

ENVIRONMENT

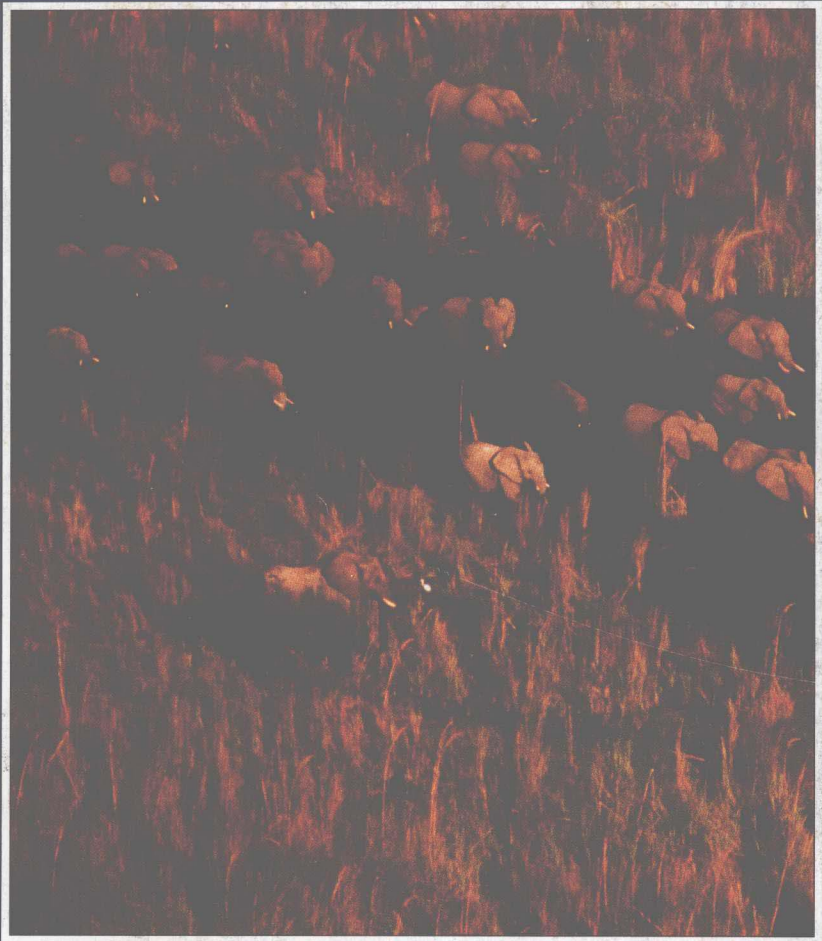
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ENVIRONMENT



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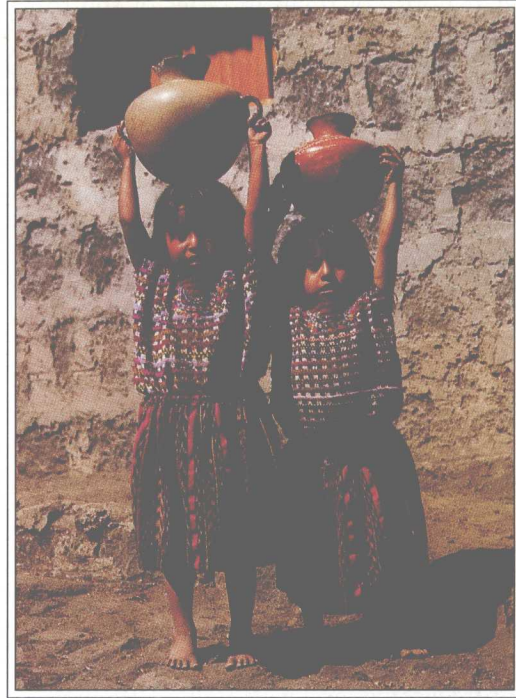
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TWO YEARS AFTER the 1992 Earth summit was held in Rio de Janeiro, 166 nations had signed the treaty, which is now considered binding. The Earth summit stood as a warning about the most critical issue of our time—the environment—and as a beacon of hope. Representatives of 178 nations had gathered in June 1992 to explore new ways to manage the planet Earth together and in harmony. Danger signs were and are everywhere, in a world divided into “haves” and “have-nots,” and it has become critical that the two begin to cooperate more effectively. The ways in which we can all work together will determine what kind of a life our children and grandchildren will lead, what kinds of expectations they can reasonably have, and how they will be able to contribute to our common prosperity.

