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THE UNIVERSITY OF CHICAGO

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- 7 Coptic Orthodox Christmas
- 10 40th anniversary of the death of Sinclair Lewis, the first U.S. Nobel laureate (1930) in literature
- 12 15th anniversary of the death of Dame Agatha Christie, U.K. author
- 13 50th anniversary of the death of James Joyce, Irish novelist
- 21 Martin Luther King, Jr., Day; a U.S. federal holiday
- 23 60th anniversary of the death of Anna Pavlova, Russian ballerina
- 26 Australia Day, commemoration of the first British settlement in 1788

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- 6 Waitangi Day in New Zealand
- 7 20th anniversary of woman suffrage in Switzerland
- 11 Foundation Day in Japan
- 13 Ash Wednesday; beginning of Lent
- 14 Valentine's Day
- 15 Chinese New Year's Day, ushering in the Year of the Ram
- 15 20th anniversary of the U.K.'s adoption of decimal currency
- 18 U.S. observance of the birthday of George Washington
- 23 60th anniversary of the death of Dame Nellie Melba, Australian coloratura soprano
- 28 75th anniversary of the death of Henry James, U.S. novelist

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- 3 60th anniversary of the adoption of "The Star-Spangled Banner" as the U.S. national anthem
- 11 20th anniversary of the deaths of Whitney Young, U.S. civil rights leader, and Frank Clune, widely read Australian author
- 14 Projected first day of Ramadan, a month of fasting for Muslims
- 17 St. Patrick's Day, a national holiday in Ireland
- 28 50th anniversary of the death of Virginia Woolf, innovative British novelist
- 30 Jewish festival of Passover
- 31 Easter in Western churches

APRIL

- 4 150th anniversary of the death of William Henry Harrison, ninth U.S. president, who died just one month after his inauguration
- 5 Chinese Tomb Sweeping festival
- 7 Easter in Eastern Orthodox churches
- 14 'Id al-Fitr, end of the Islamic month-long fast of Ramadan
- 17 30th anniversary of the disastrous Bay of Pigs invasion in Cuba
- 21 65th birthday of Queen Elizabeth II
- 24 75th anniversary of the Easter Rising in Dublin; in December 1921 the Irish Free State was born
- 27 200th anniversary of the birth of Samuel Morse, U.S. painter and inventor

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- 1 International Labour Day
- 5 Centenary of the first concert in Carnegie Hall, New York City
- 5 30th anniversary of the first U.S. space flight by Alan Shepard
- 12 U.S. Mother's Day
- 13 30th anniversary of the death of Gary Cooper, U.S. movie actor
- 18 Armed Forces Day
- 20 Victoria Day in Canada
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- 30 30th anniversary of the assassination of Rafael Trujillo, brutal ruler of the Dominican Republic for more than 30 years

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- 1 375th anniversary of the death of Tokugawa Ieyasu, founder of the last Japanese shogunate
- 2 50th anniversary of the death of Lou Gehrig, legendary U.S. professional baseball player
- 12 Philippine Independence Day
- 16 U.S. Father's Day
- 23 Projected first day of the annual Muslim pilgrimage (the hajj) to Mecca, Saudi Arabia
- 29 50th anniversary of the death of Ignacy Paderewski, Polish pianist, composer, and statesman
- 30 20th anniversary of the ratification of the 26th Amendment, giving U.S. 18-year-olds the right to vote

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- 1 Canada Day
- 2 30th anniversary of the death of Ernest Hemingway, U.S. author and Nobel laureate (1954) in literature
- 4 U.S. Independence Day
- 6 20th anniversary of the death of Louis Armstrong, virtuoso U.S. jazz trumpeter
- 13 Islamic New Year's Day, provided the Moon is actually sighted
- 17 Constitution Day in South Korea
- 20 Independence Day in Colombia
- 23 40th anniversary of the death of Henri-Philippe Pétain, French Army general and World War I hero, who was later disgraced as head of Vichy government during World War II

AUGUST

- 1 Confederation Day in Switzerland
- 1 10th anniversary of the death of Paddy Chayefsky, U.S. playwright
- 6 Annual Peace Festival in Hiroshima
- 9 Independence Day in Singapore
- 14 40th anniversary of the death of William Randolph Hearst, U.S. newspaper publisher
- 17 Independence Day in Indonesia
- 27 20th anniversary of the death of Margaret Bourke-White, U.S. photographer and innovator in the field of photojournalism
- 29 10th anniversary of the death of Lowell Thomas, preeminent U.S. radio commentator, author, and journalist

SEPTEMBER

- 2 Labour Day in U.S. and Canada
- 2 325th anniversary of the outbreak of the Great Fire of London. It burned for four days and destroyed a large part of the City of London
- 8 150th anniversary of the birth of Antonin Dvorak, Bohemian composer
- 9 Rosh Hashana, Jewish New Year
- 9 15th anniversary of the death of Mao Zedong, founder of the People's Republic of China
- 18 Yom Kippur, Jewish Day of Atonement
- 22 Chusok, Korean Moon festival, a joyous three-day family celebration
- 22 200th anniversary of the birth of Michael Faraday, English scientist

OCTOBER

- 2 60th anniversary of the death of Sir Thomas Lipton, British tea merchant and famed yachtsman
- 6 10th anniversary of the assassination of Egyptian Pres. Anwar as-Sadat
- 9 Annual commemoration of the creation of the Korean writing system
- 12 Columbus Day; observed in the U.S. on October 14
- 14 Thanksgiving Day in Canada
- 18 60th anniversary of the death of Thomas Edison, prolific U.S. inventor of such things as the incandescent light bulb and the phonograph
- 24 United Nations Day
- 31 Halloween

NOVEMBER

- 11 Veterans Day in the U.S.; formerly observed as Armistice Day, marking the end of World War I
- 13 60th anniversary of Hattie Caraway's appointment to the U.S. Senate. Two months later the Arkansas Democrat became the first woman ever elected to that body
- 14 275th anniversary of the death of Gottfried Leibniz, German philosopher and mathematician
- 21 75th anniversary of the death of Francis Joseph, emperor of Austria and king of Hungary
- 22 75th anniversary of the death of Jack London, U.S. author
- 28 U.S. Thanksgiving Day

DECEMBER

- 4 200th anniversary of *The Observer*, a London Sunday newspaper
- 8 50th anniversary of the U.S. entrance into World War II
- 13 525th anniversary of the death of Donatello, Italian master sculptor
- 15 25th anniversary of the death of Walt Disney, U.S. creator of Mickey Mouse and other cartoon immortals
- 25 Christmas Day
- 30 75th anniversary of the death of Rasputin, an illiterate Siberian mystic who exercised extraordinary influence over Emperor Nicholas II and Empress Alexandra of Russia
- 30 300th anniversary of the death of Robert Boyle, Anglo-Irish scientist

Global Environment— *A Planet in Stress*

BY KONRAD VON MOLTKE

Earth Day 1990 marked the 20th anniversary of the emergence of environmental protection as a public priority. By the first Earth Day in 1970, laws to protect water or air, to prevent industrial accidents, or to establish parks existed in many countries. In densely populated Europe these laws dated back to the 19th century. In the United States the National Environmental Policy Act (NEPA) was enacted in 1969. But Earth Day 1970 turned a topic that had received sporadic government attention into an important political issue as millions of people took to the streets to demonstrate their concern for the environment.

For the past 20 years, this popular support has been the bedrock of environmental policy. The simple truth is that no government anywhere protects the environment unless forced to do so by its citizens. Other interests are always more immediate, more powerful, more vocal, wealthier, and closer to the traditional concerns of government. By Earth Day 1990 the number of people involved worldwide had swelled to 100 million and more. Perhaps more significant than the parallels between the two events, 20 years apart, were the differences. Earth Day 1970 was a catalyst, focusing attention on problems that had gone largely unobserved. Earth Day 1990 focused on known issues; in 1990 it would have been a surprise if participation had been lower.

The past two decades witnessed the emergence of a global citizens' movement, a broadly diverse agglomeration of organizations mobilizing around many issues but sharing a concern for the environment. Only the most authoritarian regimes have succeeded in repressing this concern; indeed, there is a necessary link between democratic government and the ability of countries to address the environmental agenda. In some Western European countries—West Germany in particular—"Green" political parties emerged. This often occurred where other environmental organizations were weak. While several Green parties now exist, they tend to reflect the political system of each country quite closely, so there are as many differences as similarities among them.

Largely unknown in the developed world is the extent to which grass-roots movements have long characterized the governance of many less developed countries. These

organizations have also turned to conservation. The self-help traditions of India based on Gandhian principles, the women's groups in Kenya, and the Christian base communities of Latin America are principal reasons why the environments of these countries have not been exploited even more ruthlessly than has been the case. Such movements represent a strong base of support for environmental protection in the countries concerned. Without such a base, all efforts are likely to remain futile.

