The Heritage Foundation Backgrounder

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FOR EARTH DAY, NINE SCIENTISTS OFFER DATA ON THE STATE OF THE ENVIRONMENT

INTRODUCTION

April 22, 1990, marks the twentieth anniversary of Earth Day, an event designed to focus attention on environmental and ecological issues. While the average American has little interest in the details of scientific and technical issues, most opinion surveys find that the public has an overriding concern for the quality of the environment. Yet concern about the environment and proposed solutions for perceived problems are almost wholly grounded in scientific theories and on the current state of knowledge in specific fields of research. Without accurate data Americans cannot hope to produce effective responses to actual problems, let alone distinguish true problems from the scores of perceived threats.

Science does not always provide a simple answer to even a simple question. This complexity has discouraged many Americans from making the necessary, careful examination of science-based policy issues. Policy makers are not above making this mistake, often producing ineffective or even harmful environmental regulations that lead to further debates and more failed policies. Although years of research may be needed even before an actual problem can be identified, many clamor for an immediate solution to every fear.

Supposed Crises as Norm. Science fiction and fear should not substitute for sound policies. On topics ranging from potential climate change to bioengineering, from the global to the microscopic, appeals to unsubstantiated speculation and untested or unproven "scientific" assertions find a ready audience in today's sensationalized media coverage of all events. Almost any claim of impending cataclysm receives an enormous amount of coverage, regardless of the true weight of the evidence. For much of today's media, "news," by definition, is bad news. This automatically focuses on accidents or supposed crises as if they were

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the norm. By the time the facts are marshalled to rebut false assumptions, as typically they have been, the public focus has shifted to the next "crisis." The result: the public never hears the full story.

The nine short papers here assembled are by scientists addressing important environmental issues. They apply fact and analysis to these topics. As Americans mark the Earth Day anniversary, their opinions should be as informed and their knowledge as complete as possible if rational, effective environmental policies are to be enacted.

♦ ♦ **Aaron Wildavsky,** Professor, Political Science and Public Policy, Survey Research Center, University of California at Berkeley, analyzes popular views of the risks involved in new products, inventions or even in the search for these. He concludes that attempts to eliminate every risk to society involve the even greater risk of stopping human progress and failing to meet new challenges in such areas as medicine and the environment.

♦ ♦ **Bernard Cohen,** Professor of Physics at the University of Pittsburgh, shows that exaggerated fears of radiation ignore even far greater risks from using other, more polluting fuel sources, and cost society billions of dollars in wasteful expenditures from unneeded regulations.

♦ ♦ **Elizabeth Whelan,** President of the American Council on Science and Health, points out that America's food supply is made safe and plentiful because of pesticides and chemicals. Efforts to eliminate these will make food less safe and more costly.

♦ ♦ **Winston J. Brill,** President of Winston J. Brill and Associates, and a research consultant on biotechnology, addresses the potential harm that arises from inappropriate restrictions on genetic research. The potential agricultural, medical, and environmental benefits from bioengineering are enormous and should not be hindered by public misconceptions.

♦ ♦ **Edward C. Krug,** soil scientist with the Illinois State Water Survey and participant in the National Acid Precipitation Assessment Program's 1990 Conference, offers evidence that "acid rain" is not killing lakes or forests in the Northeast. He argues that the small environmental impact from manmade emissions of sulfur can be corrected for less than one percent of the cost of the Clean Air Act approach.

♦ ♦ **S. Fred Singer,** Professor of Environmental Sciences at the University of Virginia, finds that ozone in the earth's atmosphere which protects man from harmful ultraviolet radiation, is not at an abnormally low level. Seasonal declines in ozone over Antarctica have been observed for over 30 years and have had no adverse effects on living creatures.