This book is intended to be a contribution to your understanding of the way the world works, and what is happening to it as its human population expands. The environmental sciences have usually been viewed in the past as a series of disconnected subjects with few integrating themes. In this book we have tied these many statements together, for only with such a synthesis can a student understand how the world works, and what we can expect of it. Every educated person needs to know the principles that are involved, and each of us must strive to understand the fundamental issues that are pre-

sented here, so that he or she can make informed decisions about appropriate actions to take. Our future way of life will be based, ultimately, on our ability to deal with the Earth intelligently.

Since 1950, the population of the world has grown from 2.5 billion people to over 5.6 billion; a fifth of the topsoil that makes it possible for us to grow the crops that we eat and feed to our domestic animals has been lost; a third to a half of all forests, depending on the region of the world, has been cut over; the characteristics of the atmosphere have been changed drastically, with thin spots in the stratospheric ozone subjecting us to damaging ultraviolet radiation and increases in carbon dioxide and other greenhouse gases inexorably leading to global warming; and thousands of species of plants, animals, fungi, and microorganisms are being lost forever with every passing year. The 22% of the world's population who live in industrialized countries (a rapidly decreasing fraction of the total) are consuming about 80–90% of what the world is capable of producing, while the 78% of people who live in developing countries have to make do with the rest. Poor people constitute more than one-fifth of the world's population, with over a billion living on less than \$1 a day; half of them are malnourished.

Over the next three decades, up to 3 billion more people will be added to the world population,

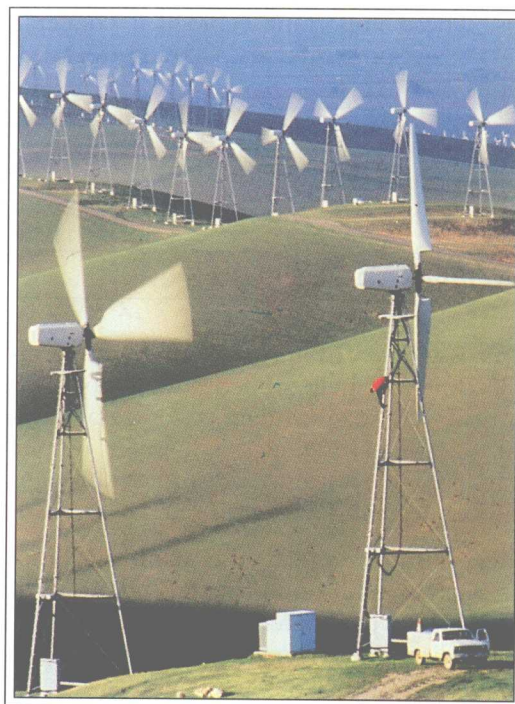
the greater majority of them in cities of the third world. Most of these people are likely to be condemned to a life of poverty and reduced expectations, as they cut over the remaining forests and exhaust the depleted soils of their native lands. We cannot sit aside and watch. The ability of our country to interact trade with other nations, critical to our economic welfare, will be sustained only to the extent that we are able to remain in meaningful contact with other nations and contribute to their stability—while our own resources are being exhausted also.

The United Nations Conference on Population and Development, held in Cairo in September 1994, as a follow-up to the Earth summit, properly emphasized the need for worldwide attention to family planning as a prerequisite to any meaningful approach to global stability. Dr. Nafis Sadiq, the director of the U.N. Family Planning Agency (UNFPA), pointed out in the documents prepared for the conference that if the estimated 300 million women in the world who do not have access to modern contraceptives and wish to have them were to be supplied with them, that the world population could level off at 8.5 billion people, a consider-

able improvement on other projections. Since we do not know if the world can indefinitely support even its present population, supplying these contraceptives would certainly appear to be a very wise investment in our common future.

For all of these reasons, it is necessary for informed citizens everywhere to take effective steps to counteract the global problems that we confront. In dealing with them, we will find new solutions to our own problems, and help to secure our own future. Pessimism is worthless as an attitude or a strategy. Rather, knowledge must be used to provide the key to effective action in a future that may only dimly resemble the familiar past. We offer you this book as a means of learning the basic facts about how the world functions, and hope that it may help to provide the tools that you will need to lead full and complete lives. We hope that it inspires you to seek additional knowledge and to take the kind of meaningful action on which our common future so clearly depends.

