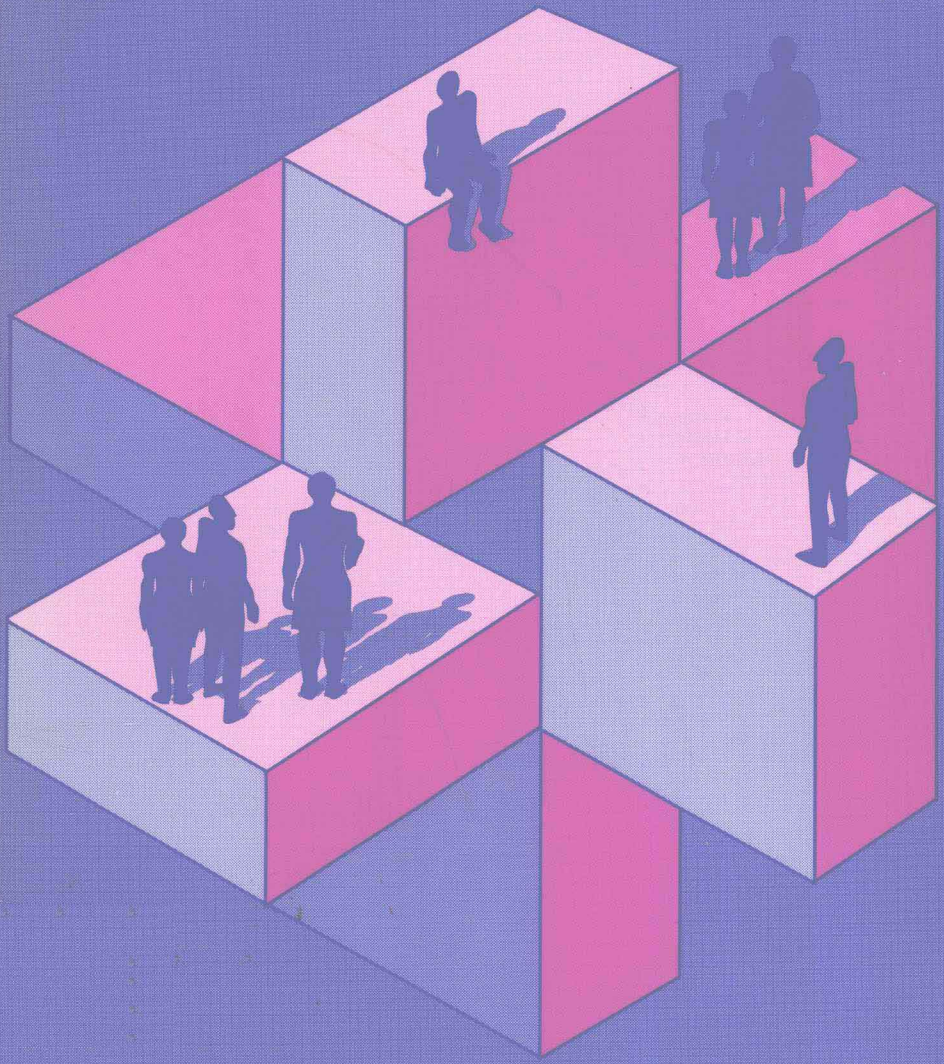
# When Science Meets The Public



Bruce V. Lewenstein, Editor

American Association for the Advancement of Science

# When Science Meets the Public

*Proceedings of a Workshop*
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*American Association for the Advancement of Science*
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# Acknowledgments

This book is the product of a workshop held at the annual meeting of the American Association for the Advancement of Science in Washington, DC, on February 17, 1991. The workshop was organized by the AAAS Committee on Public Understanding of Science and Technology (COPUS&T), led by chairman Sheila Grinell and staff officer Patricia S. Curlin; help came from COPUS&T members Valerie Crane, Michael Templeton, and Talbert Spence, in conference with Sharon Dunwoody at the University of Wisconsin—Madison. Support from the AAAS staff came from the staff of the Education and Human Resources Programs Directorate. At the workshop and later, while editing the proceedings, I had the help of Steven W. Allison and Michele Finkelstein, as well as institutional support from Cornell University's Department of Communication. Production of the book was ably assisted by Maria Sosa and Gloria Gilbert. Thank you to all those who helped.

