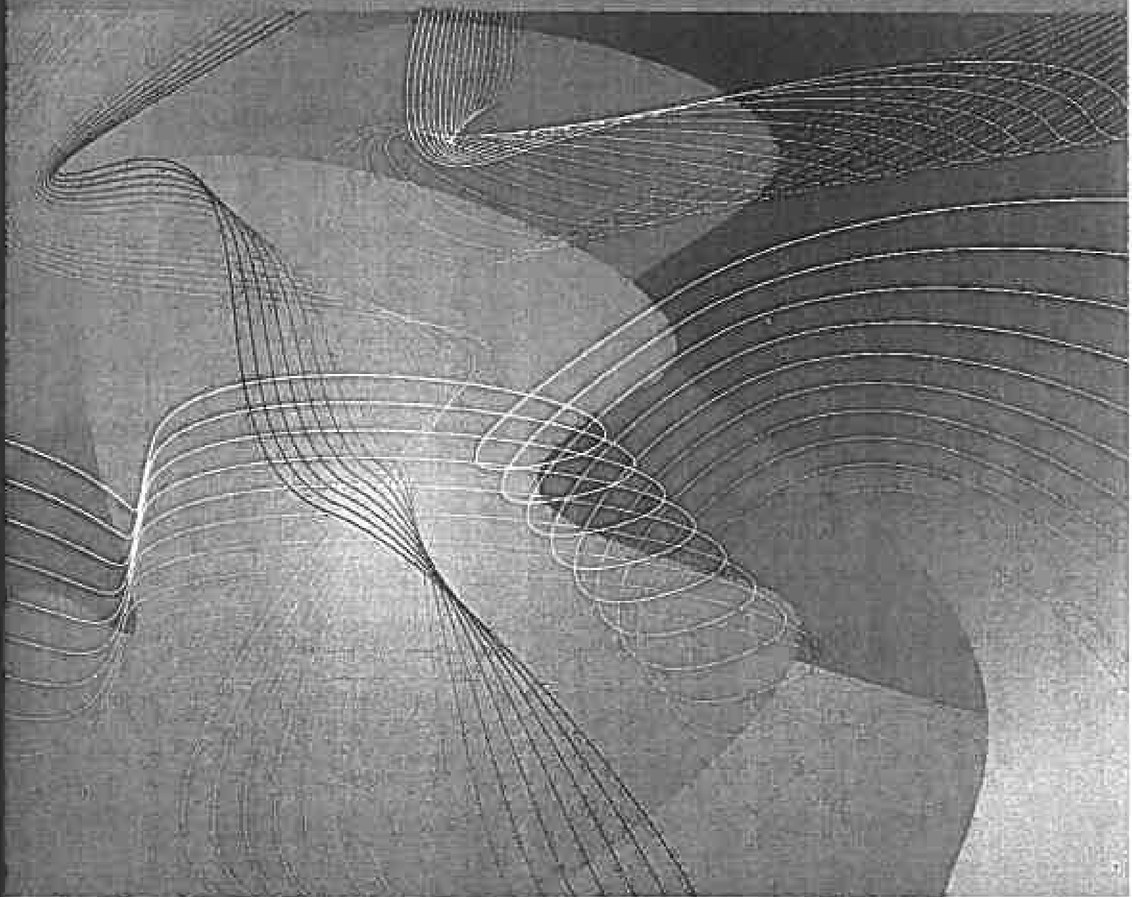
ROUTLEDGE

# COMMUNICATION AND ENGAGEMENT WITH SCIENCE AND TECHNOLOGY

## Issues and Dilemmas

A Reader in Science Communication

Edited by John K. Gilbert and Susan Stocklmayer



# COMMUNICATION AND ENGAGEMENT WITH SCIENCE AND TECHNOLOGY

Science communication seeks to engage individuals and groups with evidence-based information about the nature, outcomes, and social consequences of science and technology. This text provides an overview of this burgeoning field—the issues with which it deals, important influences that affect it, the challenges that it faces. It introduces readers to the research-based literature about science communication and shows how it relates to actual or potential practice. A "Further Exploration" section provides suggestions for activities that readers might do to explore the issues raised. Organized around five themes, each chapter addresses a different aspect of science communication:

- Models of science communication—theory into practice
- Challenges in communicating science
- Major themes in science communication
- Informal learning
- Communication of contemporary issues in science and society

Relevant for all those interested in and concerned about current issues and developments in science communication, this volume is an ideal text for courses and a must-have resource for faculty, students, and professionals in this field.