PETER H. RAVEN
St. Louis, Mo.
October 1994



THE CHALLENGE of creating and maintaining a sustainable environment is probably the single most pressing issue that will confront students throughout their lives. Today, environmental science is not only relevant to students' personal experience, but vital to the future of the entire planet. As humans increasingly alter Earth's land, water, and atmosphere on local, regional, and global levels, the resulting environmental problems can seem insurmountable. Armed with the proper tools, however, students need not find these issues overwhelming. *Environment* equips students with the most essential of these tools: an understanding of the concepts that underlie the problems.

One of our principal goals in preparing this book is to convey to students an appreciation of the marvelous complexity and precise functioning of natural ecosystems. *Environment* begins with an exploration of the basic ecological principles that govern the natural world, and considers the many ways in which humans affect the environment. From the opening pages, we acquaint students with current environmental issues—issues that have many dimensions and that defy easy solutions. Later chapters examine in detail the effects of human activities, including overpopulation, energy production and consumption, depletion of natural

resources, and pollution.

Although we do not sugarcoat these problems—many are very serious indeed—we try to avoid the gloomy predictions of disaster so common in environmental science textbooks today. Instead, students are encouraged to take active, positive roles, using the practical and conceptual tools presented in this book, to meet the environmental challenges of today and tomorrow.

Environment integrates important information from a number of different fields, such as biology, geology, chemistry, physics, sociology, government and politics, and demographics. Because environmental science is an interdisciplinary field, this book is appropriate for use in environmental science courses offered by a variety of departments, including (but not limited to) biology, geology, geography, and agriculture.

This book is intended as an introductory text for undergraduate students, both science and non-science majors. Although relevant to all students, *Environment* is particularly appropriate for those majoring in education, journalism, political science/government, and business, as well as the traditional sciences. We assume our students have very little prior knowledge of how ecosystems work, how matter and energy move through ecosystems, and how population dynamics affects and is affected by

ecosystems. These important ecological concepts and processes are presented in a straightforward, unambiguous manner.

INSTRUCTIONAL FEATURES

Environment is written in an interesting, conversational style that will help students remember important concepts. The up-to-date coverage of environmental topics includes many unique applications and interesting case studies throughout. Numerous learning aids are used.

1. **Chapter outlines** reflect the main headings within each chapter and provide students with an overview of the material covered.
2. **Tables and graphs** summarize and organize information.
3. Carefully rendered **illustrations** and stunning color **photographs** support concepts covered in the text, elaborate on relevant issues, and add visual detail.
4. **New terms** are in boldface, permitting easy identification and providing emphasis. Occasional boxed **Mini-Glossaries** define closely related terms or potentially confusing new terms and are located within the chapter for handy reference.
5. **Focus On** boxes spark student interest, present applications of concepts discussed, and familiarize students with current issues.
6. **You Can Make a Difference** boxes suggest specific courses of action or lifestyle changes students can make to improve the environment.
7. **Envirobriefs** provide additional topical material about relevant environmental issues, highlighting comparative data across domestic and international regions. Envirobriefs can be used as a starting point for lively classroom discussions. The source for many Envirobriefs is *EcoSource*, a Canadian environmental research and writing group located in Guelph, Ontario.
8. **Meeting the Challenge** boxes discuss pressing environmental dilemmas that defy easy answers. Examples of how others have responded to challenges allow the student to consider effective problem-solving.
9. **Chapter summaries** are presented as numbered statements at the end of each chapter to provide a quick review of the material presented.
10. **Discussion Questions** encourage critical thinking and focus on important concepts and applications.
11. **Suggested Readings** provide current references for further learning.
12. **Research Projects** at the end of most chapters direct students to conduct a local investigation related to the chapter topic.
13. Eight **interviews** with prominent individuals who are making a positive impact on the environment explore the issues and trends they consider to be most vital, and emphasize the importance of active involvement in environmental affairs.
14. Immediately following Chapter 24, a four-page spread is devoted to the “**Earth at Night**,” an annotated composite of satellite photos dramatically depicting the human presence on Earth.
15. Four **appendices** provide useful supplemental material. “A Review of Basic Chemistry” examines the fundamentals of chemistry for students who did not take chemistry in college or high school and for all other students to use as a handy reference. “How to Make a Difference” is a guide to environmental organizations and government agencies as well as information on internships. “Green Collar Professions” serves as a reference for students interested in pursuing careers in the field. “Units of Measure” provides useful conversions of units of measure used in the text.
16. A separate **glossary** is provided, facilitating rapid location of definitions.
17. In keeping with the global focus of *Environment*, the **index** provides country and U.S. state names for easy reference of regional issues.
18. A **world map** highlighting some of the environmentally sensitive areas discussed in the text appears inside the front cover and is conveniently chapter-referenced.

