

From:
ORION
Summer 1985

BIOSPHERE RESERVES

*Their History
and Their Promise*

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In the annals of human civilization, national parks represent a significant achievement, a rare testimony of one generation's respect for the next. Since the birth of Yellowstone National Park in 1872, the national park concept has spread around the globe. In country after country, miracles of natural creation have been set aside as wellsprings of national pride and sources of spiritual renewal. Their power to inspire the heart and humble the mind continues to motivate legions of people to help perpetuate these unique symbols of regard for the natural world and human posterity. The burgeoning demands of human society, however, are threatening parklands everywhere. These pressures are at the same time foreclosing opportunities to enrich the future of humanity through the creation of new parks.

In most developed countries, parks and similar areas are supported by longstanding conservation traditions, articulate constituencies, a host of laws and regulations, and protective administration. Nevertheless, the threats mount. In a 1980 report to the U.S. Congress, the National Park Service identified seventy-three categories of human influence known or suspected to be causing adverse effects on park resources. More than half the influences originate from outside the parks' boundaries and legal jurisdiction. Transborder influences such as atmospheric pollution and land-use changes may gravely compro-

mise the very basis for a park's existence by disrupting its ecosystems and the flora and fauna within. The most intractable influences are byproducts of economic development, and are often the cumulative result of scores of individual decisions made in many locations. The effects may increase so gradually that people don't notice them. Because the influences interact in complex ways, cause-and-effect relationships may be difficult to prove. Sometimes, all we know for certain is that a lake or forest or estuary is in decline. Without convincing scientific evidence on these relationships, governments are reluctant to act because of adverse social, economic, and political consequences. Yet to allow the damage to continue risks more dire consequences later.

In developing nations, the problems are even more formidable. Here fragile economies are being overwhelmed by legitimate demands of growing human populations for food, firewood, and shelter. With their limited financial, technical, and institutional capabilities, many countries are presently unable to protect and manage areas for conserving natural diversity and to prevent damage from development projects and other local encroachment.

Increasingly, the security of protected areas in developing countries depends on whether people living near or within the areas participate in their management and feel committed to their conservation. If

Various functions of the biosphere reserve are illustrated here and in the following pages. Great Smoky Mountains National Park in Tennessee and North Carolina is an example of the temperate broadleaf forest, one of the natural regions or biomes in which MAB seeks to lay the scientific groundwork for conserving and managing a representative ecosystem.

BIG THICKET NATIONAL PRESERVE



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Arizona's Organ Pipe Cactus National Monument is another example of one of the world's major ecosystems—the warm desert.

people are ignored or displaced, or if they do not see an economic benefit, they often become ambivalent or hostile toward the goals of a protected area. Lacking viable subsistence alternatives, they may cause severe ecological damage through poaching, wood-cutting, trespass grazing, and clearing of land for agriculture or settlement—activities sometimes carried out with the tacit consent of government. The result: “paper parks,” signed into being on parchment but devoid of reality on the ground. In fact, many areas that appear well protected may have remained unscathed largely by virtue of their remoteness from intensive human settlement. Changing social conditions could readily place them in jeopardy.

WORKING MODELS: THE POWER OF PROOF

Urgently needed are examples of protected areas that demonstrate the value of conservation in sustaining society. The working models should not only conserve natural diversity but also provide the scientific basis for rational use and development of ecosystems. They should help solve problems in the relationships between people and the environment, to the lasting benefit of both.

These models must be based on the twin pillars of information and cooperation. Accurate scientific information is essential, to identify and evaluate problems, predict future conditions and trends, and promote the case for rational decisions on the use and management of ecosystems. Through cooperation, human and financial resources can be marshalled to gather and share the information, to educate and train people to apply it, and to foster a conservation ethic that ensures enduring stewardship and wise use. By developing these largely unrecognized capabilities, protected areas can promote sustainable economic development in ways that conserve natural diversity. The international network of biosphere reserves offers a framework for building such models.

Through the biosphere reserve network, national parks and other traditional protected areas are encouraged to function as mainstays of a region's environmental and economic health. Managers are encouraged to extend their horizon of concern beyond the park's boundary and to explore avenues of local, regional, and international cooperation in underwriting its security. The biosphere reserve is in fact a modern management approach and a new tool for fostering support for the protected-area movement as it enters its second century. Let us, then, review briefly the history of the biosphere reserve and the United Nations' Man and the Biosphere Program, of which it is such an important part.