**John Gilbert** is Professor Emeritus of The University of Reading, Visiting Professor of King's College London and Editor-in-Chief, *International Journal of Science Education*.

**Susan Stocklmayer** is Professor of Science Communication and Director of the Australian National Centre for the Public Awareness of Science at the Australian National University.

John Gilbert and Susan Stocklmayer are Joint Editors of *International Journal of Science Education, Part B: Communication and Public Engagement.*

# COMMUNICATION AND ENGAGEMENT WITH SCIENCE AND TECHNOLOGY

## Issues and Dilemmas

*A Reader in Science Communication*

*Edited by John K. Gilbert and Susan Stocklmayer*

Routledge
Taylor & Francis Group
NEW YORK AND LONDON

First published 2013
by Routledge
711 Third Avenue, New York, NY 10017

Simultaneously published in the UK
by Routledge
2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

*Routledge is an imprint of the Taylor & Francis Group, an informa business*



*Library of Congress Cataloging in Publication Data*
Communication and engagement with science and technology : issues and dilemmas : a reader in science communication / edited by John K. Gilbert and Susan M. Stocklmayer. — 1 [edition].
pages cm
Includes bibliographical references and index.
ISBN 978-0-415-89625-2 (hbk : acid-free paper) — ISBN 978-0-415-89626-9 (pbk : acid-free paper) — ISBN 978-0-203-80752-1 (e-book) (print) 1. Communication in science. I. Gilbert, John (John K.) editor of compilation. II. Stocklmayer, Sue, editor of compilation.
Q223.C6555 2013
501' 4—dc23
2012019156

ISBN: 978-0-415-89625-2 (hbk)
ISBN: 978-0-415-89626-9 (pbk)
ISBN: 978-0-203-80752-1 (ebk)

Typeset in Bembo
by Saxon Graphics Ltd, Derby

Printed and bound in the United States of America on sustainably sourced paper by IBT Global

SUSTAINABLE FORESTRY INITIATIVE
Certified Sourcing
www.sfiprogram.org
SFI-01234

ıtness

:orial material, and of the authors
:h sections 77 and 78 of the

›roduced or utilised in any form
›r hereafter invented, including
:trieval system, without

; or registered trademarks, and are
ıfringe.

issues and dilemmas : a reader in
ʌ1. Stocklmayer. — 1 [edition].

-0-415-89626-9 (pbk : acid-free
unication in science. I. Gilbert,
›r of compilation.

ly

# CONTENTS

# PREFACE

## The Changing Face of Science Communication

*John K. Gilbert and Susan Stocklmayer*

'Science communication' is a convenient phrase for 'communications concerned with science, engineering, or technology'. The interplay between these three aspects has increased steadily over the past few hundred years, accompanied by increased industrialization worldwide, but the need to communicate their impact has been recognized only relatively recently. Science communication as a discipline (as distinct from science journalism) has emerged in the past 20 years or so, and has deepened and strengthened as scientific and technological issues of importance to humanity have gripped the public's attention. In this book, science, engineering, and technology—and sometimes mathematics—are often grouped together as 'science'. This is for simplicity of writing, and we acknowledge that it is less than ideal. Other expressions such as STEM (Science, Technology, Engineering and Mathematics) have a real place in educational literature, but we have decided that this acronym, and others like it, have formal overtones that are out of place here.

Increasingly, various interactions of science, engineering, and technology have affected people's personal lives through better health, better living standards, and better nutrition. More efficient transport has altered the social dynamics of villages, towns, and cities. At the same time, the economic impacts of changing agricultural practices and unevenly distributed resources have had an effect on every citizen in the developed and developing world. In sum, our cultural lives have changed to the point where we no longer perceive ourselves or others as we did even fifty years ago. These global changes make a new approach to science communication imperative.