# Foreword

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The workshop documented in the following pages was organized as an experiment. Members of the American Association for the Advancement of Science's Committee on Public Understanding of Science and Technology wanted to test the hypothesis that all science communicators—newspaper reporters, TV documentarists, museum exhibit builders, science club organizers, corporate and university information officers, and the researchers who work with them—can benefit from joint discussion of the common ground in science communication. In designing the workshop, we began to explore that commonality and to examine the uses that members of the public make of our various efforts.

Science information reaches the public through media and institutions that are isolated from one another, that often have commercial motives, that reach different audience segments, and that use different communications strategies. The people who work in these institutions become experts in their own fields, but often have little contact with other media. There are few opportunities to share significant research results or critical experiences across the science communication media; there are few opportunities to explore effects and alternatives from the point of view of society as a whole. Our workshop was organized specifically to fill this gap.

The response to the workshop convinced us that science communicators and researchers want to share a larger view of their work. Over 100 people from different media or with different research interests came to the workshop to hear and question 20 panelists with different perspectives. The exchange was invigorating and remarkably consistent, and

there were requests for more. Hence, additional workshops are being planned, each of which will explore an aspect of science communication across media and will be sponsored jointly by AAAS and by the British Association for the Advancement of Science.

We hope that this volume, and the subsequent workshops, will stimulate fresh and useful thinking about how science works its way into public discourse. We hope that they contribute to the ongoing refinement of research questions and the enhancement of practical techniques in all

# Introduction

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Many people support "public understanding of science"—but they don't always agree on what the phrase means. Since the early years of the 19th century, when large numbers of scientists, educators, and other community leaders began to notice that science was becoming too specialized for many nonscientists to follow, leaders of the scientific community around the world have called for more and better efforts to encourage public understanding of science. Scientists have created and supported a wide range of communication efforts—from demonstration halls and public lectures in the mid-1800s through mass-circulation magazines for armchair scientists in the 1980s, from natural history museums of the 1880s through interactive science centers of the past generation, from chatty television shows like Don Herbert's "Mr. Wizard" through multimedia extravaganzas like Carl Sagan's "Cosmos," and from programs at youth clubs through adult education classes—all in an effort to keep nonscientists informed about the developments of science.[1]

This history is relevant to those of us who believe that science can help solve many of the social problems faced by the world today. We are concerned about the clear gaps in the public's knowledge of science, and public understanding of science is for us an important goal. Some of us want a public better able to judge between competing technical arguments on such topics as energy conservation, solid waste disposal, pesticide risk, and social welfare policy. Others of us want a public more capable of distinguishing between logic and trivia in debates about government budgets. Some of us want more young people, of all genders and races, to include science in their dreams about how they will spend their lives. And still others of us want mainly for the public to comprehend the beauty and intellectual challenge of the ideas that we believe are central to science.

Yet no matter what motivates a concern for public understanding of science, the issue is one of the most intractable and important facing our society today. From the founders of Britain's Royal Institution at the turn of the 19th century, to the proselytizing scientific lecturers who traveled across England and the United States in the late 1800s, to Harvard president (and chemist) James Bryant Conant's 1947 call for understanding science, to C.P. Snow and his 1959 warning about the development of two separate cultures, to studies in the 1980s by the British Royal Society and the American Association for the Advancement of Science (AAAS), the issue of public understanding of science has remained central to the complex relationship between science and society.[2]

