Education and Outreach for Dark Skies – 2006-2009

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Introduction

The official goal of IAU Commission 50 is "to attempt to prevent compromise of ground-based sites for both optical and radio astronomy". This requires awareness, understanding, and appreciation of the issues by the public, and by the governments that they elect. This is one aspect of *scientific literacy"* – public awareness, understanding, and appreciation of the scientific issues which affect their society and their lives.

This can be accomplished by effective public education, outreach, and communication. As I was preparing this paper, I received my July-August 2006 issue of *Mercury*, the non-technical magazine of the Astronomical Society of the Pacific (ASP). It has an excellent article on dark skies. The sidebar on "Five Simple Ways to Support the Dark Sky Movement" began with "Educate yourself and others"!

IAU Commission 46 (Education and Development) should have the interest and expertise to advise and collaborate. So should the new IAU Commission on Communicating Astronomy. International Year of Astronomy 2009 provides an ideal opportunity for this. But time flies, and the time to act is *now*.

How do dark skies and light pollution connect with astronomy education and outreach? The answer is complex, because there are many forms of and channels for education and outreach, many organizations, institutions, and individuals who participate in education and outreach, and many audiences, ranging from children and teens, to adults and seniors. It's generally true that a large variety of individual connections between astronomers and their audiences will already have been made at the local grass-roots level. The best strategy is to identify these connections, and encourage and support them.

One-on-one interactions between astronomers – both professional and amateur – and the public can be crucial. Science, after all, is a human endeavour. A major funding initiative in my province aims to bring science researchers into direct contact with youth. Many astronomers attribute their interest in astronomy to their first look through a telescope. I was pleased that, on the cover of the document that outlines Canada's Long-Range Plan for Astronomy, a picture of a child looking through a small telescope was front and centre!

But this represents one end of a spectrum. The other end is high-exposure (but low-contact) communication such as two pages in a widely-used Canadian school textbook [*Science 9*, ITP Nelson Canada], a full page in Canada's national newspaper [*Globe and Mail*, 12 January 2002], or an article in the leading weekly newsmagazine in the US [*Time*, 31 January 2000].

Our task is not easy. Education and outreach audiences are swamped with messages, web-sites, resources, and other material, and ours is just one more "cause" – though it is a worthy one. Users seldom have the time to look at all this material; they tend to look for material in familiar places, from organizations that they know and trust, prepared in user-friendly form. The IAU itself is not well-equipped to reach the local or even national level. In 2003, the IAU passed a Resolution with respect to the importance of astronomy in the education system. I question how effectively the IAU communicated this Resolution to individual countries, and

what effect it had. IAU Commission 46 does not have a Program Group in K-12 education; it should. It does not have a Program Group in dark-skies issues; it should. So we must work through existing partners who *do* have the ability and willingness to connect with communities all over the world. If you Google on "education, outreach, dark skies and light pollution", most of the results have some connection with the International Dark-Sky Association. With them and other appropriate partners, we should develop and promote a small number of excellent, well-tested activities and resources. We can't do everything, so we should do a few well-chosen things well. "Less is more".

There are "best practices" in education, outreach, and communication. Conferences have been held, and proceedings of these are available. The Astronomical Society of the Pacific is holding such a conference in mid-September 2006, in Baltimore. Yet many of us do not understand these "best practices". University instructors are the ultimate amateurs; very few of us have any pre-service or in-service training in education, outreach, or communication.

Light Pollution and Education

One of my particular interests in the education aspects of light pollution came from my experience in adding astronomy to the school science curriculum in my province of Ontario. Those who develop and deliver curriculum are aware that science is much more than facts; it includes science knowledge (or content), science skills, applications of science, and attitudes to science issues. The curriculum should also include "science, technology, society, and environment", or STSE to use the standard acronym. And there is no better STSE topic in science than the study of light pollution! In Ontario, the study of light pollution would meet 12 different expectations of the school science curriculum! That was one of the things that motivated Dave Crawford, Margarita Metaxa and me to create an on-line resource for teachers, for the Astronomical Society of the Pacific, dealing with light pollution. We were building on Margarita Metaxa's excellent and continuing projects in Greece and elsewhere in Europe.

Our resource had two parts. One was an activity that involved star-watching; I shall return to this later. The other part had to do with investigating lighting and light pollution locally and practically; this can be done on cloudy nights! It involves a set of skills that are rarely taught, even in university, but should be: how to investigate societal and environmental issues; how to work with non-astronomers such as engineers, administrators, politicians, and the community; how to prepare effective documents and proposals on such topics; how to achieve action and results. The H.R. MacMillan Space Centre in Vancouver includes, within its school programs, a 2-hour session on this topic for grade 8-11 students in social sciences, or environmental studies. A very effective and highly-recommended teaching strategy for this and other such topics is *problem-based learning*, in which students work in teams to research, understand, and solve some real-world problem.

Teenagers are a rather neglected audience in science outreach, yet they are obviously the citizens and leaders of tomorrow. Many of them have a genuine interest in problems of the environment, global warming, and energy conservation. Others are interested in effects of technology on health and safety of humans and other species. Both of these areas connect with light pollution. In Toronto, for instance, there has been a special concern about the thousands of birds that die at night through collisions with fully-lighted high-rise buildings.