### Changes in Who Communicates

When Western science first began to be institutionalized, beginning with the founding of the Royal Society in England in 1660, scientists met face to face in

Communication

'er

ır 'communications concerned
nterplay between these three
ındred years, accompanied by
l to communicate their impact
: communication as a discipline
the past 20 years or so, and has
ological issues of importance to
his book, science, engineering,
ıre often grouped together as
acknowledge that it is less than
Technology, Engineering and
ature, but we have decided that
ones that are out of place here.
engineering, and technology
ı better health, better living
transport has altered the social
ne time, the economic impacts
distributed resources have had
developing world. In sum, our
ve no longer perceive ourselves
se global changes make a new
.

utionalized, beginning with the
560, scientists met face to face in



order to share their discoveries. Engineers also began to do so. As the number of practitioners grew, their results were usually published in printed papers intended only for their peers. The specialized technical languages that grew up around this practice made the papers accessible only to the initiated—that is, to other scientists and engineers. Scientists, in particular, began to be seen as an elite group, cleverer than other people, and communicating in a mysterious and confusing secret language. This idea of elitism was reinforced though formal education systems, beginning with the introduction of 'science' as a formal school subject in the late 1800s. From 1860 onwards, in the UK at least, the purpose of the science curriculum was predominantly to screen students and prepare those perceived to be the most able for the study of sciences at university level. The outcome of this approach was that the barrier to access and understanding of science was steadily raised. This was despite some dissenting voices, who from the beginning argued that school science should be included in the education of every citizen.

The practice of science today, however, needs public support and public funding. This need for support has been graphically underlined by crises of science that have affected many nations. Mad cow disease (BSE), bird flu (SARS), genetic modifications of crops and animals, climate disasters, radiation disasters—the list goes on. The public voices from many quarters have been loud in condemnation of poor communication practices attached to many of these crises, and scientists have often been blamed. Those interested in science communication need to hear these varied public concerns and understand their effects on the practices and policies of science. To draw an analogy from chemistry, science communication has become 'multivalent'. That is, it involves a wide range of people in different groups, interacting with each other.

## Changes in how Communication can Take Place

The present recognition of science communication as an important aspect of the practice of science itself has come about because ordinary people are now accessing information in an unprecedented way, in both quantity and quality. Information about science, however, is often confusing and still difficult both to access and to understand. It would be easy to say that this is not very important—that scientists will continue to research and publish, no matter what anyone else thinks or does—but this is a naïve view of how science works. The practice of science has changed, and with it, the need for science communication.

Communications are now produced by, and directed at, scientists, mediators, funding agencies, politicians, and many other public groups. There are many players and they communicate through different modes. In addition to a massive growth in the number of scientific journals, 'mediation' is now provided between the communities of scientists and between their many 'publics' in a wide variety of ways including newspapers, magazines, TV, books, museums and science centres and, increasingly, the Internet. Each of these modes has a particular strength and is well received by different audiences. Each also requires to be better understood in terms of its impact, its strengths and its weaknesses.

These changes mean that well-educated scientists, engineers, and technologists must today both know about, and have skills in, science communication. Moreover, there continues to be a steady growth in jobs that entail not only specialist knowledge of science but also these particular science communication understandings and skills. All knowledge that is valued rests on a consensus by some group of people as to what is distinct about it and why it should be valued. Each distinct claim to be a form of knowledge rests on its epistemology, the grounds for making the claim. Science communication, which is only slowly establishing its claim to be a distinct form of knowledge, rests on the epistemologies of science. In addition to those, it rests on the use of social sciences to explore the impact of science on the psychology of individuals, the sociology of groups, and the economic consequences for all. These are complex issues.

## Science, Engineering, Technology, and Social Sciences

The aim of science is to understand the world-as-experienced: that is, how it behaves, of what it is composed, and why that behaviour occurs. Despite the fact that there is no one model of how a scientific enquiry should take place or be evaluated, there are some statements about the epistemology of science that can safely be made. For example, science as currently practised assumes realism (the world exists independently of our experience), objectivity (on the part of researchers), methodological pluralism (in the conduct of enquiry), logicality (in the analysis of data), predictability (in respect of future events), and tentativeness (the modification of ideas is always possible). The persistence of scientific ideas over many years is a tribute to their usefulness. Many people also believe that science is socially shaped to some extent, recognising that it is influenced by what seems particularly salient within a given tradition at a particular time.

Engineering, on the other hand, is concerned with design, focused on improving the quality of life or the efficiency of processes through practical applications of science. In the application of engineering principles, the methodology of science is used to make and to test predictions. Technology takes this further: it is the use of techniques at a practical level within an organisational framework, to solve the problems that arise as the products of engineering are developed and implemented. The ideas of science, applied within engineering, are actually implemented in technology and have a direct impact on the lives of humans and other species.

