late what it is to have a developed society and to be a developed human being at low levels of income. I have argued that a basic-needs conception of development is a central part of this notion. Basic needs can be satisfied at relatively low levels of income, but only if a society deliberately seeks a development path that will do so.

It may be objected that this is all very nice for those in rich countries to espouse because it leaves them at the top and tells the rest of mankind to settle for less. This objection misses the point. The prescription of low incomes and high leisure levels is not offered merely to the poor. It also represents the direction that we in the rich countries should go in, if we are to become not just rich, but truly and fully developed.

—Jerome Segal

Jerome Segal is a Research Associate at the Center for Philosophy and Public Policy and Senior Advisor for Agency Planning at the Agency for International Development (AID). This article is condensed from his Center working paper "What Is Development?" The views expressed are not necessarily those of the U.S. government or of AID. To order "What Is Development?" see page 15.

The Biotechnology Controversy

Biotechnology, according to most commentators, promises to revolutionize industry and everyday life. The British journal *The Economist* predicts that "biology will launch an industry as characteristic of the twenty-first century as those based on physics and chemistry have been of the twentieth century." Statements such as this express the sense of exhilaration and apprehension which, over the past few years, has produced screaming headlines, Promethean prospects, stock-market fever, and all sorts of intellectual inflation. On even the most conservative view, however, new developments in biotechnology are likely to affect the way we think about the living world and the way we understand our relationship to it.

Nature and Society

Anthropologists, in describing the tribes they study, frequently emphasize the relation between the social structure of the tribe and its cosmology or view of nature. Among these anthropologists, Mary Douglas most prominently has argued that "the moral commitment of a community to a set of institutions" is secured by its view of what is natural and what goes contrary to nature, in other words, "how the environment will react." The conception of nature implicit in social arrangements and institutions, according to Douglas, "exists as a structure of meaningful distinctions." The social order begins to come apart, she adds, when "separate voices claim to know about different environmental constraints" and different visions of nature contend for credibility.

It is commonplace to point out that the great social and cultural revolutions in society have been accompanied by—and are to an extent caused by—major changes in assumptions about nature and the place of humanity in it. The cosmology of pretechnological societies, for example, found in nature all sorts of omens and meanings by which people could explain natural events to themselves (e.g., as divine rewards and punishments) in order to give significance and importance to their own actions. The distinctions tribal societies drew between the pure and the polluted, the safe and dangerous, often served to legitimate power relationships and the rules and conventions which governed behavior in those societies.

After Galileo and Newton, a conception of the living world became dominant which reflected the order scientists had found in the physical world. The eighteenth century presented nature as a masterpiece of organic forms set together in a perfect design by a benign creator, a Great Chain of Being. A hierarchical and conventional order in society—where each group understood its station and its duties—reflected this idea of an immutable and static order in nature.

After Darwin, the nineteenth century experienced a reversal in its conception of the way the living world is organized. In the early days of evolutionary theory, Social Darwinists were quick to extend the ideas of competition, struggle, adaptation, fitness, and change from plant and animal communities to human societies, thus making "natural" the "great transformation" of land and labor into fungible, marketable commodities. It was only after a great deal of humane reconsideration—a battle still going on today in the arguments over sociobiology—that culture and nature were sufficiently distinguished to overcome some of the excesses of the Social Darwinist and eugenics movements.

By the 1960s, evolutionary theory had become established and with it a historical appreciation of man's origin and place in nature. In the United States, the environmental movement emphasized the importance of preserving the products of natural history, particularly biological communities, the "integrity" of which, so they argued, supported human survival. Environmental legislation enacted during the 1960s and 1970s called upon the nation to preserve the "health" of ecosystems, the "integrity" of the nation's waters, and the "balance" of natural populations. These laws

presupposed the idea that biological communities have a character or an identity we should preserve and respect. The environmental law of the 1960s and 1970s did not regard nature as a congeries of raw materials fit for limitless human intervention and manipulation but as a system of natural resources and communities which should be altered as little as possible.

