. To achieve success a program of careful preliminary research will be necessary, paying attention to the following points in regard to all aspects of space missions:

- * Identify likely sources of undesirable pollution;
- * Measure present levels and predict future levels;
- * Assess future impact of pollution on research goals;
- * Investigate likely severity and irreversibility;
- * Formulate preventative or minimisation procedures;
- * Set guidelines for assessing preservation values;
- * Develop means to protect sensitive environments;
- * Seek ways to increase awareness of the issues.

The working Group recommended the establishment of an international scientific committee to involve all relevant agencies and draw up suitable procedures and protocols for achieving success. It should be very much less costly to be proactive in this endeavour than to allow permanent harm to sensitive regions of the interplanetary environment.

14. THE PROCESS OF FREQUENCY MANAGEMENT, INTERNATIONAL TREATIES AND THE RESPONSIBILITY OF ASTRONOMERS

J. Tarter (SETI Institute)

Working with national and international regulatory bodies to allocate the radio spectrum, and monitoring regional applications for spectrum usage are increasingly becoming the cost of doing radio astronomy. Economic incentives are enormous, with new services constantly seeking additional allocations within the radio spectrum. Radio astronomers cannot depend on the goodwill of for-profit service providers to keep portions of the spectrum free for the use of the passive services (radio astronomy and remote sensing). At present, a small number of senior scientists and managers are struggling against this tide. They should not only be praised, and thanked, but joined. It is imperative that current and future generations of radio astronomers learn the business of frequency management and participate in the distribution of this scarce resource.

15. EDUCATING THE PUBLIC ABOUT PRESERVATION OF THE ASTRONOMICAL WINDOWS

W. T. Sullivan, III (Univ. of Washington)

If astronomers are going to succeed in their efforts to keep the skies free of light pollution and radio interference, then they must deal not only with lighting and radio engineers, business concerns, and politicians, but also the general public. If the public becomes persuaded that clear, pristine skies are worth having for the same sorts of reasons that we value drinkable water and

breathable air, then we have gained the most important constituency. It is, after all, the public who pay the taxes, who buy the products, and who vote in elections. Just as with other environmental issues, if the public is won over, then the engineers and policy makers (eventually) must follow along.

In this paper I highlight efforts around the world that have been particularly noteworthy in the cause of reducing light pollution by educating the public. Radio interference is also of great harm to astronomers, but it will be covered only briefly in this paper because very little has been done to educate the public about the radio problem. This is because radio pollution is a more abstract and technical concept for the average person, as well as because many of the problems are addressable at the international (World Telecommunications Union) and national levels. With light pollution, however, the battles are more often on a local stage.

The premier organization fighting light pollution and educating the public about it is the International Dark-Sky Association (www.darksky.org/ida/index.html), based in Tucson, Arizona, USA, and with over 2000 members in 69 countries. Over the past ten years IDA, largely through the person of David Crawford, has been able to not only preserve dark skies for observatories, but more significantly convince a great number of lighting engineers and public officials that it's in their own best interest to use lighting systems that are also beneficial to astronomers. Exterior lighting for streets and buildings that does not shine upwards saves a great deal of money, does its job much more efficiently and safely, and is aesthetically more pleasing. An alliance has been forged between those on all sides who are "enlightened" and it is steadily growing in its size and influence. For the cause IDA has produced 7 slide sets, 120 information sheets, and 2 videotapes.

The best way to check other major efforts around the world is to visit the Web sites linked to IDA's site. For example, in the United Kingdom the Campaign for Dark Skies (CDS) has also been effective in its educational and political efforts. Their booklet *Starry, Starry Night*, produced in conjunction with the Council for the Protection of Rural England, is first-rate in promoting dark skies and good lighting practices. CDS has also promoted "Star Watch UK", a project for schools and other youth groups to count the stars visible in a well-defined area of the sky. This type of program has also been done in Canada and the USA, and especially in Japan, where it was funded by the national Environmental Agency. Based on these amateur data, maps were constructed for sky brightness all around Japan. Even more than the maps, the real value of such projects is the increased awareness they bring to the public of deteriorating sky conditions. Many other examples, from countries such as Switzerland, Holland, Italy, and Spain, are discussed in the full paper.

16. PUBLIC EDUCATION TO PRESERVE DARK SKIES AND ASTRONOMICAL WINDOWS WITH EAVESDROPPING AND ROBOTIC TELESCOPES

J. E. F. Baruch (Robotic Observatories)

Abstract

It is suggested that the only guarantee for the preservation of dark skies is the guarantee that exists in the hearts of the people around the world. This paper notes how rising living standards and increasing GNP are associated with light pollution destroying the heritage of the night sky. It argues that it is necessary to decouple light pollution from rising living standards. A contribution to this process is to provide indices that are easily understood and useable for measuring the quality of the night sky.

It is shown how robotic telescopes can provide access to the night sky for people in the developed world through programmes which provide education, involvement in astronomy research and access to the leading edge of astronomy through the new technique of eavesdropping. These education programmes will help to bring an understanding of the value of our heritage that belongs to our grandchildren: The Night Sky.

17. THE ISSUES OF SPACE DEBRIS AND NEAR-EARTH OBJECTS AT THE UNITED NATIONS

H. J. Haubold (United Nations Office for Outer Space Affairs)

The focal point of the United Nations activities in the field of peaceful uses of outer space is the Committee on the Peaceful Uses of Outer Space (COPUOS), set up in 1959 by the General Assembly. Since its establishment, the Committee and its two subcommittees (the Scientific and