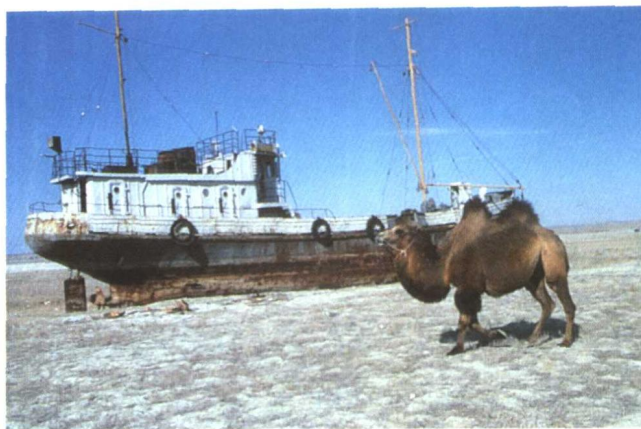
Nothing has demonstrated the link between democracy and conservation quite so dramatically as the emergence of Eastern Europe from totalitarian rule. Nascent environmental organizations played a central role in the political transition. By the mid-1980s it was possible to identify incipient environmental movements in all the countries of the Soviet bloc. In Poland, for example, representatives of the Polish Ecological Club sat at the roundtable talks that led to participation of the Solidarity movement in the government. In Bulgaria the immediate cause of the

REUTERS/BETTMANN



A ball resembling the Earth is passed from person to person at the 1990 Earth Day rally in Washington, D.C. Since the first Earth Day was observed in 1970, concern for the environment has progressed from a grass-roots movement to an international priority.

Konrad von Moltke is senior fellow at the World Wildlife Fund/Conservation Foundation in Washington, D.C., and adjunct professor of environmental studies at Dartmouth College, Hanover, N.H.



Eastern Europe's socialist regimes have left behind such environmental tragedies as Romania's Copsa Mica factories (left), which emit some 30,000 tons of soot into the air each year, and the near depletion of the Soviet Union's Aral Sea (right).

(LEFT) ED HILLE—MATRIX; (RIGHT) LEHTIKUVA—NOVOSTI/PHOTOREPORTERS

old government's downfall was a protest by Ecoglasnost, a small environmental organization.

The environmental wasteland left behind by the socialist regimes of Eastern Europe provides an object lesson in the havoc industrialization can wreak in the absence of adequate environmental safeguards. The Chernobyl disaster in the Soviet Union has become a worldwide symbol for the hazards of nuclear power. Energy is wasted everywhere, contributing to global warming. Krakow in Poland demonstrates how air pollution can destroy buildings and with them an entire cultural heritage. Forests in central Europe have collapsed under the burden of acid rain. The mining districts of Poland, Czechoslovakia, and the Soviet Union show how cumulative environmental effects ultimately shorten the life expectancy of the people living within range of multiple pollution sources. The Aral Sea in the Soviet Union, one of the world's largest lakes, is rapidly disappearing because of unsustainable water use. Major rivers in Poland are so polluted that they are useless even to industry without additional treatment, let alone for drinking, fishing, or swimming. Some experts calculate that Poland is losing 10–20% of its gross national product to pollution.

These have become potent symbols of human destruction of the environment, joining the early images from Western industrialized societies: the 1967 wreck of the *Torrey Canyon* pouring oil onto the shores of Britain and France; the pesticide-caused "silent spring" invoked by Rachel Carson in her book of that name; Lake Erie threatened with eutrophication, leading to eventual depletion of the dissolved oxygen vital to aquatic life; the Rhine in the late '60s choking on the economic success of the people living along its banks; the 1976 industrial accident at Seveso, Italy, that spread dioxin over an unsuspecting population; the 1984 accident at a factory producing materials for pesticides in Bhopal, India, which killed more than 2,000 people; the 1989 *Exxon Valdez* oil spill off the Alaskan coast, causing devastation that experts had claimed would not happen.

In a recent survey undertaken for the United Nations Environment Program, people in 16 countries, representing all regions and political systems, were asked about their environment. The answers were almost uniform: concern about environmental degradation was high in Kenya and in West Germany. Hungarians agreed with Japanese and Senegalese in expecting environmental quality to decline further. People everywhere thought governments should

be doing more to protect the environment. Faced with this broad consensus, governments have struggled to find the right answers.

Over the past two decades, the environmental agenda has grown and changed shape, making it particularly difficult for governments to decide on a course of action. Scientists keep providing new information that changes the picture, and the environment has an unsettling habit of being more complex than had been thought; measures that were once thought sufficient to resolve an issue turn out only to have uncovered a new problem. Nevertheless, 20 years after Earth Day 1970, some of the core issues are visible. They continue to challenge the patterns of economic development that have been the foundation of success for industrialized societies.

Science and Environmental Policy. The environment does not "speak," so how do we know what ails it? Sometimes we can see or smell when something is wrong in the environment; when the birds disappear we can even "hear" it. When the windows need washing more frequently, when clothes are dirty, or when grime covers everything, the state of the environment needs no explanation. But how do we ascertain the presence of invisible toxic substances, subtle changes in the balance of ecosystems, the loss of biological diversity? How do we know about regional phenomena like acid rain or global ones like stratospheric ozone depletion or global climate change? Scientific research is the only means available. Consequently, environmental protection and scientific research have formed a close link. Science provides the basis for action in environmental affairs. It also introduces a critical dimension of uncertainty.

The achievements of science in the environmental arena are remarkable. For more than a decade, researchers in Europe and North America have been seeking to unravel the complex linkages between acidifying emissions, principally from combustion in refineries, factories, and vehicle engines, and the increase in the acidity of rain, snow, fog, and other forms of precipitation. The chain of consequences is long and increasingly tenuous the farther one goes from an identifiable source. Many questions remain, but scientists are beginning to recognize the complexity of ecosystems—and that acidification is not the only threat from combustion processes.

Over a period of two decades, a controversial hypothesis on stratospheric ozone depletion put forward by two researchers in California, Sherwood Rowland and

Mario Molina, has been shown to be essentially correct. British researchers in Antarctica discovered a "hole" in the stratospheric ozone layer; satellites had missed the phenomenon because it was so unexpected that computers had not been programmed to detect it. Then a major international research effort spearheaded by the U.S. National Aeronautics and Space Administration provided convincing evidence linking the presence of chlorine in the stratosphere to processes of ozone degradation. The chlorine could be traced to a number of chemical products.

In the early '80s researchers working on global climate models formulated a hypothesis that became known as nuclear winter. They were able to demonstrate that full-scale nuclear war was likely to cause extended periods of severe cold because debris would enter the atmosphere and circle the Earth, blocking out sunlight. The resulting frost would destroy most of the biological processes humans rely on for sustenance. The nuclear winter theory helped spread the realization that nuclear war must be avoided at all costs.

In a research effort spanning many countries, scientists have now turned to the greatest of all environmental issues, global warming. There is virtual agreement about the chemical and physical principles that affect the planet's temperature as sunlight enters the atmosphere: some of the energy is retained and transformed, but most is reflected back into space. There is also widespread agreement that an increase in the concentrations of certain key compounds, known as greenhouse gases, will cause the planet's average temperature to rise and its climate to change. There is wide disagreement on what the climate would have been without these changes and, consequently, about the potential significance of "global warming."

Science Does Not Give Clear Answers. Some of these issues challenge the very foundations of scientific research. The questions concern large, complex issues, but scientific research proceeds in many small steps based on the formulation and testing of hypotheses. Issues such as

nuclear winter or global warming cannot be tested in real conditions. Acid rain involves so many factors that cause-and-effect relationships are difficult to establish. People are exposed to many toxic substances from natural sources and through industrial emissions, as well as through food additives, cosmetics, and other consumer products and through smoking; it is often impossible to weigh the effects of individual factors or to identify causal relations. Only rarely can a disease such as asbestosis be linked to a single substance—in this case, asbestos—and even then susceptibility, other exposures, and personal habits such as drinking and smoking affect the outcome. While only science can provide information about environmental phenomena, the scientific method is not suited to finding answers to environmental issues.