♦ ♦ **Patrick J. Michaels,** environmental scientist of the Department of Environmental Sciences at the University of Virginia, addresses the weaknesses in current computer models predicting "global warming." He offers empirical data showing that average worldwide temperatures are not rising significantly.

no logical stopping points. It might be irresistible for government bureaucrats or others to suggest that if a one-in-a-million risk is good, then a one-in-one-billion risk is even better. Never mind that the cost of reaching such low risk levels redirects society's resources in ways that result in greater overall harm.

Since greater wealth and other resources offer the means for a safer and healthier society, reducing society's wealth through over-regulation with no attempt to balance costs with benefits ultimately will reduce the people's health and safety. A strategy of pure prevention is akin to making an organism so sensitive that the smallest threat of harm leads it to set off so many of its defenses that it collapses from exhaustion and dies.

Willingness to Take Risks. The second problem with a public policy of preventing any risk or danger from any new innovations follows from the fact that failure to innovate itself can be very harmful. Society cannot continue to realize the growth in safety and health it has experienced for the past century without encouraging technical, engineering, industrial and scientific progress. The more that policy makers restrict experimentation or the trial-and-error approach, the less innovation there will be. Old hazards will not be reduced as much as they would have been. New benefits to society will be delayed or never materialize. Thousands or millions of people might suffer or die from lack of new medicines. To find a solution to new dangers, such as AIDS, will require a willingness to take some risks, to eliminate others.

It is impossible to develop rapid improvements in health and safety without an innovative technology based on continuous, noncentralized, trial-and-error decision making. The history of promoting safety through a centralized system is poor. If Big Brother knew best, the Soviet Union would have rising rather than declining health and safety rates. Just as Eastern Europe was enslaved in the name of some perfect "liberty," so health can be harmed in the name of some perfect "safety."

Safety without risk is a delusion. Uncertainty about the consequences of present acts and about others as yet unforeseen cannot be reduced to zero. Health and safety are provided in the same manner as other goods, by means of trial-and-error risk taking. Only by allowing this process to continue will society be able to reap the benefits of increasing levels of health.

RADIATION AND OUR SOCIETY

Bernard L. Cohen

Nuclear radiation consists of various subatomic-size particles such as gamma rays, electrons and alpha particles travelling at speeds of approximately 100,000 miles per second. They penetrate deep inside the human body, each one damaging about 100,000 cells as it passes. This damage might initiate a fatal cancer, or if it is in a reproductive cell, it could cause genetic defects in later generations.

This makes radiaiton seem very dangerous, but before panicking one should recognize that every person is struck by about 15,000 of these particles every second, a total of 500 billion every year or 40 trillion in a lifetime, from natural sources alone. When a patient receives an x-ray, he is struck by about a hundred billion particles.

It is true that any single one of these trillions of particles might cause a cancer or a genetic disease. But the probability of any one particle having such an effect is very low, about one chance in 20 quadrillion or 20 million billion. Thus, even though such a particle passes through each human body 15,000 times every second, less than one percent of the population is ever affected by them. Of course, people are subject to innumerable other such fatal games of chance. For example, every bite of food and every breath of air contains trillions of carcinogenic molecules any one of which can cause cancer, and millions of germs that can kill through causing other diseases. Walking involves risk of a fatal fall; staying still, however, risks cardiovascular problems from lack of exercise. Every action involves risk.

Resulting in Bad Public Policy. To understand radiation risks, one must compare them quantitatively with other risks. Thanks to over a half century of research, effects of radiation are better understood than those of almost any other environmental agent. The nature of these effects are agreed upon, with relatively insignificant variations, by such scientific groups as the National Academy of Sciences' Committee on Biological Effects of Ionizing Radiation, the International Commission on Radiological Protection, and the Congressionally chartered National Council on Radiation Protection, the United Nations' Committee on Effects of Atomic Radiation, the U.S. Environmental Protection Agency, Britain's National Radiological Protection Board, and similar official bodies charged with responsibility for radiation protection in every nation of the world.