THE UNIQUE MISSION OF THE MAN AND THE BIOSPHERE PROGRAM

The Man and the Biosphere Program, or MAB, is the best known of the science programs of UNESCO, the United Nations Educational, Scientific, and Cultural Organization. MAB's ambitious purpose is to enjoin the cooperation of science and society in establishing harmonious relationships between people and the environment. The program looks to the holistic science of ecology to provide the basis for these relationships.

MAB's immediate predecessor was the International Biological Program (IBP). IBP was launched in the 1960s, through the joint efforts of UNESCO, nongovernmental scientific organizations, and participating governments in developed countries.

IBP's interdisciplinary projects amassed huge banks of basic information on the tundra, deciduous forests, grasslands, tropical forests, and other major natural regions of the world. The program made possible unprecedented scientific advances, which gave ecology international respectability and the opportunity to contribute in addressing complex environmental problems. With termination of the program in view at decade's end, many scientists saw the need to maintain IBP's momentum, while expanding and redirecting its efforts.

Such was in fact the recommendation of UNESCO's Biosphere Conference of September 1968. Attended by 238 delegates from 63 member states and more than 100 representatives from the United Nations and other organizations, the conference proposed a program that would continue and extend the work of the IBP. International working groups of scientists met to develop a practical approach for implementing the recommendation, and in November 1970 the UNESCO General Conference initiated a

"long-term intergovernmental and interdisciplinary program on Man and the Biosphere focusing on the general study of the structure and functioning of the biosphere and its ecological regions, on the systematic observation of the changes brought about by man in the biosphere and its resources, on the study of the overall effects of these changes on the human species itself, and on the education and information to be provided on these subjects." The conference invited UNESCO's member states to set up national committees for participation in the program and established an International Coordinating Council to set policy and priorities.

At its first meeting in November 1971, the new council launched the program, proposing thirteen project areas for MAB's research and educational activities (a fourteenth was added in 1974). The U.S. delegation, led by Donald R. King of the State Department and Ted Byerly of the Department of Agriculture, played an important role in designing the new program.

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Mexican poppies in bloom in Organ Pipe National Monument, Arizona.



PHOTO COURTESY VEDER/WEBER

Conserving the gene pools of rare and endangered plant and animal species is a focus of MAB's efforts. A last stronghold of the endangered mountain gorilla is Rwanda's Volcanoes National Park. This biosphere reserve has been reduced twice for agricultural development and is increasingly used for subsistence activities. The area is now part of a regional demonstration project, which, if successful, will secure the mountain gorilla's habitat by improving the economic status of local people.

MAB PROJECT AREAS

1. Tropical Forests
2. Temperate Forests
3. Grazing Lands
4. Arid Lands
5. Fresh Water and Coasts
6. Mountains and Tundra
7. Islands
8. Biosphere Reserves
9. Cultivation Systems
10. Major Engineering Works
11. Urban Ecosystems
12. Demographic Changes
13. Perception of Environmental Quality
14. Environmental Pollution

Projects 1-7 focus on major natural regions, or biomes. The objective is to lay the scientific groundwork for managing ecosystems on a sustainable basis for a broad range of amenities and commodities. Projects 9-13 are concerned with types of interactions between man and the environment, with the objective of improving these relationships through scientific understanding. In order to provide a balanced perspective, research under all of the projects is interdisciplinary, involving both the natural and social sciences.

Project 8 is directed toward the establishment of a coordinated network of protected areas that can conserve biological diversity and demonstrate the

value of conservation in improving human well-being. The name biosphere reserves recognizes the special status of these areas in promoting the conservation and intelligent use of the thin veneer of air, soil, and water that supports all life on earth. As centers for research, education, and training, biosphere reserves give geographic focus and continuity to the MAB program.

During the past thirteen years, 105 countries have joined the program and formed their own national MAB committees. A small secretariat staffed by thirteen professionals at UNESCO's Paris headquarters coordinates the international program by serving as a clearinghouse for information and a catalyst for garnering financial and human resources for research, training programs, conferences, and other field projects. More than a thousand such projects have been implemented during MAB's brief history.