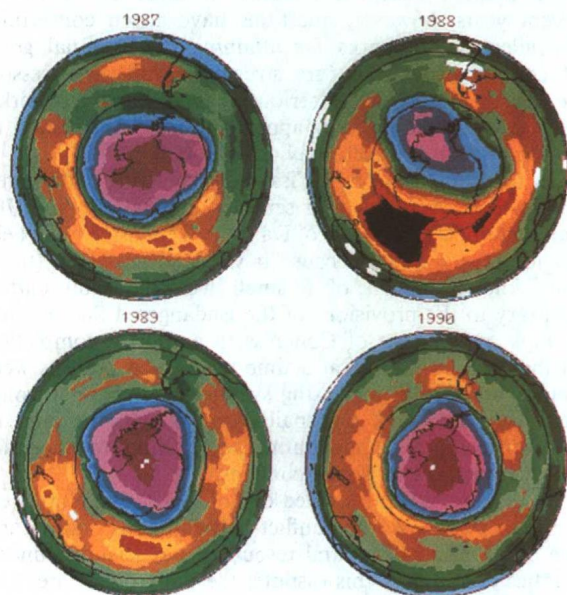
The natural sciences analyze what they see before them. The past is sometimes accessible through the physical record—fossils, ice cores, tree rings, or air trapped in glaciers. The future is more difficult: how can one formulate hypotheses about the future, and how can one test them before the future arrives? However, policymakers demand answers concerning possible future events because measures that will avoid, or at least mitigate, future environmental calamities must be adopted today.

It is not surprising that there are scientific disputes about the extent of environmental degradation. Such disagreements are vital to scientific progress. However, they create havoc in the political arena. How are policymakers to know whether a scientist who contradicts a widely accepted hypothesis is right or wrong? Frequently they cannot wait for the answer. In recent years a number of disputes have achieved public notoriety. For example, Bruce Ames is the inventor of one of the most widely used tests to determine the toxic potential of chemicals without resorting to animal testing. Recently he pointed out that most people are exposed to numerous carcinogens in their normal diet because many plants contain them naturally. The implication is that concern about carcinogens of human origin is exaggerated since people can cope with naturally occurring substances that are much more toxic. The debate this set off has not yet been settled. The key issue is whether adding anthropogenic toxic substances to those that occur naturally has a disproportionate effect; that is, whether people are used to natural levels of toxins but react when these are augmented.

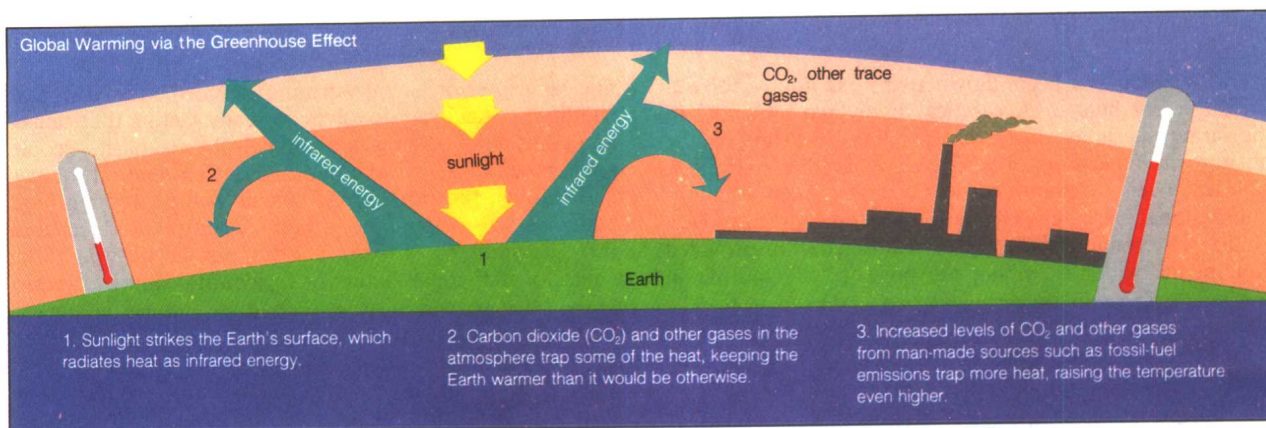
Perhaps the most visible recent dispute has centered on global climate change. A wide consensus exists among scientists that doubling of carbon dioxide in the atmosphere from preindustrial levels will cause a rise in average temperatures of between 1.5° and 4.5° C (2.7° and 8.1° F). The results of such an increase could be dire; shifting rainfall patterns and rising sea levels are among the most dramatic possibilities. A rise in average temperatures of 1.5° to 4.5° C may not seem like much, but it would mask much more pronounced changes in some areas. A comparable cooling would cause a new ice age. A doubling of carbon dioxide in the atmosphere is generally expected to occur by 2025 if no measures are taken to delay it. However, a number of scientists have recently challenged these findings, arguing that factors not previously taken into account could significantly change the assessment. There is no true test of these hypotheses short of waiting until 2025—not really an acceptable alternative.

Interpreting Science for Policy. The translation of scientific research for policymakers and managers has become an important function in its own right. NEPA introduced environmental impact assessment as a regular practice in

NASA



Total Ozone Mapping Spectrometer (TOMS) images taken over a four-year period reveal a hole in the ozone layer above Antarctica. The hole, indicated by differing shades of pink, was linked to the presence of chlorine in the Earth's stratosphere.



U.S. federal agencies. Environmental assessments must be made before major federal actions are undertaken, and this requirement has been interpreted to cover the issuance of licenses and the provision of funding, even outside U.S. territory. Environmental assessments now form an integral part of environmental management in most countries, though Western Europe, with a long tradition of land-use planning, has requirements different from those in North America. Many less developed countries which—like the United States—have no such tradition, have adopted the American approach. The World Bank and most other development agencies also require use of this technique to assess projects before they can be considered for approval. Thus environmental assessment has become an almost universal tool in developing an information base for rational decision making.

As the environmental agenda has unfolded over the past decades, it has become increasingly important to identify a unifying theme around which to group issues and on which to base decisions concerning priorities. One possible theme is the concept of risk. Assessing risks associated with environmental phenomena requires evaluation of two factors. The first is the hazard associated with an issue—the inherent potential to cause harm—for instance, the toxicity of chemicals, the environmental damage that could be caused by acid rain, the destructive potential of global warming. The second factor is the likelihood that populations or ecosystems, especially those of greatest vulnerability or sensitivity—children or pregnant women on the one hand, wetlands and high-altitude ecosystems on the other—will be exposed to that hazard.

In theory, it should be possible to achieve a comparative evaluation of risks—for example, those associated with toxic substances, acid rain, nuclear energy, fossil fuel combustion, stratospheric ozone depletion, or global warming—and to establish priorities for the allocation of limited resources. In practice this ideal has proved elusive. Crucial information may be lacking. Thus the National Research Council concluded in 1984 that fewer than 2% of the chemicals currently used for commercial purposes have been tested sufficiently to permit a complete health assessment. In other cases the scientific uncertainties are such that no reliable assessment can be made.

Every environmental hazard has an individual “footprint.” Some chemicals, like cadmium, may create hazards because, once emitted, they can move through the environment and reappear in unexpected places. Others, like lead, do not move at all and accumulate over exceedingly long periods. The hazards of some chemicals are related to their ability to be absorbed and transformed biologically. Others, like chlorofluorocarbons, are hazardous because they are not biologically absorbed but remain stable until they reach the stratosphere, where they cause damage to the ozone layer. It has proved difficult, if not impossible, to

compare the risks associated with such different hazards, particularly since the public's perceptions of risk can differ dramatically from those of experts. So while risk assessment is a useful tool for comparing environmental hazards, it does not provide clear answers. Ultimately, these must be found through political means.

The Shape of the Environmental Agenda. The antecedents of the environmental agenda lie in the conservation movement and the long process of establishing wilderness areas and parks, islands protected from the encroaching processes of industrialization. In the years around Earth Day 1970, environmental policy was fueled by concern about forms of pollution that were most tangible. It has grown to encompass many more issues, creating linkages to other areas of policy such as agriculture, transportation, energy, urban affairs, international economic relations, even national security. In recent years it has come full circle to refocus on ecosystems and biological diversity as the ultimate indicators of the health of the environment.

It is now possible to speak of “classic” environmental issues. Nature protection, air pollution, water management, and preservation of the soil were the original foci of environmental policy.

Nature Protection. The movement to create wilderness areas and national parks dates back to the establishment of Yellowstone National Park in 1872. Since then, parks have become accepted features in most countries. In recent years, however, questions have arisen concerning the adequacy of parks for attaining the essential goals of conservation. Many are struggling with an excessive burden of visitors. More seriously, even the largest parks, such as Yellowstone, now appear too small in relation to the ecosystem of which they are a part.

In the United States the issue of protecting endangered species has given rise to a series of conflicts. In the '70s completion of the Tellico Dam in Tennessee was held up for several years because it would destroy the (then) only known habitat of a small fish, the snail darter, contrary to the provisions of the Endangered Species Act. It took another act of Congress to authorize completion of the dam, ironically, at a time when such projects were being viewed with increasing skepticism. In a final irony, scientists discovered the snail darter some time later in another location, demonstrating once again how uncertain science can lead to policy conflicts.