While the general nature and effects of radiation are well understood, policy makers often act without applying the available quantitative information. The results are bad public policies. For example, use of electricity in the U.S. has increased steadily for over a century, growing at a rate of around 4.5 percent annually in recent years. This growth requires new power plants, and the only viable fuels for these are nuclear or coal. The best scientific estimates of the health effects caused by a plant producing one million kilowatts of electricity are:

1) **From a coal-burning plant**, about 25 deaths per year due to air pollution;

2) **From a nuclear plant**, about 0.05 deaths per year owing to radiation resulting from reactor accidents, treated on a probabilistic basis; radioactive waste, ad-

ding up effects over millions of years; escape of radioactive materials during operations; and all other effects.Thus rational scientific analysis indicates that a coal-burning plant is 500 times more harmful to public health than a nuclear plant. Yet coal-burning plants are often chosen over nuclear plants because the public considers the latter to be too dangerous.

The fear of radiation appears even more irrational when comparing public reaction to radiation from different sources. Nearly any risk can be reduced by spending money. For example, new highway safety measures such as improved street lighting, upgraded guard rails, or break-away sign supports can save lives at a cost of about $100,000 per life saved. Money spent on screening programs to detect cancers in early stages also saves lives at a similar cost. The Nuclear Regulatory Commission (NRC) estimates that a nuclear power plant built in the early 1970s with technology available at that time will cause an average of one death due to reactor accidents over a 40-year operating lifetime. Despite tens of millions of dollars spent to research reactor safety, this estimate has not changed substantially since 1975. The press sometimes refers to reactor accidents that can cause up to 50,000 deaths, but these are expected only once in 10 million years, an average of only 0.005 deaths per year. The NRC in the late 1970s and early 1980s tightened safety requirements that increased the cost of a nuclear power plant by $2 billion. Presumably this was to avert that one death, a cost of $2 billion per "life saved."

$100 Million to Save a Life. Even if reactor accidents are not considered, great sums are spent for small statistical gains in regulating nuclear power. About $100 million per life saved is being spent on radioactive waste management. An NRC regulation requires that nuclear plants install equipment to reduce releases of radioactive iodine if it will save one statistical life for every $100 million spent.

A far greater danger of harm from radiation exposure is from radon in homes. Radon is a naturally occurring, radioactive gas that can become trapped in well-insulated homes, building up to potentially dangerous levels. It is estimated that 10,000 Americans die each year from exposure to radon, over a thousand times more than are ever expected to die from nuclear power's radiation. A substantial fraction of these lives can be saved by rather simple and cheap procedures. Such prevention efforts cost about $25,000 per life saved using the same sort of estimates as those applied to nuclear power safety measures. Yet only 2 percent of American families have taken even the first step of spending $12 to measure radon levels at home.

Policy Makers Ignoring Facts. Since the particles are absolutely identical, when a human cell is struck by a particle of radiation, the health effects are the same whether that particle comes from radon in the home or radiation released by a nuclear power plant. Current policies result in spending hundreds of millions or billions of dollars per life saved to avoid small risks, when far greater benefits are available for far lower expenditures. The information is available to policy makers. Yet they too often ignore the facts and thereby waste huge amounts of the nation's wealth and health.

PESTICIDES, THE NATION'S FOOD SUPPLY – AND YOUR HEALTH

Elizabeth M. Whelan

"Pesticide" has become a pejorative word. With headlines claiming that Alar, technically a growth regulator, not a pesticide, formerly used on apples, ethylene dibromide or EDB a fungicide used on grains and other agricultural chemicals "cause cancer," Americans have become understandably concerned about pesticides' use on produce.

Despite the flurry of regulatory activity to deal with the public anxiety about pesticides, there is no evidence that pesticide residues cause human cancer, and no recorded cases of any human ill health related to exposures to residues of pesticides used in an approved, regulated manner. Pesticides assure man that most crops survive the ravages of insects and end up on the dinner table. The public and policy makers should reject policies that might endanger America's food supply.