THE ORGANIZATION OF ENVIRONMENT

Part 1 Humans in the Environment

Chapter 1, Our Changing Environment, introduces environmental science and highlights a number of serious environmental issues. Chapter 2, Solving Environmental Problems, expands on the nature of science and presents the steps that should be followed to resolve environmental problems. Part 1

includes an interview with Lester Brown, founder of the Worldwatch Institute in Washington, D.C., on the Environmental Revolution.

Part 2 The World We Live In

Part 2 provides a detailed introduction to the principles of ecology. It is organized around the ecosystem, which is the fundamental unit of ecology. Chapter 3, *Ecosystems and Energy*, discusses the linear flow of energy through ecosystems, and Chapter 4, *Ecosystems and Living Things*, examines the living organisms that comprise ecosystems. In Chapter 5, *Ecosystems and the Physical Environment*, the cycling of materials in ecosystems is discussed. The influence of climate on ecosystems is also examined in Chapter 5. Chapter 6, *Major Ecosystems of the World*, examines the major biomes of the terrestrial environment as well as major ecosystems of the aquatic environment. Human activities relating to economics and government policies are covered in Chapter 7, *Ecosystems, Economics, and Government*. Part 2 includes an interview with George Woodwell, Director of the Woods Hole Research Center in Massachusetts, on *Global Ecology and the Human Factor*.

Part 3 A Crowded World

The principles of population ecology are discussed in Chapter 8, *Understanding Population Growth*. Although the human population is the focus of this chapter, the fact that human populations follow the same principles of population ecology as other living things is emphasized. Chapter 9, *Facing the Problems of Overpopulation*, examines sociological and cultural factors that affect human population growth. Part 3 includes an interview with Stanford University's noted population authorities, Anne and Paul Ehrlich, on *A Population Policy for the Super-Consumers*.

Part 4 The Search for Energy

The environmental impact of the human quest for energy is considered in this section. Chapter 10, *Fossil Fuels*, discusses the problems associated with the use of oil, coal, and natural gas. In Chapter 11, *Nuclear Energy*, the use of nuclear power as a viable energy source in the future is considered. Chapter 12, *Renewable Energy and Conservation*, sur-

veys energy alternatives to fossil fuels and nuclear energy. Part 4 includes an interview with L. Hunter Lovins, co-founder of the Rocky Mountain Institute in Colorado, on *Efficiency Technology: Less Energy, More Power*.

Part 5 Our Precious Resources

Overusing and abusing our natural resources is considered in detail in Part 5. Chapter 13, *Water: A Fragile Resource*, describes the problems that can arise from an overabundance or a lack of water resources. In Chapter 14, *Soils and Their Preservation*, the significance of soil, the least appreciated natural resource, is explained. Chapter 15, *Minerals: A Nonrenewable Resource*, discusses some of the problems associated with our increasing use of minerals. In Chapter 16, *Wildlife: Our Plant and Animal Resources*, the importance of biological diversity is developed. Chapter 17, *Land Resources and Conservation*, examines how we use land and the important ecological contributions made by natural areas. Chapter 18, *Food Resources: A Challenge for Agriculture*, explains the challenge of providing enough food for the ever-expanding human population. Part 5 includes two interviews, one with Russell Train, Chairman of the World Wildlife Fund in Washington, D.C., on *Preserving Biological Diversity in the Developing World*, and one with Richard Mahoney, Chairman and CEO of Monsanto Company in St. Louis, on *Delivering Biotechnology to Developing Nations*.