In the late '80s the spotted owl of the Pacific Northwest came to symbolize the conflict between conservation and the exploitation of natural resources. No scientific uncertainties accompany this dispute; the old-growth forests of the Pacific Northwest are the spotted owl's last habitat, and their removal—even if there is reforestation—will likely cause the extinction of this species. On the other hand, thousands of jobs in the region depend on the timber industry, and the fact that demand for wood

products will create replacement jobs in other regions is slim consolation for people who have built a way of life around the logging of majestic trees.

The dispute about the spotted owl has a wider significance. Worldwide, the challenge is to protect critical ecosystems from continuing degradation, whether these are wetlands in the United States, arctic tundra ecosystems in Alaska, Himalayan highlands, or tropical forests in Brazil, Madagascar, or Indonesia. If the rich, industrialized countries prove unable to protect their resources from devastation, how can poorer countries be expected to balance their development needs with the requirements of conservation? The spectacle of Australians arguing about tropical forests in Queensland and Americans unable to face the inevitable end to the logging of old-growth forests does not provide a useful example for other countries.

Air Pollution. Most Western countries have invested billions to reduce air pollution, clean waste water, and institute measures of soil conservation. However, it can take several years from the time a measure is enacted until its effects are felt in the environment, and during this period pollution levels continue to grow. Thus emissions of pollutants into the atmosphere typically continued to rise through the '70s and often into the '80s, with stabilization at high levels sometimes followed by a decrease. In most Western countries emissions per unit of industrial production declined steadily over this period, but total production rose, so total emissions did not fall as dramatically as anticipated.

The earliest successes in air pollution control were achieved with particulates. The technology involved is relatively simple, involving change in fuel or the installation of dust-control equipment, such as electrostatic precipitators or bag filters, in power plants and factories. The visual impact of removing larger particulates is particularly dramatic; cities marked by particulate smog and haze can be transformed in a relatively short time. Concern has shifted to the finer particles (aerosols), which are less immediately evident although they may also contribute to haze. Such fine particles typically become vehicles for a range of toxic substances, which can find their way into the lungs.

Because of its high toxicity, carbon monoxide was targeted for control at an early date, with automobiles as the primary focus. Transport contributes as much as 90% of all anthropogenic emissions of this pollutant, with by far the largest portion coming from automobiles. Reductions in carbon monoxide emissions were first achieved in the United States and Japan, but by the end of the

'80s the downward trend was evident in most Western industrialized countries, with the exception of southern Europe.

Nitrogen oxides are precursors of acid rain. They also contribute to the formation of photochemical smog in sunny climates, such as southern California and the Mediterranean basin. In most industrialized countries automobiles are a major source of nitrogen oxide emissions. Beginning in 1975, three-way catalytic converters were installed on most new U.S. cars, but the results proved disappointing. Catalytic converters represent state-of-the-art technology, achieving the greatest possible reductions in nitrogen oxide emissions short of a radical redesign of automobiles. However, as they were being phased in, the number of cars on the road and the average number of miles each car was driven annually also increased. Nitrogen oxide emissions in the U.S. peaked in 1979 and have been falling slowly ever since—a total reduction of about 10%, compared with a reduction in emissions per mile driven of about 50% between 1978 and 1987. Because of other trends in the society, the technological fix failed to improve environmental quality as much as might be expected.

Sulfur dioxide has been the focus of particular attention because of its direct, proven link to acidification of the environment. For almost two decades industrialized countries have used a range of policies to maintain a downward trend in total sulfur dioxide emissions. Japan achieved a truly dramatic reduction of its sulfur dioxide emissions in the late 1970s, followed by West Germany and other European countries in the 1980s. As is also the case for nitrogen oxides, only a policy with emission reduction as its immediate goal can achieve this result.

The outcome of these efforts has been an improvement in the quality of air in most cities. Difficulties have been encountered with a pollutant that is not emitted directly but is formed through chemical reactions in the atmosphere: tropospheric ozone. Such secondary pollutants are extremely difficult to control. Nitrogen oxides, volatile organic chemicals, and sunlight, as well as the presence or absence of wind, all play a crucial role in the formation of tropospheric ozone. In some instances it even appears that reducing some but not all of these factors may actually contribute to an increase in ozone formation. This shift from relatively straightforward issues to increasingly complex phenomena is characteristic of environmental policy in the '90s.

Water Pollution. Reduction of traditional water pollutants is one of the success stories of environmental protection. Through a prodigious effort, wastewater in most industrialized countries is now treated. At the same time, treatment methods continue to be refined, as physical treatment has been supplemented by secondary (biological) treatment and in many cases by chemical treatment. As a consequence, the quality of surface waters everywhere has been improving, at least as measured by traditional criteria. The Thames in England and the Rhine are symbols of this change. Major bodies of surface water, like Lake Erie in North America and Lake Mjøsa in Norway, have been rescued from what appeared to be inevitable eutrophication in the early '70s.

As with air pollution, problems associated with water pollution have shifted—in this case away from point sources of emission and underground. The success in reducing point-source emissions—outflows from a factory or a house—contrasts with the continuing difficulties in controlling nonpoint sources, indirect flows from farms and roads or deposition from the air. These nonpoint

PAT & TOM LEESON—PHOTO RESEARCHERS, INC.

The spotted owl of the U.S. Pacific Northwest sparked debate between conservationists concerned with the survival of a threatened animal and the local timber industry concerned with the loss of jobs.



sources typically involve multiple pollutants. They have caused a rise in toxic substances and an increase in eutrophication in unexpected places—small streams in rural areas and large estuaries receiving runoff and air pollution from an extended area.

Relatively little is known about the quality of groundwater in most countries, despite the importance of the resource. Among other uses, many areas depend on it for drinking water. All groundwater contains some impurities. The types and concentrations of natural impurities depend on the nature of the geologic material through which the groundwater moves and the quality of the recharge water. It is certainly possible for groundwater to be naturally unsuited for human consumption or agricultural or industrial uses. The main concerns, however, have focused on anthropogenic sources of contamination, the most important of which are biological contaminants, inorganic substances such as metals or nitrates, and organic substances such as those used in dyes, food additives, detergents, plastics, solvents, and pesticides. In densely populated Europe excessive levels of nitrates and the presence of pesticides have led to a questioning of agricultural practices involving high levels of pesticides and fertilizers.

In some arid regions, like the western United States, Spain, the Nile River basin, and Argentina, the limits of available water are now in sight, certainly if current wasteful practices are continued. It will no longer be possible to meet all the established needs, particularly for growing urban populations and agriculture, forcing painful decisions to establish priority uses. Water conflicts are therefore likely to become more prominent in the coming decade, particularly as the environmental consequences of large dams become apparent. Since the success of the Tennessee Valley Authority in building dams and "taming" rivers while revitalizing the economy of an entire region, dams and development have seemed almost synonymous. In recent years, however, resistance to development based on massive dam-building projects has grown around the world. Large dams can be extremely disruptive. They flood fertile river valleys, and frequently their designers have paid inadequate attention to such factors as deforestation, which can cause siltation. The benefits generally are reaped by urban populations and privileged country dwellers; the burdens are borne by others.

Soil Conservation. Air and water quality are concepts everyone can understand, even if the chemical and physical details are highly complex; soil protection requires quite a different perspective. The dominant issue is protection of topsoil, the thin layer of fertile soil on which our food supply depends, and the overriding threat is erosion. The topsoil layer has been mined with reckless abandon. In parts of the world, a bushel of topsoil is lost for every bushel of food grown; in Iowa the ratio is even higher, ranging up to 50 tons of topsoil lost to erosion per acre per year. This far outstrips the ability of natural processes to regenerate soil fertility. The resulting deficit cannot be made up fully with artificial fertilizer, so farmers find themselves on a downward spiral with inputs increasing faster than yields.

The soil lost in one place ends up in another, causing a new set of problems. Erosion leads to siltation of vital waterways and dams, shortening their useful life or requiring additional efforts at dredging and clearing. These problems are particularly difficult to manage because they are the cumulative result of many dispersed actions, the unintended consequence of efforts to maintain the food supply.

Waste Disposal. Twenty years of environmental control policies have significantly decreased direct emissions, certainly per person or per unit of economic activity in the industrialized countries. In many cases, however, this reduction was based on "end-of-pipe" controls, which simply hold back pollutants or shift them from one environmental medium to another. In practice, there is no difference between emissions and waste. Environmental emissions are simply a form of waste disposal that distributes waste indiscriminately over the surrounding environment. Emission control without technological change necessarily results in a dramatic increase in the amount of wastes to be disposed of elsewhere. Thus an important result of emission controls has been the creation of extraordinary mountains of wastes, often containing substances that classify them as hazardous. In Hamburg, Germany, for example, more than 70% of all hazardous wastes needing disposal are the product of environmental protection technologies: scrubbers, filters, precipitators, catalysts, wastewater treatment facilities. The disposal of these wastes has become a major problem in its own right.