Growing interest in work on recombinant DNA during the 1970s challenged the idea that there are boundaries in nature (whether put there by God or by evolutionary history) that we should respect or that we cross at our peril. The "Recombinant DNA War" pitted two strong ideological positions against each other. On the one side, members of religious communities together with many environmentalists and members of the concerned public felt that there is something sacred about life, something about the identity of species we should respect, and that no good could come from crossing lines that either God or Nature had drawn. On the other side, many scientists and others considered fears such as these superstitious and regarded nature more as an object of endless manipulation, investigation, and use than as an object of ethical, religious, cultural, and aesthetic concern.

Debate over the risks and hazards posed by "designer genes" and recombinant DNA masks more fundamental differences concerning the extent to which we should preserve nature and the processes which are somehow "intrinsic" to it vs. the extent to which we may view the living world, quoting engineer Edward Yoxen, as "a vast organic Lego kit inviting combination, hybridization, and continual rebuilding."

Natural Resources vs. Raw Materials

On college campuses during the 1970s, Hans Bethe, the eminent nuclear physicist, and Barry Commoner, the environmental activist, debated issues involving the dangers of nuclear power and pollution. In these debates, when Commoner spoke of the depletion of natural resources, Bethe would respond vehemently that there are no *natural resources* but only *raw materials.* Behind the conceptual difference between "raw materials" and "natural resources" lies a fundamental distinction for evaluating new technologies and justifying regulations.

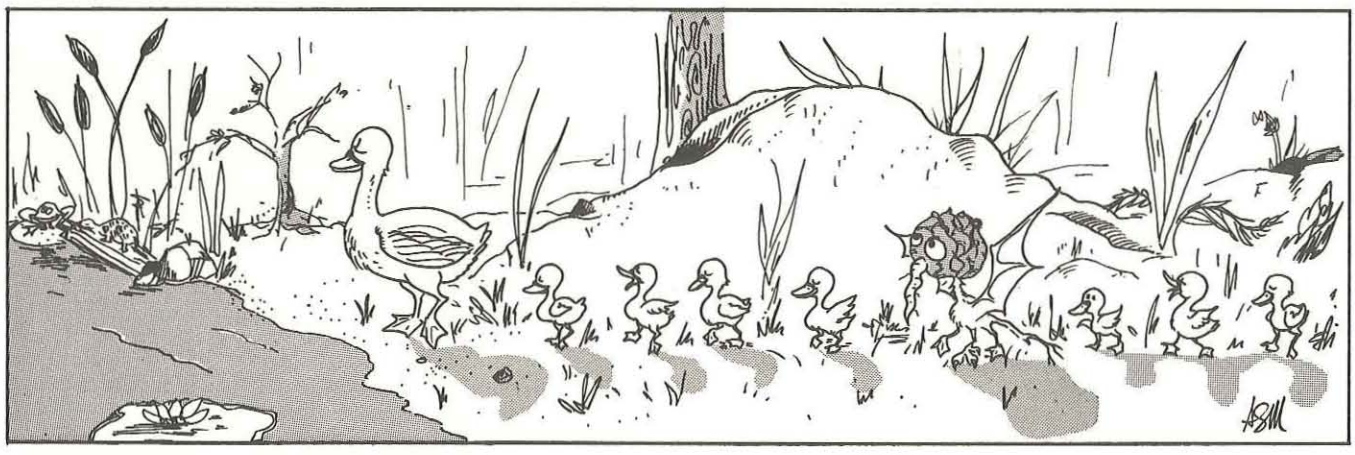
For Commoner, natural objects come in natural kinds; form determines function. When we force or cross natural boundaries too often, as by an incautious and intrusive use of technology, we court environmental disaster. For Bethe, things do not have essences or forms determining their function. Rather, our cleverness in molding and manipulating materials to meet our needs determines what objects exist and the value they may have for us. Technology is the key to cornucopia, not the cause of catastrophe.