In the United States, the MAB National Committee, established in 1972, consists of representatives from government agencies, universities, and private organizations. The committee sets policy and determines priorities for research and other activities, which are planned by eleven interdisciplinary directorates for the various MAB project areas. Funds provided by participating agencies are administered by a small secretariat at the Department of State. Since 1980, U.S. MAB has funded in excess of 2.5 million dollars in field projects, some of them co-funded by outside institutions. In testimony of MAB's benefits, the United States is strengthening

its support for its MAB program and will continue to collaborate with other nations on MAB projects, despite its recent withdrawal from UNESCO and the consequent loss of its seat on MAB's International Coordinating Council.

THE MULTIPLE FUNCTIONS OF BIOSPHERE RESERVES

Biosphere reserves, a new category of protected area, are designed to conserve, gather, analyze, communicate, and employ information for the purpose of sustaining natural and managed ecosystems. While no model of a biosphere reserve applies universally in practice, an idealized model is helpful in illustrating potential functions and their interactions.

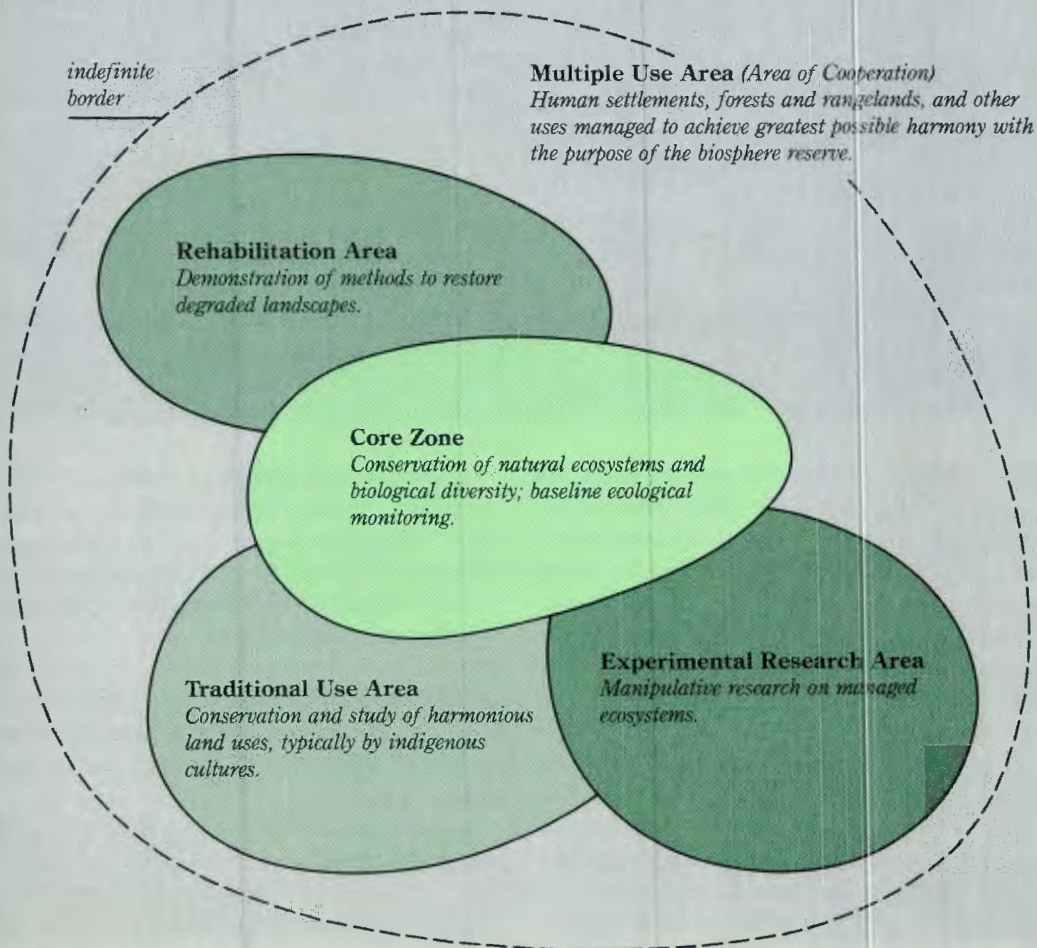
The backbone of a biosphere reserve is the *core zone*, an undisturbed, self-sustaining landscape embracing as much of the region's natural diversity as possible. Within the core may be studied biological evolution and natural processes that are largely free

of human interference; thus the core serves as a global benchmark of ecological health. It also sets the ecological standard against which to compare the effects of human uses and scientifically planned manipulations occurring elsewhere in the reserve. In most countries, the core is a national park or similar area, which is protected legally and managed for the least possible human disturbance. More than 80 percent of biosphere reserves presently consist solely of such areas.