As long as waste disposal is free, or nearly free, polluters are not confronted with the real costs of their activities and lack incentives to change their ways. In fact, they are receiving a subsidy from the environment that distorts their economic decisions just as surely as a subsidy from government. The experience of the European Communities with hazardous wastes is instructive. Confronted with rising waste-disposal costs, some companies adjusted their production processes. Others sought to avoid disposal costs by seeking less expensive—and often environmentally unsound—options, frequently involving uncontrolled disposal and transport of wastes over long distances. At the same time, waste-disposal facilities constructed to handle a regional waste stream found themselves without clients. Ultimately, the only solution was to shift to a policy that forces every jurisdiction to confront its own waste-disposal problems, with transport only a solution of last resort. Every member country now has the right to license not only the import but also the export (to protect its waste-disposal industry) and transit (to protect its citizens) of hazardous wastes. Disposal costs are now beginning to approach appropriate levels, creating proper incentives for recycling and waste reduction.

Integration. Many environmental measures adopted over the past 20 years have been designed in a state of crisis. Growing pollution in urban centres forced measures for air pollution control. Surface waters in danger of ecological collapse created a powerful inducement to deal with water pollution. Many of these policies have indeed resolved the immediate problem. However, excessive focus on single mediums has tended to obscure the interconnectedness of environmental phenomena. Reducing pollution levels in one environmental medium almost always involves some relocation of pollutants to another. There is now an effort to take a more integrated approach to environmental problems.

Integration offers several important advantages. If possibilities for transferring pollution problems from one medium to another are eliminated, powerful pressures to prevent or solve them are created. It becomes possible to make choices between mediums that reflect both environmental and economic priorities; in a facility located on the seashore, it may be preferable to allow less air and more water discharges; in a facility located on a small river, priorities could be the reverse. The process of setting priorities is improved if the full range of options is kept in view. Cooperation with other policy sectors is also



Reaching well beyond populated areas, pollutants have spread to such places as the Antarctic (above), where penguins have been discovered to have the pesticide DDT in their systems, and the Alps, where trees in the high-altitude region (right) have died from effects of air pollution.

(LEFT) TONY STONE WORLDWIDE; (RIGHT) ERICH HARTMANN—MAGNUM



improved and, ultimately, simpler administrative systems can be designed.

If pollution-control efforts are not to focus on environmental mediums, what is to be the unifying theme? A number of options are emerging. It is possible to take each source as a unit, irrespective of the medium involved; for example, discharges to air, water, and land from a facility are viewed as interchangeable—which is frequently the case, within limits set by technology. It is possible to focus on substances, irrespective of sources and mediums; for example, all discharges of cadmium and its potential pathways to the environment. Finally, it is possible to focus on regions; for example, sensitive ecosystems or water catchment areas. This regional ecosystem approach is clearly the most comprehensive.

Ecosystem Management. Environmental policy began with concern about ecology and ecosystems, building on a tradition of conservation. For two decades it was driven by the need to resolve urgent problems of protecting human health. It now appears to be returning to its origins, recognizing that the ultimate challenge is to protect not only human health but also critical ecosystems. This is a much more difficult task than one might imagine. Ecosystems can be large or small. A pond is an ecosystem, and so are the Great Lakes, but a swimming pool is not. The critical balance in ecosystems is not something humans can manage, even though humans may affect ecosystems in many ways. It is this “unmanageable” aspect of ecosystems that renders the formulation of policies for their protection particularly difficult. How can we ensure the vitality of ecosystems if we are unable to control most of their critical variables?

The simplest answer to ecosystem protection is to avoid all human interference—essentially through the creation of wilderness areas, or at least parks. In practice, this is an answer only in those select areas of the planet where people remain strictly on the margins, such as the polar or high mountain regions. Recently even these areas have showed signs of degradation. High-altitude forests in the Alps have been severely affected by the phenomenon of tree dieback known by its German name, *Waldsterben*, now widely attributed to complex air pollution phenomena. The pesticide DDT has been found in the fatty tissue of Antarctic penguins, thousands of miles from any known application of the substance.

Global warming threatens to rewrite the ground rules for conservation as ecosystems shift toward the poles

or up mountainsides. As many scientists see it, this shift will occur more rapidly than critical components of the ecosystems can adjust, causing a collapse. Trees can “move”—as they reproduce, their range can shift to reflect changing weather patterns—but they cannot move rapidly. Larger animals may not be able to adjust to global warming as they find themselves trapped, with cities, highways, or farms blocking the routes they must take as weather changes. If the Arctic tundra begins to melt, caribou will have nowhere to go but into the ocean. There is more at stake in the Arctic tundra than the protection of caribou; many scientists fear that a thaw in that region could release prodigious amounts of methane, a “greenhouse gas” even more efficient at warming the globe than carbon dioxide.

The response to these developments is caution, not despair: ecosystems can and do absorb human intrusions, and ecosystems changed by human intervention can be as valuable and as worthy of protection as entirely natural ones. There are no ecosystems in Western Europe untouched by human culture and change; yet clearly the character of British farmlands, the Rhine Valley, or the coastal regions of the Mediterranean *should be respected*, as should the structure of rural communities in Africa or Asia. What is needed, however, is a much more sensitive and precautionary approach to ecosystem change, and that modest goal may imply some far-reaching adjustments.

The Great Lakes System. In the Great Lakes of North America, bottom sediments tell a story: recently deposited sediments are significantly less contaminated than those deposited a decade ago. But progress on this front is diminished by the legacy from the past, when virtually every form of chemical, mineral, and organic waste known was deposited in the depths of the lakes. Inevitably, most of these buried contaminants are recirculated. This source of potentially dangerous contamination will be around for decades. Direct discharges from human activities, resuspension of contaminants from bottom sediments, contaminant discharge through groundwater, and atmospheric deposition all contribute to keeping contaminant concentrations in the Great Lakes food web at levels that threaten the health of fish, wildlife, and humans. Because of natural processes, contaminant levels in predators at or near the top of the food web are of particular concern. In some places these fish, birds, and mammals exhibit severe problems—a clear warning to humans that risks can persist years after direct discharges cease.



These British farmlands are among the areas of Western Europe where human intervention has worked within the confines of the environment. Despite the changes wrought upon the natural landscape, people and nature are able to exist together in harmony.

G.R. ROBERTS—PHOTO RESEARCHERS, INC.

The North Sea. Unlike the Great Lakes, the North Sea is a part of the open oceans, with strong currents in many sections. Its problems derive from an extraordinary influx of pollutants from land-based sources and the manner in which these pollutants then disperse in the ecosystem, putting at risk the most sensitive areas, the extensive tidal wetlands along the coast of The Netherlands, Germany, and Denmark. Protecting the North Sea requires the cooperative effort of eight countries and involves reducing both direct and indirect discharges. The lessons being learned in the Great Lakes and the North Sea can be applied to other regional seas, such as the Baltic, the Mediterranean, and the Caribbean. They carry a warning that large bodies of water are not the limitless sinks they may appear.

Responding to Acid Rain. An international effort similar to that needed for the North Sea is shaping up in Europe for acid rain. The driving forces in this case are the concept of "critical loads," developed by the Scandinavian countries, and the "precautionary principle," which originated in West Germany. A critical load is defined in a recent international treaty as "a quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified elements of the environment do not occur according to present knowledge." The intensive study of acidification processes in the environment has shown that some ecosystems are much more sensitive than others and that certain elements of ecosystems are more sensitive than others. Studies of sensitive soils in Sweden and The Netherlands have shown that the tolerance of these ecosystems to acidification is much lower than previously thought. The conclusion of policymakers in The Netherlands has been that emissions of sulfur dioxide must be reduced by 80% and those of nitrogen oxides by 50% by the year 2000, and even such reductions will leave their most sensitive ecosystems at risk.

Faced with pressure from its citizens, the growing complexity of environmental issues, and the continuing uncertainty of scientific research results, the West German government turned to precaution as a guiding principle of environmental policy. This approach is receiving an increasingly sympathetic hearing in other countries of Europe. In a West German policy document, the precautionary principle is defined as "all actions which serve

the protection against specific environmental hazards; the avoidance or reduction of risks to the environment before specific environmental hazards are encountered; and in a future perspective the management of our future environment, in particular the protection and the development of the natural foundations of life." This definition encapsulates the shift in priority from environmental policies aimed at risk reduction to those seeking to avoid risks altogether.

Ecosystem Management and the Third World. The ultimate challenge to ecosystem management is the development of policies that preserve tropical forest systems while still permitting the economic use of their rich resources. Many plants and fruits in everyday use, ranging from begonias to tomatoes, as well as medicines (by some estimates, 25% of all currently used medicines) originated in tropical ecosystems. Presumably there are many more to be found, if we can preserve the ecosystems long enough to find them.