Like science itself, the study of public understanding of science is fragmented. In one strand, researchers have been looking for more than 50 years at science journalism, asking how science is reported as news—and how that reporting could be improved. Another strand, evaluations of how well museums present information, stretches back at least to the 1920s. In more recent years, a separate literature has developed on science literacy, including both studies of the public's knowledge of particular scientific and technological topics as well as prescriptions and plans for addressing the lack of knowledge on many topics. And in the community of historians, sociologists, philosophers, and others who take science itself to be their subject, public understanding of science has been one of the emerging issues of the last two decades.[3]

Because of this fragmentation, it has been unclear whether the many separate fields with an interest in public understanding of science—including both practitioners and researchers in the areas of journalism, museums, science education, and science studies—could come to any consensus. Do they agree on what the public knows about science and technology? Do they agree on what the public *should* know about science and technology? Do they know how best to convey information about science and technology to the public? Are there areas of overlap or, worse, contradiction between different approaches to public understanding of science and technology? Does anyone know if the right questions are even being asked?

To explore these questions, the AAAS's Committee on Public Understanding of Science and Technology (COPUS&T) organized a workshop in February 1991, at which the talks and papers collected in this volume were originally presented. COPUS&T believed that museums, newspapers, magazines, children's clubs, television shows, government offices, and all other institutions devoted to public understanding of science were

in fact dealing with the same issues. It believed that the researchers who look at each of these institutions, and the practitioners who turn the ideas of these institutions into physical products, are each working with the same materials. The goal of the workshop—and thus, of this volume—was to see whether these disparate groups could speak the same language and contribute to each other's fields. COPUS&T suspected that common themes would emerge and that progress in all the fields that make up public understanding of science would be served by making those common themes clear.

The fundamental belief held. Not only did all the groups speak each other's language, but they came to remarkably similar conclusions. Those conclusions can be summarized by a single statement: Whether one is concerned about production or research, about television or museums, about literacy or critical thinking, new ideas in this field will come only when we take the perspective of the *audience*. It is the audience that practitioners are trying to serve. Though supporters of public understanding of science may have many interests of their own, these interests are not necessarily the interests of consumers of information about science—the audience. To understand what information is important, to understand what techniques work, to understand how and why and where and when to achieve public understanding, we need first to understand the audience.

This audience-centered perspective leads to a criticism that is implied in many of the papers in this volume, though it is rarely stated explicitly: We are wrong to devote energy to jeremiads about the state of science education or about the need for greater public understanding; we are wrong to focus too much on studies of how journalists and museum curators go about their work. These topics are important only to people who are already convinced that public understanding of science is critical to the future of our society.

Instead, the papers in this volume urge people concerned about public understanding of science to focus on the audience side. Most fundamentally, these people must ask: What does the public perceive when it encounters science? Only when that question is answered can practitioners, researchers, and others proceed to—and eventually answer—questions about what methods of production are most suitable, or what training is appropriate for science communicators, or other questions that have occupied this field for years.

The papers in this volume are divided into five major sections. The first section (*The Need: Why Should We Understand Public Understanding of Science?)* contains an eloquent call to reassessment by physicist Philip Morrison. Continuing in the long tradition of eminent researchers who have devoted significant efforts to public understanding of science, Morrison considers the role of science in modern culture. By comparing science with sports, another central element of modern culture, Morrison shows how widespread understanding can be—if only we learn to recognize what understanding means for the public.

Morrison presented his ideas ("more than a metaphor, less than a model," he said) at the beginning of the workshop; they struck a chord and many speakers referred to them throughout the day. Thus it is important for us to explore their implications. Sports is widely understood in our culture because virtually everyone is at some time an amateur participant in sports. But we don't have a good "amateur" role for most aspects of science—we need to develop one. Similarly, sports offers many opportunities for passive spectators to watch professionals (and amateurs) at play. Although the accounts of science that appear in newspapers, magazines, television shows, and museums help nonscientists observe science, they don't offer the same kind of immediate feedback that watching sports does. So Morrison is challenging us to find ways for the public—the audience—to experience science in the same vicarious way that it experiences sport. Then, perhaps, we will create a culture of science as pervasive as the culture of sports in our society.