The distinction between natural resources and raw materials epitomizes the two sides in the debate over nuclear technology, but it also is relevant to the controversy surrounding biotechnology. Those on one side of the debate assert that the history of evolution has made natural species and ecosystems what they are and has given them forms or essences which we ought to respect. We engage in manipulation at our peril. Those who inherit Hans Bethe's position, on the contrary, tend to see nature as a collection of materials which mankind manipulates to serve its interests and ends.

Two Concepts of Ecosystems

These two approaches motivate two different strategies for environmental management, for example, in the Chesapeake Bay. In the past, the major emphasis in Chesapeake Bay management has been to clean up the Bay or otherwise restore natural conditions so that the species adapted to it, e.g., striped bass and winter flounder, may thrive. Biotechnology presents an opportunity to work in the opposite direction. We may change the genetic structure of those species so that they can better survive in the Bay as it is or as it may become as a result of increasing pollution. This may be a more efficient strategy for fisheries management.

It is not unlikely that there will emerge as a consequence of biotechnology two different trends in ecological research. One may be tied to natural history and will study systems like the Bay as natural resources



Reprinted from *BioScience,* May 1985, Vol. 35. No. 5
© 1985 American Institute of Biological Sciences

whose form is somehow "given" by events in the past. A second trend will investigate systems as independent of their histories, as reactions among raw materials, biotic and abiotic, of various sorts, all of which may be amenable to manipulation.

The question then may arise which conception of the ecosystem we should use in formulating and enforcing environmental regulations. To insist on the first conception, which ties the ecosystem to its past, would lead us to limit the degree to which we can alter the makeup of bass, flounder, and other species to allow them to thrive in waters which are no longer fit to support them otherwise. We might require, indeed, that these fish be treated as indicator species, and believe that their disappearance suggests that pollution be reduced, not that they be altered to survive it. On the other hand, we may think of ecosystems completely in technical ahistorical terms. In that case, genetically engineered species, even if they bear little or no relation to "natural" ones, could form biological communities as interesting to study and as worthy of protection, prima facie, as any which have evolved over 10,000 or 100,000,000 years.

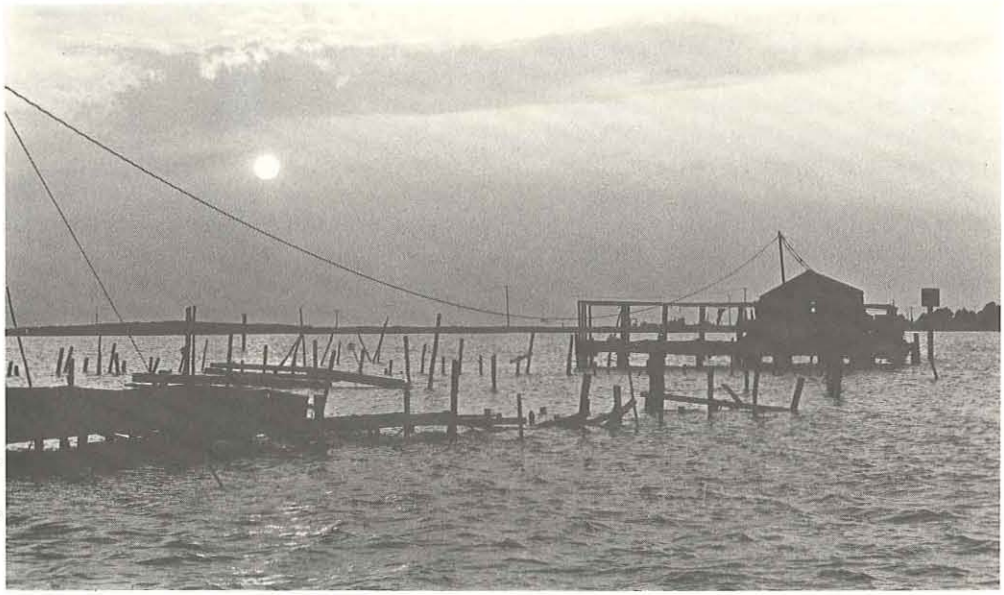


Photo by Skip Brown

The Chesapeake Bay

Two Mandates for Management

The Water Resources Council in 1973 stated in its *Principles and Standards* that the use of the nation's water and land resources should "be directed to improvement in the quality of life through contributions to the objectives of national economic development and environmental quality." It defined these objectives respectively as: "to enhance national economic development by increasing the value of the Nation's output of goods and services and improving national economic efficiency" and "to enhance the quality of the environment by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems."