"Only the Dose Makes the Poison." A look at the facts shows that fears over pesticides are misplaced. The most basic principle of toxicology is "only the dose makes the poison." Pesticides by definition are poison. They are meant to kill insects and other predators. Indeed any chemical can be harmful if the dose is high enough. The scientific reality is that the exposure of American consumers to pesticides is minuscule. The Environmental Protection Agency sets allowable tolerances for residues in food over 100 times more than necessary to protect health. The Food and Drug Administration inspects food to make sure those tolerances are respected. With the margin of safety built in, there is no further health protection to be achieved by further limiting exposure.

Demands that no poisons or carcinogens be in any food are unrealistic. To begin with, most natural foods abound in toxins. Further, the concerns about pesticide residues come almost exclusively from the observation that these chemicals can be designated "carcinogens." Yet this fact is based exclusively on animal studies, with no discernable link to humans. For example, scientists have now determined that a multitude of natural chemicals, including those in pepper, mustard, mushrooms and bread, also cause cancer in animals. The scientific consensus now is that extrapolating from high-dose animal experiments to trace exposures of humans to pesticides and other chemicals is not scientifically valid.

Epidemiologists have identified a number of factors that increase the risk of human cancers. Cigarette smoking, overexposure to sunlight and radiation, alcohol abuse, particularly in conjunction with smoking, certain occupational exposures, and reproductive practices, such as women having their first child at an advanced age, contribute to the risks of developing specific types of malignancies. No cancer epidemiology textbook lists pesticide residues as a cause or probable cause of human cancer.

Necessary Human Intervention. The world's ability to feed its billions of inhabitants is in part a testament to man's ability to protect crops from insects. Without deliberate human intervention, nature rapidly would eradicate the world's food-producing capacity and unleash the crop-destroying pestilence that

has plagued much of human history. Calls for limits or the banning of pesticides, based on unsubstantiated fears of a one-in-a-billion chance of contracting cancer would threaten millions of people by reducing their food supplies. Many would be threatened even with starvation. Without pesticides there would not be an abundant, inexpensive, varied supply of food for this nation on a year-round basis.

In assessing the current public anxiety about pesticides, the public and policy makers are faced with a stark choice: either they can respond to those worries with facts, or they can bow to perceptions. Consumers must evaluate the purely hypothetical risks of pesticides, based on no evidence, contrasted with the grave dangers posed to the food supply by denying farmers the chemical tools they need to feed this country and the rest of the world.

BIOTECHNOLOGY OFFERS ENVIRONMENTAL BENEFITS

Winston J. Brill

Most of the food we eat, from meat to fruit to vegetables, is the product of traditional cross-breeding, a form of "genetic engineering." Animals with desirable traits, such as less fat, or plants more resistant to pests are mated or bred with one another to produce more organisms with those traits. Biotechnology is a newer science that involves transferring genetic material that produces an organism's traits, directly from one cell to another in an effort to improve or introduce desired traits to an organism. In this regard it is much like the traditional, but far slower and less certain, methods of breeding for selective traits.

Genetic engineers can go beyond traditional breeding. They isolate one or several genes from an organism and introduce these genes into the chromosome of another organism. Species barriers can be overcome. For example, bacterial genes can be added to plants.

The new techniques of biotechnology have great promise for more efficient agriculture. Application of these techniques may be critical to maintain a satisfactory quality of life as the planet's population increases and as greater attention is paid to environmental problems.

Inhibiting Crop Pests. Laboratories already have produced genetically engineered plants that ward off caterpillar and virus problems. Microorganisms have been engineered to inhibit a variety of crop pests after the microorganisms have been applied to the field. These engineered organisms reduce or eliminate the need for pesticides. There is good reason to believe that the pests will not readily overcome this resistance, as they have with most chemical pesticides. Work also is progressing to produce plants that utilize fertilizers more efficiently, that can reduce the cost of producing crops and possibly decrease fertilizer pollution in lakes and streams. Biotechnology should be able to produce plants that will grow in hostile climates, for example, in the extremely dry parts of Africa. In human health care, genetically engineered organisms are now producing important pharmaceuticals; in fact, this is where most of the biotechnology research and commercial activity has focused.