The second section *(The Concept: What Do We Mean by Public Understanding of Science?)* asks us to set aside our preconceptions about what the public "needs" to know. Instead, three very different papers challenge us to step outside of narrow interests and into the perspective of the broad, general public—or, more accurately, the many broad, general publics that constantly emerge, realign, dissolve, and reemerge in our society.

John Ziman, an eminent British physicist who has devoted much of his career to understanding the role of science in society, reviews the results of several research projects initiated in Britain after the 1985 Royal Society report on public understanding of science. He shows that each of these projects, in different ways, has found that public understanding makes sense as a concept only when it is defined from the public's point of view.

Valerie Crane, a communications researcher who works with television stations and museums across the country, draws on many of her own research projects to see what happens when one takes the audience's perspective. Too many times, she demonstrates, producers of material intended to improve the public's understanding of science and technology forget to consider the public's needs. Instead, they make decisions based on their own priorities, their own interests. The result? All too often, the audience tunes out (literally). Crane includes recommendations for how to approach public understanding from the audience's point of view.

Finally, Marcel LaFollette, a leading researcher in the world of science and technology studies, reviews the perspectives that have governed much of the previous work in public understanding of science and shows how that work has failed to resolve the issue. She attributes much of the failure, once again, to the lack of commitment to taking the audience's point of view. LaFollette's comments were originally given as an ad hoc summary at the end of the workshop, which is perhaps why they are the most explicit of all the comments in this volume at urging a rethinking of approaches to public understanding.

The third section *(The Data: Studying the Audiences for Public Understanding)* offers three case studies. Each is very different, but each gives us an example of how to consider the public's perspective—the *audience's* perspective—when talking about public understanding of science. These papers are valuable not just for the results they report, but also as models for how to study the audience's perspective. Unlike the other chapters in the book, these papers were originally prepared for publication, not just oral delivery; they are more technical in nature.

Brian Wynne gives an analysis of how sheep farmers in the Cumbrian hills of England responded to government communication efforts after radioactive contamination from the 1986 Chernobyl accident made their sheep unfit for market. By forcing us to take the perspective of the farmers, Wynne shows us that their knowledge of sheep farming, market realities, local geography, and other issues is every bit as much "expert knowledge" as all the book learning and experimental data of the government scientists. What's more, the farmers' knowledge was in many ways more appropriate to the immediate context than the "experts'" knowledge. Wynne is saying that we must be careful when claiming to know what is *best* in any situation.

Kara Marchman and Janine Jason describe the careful planning and strategy of a major public health campaign. By laying out the methods and results of the Centers for Disease Control's AIDS campaign, Marchman and Jason show how the opinions of small groups of knowledgeable experts must be tested against the realities of how messages will be perceived and then recast in order to achieve the desired goals. Public relations and advertising specialists have long known the importance of researching public perceptions, but Marchman and Jason show just how wrong one can be if one fails to learn what the audience is getting from a message.

Finally in this section, Eve Hall, Shalom Fisch, and Edward Esty of the Children's Television Workshop (CTW) provide another example of how to find out what the audience is really getting from all the carefully crafted multimedia messages about science. In a thoughtfully designed experiment using the mathematics show *Square One TV*, the CTW researchers tested the goals of the television producers against the progress that students actually made in using complex problem-solving behaviors. Though the results were impressive, the real message of this chapter is the importance of testing productions against the goals that were originally set for them. It is easy to let a slick and glossy production claim that it is doing the job; only by being critical and testing the results will one really know if one is reaching the audience.

The papers in the fourth section *(The Applications: The Art of Explaining for Public Understanding)* began as a roundtable discussion about how various practitioners of public understanding of science try to produce good explanations. Each practitioner agreed that creating good materials begins only when the producer starts from the audience's point of view. Whether one is writing articles for the readers of a newspaper science section or signs for a family visiting a museum, the goal must be to learn what the audience knows and wants and to begin creating from there. The chapters here are brief, but they represent the hard-won, hands-on knowledge of people on the front line of public understanding of science efforts.