In this and any other activity for school teachers and students, it is important to involve teachers in the development, testing, evaluation, and improvement of the activities. Fortunately, educational funding by NSF and NASA in the US usually enables and requires this to happen,

so we should take advantage of activities and resources that exist. Furthermore: the highest impact and leverage occurs when we work with curriculum developers, textbook publishers, and science teachers associations.

Likewise: it is important, if astronomers work individually with teachers to implement the activities in classrooms, for the astronomer-teacher relationship to be a true partnership. The Astronomical Society of the Pacific's *Project ASTRO* is exemplary in this respect. I strongly recommend the manual which comes with this program. It stresses that astronomers and teachers are equal partners; astronomers have the content knowledge, and teachers are the education professionals.

Getting the Family Involved

An ongoing problem with any night-time activity in astronomy is that "the stars come out at night, the students don't". That's partly because of issues of safety and security. The obvious solution is to get the students' families involved, and this has been done in exemplary fashion by the Astronomical Society of the Pacific's *Family ASTRO* program. These same issues of safety and security, along with the fact that light pollution can be studied on cloudy nights, in urban locations, makes it an effective topic for family study and discussion. As with *Project ASTRO*, this program was carefully developed and tested, and should be adopted or adapted by others where possible.

Project ASTRO and *Family ASTRO* both stress a discovery approach to astronomy, and the discovery of a constellation pattern, or of the sight of Saturn in a telescope, are wonderful introductions to the night sky.

The Planetarium Connection

Planetariums are an effective tool for introducing astronomy, and the night sky, to people young and old. Almost a million Canadians visit planetariums each year. Yet the IAU has a chronic problem – lack of direct contact and liaison with the planetarium community, represented internationally by the International Planetarium Society. This issue has been discussed in Commission 46 for at least 30 years, without result. Now is the time for IAU Commission 46 to add a Program Group on planetarium and science centre liaison, as well as Program Groups for K-12 education, and for dark-skies issues!

Planetariums typically begin a night-sky program by showing the sky as seen from a city location (since most planetariums are in cities). Then they adjust the lights to show the sky as seen from a dark-sky location. The reaction is always the same — "oooh!". So we need to get the planetariums and science centres on board.

In fact: planetariums would be ideally suited to demonstrate and promote the star-watching activities that I will describe in a moment.

Planetarium Software

A relatively new form of planetarium is sky-simulation software. The standard package in the schools in my province is *Starry Night*. These packages can also simulate the transition from city sky to dark sky – something that should be built into curriculum activities. Again, it bridges science, technology, society, and environment. But neither a planetarium, nor planetarium software, can replace the experience of seeing the actual night sky, and seeing an astronomical object through a telescope.

Observing and Counting Stars

Citizen Science: The Ontario Science Centre, in Toronto, has been one of the world's foremost science centres for four decades. Long famous for its hands-on exhibits and programs, it has recently embarked on a major new seven-part programming initiative called *Agents of Change*. The *Innovation Centre*, opened last month, is aimed at teen-agers and young adults, and is apparently the first major science centre exhibit aimed directly at this audience. One of the components of *Agents of Change* is *Citizen Science*, which is developing projects in which citizens, young and old, can make scientific observations and measurements, submit them via the Internet, and see how their measurements compare with those of others. The first *Citizen Science* activity was *Starwatch* – prompted, I think, by the great North American power outage of August 15, 2003. On this occasion, millions of North Americans saw a dark sky for the first time. The Ontario Science Centre now holds an annual star party every August 15, attracting thousands of participants. You can access *Starwatch* at:

http://www.redshiftnow.ca/starwatch/

StarWatch is a partnership with the H.R. MacMillan Space Centre in Vancouver. A key person in this project is Sara Poirier, a staff astronomer at the OSC. She is an astronomy graduate, and already has international experience through the Vatican Observatory Summer School, and the International Space University.

Globe at Night is an even larger project, which has already received over 4500 observations from over 18,000 people across the globe. You can access it at:

http://www.globe.gov/GaN

It organizes "campaigns" to starwatch; the last was 22-31 March 2006; the next is 8-21 March 2007. See Connie Walker's poster SPS2-96 at this IAU GA for more information about this project.

These and other starwatch programs incorporate fundamental science skills: planning an investigation, using tools such as star charts, making and recording observations or measurements, understanding the factors that may affect the reliability of an observation, and communicating the final result. Students can compare their results with their classmates', or with those from other students all over the country, or the world. This is a tremendous motivational factor.

Citizen Science was developed for the express purpose of involving citizens of all ages – including adults – in science. It follows the well-established role of amateurs in astronomy. But there have been many forms of citizen science over the years. It makes science more "democratic" in the sense that citizens can participate actively in it. One of the most interested and supportive audiences for astronomy is older adults or seniors. They can also be very influential because of their connections, and very helpful because of their experience and their time available.