It is concern over the nature and consequences of these impacts that has led to the recent rapid rise of the importance of science communication. Any examination of these effects, however, requires use of the social sciences, which therefore confers on science communication studies a particular multidisciplinary

t audiences. Each also requires
strengths and its weaknesses.
.ts, engineers, and technologists
in, science communication.
:h in jobs that entail not only
:icular science communication
valued rests on a consensus by
it and why it should be valued.
rests on its epistemology, the
iication, which is only slowly
of knowledge, rests on the
, it rests on the use of social
psychology of individuals, the
ıces for all. These are complex

## Social Sciences

ıs-experienced: that is, how it
ɔehaviour occurs. Despite the
ific enquiry should take place
ıt the epistemology of science
as currently practised assumes
‹perience), objectivity (on the
(in the conduct of enquiry),
· (in respect of future events),
vays possible). The persistence
their usefulness. Many people
me extent, recognising that it
: within a given tradition at a

ned with design, focused on
of processes through practical
f engineering principles, the
› test predictions. Technology
at a practical level within an
ıs that arise as the products of
The ideas of science, applied
ı technology and have a direct

es of these impacts that has led
science communication. Any
ıse of the social sciences, which
ies a particular multidisciplinary



aspect. In this book, the many factors affecting the relationship between these disciplines are explored.

## The Aims of this Book

This book is intended to:

- Provide an overview of the field of 'science communication', i.e. what it deals with, important influences that affect it and, in particular, the challenges that it faces;
- Provide an introduction to the researched-based literature about science communication, especially in respect of these challenges;
- Show how this literature relates to the potential and actual practice of science communication;
- Provide suggestions for activities that readers might do to explore the issues raised.

## The Themes that are Addressed in this Book

After this introductory Preface, *The changing face of science communication*, the book is organized in five parts:

### *Part I: Models of Science Communication—Theory into Practice*

In this section, two theoretical chapters give an overview of the ways in which science is communicated. In Chapter 1, Masakata Ogawa sets out a challenge to communicators, questioning their purpose in communicating and the place of public engagement in science. He introduces the idea of a communication model. In Chapter 2, Sue Stocklmayer develops this theme.

### *Part II: Challenges in Communicating Science*

In Chapter 3, Suzette Searle discusses the engagement between the communities of science and the general public, from the perspective of practicing scientists. Such communication will only be meaningful if there are clear roles for science in personal, social, and public policy. These roles are suggested by Will Grant in Chapter 4. In Chapter 5, Lindy Orthia discusses what is needed if public resistance to science is to be overcome.

### *Part III: Major Themes in Science Communication*

This section addresses important aspects that take centre stage when the themes being communicated are associated with science. In Chapter 6, Craig Trumbo discusses the notion of 'risk'. Maurice Cheng, Arthur M.S. Lee, Ka-Lok Wong and Ida Mok tackle the vexed subject of 'the use of numbers in science communication' in Chapter 7. The issues of ethics and accountability in both science and in communicating about science are debated by Rod Lamberts in Chapter 8. The nature of and relationships between evidence and belief are discussed by Michael Reiss in Chapter 9.

## Part IV: Informal Learning

Part IV discusses learning about science in various settings. In Chapter 10, John Gilbert presents those issues that control the effectiveness of science communication and suggests 'best practice' in them. Whilst 'science education' is established in the formal education sector, the ideas of 'science communication' are still emerging. In Chapter 11, Sean Perera and Sue Stocklmayer discuss the relationships between the two. The great importance of informal environments in science communication are recognised in Chapter 12, where Léonie Rennie discusses 'best practice' in that provision.

## Part V: Communication of Contemporary Issues in Science and Society

Many matters of public interest and concern nowadays involve science and their implications for human affairs. This section addresses several important examples. Climate change is an issue that has occupied global attention for more than two decades: in Chapter 14, Justin Dillon and Marie Hobson discuss the evolution of responses to this complex environmental problem. Communication issues become pressing when a general issue turns into a crisis: in Chapter 15, Yeung Chung Lee evaluates the effectiveness of communications to the public using the case study of the outbreak of Severe Acute Respiratory Syndrome (SARS) in Hong Kong. In Chapter 16, Julia Corbett talks about communication of the great challenges associated with on-going attempts to achieve 'sustainability' in respect of the Earth's resources. Indigenous science and local knowledge are increasingly recognized as having important contributions to make to our understanding of science; Yonah Seleti poses the challenges of incorporating these worldviews into a more narrow Western science culture in Chapter 16. Last, this section and the book conclude with an address, by Chris Bryant, to an issue that has only gradually emerged as the study of genetics and behaviour have become sophisticated: What does it mean to be human and what are the implications for the communication of science?