Sharon Dunwoody, who teaches and does research on science journalism, provides a short introduction to the problem of explanation; Jonathan Ward, an independent television producer, reviews television techniques; Libby Palmer, who directs an after-school program of science activities for Girls Incorporated, describes the group's methods for engaging girls in science; Tom Siegfried, a newspaper science writer and science editor, summarizes the elements of successful newspaper explanations; Robert

Sullivan, associate director for public programs at the National Museum of Natural History, describes the goals and techniques of science museums; and Katherine Rowan, who teaches and does research on science writing, analyzes what kinds of explanations work in different contexts—whatever those contexts may be.

The final section *(Summary: New Directions For Public Understanding of Science)* is a brief statement by Shirley Malcom, head of AAAS's Directorate for Education and Human Resources Programs, about what is learned by bringing together these papers on public understanding. Malcom is explicit in her challenge to us: One must go to where the audiences are, speak their languages, and understand their vision of science if one is ever to be successful at engaging the broad public into the enterprise of science.

Two appendices by Patricia S. Curlin of AAAS provide information about the AAAS's Committee on Public Understanding of Science and Technology, which sponsored the workshop from which this book emerged, and also list selected resources that will allow one to continue exploring the issues raised in the book, including organizations and publications.

As noted above, most of the papers in this book were originally presented orally. Although they have been edited to read more smoothly and reorganized to make the book's argument clearer, readers should take the papers—and the ideas—in the book not as finished products, but as spurs to further work.

## NOTES

Bruce V. Lewenstein is assistant professor in the Departments of Communication and Science & Technology Studies at Cornell University. He is the head of a science communication sequence for undergraduate students, and he does research on the history of science popularization.

1. For introductions to these efforts, see John Burnham, *How Superstition Won and Science Lost: Popular Science and Health in the United States* (New Brunswick, NJ: Rutgers University Press, 1987); Jack Meadows, "The Growth of Science Popularizations: A Historical Sketch," *Impact of*

*Science on Society*, 1986, 36:341–346; Morris Berman, *Social Change and Scientific Organization* (Ithaca, NY: Cornell University Press, 1978); Steven Shapin and Barry Barnes, "Science, Nature, and Control: Interpreting Mechanics' Institutes," *Social Studies of Science*, 1977, 7:31–74; Sharon Friedman, Sharon Dunwoody, and Carol Rogers, eds., *Scientists and Journalists: Reporting Science as News* (New York: Free Press, 1986); and David Evered and Maeve O'Connor, eds., *Communicating Science to the Public* (Chichester/New York: John Wiley & Sons, 1987).

2. Berman, *Social Change*; Burnham, *How Superstition Won*; James Bryant Conant, *On Understanding Science* (New Haven, CT: Yale University Press, 1947); C.P. Snow, *The Two Cultures, and a Second Look* (Cambridge: Cambridge University Press, 1964); Royal Society of London, *Public Understanding of Science* (London: Royal Society, 1985); and American Association for the Advancement of Science, *Science for All Americans* (Washington, DC: AAAS, 1989).
3. See, for example, David Dietz, "Science and the American Press," *Science*, January 29, 1937, 85:107–112; E.S. Robinson, *The Behavior of the Museum Visitor* (Washington, DC: American Association of Museums, 1928); National Science Board, "Public Science Literacy and Attitudes toward Science and Technology," *Science Indicators—1989* (Washington, DC: National Science Board, 1989), pp. 161–177; AAAS, *Science for All Americans*; and Marcel C. LaFollette, *Making Science Our Own: Public Images of Science, 1910–1955* (Chicago: University of Chicago Press, 1990). Additional literature can be traced through the bibliography in Appendix B of this volume.

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# I. The Need

## *Why Should We Understand Public Understanding of Science?*