NASA and the Canadian Space Agency (CSA) are now collaborating on a new education activity of this kind. The Star Count Project will investigate the visual quality of the night sky and help assess the extent of atmospheric light pollution. NASA and the CSA are inviting U.S. and Canadian students to participate in an effort to study these factors.

The project was suggested and is being supported by CSA astronaut Steve MacLean. He is a member of the crew of the Space Shuttle Atlantis on the next mission, designated STS-115, to the International Space Station. The mission is scheduled to launch in September 2006.

MacLean will perform the Star Count experiment during the mission. While in space he will upload star observation information into a database via the Star Count Web site. As part of

the project, students will learn how to estimate the number of stars observed based on random samples of sections of the sky. Students will add to the database by entering their location, number of stars observed and information about their viewing conditions. The students will be able to compare their observations with MacLean's and other observers.

Star Count is a project of the NASA Student Observation Network. The network is a collection of online inquiry-based activities that challenge students to find answers to research questions by making their own observations and interpreting them with NASA data.

The Star Count Project is directly tied to NASA's major education goal of attracting students to science, technology, engineering and mathematics studies. NASA is committed to engaging and retaining students in these disciplines which are crucial to the agency's future missions.

For information about NASA education programs, Star Count Project and the Student Observation Network, visit:

http://www.nasa.gov/education

International Year of Astronomy 2009

International Year of Astronomy 2009 is an IAU-led project which can be "the right thing at the right time" for us. It celebrates the 400th anniversary of Galileo's development of the astronomical telescope. We assume that the role of the IAU will be to act as a clearing-house for ideas, to encourage and support local ideas i.e. taking a bottom-up rather than a top-down role. In any case, the IAU has limited funds to support IYA2009 activities; what it does have is motivation, enthusiasm, expertise, and authority.

At the national and local level, funding opportunities may be more promising; IYA2009 has great potential for corporate sponsorship, because of its uniqueness and broad appeal. Likewise, media sponsorship will provide a way of promoting and publicizing activities, both local activities and ones with national scope.

In Canada, we already have a small steering committee, which is beginning to make plans for country-wide activities, particularly local ones. Our steering committee includes Dennis Crabtree, Jim Hesser, and Andy Woodsworth; although all three are from professional government astronomy, they also have many connections with other parts of "the astronomical community". It also has me and Jayanne English, both from professional university astronomy; again, we both have other connections – me with education, and she with art, design, and the media. Finally, it has Scott Young and Remi Lacasse, representing the English- and French-language astronomy clubs; Scott also represents the planetarium community.

The first ideas to come to mind were ones involving skygazing, looking through telescopes, and thus becoming aware of light pollution. For instance: how many Canadians could be given the opportunity to look through a telescope in 2009, as Galileo did in 1609?

The Importance of the Amateur Astronomy Community

Amateur astronomers, as most of you know, are people who do astronomy as a hobby. Many of them are professionals in other fields, and they bring these skills, and others, to astronomy. All of them are enthusiastic. They make important contributions to both education and research.

They are also very numerous. There are as many "master" amateur astronomers as professionals, and ten times more less-"serious" amateurs who are able and interested enough to contribute to public outreach.

The relationship between professional and amateur astronomy can be a delicate one, depending on the country and on the situation. The IAU and its commissions have no formal liaison with the amateur community. Often at the local level, there is cooperation and partnership in education and outreach in what I call "the astronomical community". One good resource for amateur-professional partnership is the proceedings of the 1999 Toronto conference on the topic [ASP Conference Series, #220], which I edited with undergraduate student Joe Wilson.

In Canada, we are fortunate to have two strong organizations of amateur astronomers, with a good balance between local and national focus. The Royal Astronomical Society of Canada, with almost 5000 members in 28 branches across the country, was a recent winner of our national award for excellence in science outreach – the *Michael Smith Award*. Its outreach activities are unusually numerous and diverse; its partners range from the traditional – universities, schools, planetariums, and parks – to the more unusual – wineries and ski lodges, for instance. The Federation des Astronomes Amateurs du Quebec is also very active in education and outreach.

In the US, there is the Astronomical League – an umbrella organization of local astronomy clubs. The Astronomical Society of the Pacific has begun developing effective partnerships with the AL, and other appropriate partners such as youth organizations, and national and state parks.

List of Recommendations

To summarize: let me list some possible recommendations, for discussion:

- Initiate Commission 46 Program Groups in K-12 astronomy education, planetarium liaison, and dark-skies issues, the latter being joint with Commission 50.
- Ensure that the latter Program Group works closely with established partners such as the International Dark-Sky Association, Astronomical Society of the Pacific etc.
- Charge the Dark-Skies Program Group to (i) develop a small number of well-developed, well-tested activities related to dark skies and light pollution, (ii) to make these and other select resources available through a website, and (iii) for IYA 2009, to serve as a clearing-house for ideas for effective local events.
- Encourage IAU members to develop or support positive, effective partnerships between professional astronomers and other members of "the astronomical community", in each country and region.
- Identify, encourage, and support local activities that can advance the cause of IAU Commission 50.
- Begin to act now.