# ABOUT THE AUTHORS

**Chris Bryant AM** has a BSc in Zoology from King's College London, an MSc in Biochemistry from University College London, and a PhD in Biochemistry from King's College London. Joining the Australian National University in 1963, he has served as Professor of Zoology, Dean of Science, and Head of the School of Biology. Together with Dr. Mike Gore, he set up the ANU Shell Questacon Science Circus which lead to the establishment of the Australian National Centre for the Public Awareness of Science. Professor Bryant was admitted to The Order of Australia in 1999. email: chrisandanne@grapevine.com.au

**Maurice M.W. Cheng** is Assistant Professor in the Faculty of Education, The University of Hong Kong. His major research interests are in the teaching and learning of science, with particular focuses on the roles and uses of diagrams, mental visual representations, scientific models, and modelling. His teaching areas include quantitative literacy, science and chemistry education, and learning psychology. He is a registered pharmacist and has taught in secondary school, and he serves on the official curriculum and assessment committees (science and chemistry subjects) of Hong Kong. email: mwcheng@hkucc.hku.hk

**Julia B. Corbett** is a Professor in the Department of Communication at the University of Utah, USA. She studies science, environmental, and health communication both from a macro-sociological view of social conflict and change, and a micro-social view of attitude and behavior change. She authored one of the first texts in environmental communication, *Communicating Nature: How We Create and Understand Environmental Messages* (2006, Island Press). Recently, her scholarship has shifted to include creative nonfiction essays about human relationships with the natural world. email: corbett.julia@gmail.com

S

ı King's College London, an MSc
ıdon, and a PhD in Biochemistry
Australian National University in
Dean of Science, and Head of the
· Gore, he set up the ANU Shell
e establishment of the Australian
of Science. Professor Bryant was
email: chrisandanne@grapevine.

in the Faculty of Education, The
h interests are in the teaching and
ın the roles and uses of diagrams,
lels, and modelling. His teaching
chemistry education, and learning
d has taught in secondary school,
ssessment committees (science and
wcheng@hkucc.hku.hk

tment of Communication at the
ence, environmental, and health
gical view of social conflict and
nd behavior change. She authored
unication, *Communicating Nature:*
*tal Messages* (2006, Island Press).
de creative nonfiction essays about
email: corbett.julia@gmail.com



**Justin Dillon** is Professor of Science and Environmental Education and Head of the Science and Technology Education Group at King's College London. After taking a degree in chemistry he taught in six inner London schools until 1989 when he joined King's. Justin is co-editor of the *International Journal of Science Education* and was President of the European Science Education Research Association from 2007-11. He is one of the coordinators of the Economic Social Research Council's Targeted Initiative on Science and Mathematics Education and is involved in R&D projects with museums, science centres, and botanic gardens in Europe and beyond. email: justin.dillon@kcl.ac.uk

**John K. Gilbert** is Professor Emeritus of The University of Reading, Visiting Professor of King's College London, Editor-in-Chief of International Journal of Science Education (IJSE)(A), and Co-Editor (with Susan Stocklmayer) of *IJSE(B) Communication and Public Engagement*. Against a background in chemistry, he has progressively worked on conceptual development, models and modelling, visualization, all in respect of the learning of science. Most recently he has begun to link these interests to informal science education for all. email: john.k.gilbert@btinternet.com

**Will J. Grant** is a researcher and lecturer at the Australian National Centre for the Public Awareness of Science (CPAS) at the Australian National University. Will holds a BA (Hons) and a PhD in Political Science (The University of Queensland). Will's research, teaching, speaking, and writing has focused mostly on the intersection of science, politics and society, and how existing relationships in this intersection are changing in response to new technologies. Current projects include longconversations.net, howtokeepfood.com and society5.net. email: will.grant@anu.edu.au

