

## FOREWORD

Astronomy has always been one of the easiest of the sciences to convey to the public. That is partly because it produces spectacular pictures that can be explained (at least in part) and admired, partly because understanding of astronomy usually does not depend upon a knowledge of a complex classification system or esoteric terminology, and partly because its extremes in distances and times challenge our imagination and philosophies.

Most scientists enjoy sharing with others the discoveries made by themselves and their colleagues. The primary purpose of scientific research is to discover, to learn, and to understand. When we succeed, we enjoy sharing that understanding. Education is most pleasurable when our audience wishes to learn and we have something important to convey.

A field that does not communicate effectively with the public soon loses its interest and support. Author André Heck explains the many different ways in which professional communication now occurs while Leslie Sage explains how such communication should be done. Astronomy done with spacecraft and large equipment is very expensive and the funds for those ultimately come from the public. The cost of astronomy prorated over the number of research astronomers is perhaps the highest in all the sciences. If astronomers do not share their results with the public, they will lose its support. However, for most astronomers the desire to share and educate dominates over the pragmatic need to win public support.

With the advent of new communication techniques (television, videos, CDs, DVDs, animation, simulations) we have new methods to communicate, in addition to the conventional ones of the printed and spoken word. Authors Raili Taylor and Nigel Henbest explain the practical advantages, difficulties, and huge expenses of astronomy explained on television, while Claus Madsen gives extensive statistics regarding the effectiveness of communication in print.

Teachers are learning that young people have changed and that the conventional method of 50-minute lectures is often not effective. The new techniques involve hands-on experiments, interactive computers, group projects,

open discussions, and other approaches yet to be developed, rather than passive attention to lecturers. Claus Madsen and Richard West in the opening chapter, Stephen Maran and Paola Catapano *et al.* in the following ones discuss effective communication techniques with the public.

Astronomy is an ideal science to illustrate the “scientific method.” As primarily an observational, rather than experimental, science, astronomy can chart the paths from the assumptions made, the observations collected, and the logical reasoning toward the derived conclusions. It is logic of science and the testing of claimed results that should be used to show the fallacy of superstition. While we can guess how much more superstition would exist if the public did not engage in logical thinking part of the time, we have not eliminated astrology, and fortune-tellers are still believed whose success rates are no higher than own guesses. Many primitive societies, unlike ours, are heavily controlled by superstition. On the one hand we need to teach logical thinking to more people and on the other hand we need to learn new ways to combat superstition.

Recent discoveries in astronomy have been spectacular, such as the X-rays and  $\gamma$ -ray bursts, gravitational lensing, missing mass,  $10^{20}$ eV particles, and galaxy-sized jets. Nevertheless, the future is likely to bring even stranger effects. We hear of vacuum energy that exceeds that of luminous energy, of (invisible) magnetic fields that dominate over kinetic energy, and possible universes outside our own. If we do not learn to communicate effectively regarding things that we can see, we will have real troubles to communicate convincingly about invisible objects.

Authors Fernand Wagner and Rosa Ros, as well as Arntraud Bacher, have surveyed the teaching of astronomy in Europe, providing statistics that are sometimes surprising. But the shocking description by Case Rijdsdijk of the primitive state of astronomy education and the lack of resources and trained people in a developing country is heart-rending. It must currently be done without the electronic tools that we take for granted in the developed countries. The task of bringing millions of people to the astronomical educational level of the average European or North American public will require herculean efforts and careful long-term planning.

A major recent change is that even organizations engaged in pure astronomical research have seen the need to engage in public education. For instance, NASA, which often refrained from spending money on non-mission oriented efforts, is now spending millions of dollars per year on public education. Andrew Fraknoi and Ian Griffin document how two organizations (the Astronomical Society of the Pacific and the Space Telescope Science Institute, respectively) have made large efforts toward public education.

Astronomy has benefited by the participation of amateurs in original research. The field is somewhat unique in the extent of that participation.

Organizations such as the Astronomical Society of the Pacific divide their efforts among public education, aiding amateurs, and serving the professionals.

People have said that one reason for astronomy's popularity is that it has not been linked with nuclear bombs, environmental pollution, politically incorrect research, or the military, as have some other sciences. However astronomical results have challenged our religious and tribal concepts of the universe. It must be considered a credit to astronomers that astronomical cosmology, unlike when Galileo Galilei and Giordano Bruno were silenced, is now accepted by most religions. Even the fundamentalist religions do not blanch at the possibility that other planets exist and might be inhabited. Although astronomy has profited from financial and technical military support and the military have used astronomical goals to justify its experiments with rockets, the public does not connect astronomy with the military.

It is now appropriate that a volume of essays be devoted entirely to the communication among professional astronomers and with the public. Many of the topics discussed in this set of volumes have not been presented in the astronomical literature. I congratulate Editors André Heck and Claus Madsen for seeing the need to present those topics and for soliciting these essays.

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