Clearly, wilderness areas and parks will play a crucial role in preserving tropical ecosystems, providing essential protection against irreversible mistakes that may occur as new approaches to the economic use of these resources are tried. Nevertheless, the future of conservation in tropical countries lies outside wilderness and park areas. The challenge is to find ways to allow people to live in these ecosystems and to permit countries to derive economic benefits from their extraordinary resources without destroying them.

If industrialized countries continue to struggle with the challenge of developing effective environmental policies, it is hardly surprising that less developed countries are finding it almost impossible to balance the conflicting demands of conservation and use of natural resources. Even a superficial look tells us that the pattern set by wealthy countries cannot be copied indiscriminately. If China were to reach only half the U.S. level of energy consumption per person using the same mix of sources, it would swamp the atmosphere with carbon dioxide. If Indonesia continues to copy the attitudes to forests that are common in temperate climates, it will be left without forests because tropical forests' regeneration is different from that of temperate forests.

These facts apply at present population levels. They will become unavoidable as population grows. Even if families limited themselves to the 2.1-children average that ultimately leads to population stability, demographers now assume that the current age structure ensures continued world population growth for some time. Should the existing dynamics of population growth continue into the next century, it is hard to imagine any environmental policies that could stave off disaster in several regions of the planet.

National Policies. Many governments are convinced that the environmental policies they have instituted are the most stringent anywhere. It is difficult to make comparisons because implementation procedures differ widely from one country to another. In practice, however, there are surprisingly few salient differences among the major industrialized countries.

Command and Control Policies. The United States was fast off the mark in the early '70s, but it fell back somewhat in the '80s. Japan, which introduced stringent policies in the late '70s, has not been a leader in recent years. West Germany, long an opponent of many measures, became a force for vigorous international policies in the late '80s. The Netherlands has pursued a long-term strategy with remarkable consistency, so its results, though less

dramatic, are comparable to those achieved elsewhere. Countries like Sweden, Canada, France, and the United Kingdom represent variations on these four themes.

In most countries there have been several rounds of legislation as governments sought to balance public pressure for environmental protection against other demands. The first rounds focused on the need to establish procedural rules and define standards—no mean task. The result has been regulations that are highly prescriptive or based on prohibitions, commonly known as command and control policies. Such policies ultimately have an economic goal: the internalization of environmental costs. However, they tend to leave polluters with few options as to means. There appears to be no real alternative to such policies, since governments must define what will be acceptable in environmental terms and what will be unacceptable, and the requirements of due process force them to be highly explicit. There is, however, a risk that policies based exclusively on command and control approaches will become self-defeating.

There are two fundamental options for setting standards. One is to specify minimum performance standards for processes—for example, emission standards for automobiles or power plants. The other is a “zero emission” standard (almost but not quite a ban). Such a standard is the goal of U.S. water-quality legislation; it is being applied increasingly in southern California for certain air emissions and may lead to radical changes of life-style there; and it is being pursued by countries such as Sweden with regard to a number of critical chemicals called “sunset chemicals.” The problem with emission standards that are set above zero is that the sum of all emissions may still exceed critical loads.

To counter this problem, governments frequently have sought to define environmental-quality standards, but it has proved difficult to do so with precision. In many cases the implied message—that total emissions must be reduced—has been unwelcome. In the United States a range of air-quality standards has been incorporated into the Clean Air Act as national ambient air-quality standards. In Europe the United Kingdom has long been a proponent of environmental quality standards for water—presumably because it, like Japan, has short, swift-flowing rivers that will regenerate quickly if only a few sources of pollution are removed.

The truth is that past policy successes have been won in areas that are relatively easy to manage. The result of these efforts in many industrialized countries is environmental quality that is still unacceptable and the prospect of deterioration if nothing more is done. In other words, the limits of command and control policies are coming into sight. They are failing to create the necessary incentives for continuous fine-tuning of pollution-abatement measures and for lasting reductions in total emissions to the environment. Policies must achieve real, substantial, and permanent reduction in total emissions of a wide range of substances. If this is the goal, how are burdens to be distributed?

Economic Incentives. Initially it was assumed that environmental protection would endanger jobs and reduce economic growth as traditionally measured, but studies in Europe have shown that investments in environmental protection create more new jobs than almost any other kind of investment. This is not surprising when one considers the kinds of goods and services environmental protection requires: a unique blend of qualified personnel and basic building and construction trades, a cross section of the work force. As governments have moved more

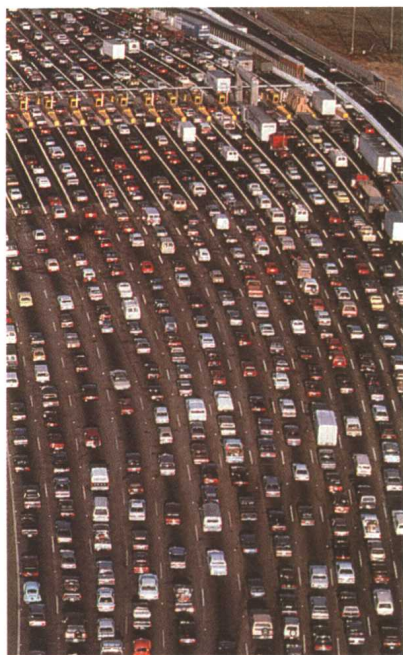
forcefully to impose environmental standards, they have created an entire new industry providing environmental goods and services. In most industrialized countries, this industry has shown remarkable growth rates over the past decade, far outstripping any losses that may have been incurred by polluting industries.

The question remains: who is to pay for these new jobs? The “polluter pays principle” provides an answer, but one that is also different from what most would expect. Environmental costs must be properly attributed to the activities that cause environmental degradation—generating electricity, refining oil, using pesticides, driving automobiles, building VCRs and computers. The costs are first incurred by the original manufacturer or provider, but they become part of the price structure and should be passed on to the true “polluter,” the ultimate consumer. In a properly functioning market economy, rigorous environmental protection results in reduced consumption. Whenever prices charged to consumers do not reflect full environmental costs—for example, when gasoline prices do not reflect the impact on tropospheric ozone production or global warming, or when food prices do not carry the full cost of irrigating crops—consumers are receiving a subsidy and are being induced to overconsume at the expense of the environment.

The “polluter pays principle” therefore defines a system of attributing environmental costs rather than identifying individual companies that must be made to pay. A crucial task of policy is to ensure that all prices reflect full environmental costs, something that is easier said than done. Setting standards and requiring the installation of pollution-control devices represent one means of achieving this goal, but in many cases it is not the most efficient approach. A number of others are currently being considered. Pollution charges impose a price on specific forms of emission; for example, sulfur dioxide, carbon dioxide, or wastewater. Presumably such charges will induce anyone who can lower costs by avoiding emissions to do so. Environmental taxes assume that the use of certain products, for example, fossil fuels, inevitably leads to environmental costs. To ensure that prices properly reflect the costs, a tax is levied on any use of these products irrespective of actual emissions. The purpose is to reduce the use of the products to acceptable levels. Tradable pollution certificates begin with the assumption that a certain amount of emissions is tolerable. They allow companies or public agencies (which must also be controlled) to bid for the use of available emissions.

Green Consumerism. If the “polluter pays principle” really is the “consumer pays principle,” then consumers need to feel the consequences of their choices. One sign of the success of environmental policies—in addition to the creation of a market for environmental goods and services—is the growth of a phenomenon that has come to be known as green consumerism. This movement, which originated in Europe and has been gaining strength in many countries, assumes that consumers can exercise power through their buying decisions and will do so if they have the necessary information.

In a perfectly functioning market, consumers would know which goods incur environmental costs because they would be more expensive. In reality, environmental subsidies continue to falsify the prices of goods ranging from gasoline to pesticides and from plastics to paper. Paradoxically, however, many consumers are willing to pay a premium for products that cause less environmental degradation, or at least to avoid buying those that are particularly dangerous. Increasingly, information is



The emissions from cars contain CO₂, which, when released into the air, contributes to global warming. To slow the damage to the environment, these and other emissions from industry and agriculture must be drastically reduced.

JAMES SUGAR—BLACK STAR

becoming available that assesses the environmental effects of such products as glass, paper, or aluminum beverage containers, disposable food packaging, diapers, cosmetic products, and consumer durables.

As consumers are influenced by such information, companies are moving to adjust their marketing strategies to take this into account, and in some instances they are replacing products or processes that entail substantial environmental consequences. Manufacturers are finding that a poor environmental reputation can adversely affect sales and thus profits. This creates incentives to improve environmental performance, not only of products but also of production facilities.

International Policies. From the early '70s it has been evident that environmental management would require an unprecedented level of international cooperation. Only now is it becoming clear just how unprecedented some of the solutions are likely to be. The demands of environmental protection are the driving force behind the creation of a new form of international relations based on cooperation rather than conflict. Hardly an environmental issue exists that does not have an international component, although not every international issue is immediately global in nature. To identify the appropriate level of action, it is useful to distinguish between universal, international, and global issues.