**Marie Hobson** is the Senior Audience Advocate at the Science Museum London. Using evidence from research conducted by herself and her team, she advocates on behalf of audiences to ensure that visitors' needs and wants are met and barriers to engagement removed. Marie completed her MA in Museum Studies at the University of Leicester in 2008. email: mchobson84@gmail.com

**Rod Lamberts** is the Deputy Director of the Australian National Centre for the Public Awareness of Science at the Australian National University. He has been a presence in the international science communication space for 15 years and supervises students across a diverse range of science communication research projects at the Honours, Masters, and PhD levels. Rod has been a pioneer in the development and delivery of science communication courses in Australia since 2000. He is also a science communication consultant for UNESCO in the Pacific, and regular public commentator on science in the media, and science and public policy. email: rod.lamberts@anu.edu.au

**Arthur M.S. Lee** is a Teaching Consultant at the Faculty of Education in the University of Hong Kong. He was a secondary school mathematics teacher in Hong Kong for 12 years before joining the University. He is interested in understanding mathematics teaching and learning in technology rich environments. His current PhD study focuses on students' conception in geometry through exploratory tasks designed with dynamic geometry tools. Since 2009, he has taken part in design and teaching of new courses with colleagues in the Faculty of Education, focusing on developing quantitative literacy among first year undergraduates. email: amslee@hku.hk

**Yeung Chung Lee** is an Associate Professor at the Department of Science and Environmental Studies, Hong Kong Institute of Education, Hong Kong SAR, China. He teaches primary science education, biology education and health education from bachelor to doctorate levels. His research focuses on Science-Technology-Society-Environment education, the nature of science, inquiry-based learning, and the use of models and analogies for developing students' conceptual understanding and metacognitive reflection. His recent interest is studying secondary students' decision-making about socio-scientific issues from cross-contextual and cross-cultural perspectives. email: yclee@ied.edu.hk

**Ida Ah Chee Mok** is Associate Professor and Associate Dean in the Faculty of Education at Hong Kong University. Her research interest includes mathematics teaching and learning and teacher education. Her teaching areas include quantitative literacy and mathematics education. She is co-editor of *Making Connections: Comparing Mathematics Classrooms Around the World* and author of *Learning of Algebra: Inspiration from Students' Understanding of the Distribution Law*. email: iacmok@hku.hk

**Masakata Ogawa** is Professor of Science Education and Dean of the Graduate School of Mathematics and Science Education at Tokyo University of Science. After a doctorate in plant physiology at Kyoto University, he taught science education at Ibaraki University, Hiroshima University, and Kobe University. His research interests include cultural and policy aspects of science education, science teacher education and science literacy. He received the Award for Distinguished Contributions through Research from the Japan Society for Science Education in 2003. He served as President of the Japan Society for Science Education and President of the East Asian Association for Science Education. email: ogawam@rs.kagu.tus.ac.jp

**Lindy A. Orthia** is a lecturer in science communication at the Australian National Centre for the Public Awareness of Science at the Australian National University. She trained as a biologist (La Trobe University) and worked for several scientific research organisations before changing disciplines to science communication. Her PhD thesis examined representations of the political, t at the Faculty of Education in the ıdary school mathematics teacher in the University. He is interested in ıd learning in technology rich ɔcuses on students' conception in ıed with dynamic geometry tools. ınd teaching of new courses with ıcusing on developing quantitative ıail: amslee@hku.hk

· at the Department of Science and e of Education, Hong Kong SAR, on, biology education and health . His research focuses on Science- n, the nature of science, inquiry- analogies for developing students' ≥ reflection. His recent interest is ʒ about socio-scientific issues from ·es. email: yclee@ied.edu.hk

Associate Dean in the Faculty of arch interest includes mathematics on. Her teaching areas include ion. She is co-editor of *Making Around the World* and author of *ıderstanding of the Distribution Law.*

:ation and Dean of the Graduate at Tokyo University of Science. o University, he taught science niversity, and Kobe University. cy aspects of science education, y. He received the Award for ·h from the Japan Society for 'resident of the Japan Society t Asian Association for Science

ımunication at the Australian ence at the Australian National e University) and worked for :hanging disciplines to science presentations of the political,



social, economic, and cultural aspects of science in the British television series *Doctor Who*, and science in popular fiction continues to be her primary research interest. email: lindy.orthia@anu.edu.au