During the 1960s and 1970s, many environmentalists and others argued that the goals of *increasing the value of goods and services* and *preserving ecological systems* were generally consistent, since ecological systems support human life and provide all kinds of goods and services. Yet, with respect to specific resources and ecological systems, it is often hard to argue that protection rather than alteration and exploitation is the best way to maximize the flow of goods and services nature offers man. The Chesapeake's role as a liquid highway, for example, does not depend upon the maintenance of a "natural" ecological system. What is more, the production of commercial fish and shellfish, it is often argued, would be far more efficient were the Bay managed on aquacultural principles, i.e., as privately held aquacultural plots, rather than as a "commons."

Developments in biotechnology are likely quickly to force the question of whether we wish to regard the Bay, e.g., as a natural resource to be treasured and protected for its biological communities or as a collection of raw materials to be managed to maximize the goods and services it may then produce. It seems that the development of marine biotechnology should be sensitive both to historical or aesthetic and to economic concerns. We owe more to the history and beauty of nature—we value the grandeur of evolution too much—to regard nature simply as a material basis for economic exploitation, however far-reaching our biotechnological potential for exploitation may become.

—Mark Sagoff

The Mary Douglas quote is from "Environments at Risk," in *Implicit Meanings* (New York: Routledge, Kegan, Paul, 1975); the Edward Yoxen quote is from *The Gene Business: Who Should Control Biotechnology?* (New York: Harper & Row, 1983).

Announcing a New Publication from The Center for Philosophy and Public Policy

The Preservation of Species: The Value of Biological Diversity

edited by Bryan G. Norton
Princeton, N.J.: Princeton University Press, 1986
$29.50, cloth

Introduction
Bryan G. Norton

Part One The Problem

1. **Species Leave the Ark One by One**
   Thomas E. Lovejoy
2. **The Biology of Human-Caused Extinction**
   Geerat J. Vermeij
3. **Social and Perceptual Factors in the Preservation of Animal Species**
   Stephen R. Kellert

Part Two Values and Objectives

4. **Human Preferences, Economics, and the Preservation of Species**
   Alan Randall
5. **On the Inherent Danger of Undervaluing Species**
   Bryan G. Norton
6. **On the Intrinsic Value of Nonhuman Species**
   Baird Callicott
7. **Philosophical Problems for Environmentalism**
   Elliott Sober
8. **Duties of Preservation**
   Donald H. Regan

Part Three Management Considerations

9. **On the Susceptibility of Different Species to Extinction: Elementary Instructions for Owners of a World**
   Lawrence B. Slobodkin
10. **Species Protection and Management Decisions in an Uncertain World**
    Terry L. Leitzell
11. **Property Rights and Incentives in the Preservation of Species**
    Robert L. Carlton

Epilogue
Bryan G. Norton

This volume is the product of a multi-year project on the preservation of species, funded by a grant from the EVIST program of the National Science Foundation and the National Endowment for the Humanities.

Order Card

Quantity	Title	Price
	The Preservation of Species — $29.50	
	What Is Development? — $2.50	

All orders must be prepaid—checks payable to Univ. of Md. Foundation. Subtotal

Postage and handling (books only) — $1.50

NAME _____ TOTAL

ADDRESS _____

CITY _____ STATE _____ ZIP _____

Return this form to: Center for Philosophy and Public Policy
University of Maryland
College Park, Maryland 20742