PREFACE

Earth is unique, a planet of rare beauty and great value.

I firmly believe that conclusions about global warming reached by researchers, such as those at my university in the Byrd Polar Research Center, are valid and based on very solid science. They are telling us that humans, by their actions, are causing the global climate to change. It therefore puzzles me when politicians, representatives of the business community, and even some physicists and chemists, make public statements that this is “junk” science. Or that it is just another “chicken little” scare of the “environmentalists”. Studies on public understanding of science among Americans by Jon Miller and his colleagues and the current political power of those advocating “creation science” as a component of the science curriculum, suggests to me that there is a deep misunderstanding of the nature of science here in the United States, perhaps shared by some scientists. If the resources devoted to the improvement of science teaching and curriculum following World War II had been effectively used I would expect that there would be an acceptance of good science by influential members of our society, and by most citizens. However, I do believe that the programs supported by the National Science Foundation over the past forty years have been effective in establishing strong science programs in our schools. After all, my colleagues and I have been recipients of some of that support for curriculum and teacher enhancement programs.

My hypothesis concerning this apparent paradox is that these science teaching renewal programs have given priority to the perceived needs of a country in conflict. As a result, they focused on the type of science supporting our technical needs, neglecting an equally important part of science, what we in this book are calling the “system sciences”. Such neglect has continued throughout the science restructuring programs taking place in the USA and elsewhere around the world—thus, the need for this book.

The need to re-examine our goals for science curricula

We have just ended a long period of conflict between the major nations, the Cold War. Science and science education played a central role in waging that war and the “hot wars” that preceded it. Now, however, science education and its practitioners have the opportunity of supporting changes in the goals of science as it adjusts to a new era. Science is being challenged by some to provide the knowledge to counter the devastating environmental problems that have been by-products of a century of war and economic conflict. It also can be employed to help solve the social problems resulting from the unfettered use of technology for political and economic gain. To support science in redirecting its goals, science educators must re-examine the very nature of science and its role in social, cultural and political systems. We must understand the broad nature of science and its methodologies, an understanding not always apparent in the professional dialog of science educators. It is our belief that such a re-examination will result in a significant change in science education; a
change founded on the view that science is, after all, a study of the Earth System in which we all live, not simply the basis for the pursuit of ever more technology.

This book offers a rationale and a developmental basis for such a re-examination. Authors from six countries, representing East and West, provide support and ideas for application of a different approach to the nature of the science curriculum. One we have called, Global Science Literacy. Most authors come from an Earth science academic background, but there also are physicists, chemists, and biologists represented as authors or co-authors of chapters. Global Science Literacy (GSL) is based on developments in the United States that resulted in an approach called Earth Systems Education (ESE), a curricular basis for literacy in science.

Earth Systems Education (ESE) uses the Earth system as the organizing conceptual theme for developing science curricula for the middle through high school levels. Children of all nations experience weather, flowing streams, and rock materials as parts of their environment. They observe the beauty of sunsets, the power of storms, the tranquility of a mountain scene, a flowing river, or an autumn day. A science curriculum organized around students' interdependence with nature and tapping into their interests in nature provides a common subject for study in all cultures. ESE includes the science methodology of the system sciences, a distinct contrast from the prevailing emphasis upon that of the physical sciences in the world's science curricula. A facility with the use of science methodology can provide the world's future citizens with universal methods of communication and problem solving as they enter the adult world.

This book is, in part, the result of an international process of expanding ESE into a Global Science Literacy program that includes a cooperative effort between faculties of The Ohio State University and Hyogo University of Teacher Education (Japan). A seven-month long global education project at Hyogo University provided an opportunity to synthesize many ideas that had evolved over the years of involvement by the authors in Earth science education. We have formulated a global version of science literacy for pre-college education that will not only improve citizens' understanding of science, but also enhance cross-cultural communication and understanding. We have also examined selected Asian cultures and drawn implications for a science program more in concert with those cultures, especially with its incorporation of system science methodology. In addition, a Fulbright grant for a subsequent project allowed us to evaluate Global Science Literacy as a basis for curriculum development at the upper secondary school level in Japan. This project was located at Shizuoka University and in the Division of Educational Research of Mombusho. Through contacts made during international conferences and professional trips, science educators from thirteen countries have become involved in enhancing and expanding ideas relating to Global Science Literacy.