**Sean Perera** is a Research Fellow at the Australian National Centre for the Public Awareness of Science at the Australian National University. Sean's research explores aspects of science education from a science communication perspective and covers teachers' professional development, informal science learning, and communicating science to culturally diverse audiences. He is currently developing programmes to enable participation of non-traditional audiences—such as mothers, grandparents and migrant refugees—with mainstream science communication. After training as a microbiologist and crop scientist (U. Bangalore and U. Peradeniya), Sean completed his PhD in science communication at ANU. email: sean.perera@anu.edu.au

**Michael J. Reiss** is a biologist and educator. He is Pro-Director: Research and Development and Professor of Science Education at the Institute of Education, University of London, Chief Executive of Science Learning Centre London, Vice President and Honorary Fellow of the British Science Association, Honorary Visiting Professor at the Universities of Birmingham and York and the Royal Veterinary College, Honorary Fellow of the College of Teachers, Docent at the University of Helsinki, Director of the Salters-Nuffield Advanced Biology Project, a member of the Farm Animal Welfare Committee, and an Academician of the Academy of Social Sciences. email: m.reiss@ioe.ac.uk

**Léonie J. Rennie** is Emeritus Professor of Science and Technology in the Science and Mathematics Centre at Curtin University and Adjunct Research Professor in science communication at the University of Western Australia. Her research focuses on learning science and technology in integrated and out-of-school contexts, and scientific literacy. She has co-authored significant reports for the Australian Government and been involved in nationally funded programs raising the awareness of science in the community. She serves on the editorial boards of several journals. In 2009, she received the Distinguished Contributions to Science Education Through Research Award from the National Association for Research in Science Teaching. email: l.rennie@curtin.edu.au

**Suzette D. Searle** is a Postdoctoral Research Fellow with the Australian National Centre for the Public Awareness of Science where she focuses on surveying public opinion on science-related topics. Her PhD thesis was "Scientists' communication with the general public: An Australian survey". Before working in science communication for the last 15 years, she was awarded two degrees in forestry and worked for 17 years for CSIRO, the Australian national science research organization. email: suzette.searle@anu.edu.au

**Yonah Seleti** is the Acting Deputy Director General for Human Capital and Knowledge Systems in the Department of Science and Technology in South Africa. He is also responsible for the National Indigenous Knowledge Systems Office. He has been a leader in the integration of African traditional medicines through the "Farmer to Pharma" initiative, bringing together indigenous knowledge, biodiversity, and biotechnology. He has also taught as visiting professor at Tulane University (New Orleans) and Roskilde University in Denmark. He has been a member of several ministerial committees and is chairperson of the Digital Innovation of South Africa, a digital library of liberation heritage. email: yohan.seleti@dst.gov.za

**Susan Stocklmayer AM** is Professor of Science Communication and the Director of the Australian National Centre for the Public Awareness of Science, which is also the UNESCO Centre for science communication. Her major research concerns issues related to science learning at the interface between science and the public, and gender and multicultural issues. As part of the University's outreach she has presented science shows, lectures and workshops on all five continents. She is the co-Editor in Chief of the *International Journal of Science Education Part B: Communication and Public Engagement* and was awarded The Order of Australia in 2004. email: sue.stocklmayer@anu.edu.au

**Craig Trumbo** earned a BA and MS in journalism at Iowa State University and a Ph.D. in Mass Communications at the University of Wisconsin-Madison with a focus on environmental health risk communication. He also holds a certificate degree in Geographic Information Systems from Pennsylvania State University. He is currently Professor in the Department of Journalism and Technical Communication at Colorado State University. Professor Trumbo's research addresses a range of interests located at the intersection of health, risk, and the environment. His areas of university teaching include mass media effects, mass and interpersonal communication theory, communication of science and technology, and risk communication. email: ctrumbo@mac.com

**Ka Lok Wong** is a Teaching Consultant at the Faculty of Education, The University of Hong Kong, where he received his BSc (mathematics) and Cert. Ed. (mathematics). He also holds a BA (philosophy) from the Catholic University of Leuven, Belgium, and an MA (mathematics education) from the Institute of Education, London. After teaching secondary school mathematics, he became involved in mathematics teacher education. Recently he has also been involved in teacher education for liberal studies where he sees the relevance of quantitative and scientific literacy. email: klwong3@hku.hk