Part 6 Environmental Concerns

The effects of pollution are examined in this Part. Chapter 19, *Air Pollution*, looks at the local effects of air pollution, including indoor air pollution, whereas Chapter 20, *Global Atmospheric Changes*, considers regional and global effects of air pollution: acid deposition, global climate change, and stratospheric ozone destruction. Chapter 21, *Water and Soil Pollution*, discusses the closely related issues of water and soil pollution. Pesticides pollute air, water, soil, and food and contaminate so much of the biosphere that they are considered in a separate chapter, Chapter 22, *The Pesticide Dilemma*. Chapter 23, *Solid and Hazardous Wastes*, examines the problem of disposing materials we no longer need or want. Part 6 contains an interview with James Strock, Secretary for Environmental Protection for California.

Part 7 Tomorrow's World

Part 7 concludes the book with Chapter 24, *Tomorrow's World*, which presents the opinions of the authors on social responsibilities, identifying some of the most critical issues that must be grappled with today in order to assure a better tomorrow. Because Chapter 24 provides a comprehensive overview of current global problems and emphasizes the way in which all are interrelated, it can be assigned at any time during the course. Part 7 contains an interview with Edward Asner, the actor and social activist, on Tropical Rain Forest Protection.

SUPPLEMENTS

The package accompanying *Environment* is the most comprehensive on the market, and includes several unique items developed specifically to augment students' understanding of environmental issues and concerns. Together, these ancillaries provide instructors and students with interesting and helpful teaching and learning tools.

1. Regional Environmental Issues Supplements contain a wealth of information about environmental issues specific to eight different regions: Northeast, MidAtlantic, Southeast, Great Lakes, Midwest, Southwest, Northwest, and Canada. Regional Supplements are available shrinkwrapped free with the text.

These innovative regional supplements provide students with compelling and thought-provoking environmental issues. Each regional packet includes background material such as essays or reports by scientists, activists, businesses, or government agencies; editorials or news articles; policy statements; proposed legislation; and opposition statements. Additionally, discussion exercises address ten environmental issues, encouraging students to analyze issues and use problem-solving skills either in verbal or written form. An outline enables instructors to organize and lead the discussion.

To inspire further student interest and activity, the supplements contain lists of environmental groups in each state; government agencies; and addresses and telephone numbers of key local, state, and federal officials. Pertinent essays and articles suggest ways in which students can contribute positively to energy and environmental conservation.

2. Two videos feature Peter Raven discussing two critical topics: destruction of the world's rain forests and species extinction.

3. Instructor's Resource Manual with Test Bank prepared by Dr. Jacqueline Webb of Friday Harbor Laboratories, University of Washington contains a chapter outline, chapter objectives, a lecture outline, key terms, and teaching tips; suggestions for discussion topics, classroom demonstrations, and field trips; and audiovisual and book resources. The Test Bank consists of short-answer essays, and true/false, multiple-choice, and fill-in questions.

4. Overhead transparencies include 150 transparencies and slides with full-color figures from *Environment*. Overhead transparencies have been reformatted with large-print labeling for easy viewing in any classroom.

5. ExaMaster+ Computerized Test Bank enables instructors to create or modify tests derived from the Printed Test Bank, and includes the capability to print out tests with answer keys and student answer sheets. Available in 5¼" IBM, 3½" IBM, and Macintosh.

6. The Laboratory Manual by Robert Wolff of Trinity Christian College assists in the teaching of laboratory, problem-solving, and thinking skills in environmental science.

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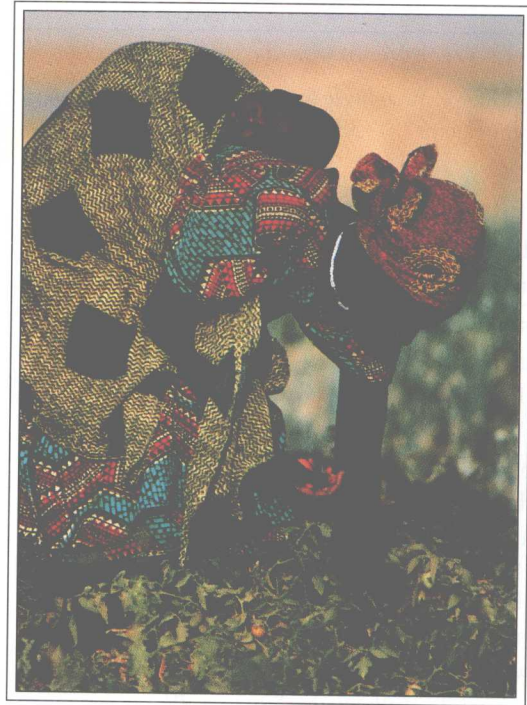
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