The resulting matrix of science and social concepts and processes are proposed as a functional international definition of science literacy. If implemented in school curricula of democratic nations, we believe it will help citizens understand the role of science in solving environmental and social problems left in the wake of a century of world war and economic conflict. It can also contribute to cross-cultural understanding and cooperation between citizens and leaders of the democracies of
the world. Thus, science curricula can have a crucial role among other curricular subjects in helping students achieve a global understanding and perspective—a major objective of the social studies curriculum construct of global education.

**Organization of the book**

In the first section of the book, we lay the historical, conceptual and philosophical groundwork for GSL, a science curriculum, international in scope, conceptual in organization, centered on the students and their habitats and representative of the very broad methodology used by scientists. In the second section, authors discuss a variety of learning environments, which, though not new to GSL, are supportive of the basic goals of the curriculum effort. These environments include the Internet, cooperative learning, effective reading materials, field investigations, and authentic assessment. In the third and last section, certain issues in curriculum development are discussed with a GSL perspective. How does one develop curriculum that is conceptually organized rather than organized by the traditional disciplines? How can GSL curricula be adapted for special learners? How can field activities and aesthetics be integrated in GSL curricula? The final chapter reports the research study conducted in Japan that looked at the feasibility of implementing GSL curricula at the upper secondary school level in that country.

**Personal reflections**

One of the best practitioners of "applied science" I knew was my father. I grew up on a farm in Wisconsin. My father went no further than eighth grade in his formal schooling. From when he was a child until he retired, he worked almost every day milking cows, planting and harvesting hay and grains, and the various other duties that went into being a successful farmer. Helping him as a child, I did not understand why he did certain things. In the spring, he would plow fields following the contours of the land instead of up and down hills even though that would often have been much easier. He also alternated different crops in parallel strips around the hills. In successive years, he would alternate crops within a single strip. He allowed trees and brush to grow along fencerows harboring animals and birds that often fed off the crops he was raising. Although he kept a bull on the farm for breeding the cows, after I became a teen-ager he sold it and joined an artificial breeding cooperative. He soon became a member of its board of directors, responsible for choosing good breeding stock, recommending technical procedures, etc., all of which took some knowledge of science. Where did he learn the knowledge that supported these practices? Partly from experience and concern. However, he also consulted with our local extension agent, and although I seldom saw him reading (he was usually too busy). In later years, after I moved to Ohio, I learned that he knew about Louis Bromfield. He had read his books, especially those that discussed Bromfield's theories of conservation farming developed on his farm not far from my home in Columbus.

If my father, with a minimum of formal education, could become an applied scientist and conservationist, why not our politicians, lawyers, business
people, common everyday citizens? Those schooled in what is generally considered the best university system in the world? I suspect with the proper education in science, such as effective global science literacy programs, they could become well informed in science and of the knowledge science develops concerning our habitat. Education has become the substitute for the kinds of practical experiences formerly shared by my father and his sons. Thus, science education has a fundamental role in providing the experiences and knowledge that will lead to an effective understanding of the Earth system we all share, and that our descendants will inherit. However, it must be the right type of science education. We hope that this book and its focus on Global Science Literacy can be a contribution toward providing the "right" science education.

Acknowledgements

This project started with a discussion on Global Science Literacy with Barbara Klemm in a hotel lounge on the beach at Waikiki, Hawaii. She suggested that we put together a book that would spell out the basis and philosophy of the concept. I am thankful for her idea and the constant interest and encouragement she has provided during this project. I also appreciate the enthusiasm expressed by each of the authors and the quality of their composing and writing efforts. Almost all of our communications were accomplished over the Internet via a GSL homepage and email. The authors' responses to editing requests, and suggestions for modifications were always prompt and accurate.

A modest amount of funding was available for the actual production of the manuscript and a presentation on the book at a conference of the National Association for Research in Science Teaching. The funds came from the Alphyl Memorial Fund at The Ohio State University. This is a fund established by students and colleagues to support activities in Earth Systems Education. It is named in honor of Victor and Phyllis Mayer, my parents. Alphyl is a combination of the first letters of my mother's and her mother's first names. It is the name of the farm in Wisconsin worked by my father and the birthplace and early home of his three sons.

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Columbus, Ohio, USA
November, 2001
Global Science Literacy
Mayer, V.J. (Ed.)
2002, XIV, 242 p., Hardcover