

SCOPE 8

Risk Assessment of Environmental Hazard

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Foreword

Threats to human health and well-being arising in or transmitted through the environment are a matter of growing concern to the international scientific community, to the general public, and to the governments which traditionally look to scientists for advice. There are at least three important reasons for this growing concern:

1. The application of rapid advances in science and technology to the control and manipulation of the environment is creating new hazards, often as inadvertent side effects of economic development.
2. Refinement of measurement techniques and the expansion of environmental monitoring networks are revealing the existence of hazards which may have been present for some time but which were previously undetected.
3. There is a growing public awareness of environmental hazards resulting from adverse experiences and the attention focused upon them by the media.

The processes through which human society at the individual, family, community, national and international levels seeks to assess and comprehend the significance of environmental threats are imperfectly understood. It is sometimes assumed that scientific research followed by the release of information on the threats themselves, together with monitoring of environmental conditions, will lead to appropriate decisions. Recent experience indicates that this is not consistently the case. Therefore, in the establishment of its mid-term programme, SCOPE established a project to investigate some relevant aspects of environmental information and policy. Under the title of the Communication of Environmental Information and Societal Assessment and Response, an activity has been organized for the purpose of examining the present state-of-the-art with respect to coping with environmental risks. A workshop was organized at the Holcomb Research Institute in Butler University, Indianapolis, Indiana with the support of the Holcomb Institute in August, 1973. The workshop was entitled '*International Research on Societal Response to Scientific Information About Man-Made Environmental Hazards.*' Several recommendations were made for future directions which might be undertaken as part of SCOPE Project 7.

Subsequently one of these recommendations, namely to study the process of environmental risk assessment, was supported by the United Nations Environment Programme and the Electric Power Research Institute of Palo Alto, California. Professor Robert W. Kates of Clark University, Worcester, Massachusetts was asked to undertake a study on comparative risk assessment and to this end a workshop was held at Woods Hole, Massachusetts from March 31st to April 4th, 1975 under the title '*Comparative Risk Assessment of Environmental Hazards in an International Context.*' A report on this workshop is available from Professor Kates.

Drawing on the background papers of the workshop and the discussions that took place, Professor Kates has now prepared a report entitled '*Risk Assessment of Environmental Hazard.*'

This report reviews the wide field of risk assessment as it has developed in recent years. The report will be of value to the international scientific community and to environmental managers and administrators. More importantly, it is a first step in the process of systematizing and organizing the knowledge that we now have of ways in which risks are and might be assessed. It provides a basis for further investigation and points to specific areas of research which need to be undertaken if humankind is to develop a more rational approach to coping with the threats arising in the environment.

IAN BURTON,
Chairman,
SCOPE Project No. 7

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Preface

This report first appeared as a background paper for the Workshop on Comparative Risk Assessment of Environmental Hazards in an International Context, held at Woods Hole, Massachusetts (U.S.A.) March 31–April 4, 1975. It was made possible by funds from the United Nations Environment Programme and the Electric Power Research Institute. At the Workshop it received the thoughtful consideration of the attendees: Gyula Bora, Gilbert Bresson, Ian Burton, William Clark, Daniel Dworkin, Ward Edwards, José Guisard Ferraz, Kenneth Guy, S. Waqar Husaini, William Ittelson, Raphaël Kasper, Ashok Khosla, Alexandre-Charles Kiss, Edward Lawless, Lennart Lundqvist, Thomas Malone, Olli Miettinen, Ezra Mishan, Harry Otway, Philip Pöhner, Richard Rudman, Paul Slovic, Chauncey Starr, Larry Tombaugh, Christopher Whipple, Gilbert White, and Anne Whyte. Subsequently it received further review from Kenneth Boulding, William Clark, Daniel Dworkin, Don Friedman, Colin Green, Thomas Malone, Paul Slovic, Gilbert White, and Anne Whyte. And it has been further reviewed on behalf of SCOPE by Gordon C. Butler, Gordon T. Goodman, R. E. Munn, and J. S. Weiner. They are collectively responsible for the many improvements in the report since the Workshop; its inaccuracies and inadequacies are solely my own.

Prior to its preparation I undertook a variety of consultations, including visits in London with F. E. Guaschi, J. E. Hutchen, David Lowenthal, Ron Pollard, and H. R. Rokeby-Johnson; in Milan with Craig Sinclair; in Vienna with Wolf Häfele, Harry Otway, Harry Swain, and the staff of the joint project of IIASA-IAEA on risk assessment; and in Warsaw with Adolf Ciborowski, Stanislaw Leszczycki, and Dariusz Stanislawski. By phone and correspondence I received help from David Bradley, Lloyd Free, Harold Green, Karl-Göran Möler, Keshavan Nair, Willi Schürpf, and Erwin Straub. Dorothy Noyes Kane, in the course of initiating me into the attitudes of the public health profession, introduced me to the ideologies of risk assessment, and I was then fortunate to explore these and other notions in the course of a week spent with the participants in the Engineering Foundation's Workshop on Risk-Benefit Methodology and Application at Asilomar, California, at the invitation of David Okrent.

The final section of this work, which is related to needed improvements in theory, method and practice, draws on the recommendations of a series of research workshops held in January and February, 1977 on hazard identification, risk estimation and evaluation, and communication and decision-making. Jointly sponsored by the U.S. National Committees for SCOPE and the Man and the Biosphere Program (MAB) and funded by the U.S. National Science Foundation, the workshops added to this review the thoughtful considerations of the participants. These were: Maya Bat-Hillel, Katrin Borchering, Marilyn Bracken, William Clark, Dennis Ducsik, Ward Edwards, Baruch Fischhoff, Charles Fritz, Eugene Haas, Robert Harris, Christoph Hohenemser, Gordon Jacobs, Daniel Kahneman, Roger Kasperson, Henry Kissman, Gary Kreps, Howard Kunreuther,

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Undertaking an international report exceeds the capacity of the solitary scholar; the foregoing list testifies to the degree of collective effort. The list of acknowledgements is long and my gratitude is deep; most of all it is to those whom I may have inadvertently overlooked.

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R.W.K.

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Introduction

Each year, at an increasing rate, we discover, rediscover or create anew threats to and from the environment. Identifying these hazards, estimating the threat they pose to humanity and the environment, and evaluating such risk in a comparative perspective is the work of risk assessment. This is not the work of specialists alone, for everyone makes appraisals of environmental threat. From the traveller's hesitancy at the water pitcher – 'Is it safe to drink?' – to the global query about nuclear waste – 'Is it safe to dump?' – individuals and societal groups make judgements about threatening situations arising from or related to the environment.

As environmental threat proliferates, scientists find themselves (or place themselves) in the center of concern, controversy, and policy formulation. Increasingly, this is happening to those working on fundamental as well as more applied problems; and also to those who disseminate their findings in the scientific literature, through more popular media, or to formal channels of advice and decision. As society needs to rely on the discoveries and judgements of science for its safety and well-being, there is need for both the purveyors and users of scientific knowledge to understand what is known about the identification of hazard, the assessment of risk and its social evaluation.

Such knowledge includes diverse theories of society and environment, of probability and statistical inference, of decision, choice and value, as well as formal and informal, logical and intuitive, methods and modes of assessment. And such theory and methods need to be considered in the context of praxis: actual experience with the risk assessment of environmental hazards and observations both from related areas of human endeavours and the controlled social laboratory. While such a task is probably beyond the efforts of the single scientist, this monograph can serve as an introductory review and a source for tentative generalizations.