Surrounding the core of the model reserve are a number of ecologically similar areas that are used for research, education, and demonstration. Collectively these areas foster knowledge, skills, and values that serve material human needs through use of ecosystem resources. Activities within such areas, for example, can lay the scientific groundwork for rural economic development that has minimal impact on natural ecological processes and genetic resources. In *experimental research areas*, manipulative research is directed to the develop-

The Ideal Biosphere Reserve

The ideal biosphere reserve conserves all of the representative ecosystems of a particular natural region. It contains the greatest possible diversity of physical and biological resources. It carries out a wide range of research, education, training, and demonstration activities in contiguous or nearby areas. Together, these activities provide the knowledge and skills needed to conserve biological diversity while enabling the ecosystems to be managed on a sustainable basis.





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The Arctic tundra ecosystem of the Noatak Biosphere Reserve in Alaska is another project area for MAB's research and educational activities.

ment of farming, grazing, forest management, and other production systems that are ecologically sustainable, technologically feasible, and acceptable to local people. These areas are also sites for experiments to evaluate techniques of vegetation and wildlife management. In *rehabilitation areas*, experiments are carried out to find ways of improving the capability of degraded areas to conserve natural diversity or support sustainable production of commodities. Although most of these areas have been damaged by human use, areas disturbed by natural events such as hurricanes are sometimes included. As with the experimental research area, comparison with the unaltered core permits assessment and monitoring over the years. Both experimental re-

search areas and rehabilitation areas act as regional centers for demonstrating research and management techniques and for training specialists and local users. In developing nations, these areas may motivate the financial participation of international development institutions such as the Agency for International Development and the World Bank, which have yet to take advantage of the scientific potential of biosphere reserves in improving the sustainability and cost-effectiveness of their rural development projects.

In his article, Ronald Engel describes the pastoral landscapes, created by centuries of human use, which are part of the Cévennes Biosphere Reserve. The inclusion of such *traditional use areas* – where



surrounds this center; this area includes human settlements and a wide range of enterprises managed to harmonize with the purpose of the reserve. The multiple uses create an area of cooperation, within which the knowledge and skills gained in the inner zones are applied to improve resource management and the well-being of people in the region. The boundaries of this area of cooperation are indefinite, and change according to the nature of the activities undertaken.

Areas are nominated as biosphere reserves by national MAB committees and approved by MAB's International Coordinating Council. Because each country is endowed with its own unique ecological, cultural, social, and economic resources and has a unique range of needs, there can be no standardized approach to developing a reserve. Instead, the watchword is flexibility, which allows each reserve the liberty to find its own approach for conserving natural diversity and sustaining human society. Modes and methods abound. A working balance among the various functions in a U.S. biosphere reserve may be inappropriate in Chile or Zaire, and today's balance may shift tomorrow to address new needs. The common element on all the

Fireweed in the Noatak Biosphere Reserve.

harmonious land uses are conserved, studied, and judiciously improved in ways that respect local traditions – is a unique feature of the biosphere reserve model. Particularly in developing countries, biosphere reserves may be our best hope for maintaining endangered human traditions, applying traditional knowledge to modern problems, and fostering pride among indigenous people in their cultural heritage. Unfortunately, such areas are not yet well represented in the existing network.

The core zone, along with the areas for experimental use, rehabilitation, and traditional use, comprise the reserve's center for gathering information and the focus for scientific research and cooperation. In the idealized model, a *multiple use area*



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In the Virgin Islands, research is providing the basis for managing traditional artisanal fishing so as to conserve the marine ecosystems of Virgin Islands National Park while helping the local economy.



PHOTO COURTESY NATIONAL PARK SERVICE

chosen pathways is cooperation among people with different perspectives and abilities – locally at the reserve itself, regionally among nearby reserves, and internationally through the global network. Time is a critical dimension in the development of a reserve. The official designation of a biosphere reserve signifies the beginning of an opportunity – an opportunity to build a biosphere reserve in form and function bit by bit, through the collective initiatives of many people. As the institutional linkages and human relationships develop, the biosphere reserve matures into a center for research, education, demonstration, and training in the region.