While special caution is required any time there is application of a new technology, the level of caution should be based on scientific principles and relevant experience. The National Academy of Sciences and other highly respected scientific groups have published reports stating that a genetically engineered organism should be no more dangerous than that same organism genetically modified by traditional methods, such as mutation and breeding. Thus, regulations that have been satisfactory for traditionally altered organisms should be satisfactory for organisms that have been modified through genetic engineering.

This conclusion is scientifically sound. The best a genetic engineer could hope to do is to add fewer than ten foreign genes to the recipient organism and have that organism survive in nature. An organism contains hundreds of thousands of genes, and the addition of a few will not radically change its character. Therefore a tomato containing a couple of genes from another organism will still look and

in most respects be like other tomatoes. It may, however, have improved taste or resistance to a pest. Genetic engineering is much more specific and predictable than breeding, which is really a random mixing of the hundreds of thousands of genes of each parent organism.

Predictions Unfounded. Anti-biotechnology activists have frightened the public into believing that genetically engineering organisms, when used in a field, could cause havoc. They evoke science fiction-like visions of mutant organisms spreading like a plague and destroying human life. There is no scientific basis for these predictions. Very little press has focused on the conclusions from the National Academy of Sciences. Thus, the public has generally been equating genetically engineered organisms with dangers, instead of with the benefits of better food, health care and less environmental problems.

The Environmental Protection Agency (EPA) regulates field testing of genetically engineered microorganisms, while the U.S. Department of Agriculture regulates genetically engineered plants. Current regulations, especially those of the EPA, are far too restrictive and play a major role in limiting the research advances in this area. A laboratory that wants to field test a genetically engineered organism, a test that may involve as little as a square meter in area, has to submit a tremendous amount of paperwork for the regulatory agency. It has been estimated that a request for a single field test costs a minimum of $200,000. In some cases state and local regulations impose additional costs. Before an engineered plant or microorganism can be shown to be effective for commercialization, many dozens of field tests will be necessary.

Regulatory Barriers Hindering Competition. Large corporations may be able to afford this. Small entrepreneurial companies usually cannot. The greatest problem, however, is that the university researcher often cannot afford such a field test, unless supported by a corporation.

The net result is that many good university researchers are avoiding basic science projects that involve field testing genetically engineered organisms. This eventually will reduce future benefits, since most applications from industrial research are developed from basic research. Biotechnology will not advance if these regulatory and public perception problems continue. The U.S. might find itself becoming less competitive in areas involving biotechnology since many other nations have not erected these regulatory barriers.

ACID RAIN AND ACID LAKES: THE REAL STORY

Edward C. Krug

For more than a dozen years, the conventional wisdom held that rain in the Northeast U.S. was acidified by Midwest electric utilities' coal burning, creating an aquatic "silent spring" – thousands of Northeast lakes were allegedly dead with thousands more soon to die. President Jimmy Carter endorsed a report by his Council on Environmental Quality in 1980 calling acid rain one of the two most serious environmental problems of the century. Such fear was understandable given the widespread claims of disaster. For example, the Congressional Office of Technology Assessment in 1984 claimed that 80 percent of Northeast lakes were or would be acidified by acid rain. The U.S. Environmental Protection Agency in 1980 claimed that acid rain had increased the acidity of Northeast lakes 100-fold over the last 40 years. In 1981 the National Academy of Sciences claimed that, at then current levels of acid rain, the number of acidified lakes would more than double by 1990.

These initial claims of disaster were unsubstantiated and have been refuted by extensive research of the past ten years. Yet, the authority and consistent repetition of these claims established a belief which persists to this day.

The ten-year National Acid Precipitation Assessment Program (NAPAP), however, proves that the claims of an aquatic "silent spring" are unsubstantiated hyperbole. NAPAP's comprehensive national lake survey found only 240 lakes of 7,000 Northeast lakes, or 3.4 percent of the total, to be "acid-dead", although this was assumed to be due to acid rain. And this percentage was found to be stable. Furthermore, most of these dead lakes have little recreational value simply because they are small and hard to get to.