Universal issues are those that occur in many or all countries, whose implications may be global, but where the appropriate level of action is local or national. Classic examples are deforestation, soil erosion, and urban problems. In all of these instances, countries can learn from one another and assist each other, but ultimately nothing can be done unless the people living in the country or region where the problem exists wish to protect their resources. Incentives for—or against—action on such issues can be created; the ultimate decision rests with the populations concerned.

International issues involve two or more countries but still have relatively limited scope. Classic examples are the protection of migratory wildlife, regional air pollution like acid rain, and the management of international watersheds. Solutions generally need to be sought at a regional level

involving several countries; for example, North America, Europe, or the Caribbean. Regional arrangements generally build on well-established precedents of international relations. There are hundreds of multilateral treaties and agreements, and thousands of bilateral ones, dealing with environmental issues.

Global issues are those that absolutely require the participation of most countries: stratospheric ozone depletion, global warming, ocean pollution, Antarctica, the use of space, and issues like trade, debt, or development that link the environment to international economic relations. Global issues often require highly innovative forms of international cooperation—none more so than global warming, in many ways the ultimate challenge to our capabilities of planetary management. Global warming represents an issue where the primary level of legislation is global—in the sense that action at lesser levels holds little hope of success unless it is followed by global arrangements—while its effects reach into every household on Earth. The answers will be unlike any form of international cooperation attempted heretofore.

Conclusion. In the past two decades the environmental agenda has presented governments at all levels with extraordinary challenges. Great strides have been taken—but yet greater strides remain to be taken. In many ways the easy solutions have been exhausted, and the next steps will need to bring more fundamental transformations at all levels of society. Citizens are organizing as never before; consumers must exercise their power when purchasing; companies will revise production processes and product lines; and governments are beginning to accept that environmental policy is here to stay.

Five major goals may help to define the next steps in this area:

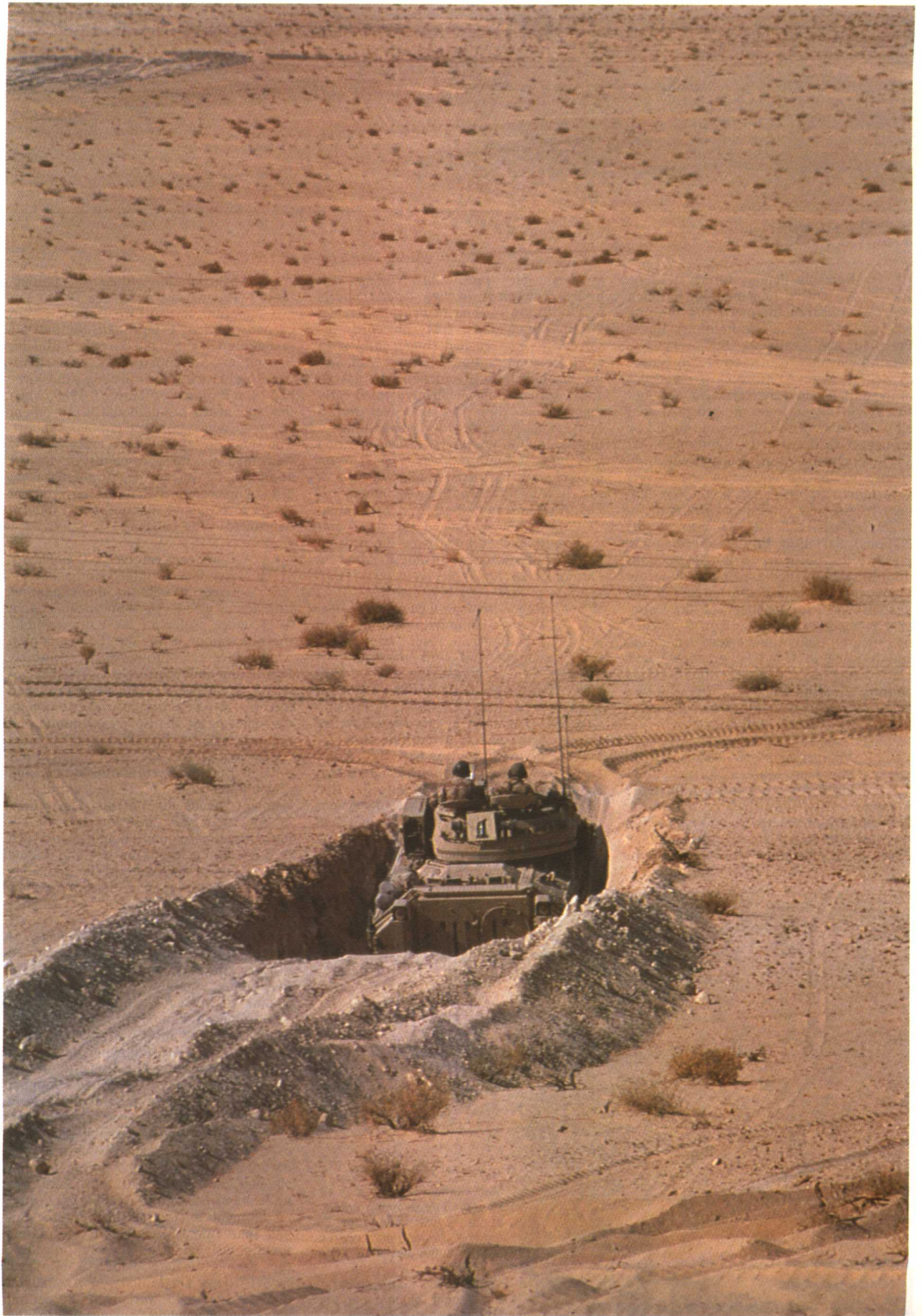
Respect for Nature. Human life depends on many natural resources. We can adapt to changes, and ecosystems can adapt to human intrusions—but only if we respect the imperatives of nature. It is not easy for many people to accept that there are values—such as the preservation of species from extinction—that transcend the demands of human society.

Basic Human Needs. The first priority, however, must be to provide for the basic needs of all people—food, water, and shelter in particular. There need be no conflict between this goal and respect for nature, but reconciling the conflicting demands involved will not be easy.

Better Integration of Economic and Environmental Policies. As long as economic and environmental priorities are seen as conflicting, we will continue to be faced with choices that are distasteful and sometimes impossible. If economic and environmental priorities are to be better integrated, our ideas about what is “economic” will need to change dramatically.

Real Reductions in Emissions. Since the environment makes no compromises, it will not be sufficient to do the best we can—we must do as well as is needed. Among other things, that will imply real reductions in the emissions of many substances, ranging from carbon dioxide to cadmium and from dioxins to nitrogen oxides.

International Solidarity. No issue promises to bind countries together as closely as the environment. It will be difficult to manage many environmental issues without a remarkable level of solidarity; it will be impossible in the case of global climate change. This represents a challenge and an opportunity. The challenge is to transcend national egoisms. The opportunity is to do so and create a planet where peace is possible, not only among people but also between people and nature.



Chronology of 1990

JANUARY

2 Romania detains former leaders. An official of Romania's Foreign Ministry announced that all those who were serving in the Politburo under Pres. Nicolae Ceausescu before he was overthrown and executed on December 25, as well as some 20 other close associates of the dictator, had been arrested. Without specifying any charges, he affirmed that all "evildoers" of the old regime would be brought to justice. He also announced that an independent news agency had been created to replace Agerpress, the former government's propaganda organ. On January 23 the new provisional government, which called itself the Council of the National Salvation Front, agreed under pressure to postpone national elections until May 20 to allow new political parties more time to organize. On January 26 the disillusioned vice-president of the council's 11-member executive board resigned because, he said, the current leadership still resorted to "Stalinist practices." His views echoed wide popular criticism of the country's interim leaders, whose numbers allegedly included many former Communists and Ceausescu supporters.

3 Manuel Noriega surrenders to U.S. Gen. Manuel Noriega voluntarily left the Vatican nunciature in Panama City and turned himself over to U.S. authorities. He had been given asylum there on December 24. The Panamanian government was fully informed of events

as they were transpiring. Noriega was under indictment in two federal courts in Florida on charges of drug trafficking. During discussions that preceded his surrender, Noriega had sought, and been given, assurances that he would not face the death penalty if convicted in a U.S. court. Vatican officials firmly denied early reports that they had in effect forced Noriega to surrender by issuing him an ultimatum. On January 4 Noriega, wearing his military uniform, was arraigned on drug charges in a federal court in Miami, Fla. In a television address on January 3, U.S. Pres. George Bush told the nation that the arrest completed the four-point agenda he had outlined when he ordered U.S. military forces to invade Panama on December 20.