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THE EVOLUTION OF MAB PROJECT 8

At the 1972 United Nations Conference on the Human Environment at Stockholm, one of the key recommendations was for a global network of protected areas that would conserve representative examples of the world's ecosystems. These areas, to

be established in each of the world's natural regions, would serve as benchmarks of environmental quality, help preserve gene pools, and provide a framework for international scientific cooperation. In his report for the U.S. delegation, Russell Train called the program "one of the major contributions of the conference." The recommendation gave a major boost to the early development of the biosphere reserve project.

From 1973 through 1975, UNESCO, in cooperation with other United Nations organizations and the International Union for the Conservation of Nature and Natural Resources, convened panels of experts to clarify the scientific mission of biosphere reserves and to set criteria for their selection. In 1974, UNESCO proposed an ambitious six-year program to develop the international network. The next year, IUCN published a classification and map of 193 natural regions of the globe. These so-called biogeographical provinces govern the selection of sites for biosphere reserves; the objective is to include examples of the characteristic ecosystems of each of these provinces within one or more reserves.

When it became apparent that United Nations organizations would be unable to fund the six-year development program, a bold measure was needed to maintain enthusiasm for the project. This came in the form of a provision in the Nixon-Brezhnev Summit Communiqué of July 1974, in which both sides agreed to support the implementation of MAB and to "designate in the territories of their respective countries certain natural areas as biosphere reserves for protecting valuable plant and animal genetic strains and ecosystems, and for conducting scienti-

mental ethics" (ecologically grounded science and values can be mutually reinforcing).

But this is overly abstract. Let us return to the concrete experience of the Cévennes Biosphere Reserve and see how I was led to such generalizations.

The overwhelming impression that my wife and I had in the Cévennes was that of *participating in the creative evolution of life*. What factors contributed to this impression?

First, the experience of time. The omnipresence of rock—the most permanent feature of the earth's surface—gave us the feeling of time as something deep and profound. In the Cévennes it was apparent that the earth is old and that plants, animals, and human beings alike have evolved through adaptation to the geologic, climatic, and topographic realities of its surface. All of these changes took time, patient eons of time—as Girard Collin phrases it, a "slower time." We sensed this time as a sacred, evolving rhythm that perfectly balances continuity and change. The neolithic dolmens and menhirs added substance to this impression, as did the evidence of centuries of laborious husbanding of soil through the removal of rocks from fields, rocks that were then used for fences and in the construction of terraces. We stood in awe of stone houses that must have taken generations to complete. And we identified with the Protestant farmers who fled to these remote and rugged slopes several centuries ago, in quest of religious freedom.

Through lifelike exhibits laid out on either side of an ascending spiral ramp, the Écomusée at Pont de Montvert mirrored the coevolution of landscape, plants, animals, and man. The écomusée served as the temple of a new ecological and evolutionary faith. Here the sacred story was told, and in the movie that climaxed the exhibits, pilgrims and permanent residents alike were invited to participate consciously in the ongoing cosmic task of transmitting the past, improved and purified, to the future.

Secondly, there was the experience of integration itself, what the park literature calls the "ancient concord between man's actions and the forces of nature." We encountered this integration in several aspects of the reserve. One was the sacred geometry of the park—like that of all biosphere reserves, a series of inner cores where natural evolution continues as undisturbed as possible, surrounded by buffer zones in which traditional human communities are encouraged to flourish, where experimentation in more adaptive ways of life is pursued, and where education and ecological research occur. This geometry, which we knew in the abstract, was an extremely harmonious one to experience as we traveled about the park. The landscape is ideal, because it richly fulfills the role of aesthetic quality: unity in contrast. Almost every vista contained a view of one of the enduring centers of natural evolution, where man is essentially a visitor, and also of a community or farm where people live in balance with the land.



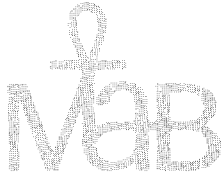
©GERARD COLLIN, PARC NATIONAL DES CÉVENNES

The landscape was a microcosm of the unity of wild and humane.