5 Rebels seek to oust Samuel Doe. Western diplomats reported from Liberia that fierce fighting in Nimba county had sent thousands of villagers fleeing across the border into Côte d'Ivoire. The latest military challenge to Gen. Samuel K. Doe's leadership had been launched in late December by troops of the National Patriotic Front of Liberia commanded by Charles Taylor. In recent years U.S. support for Doe had significantly weakened, mainly because there was little evidence that observance of human rights by his government had improved or that serious efforts were being made to eradicate official corruption.

10 Martial law lifted in Beijing. Premier Li Peng (Li P'eng) announced that China's State Council had decided to terminate martial law in Beijing (Peking), effective at midnight. Martial law, accompanied by the positioning of military units on the city's outskirts, had been imposed on May 20, 1989, when the student-led pro-democracy movement began to win significant popular support. The end to martial law was warmly welcomed by most residents of Beijing and foreign governments, but there was no general expectation that the government would relax in any significant way its firm control over the citizenry.

11 Gorbachev cautions Lithuania. Soviet Pres. Mikhail Gorbachev arrived in Vilnius, the capital of Lithuania, where he desperately sought to convince leaders of the Baltic republic that secession from the Soviet Union would have calamitous effects. Untimely Lithuanian independence, Gorbachev insisted, would weaken Soviet security and imperil his program of *perestroika* (a restructuring of the Soviet economic and political systems). In addition, he pointed out, secession would involve negotiations on defense, trade, communications, and possibly compensation to the central government for its investments. Separation, he reiterated, was a decision of far-reaching consequences and should be pursued through legal steps currently being drafted by the Soviet legislature. The three-day visit ended without any public concessions on Lithuania's part.

14 Azerbaijan erupts in violence. At least 25 persons were reported killed in Baku, the capital of the Soviet republic of Azerbaijan, in a new outburst of ethnic rage against predominantly Christian Armenians by gangs composed mostly of local Azerbaijani Muslims. The following day Soviet Pres. Mikhail Gorbachev placed the region under a state of emergency. On January 16 some 11,000 troops and police were flown into the area to end the slaughter, which at times verged on civil war. After overcoming determined resistance on the part of armed civilians, government troops claimed on January 20 that Baku was under their control. On January 22, after an all-night session of the Supreme Soviet (parliament), Azerbaijan's legislators unanimously endorsed a resolution calling for the immediate withdrawal of all Soviet troops. On January 27 Azerbaijani officials offered to work with the central government to find a solution to the



U.S. DEPARTMENT OF DEFENSE

Gen. Manuel Noriega of Panama stands under guard aboard a plane bound for the U.S. Noriega surrendered to U.S. authorities after spending 10 days in the Vatican nunciature, where he had sought refuge during the U.S. invasion of Panama.

republic's ethnic problems, but only after Moscow withdrew the Army. Failure to do so, the Azerbaijani parliament warned, could spark new Azerbaijani demands for independence.

15 Bulgaria weakens Communist Party. The Bulgarian National Assembly voted to delete from its constitution the words that had guaranteed the Communist Party a monopoly on power for more than four decades. Bulgaria was the most recent Eastern European Communist bloc nation to take this step toward multiparty democracy. The National Assembly, however, after heated debate, did not vote to delete constitutional references to Bulgaria as a socialist state headed by the working class. During a meeting of politicians the following day, opposition leaders demanded office space, free access to television and radio, and an independent newspaper. On January 18 the Bulgarian state radio announced that 78-year-old Todor Zhivkov, who had ruled Bulgaria for 35 years until he was ousted on Nov. 10, 1989, had been placed under house arrest. The charges against him included misuse of government money and property.

16 UN to push for Cambodian peace. The five permanent members of the UN Security Council (China, Great Britain, France, the U.S., and the U.S.S.R.) endorsed a series of basic principles that, it was hoped, would bring political stability to ravaged Cambodia and end years of bloody conflict. These principles, first suggested by Australia, included a cease-fire, verified withdrawal of all foreign troops, a cessation of outside military assistance, and an active UN role in the peace process. The eventual goal would be UN-supervised free and fair elections, with prior guarantees that all parties contending for power would respect the outcome. An effort would also be made to form a nonpartisan national council that, during the period of transition, could serve as a conservator of Cambodian sovereignty.

17 Daw Aung San Suu Kyi disqualified. The military rulers of Myanmar, formerly called Burma, officially declared Daw Aung San Suu Kyi disqualified as a candidate for office in the national elections scheduled for May. Daw Aung San Suu Kyi, daughter of Aung San, the assassinated hero of Burmese independence, had been under house arrest since July 1989. The 44-year-old secretary-general of the National League for Democracy (NLD) party stood accused of "attempting to divide the army." That same charge had been leveled against Tin Oo, chairman of the NLD, who was declared guilty and sentenced to three years in prison at hard labour. The arrest of numerous antigovernment politicians and severe restrictions on local and foreign reporters were widely seen as blatant attempts to assure that Gen. Saw Maung, who had headed the country since a 1988 coup, would remain in power.

20 Haiti leader declares emergency. Lieut. Gen. Prosper Avril, head of Haiti's military government,

declared a state of siege throughout the country "to protect democratic accomplishments against terrorism." The immediate cause of the decree was the murder on January 19 of an army colonel in the Presidential Guard and two women who were passengers in his car. On January 21 prominent members of the opposition who had been arrested after the slayings were deported. Local and foreign observers expressed a belief that Avril was merely using the deaths as a pretext for destroying his political rivals, intimidating his critics, and eventually canceling promised free elections.

21 ANC approves a new strategy. After a five-day meeting in Lusaka, the capital of Zambia, leaders of South Africa's outlawed African National Congress (ANC) announced the adoption of a new strategy to end apartheid in their country. The congress would seek to become a true political entity so it could deal directly with the government and thus play an active role in the political and social transformation of the nation. The ANC, however, would not abandon such traditional tactics as protests and strikes to press demands for an end to racial segregation and the white minority's monopoly on political power.

Violence escalates in Kashmir. In the bloodiest such violence in several years, dozens of persons were killed when Indian troops tried to quell ethnic unrest by enforcing a curfew in Srinagar, the summer capital of Jammu and Kashmir state. The predominantly Muslim population had sought for decades to break away from India, which is overwhelmingly Hindu, and become either independent or part of Pakistan. China also occupied part of the Jammu and Kashmir region.

22 Roh and two rivals join forces. During a television address, South Korean Pres. Roh Tae Woo announced that he and two prominent leaders of opposition political parties had agreed to merge their organizations to end the bickering that had virtually paralyzed the National Assembly since the 1987 presidential election. As a consequence, Roh's Democratic Justice Party, the Reunification Democratic Party headed by Kim Young Sam, and the New Democratic Republican Party led by Kim Jong Pil would become a new political entity, tentatively called the Democratic Liberal Party. Each of the three factions would have a role in running the government, and each, albeit in different ways, would improve its future political prospects. Kim Dae Jung, the leader of the Party for Peace and Democracy, angrily denounced the merger as "a coup d'état against representative politics and the democratic institution of elections."

Yugoslavia permits new parties. Delegates to Yugoslavia's Communist Party (League of Communists) congress voted 1,654-28 to allow the formation of opposition political parties. The vote effectively ended the Communist Party's 45-year monopoly of power, which had been guaranteed by the constitution. The decision also opened the way for free local elections, possibly



People in Azerbaijan block troops sent by the Soviet government to control the ethnic violence that erupted between Azerbaijani Muslims and Christian Armenians.

NOVOSTI/SYGMA

in April. The Communist Party's claim that it was still the only viable unifying force in the nation was badly damaged by bitter disagreements during the congress. Reformists were especially angry because amendments regarding human rights and changes in the criminal code failed to pass.

23 Soviet troops to depart Hungary. Hungarian Prime Minister Miklos Nemeth informed the National Assembly that the Soviet Union had agreed to withdraw its troops from Hungarian soil. No deadline was announced, but the pullout was expected to be linked to a general reduction of opposing forces in central Europe. Although Soviet troops had been stationed in Hungary since the end of World War II, popular resentment against their presence was especially intense because of their role in suppressing the 1956 popular revolt.

25 Senate sustains Bush veto. Yielding to heavy pressure from the White House, Republican senators supplied the votes necessary to uphold Pres. George Bush's veto of legislation that would have given Chinese students attending class in the U.S. legal protection against deportation after their visas expired. The House had already voted overwhelmingly (390-25) to override the veto, but a two-thirds majority in each house of Congress was needed to turn the bill into law. Although Bush insisted that an executive order was all that was needed to protect the students, those critical of his China policy pointed out that an executive order could be reversed with a simple stroke of a pen and thus provided no secure protection for the young Chinese intellectuals.

29 Poland's Communist Party dissolved. The leadership of Poland's Communist Party voted to dis-