We found a second instance of this integration in the traditional cultures and economies of the cause-dwellers and Cévenol people themselves: in their movement across the land, as they went out to cultivate their fields or lead their flocks along the roads; in their towns in which houses fit against one another as so many interpenetrating organs in a great stone body; in the chestnut trees that covered the schist countryside and provided timber and fruit; in the rare strains of rye that had been selected over centuries to grow on the mountain slopes. One activity that powerfully models this kind of integration, but which we experienced only vicariously, is *trans-humance*. Each spring for generations, mountain dwellers have allowed shepherders to lead their flocks from valleys far below the park up to pastures on the mountainsides, because the sheep supply nutrients to the soil that the mountain dwellers need to cultivate their crops.

The great symbol that comes to mind to describe this integrative experience is "art." The traditional

A thatched roof is restored by a farmer in Mont Lozère.



civilizations of the Cévennes are a precious heritage because they are “artful” civilizations. They exemplify a sustainable and fulfilling relationship between *homo faber* and his environment. In the Cévennes a great truth was disclosed to us: the dichotomies of the modern world, between technology and community, science and values, past and present, are due to our loss of the middle term – the integrative function of art, the creative capacity of human beings to pursue a way of life that adapts to, while simultaneously modifying, the environment, a way of life that turns the unconscious reciprocities of organism and environment into deliberately and freely chosen bonds of concord.

This brings us to a most significant point. Science in the Cévennes park is conceived as one of the human arts to be used on behalf of the total creative experience of the community of life. The scientific program of research serves to enhance both human actualization and natural evolution. The great vulture was reintroduced with the help of science, the strains of mountain rye are being preserved with the help of science, the fertility of the mountain soil is being increased with the help of science, new and more adequate building materials are being introduced with the help of science. In each of these cases, science is a means to the coevolution of humanity and nature. And in each of these cases, the contribution of science to sustaining life is made possible by visible working relationships between scientists and local people. Knowledge is constant-

8 of the program, Biosphere Reserves.

In Egyptian hieroglyphics, the ankh stands for “Eternal Life,” or simply “living,” and forms part of such words as “health” and “happiness.” Historians of religion suggest that the shape of the symbol represents the circle of life spreading outwards from the Origin and animating all existence. The shape may also be perceived as a knot binding together the elements to form one whole, and this may account for the ankh’s association with various forms of organic symbolism. From these images, we may surmise that the ankh is being used to designate biosphere reserves as those special or sacred places that preserve and enable the evolutionary processes of life.

The ankh is in addition one of the most ancient forms of the cross, an archetypal symbol with many variations, but always pointing to some kind of conjunction of opposing forces. In the case of the ankh, the nature of the two opposing forces is indicated by two alternative traditional readings of the symbol: on the one hand, as representing the sun, the sky, and the earth (by reference to the circle, the vertical, and the horizontal lines); on the other hand, as representing a protean human figure (by reference to the circle as the head, the horizontal line outstretched arms, and the vertical line an upright body). The two forces that are conjoined in the biosphere reserves are the destinies of humanity and nature.

A morphological similarity between the ankh and a key is also readily apparent. Indeed, Egyptian gods are sometimes shown holding the ankh by the top as though it were a key, the key of Eternal Life opening the gates of death onto immortality. The biosphere reserves are the sacred spaces that show *how* the creative arts of civilization can be used for the successful coevolution of humanity and nature.

Such speculations on the overall symbolism of the MAB program and the biosphere reserve network suggest that if we are to read the full text of this new category of protected areas, we must grasp the relationship of each individual reserve to the system as a whole. Biosphere reserves derive their name from the fact that they are of importance to the survival of the entire biosphere. But only in the most general way may we consider the experience of any particular biosphere reserve a perfect microcosm of the biosphere itself, for the biosphere is not a formal unity; it is an organic unity, or unity-in-variety. The only true and perfect microcosm of the biosphere is the entire network of biosphere reserves in its inter-related diversity. This is a novel emergent in the history of human perceptions of sacred space, one that deserves careful explication.

The biosphere includes all living organisms and their interactions with one another and with non-living matter over the surface of the globe. To our knowledge, this is the ultimate ecosystem, for it includes the most diverse collectivity of organisms mutually cooperating with the most comprehensive environment. The biosphere is composed of a com-

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ly being looped back into consequences people can see and understand and into projects in which they can participate and from which they can benefit. When the literature of the biosphere reserves speaks of the human ecosystem as the ultimate unit of scientific accountability, this, concretely, is what it is talking about.

The cosmic order the biosphere reserve represents is not that of an objective eternal reality unaffected by human aspiration and choice, but the dynamic order of creative coevolutionary advance.

Microcosm of the Biosphere

The Egyptian anserated cross – the Nem Ankh – is the symbol for the Man and the Biosphere program of UNESCO. It is a striking symbol for Project

plex unity-in-variety of some fourteen regional ecosystems, technically biomes or biogeographical provinces, each made up of distinctive types of vegetation and animal life. Tropical forests, grasslands, deserts, and deciduous forests are examples of biomes. Each biome, in turn, is composed of a unity-in-variety of ecosystems in the more proper sense of the word, that is, local communities of organisms in mutual cooperation with their local environments.

The general structure of the biosphere is roughly like that of a federal government. It is composed of an immense variety of local communal units (ecosystems) organized into a variety of distinctive regional wholes (biomes), which in turn make up the whole. Thus, in order to have a microcosm of the whole, there must be a network of representative portions of every significant local unit (comparable to provincial or state assemblies).

This is precisely what the system of biosphere reserves is designed to be: a microcosm of the biosphere, composed of a cooperative network of protected areas, each of which includes representative examples of each of the ecosystems of a particular biome. It is no coincidence that two key words that recur throughout the biosphere reserve literature are "representative" and "cooperative." The biosphere reserve system (when complete) will represent in microcosm as perfect a model of the biosphere conceived as a cooperative organic whole as it is possible to achieve.

Note that this model of interlocking representa-

tive ecosystems also embraces representative examples of adaptive human economies (traditional and experimental). Thus the biosphere reserve network becomes a nearly perfect model of a sustainable global culture.

Taking the long view, it is possible to see three great stages in mankind's relationship to the Earth. In the first, human evolution was limited to local communities functioning within the constraints of local ecosystems. In the second, the stage we are currently moving through, human evolution is alienated from the rest of nature, and is indiscriminately exploiting local ecosystems throughout the biosphere. In the third stage, the stage the biosphere reserves are preparing us for, human evolution will achieve a sustainable relationship to each particular ecosystem in the context of a cooperative global relationship to the biosphere as a whole. In this stage, if it comes, human civilization will be a true partner in the evolution of the Earth conceived as a living, growing unity. ●

J. Ronald Engel is professor of social ethics at Meadville/Lombard Theological School, affiliated with the University of Chicago, and author of Sacred Sands: The Struggle for Community in the Indiana Dunes (Wesleyan University Press, 1983). In 1984 he spent eight months in the United States, Africa, and Europe, investigating the symbolism of the UNESCO system of biosphere reserves.

Spring in the Cévennes.



Green Inheritance



JORGE PROVENZA/SEAPHOT

Green Inheritance. The World Wildlife Fund Book of Plants, Anthony Huxley, Garden City, New York: Anchor Press/Doubleday, 1985. Hardcover, \$19.95. Illustrations. Index. 193 pages.

by Peter H. Raven

This book eloquently demonstrates our utter dependence on green plants. Together with a few species of bacteria, green plants and algae provide the only means of capturing energy from the sun and making it available for all other forms of life. Thus fewer than 300,000 kinds of organisms make possible the existence of at least fifteen times that many kinds of animals, fungi, and microorganisms, including ourselves.

In the more than 400 million years in which plants have existed on land, the numbers of their species have steadily grown—but now, in our lifetime and that of our children, we are facing a sudden and drastic reduction in these numbers, which could eliminate as many as a quarter of the living species by the middle of the next century. Insofar as this prediction is true, we would be limiting the options of humanity for the future, since our livelihood depends to such a great extent on plants.

Beautifully illustrated with more than 250 paintings and many well-chosen photographs, this handsome book will provide comprehensive assistance to those who wish to inform themselves more completely about the ways of plants, their fascinating adaptations, the ways in which they serve us, and their roles in controlling climate and in safeguarding water, soil, and the very air we breathe. The stories of the plants that directly feed, clothe, and shelter us—only a surprising few thousand species of all those that exist—are told in an enjoyable and readable style. Separate sections