Pressure for Politically Desired Results. When NAPAP published these lake survey results in its 1987 Interim Assessment, environmentalists and their allies in Congress were outraged. NAPAP's director, Lawrence Kulp, left in the midst of the turmoil. Members of Congress demanded that the new director produce the politically desired results. This furor diverted public and political attention from the expensive survey results showing no aquatic "silent spring" and allowed policy makers to proceed with plans to deal with a "problem" of far greater magnitude than the one that actually existed. Thus, last October 5, NAPAP's new director, Dr. James R. Mahoney, told the Senate Subcommittee on Environmental Protection that deacidification of about half of the acidic lakes over the next 50 years might conceivably justify the potential $300 billion cost of proposed acid rain controls. But his own NAPAP report admitted that all 240 acid-dead lakes could be deacidified simply by adding acid-neutralizing limestone for just $20 million, one fifteen-thousandth of the cost of the proposed acid rain bill.

The February 1990 NAPAP conference on the final results of this $600 million research program reduced aquatic effects to a trivial issue. While it was previously reported by NAPAP that most of the existing "acid-dead" lakes are acidic because of acid rain, additional study of Adirondack lakes (considered to be the lakes most severely acidified by acid rain) showed that over half of the fishless acidic lakes were acidified by natural organic acids. Most of today's acidic lakes

were probably naturally acidic before acid rain. The existing models do not yet incorporate these types of natural acidity.

These new research findings on the widespread importance of natural acidity were further supported by lake sediment analyses showing that, while some Adirondack lakes have recently become more acidic, the average Adirondack lake is more alkaline now than it was 150 years ago, not more acidic. New research shows that land-use change is almost universal in the Northeast. Only 60,000 of over 60,000,000 acres of forest have not been cut and regrown, or 0.01 percent. Land-use changes can result in either alkalinization or acidification of lakes and streams. This introduces major uncertainties about any changes there have been in acidity or alkalinity.

"Rivers of Hunger" Predating Industrial Activity. The notion that acid rain is responsible for acidity in lakes and streams is also contradicted by the existence of highly acidic surface waters in regions without acid rain. Fraser Island, Cooloola National Park, and Tasmania in Australia, and the Westland area of New Zealand have no acid rain, yet are filled with highly acidic lakes and streams. Indeed the magnitude of acidic surface waters in areas without acid rain dwarfs that of areas supposedly "devastated" by acid rain. In the Amazon basin, a river system the size of the Mississippi, the Rio Negro is naturally acidic and fishless. The naturalist and explorer Alexander von Humbolt wrote about these "rivers of hunger" nearly 200 years ago, definitely pre-dating industrial activity in that part of the world.

The public belief in the acid rain "problem" was created by repetitive and unproven assertions from ostensibly authoritative sources in U.S. government programs and agencies. This misinformed public opinion has, in turn, dominated the politics of acid rain. The U.S. is now on the verge of adopting a Clean Air Act which, among other things, seeks a multi-billion dollar reduction of acid rain emissions to restore lakes and streams. Yet most of this concern is not based on scientific fact. Policy makers who ignore the evidence on acid rain will waste billions of dollars and, in the long run, cast doubts on the credibility of environmental concerns.

STRATOSPHERIC OZONE

S. Fred Singer

Ozone is a natural component of the earth's atmosphere. It is a type of oxygen molecule formed when high energy components of solar radiation break apart other compounds, allowing the oxygen to recombine as ozone. In high concentrations at the planet's surface, ozone is considered a pollutant that can irritate lungs and eyes, and lower crop yields. This ozone can be created by reactions of either manmade or natural chemicals and is a primary constituent of urban "smog."

High in the stratosphere, however, ozone forms a natural layer that efficiently absorbs ultraviolet (or UV) radiation from the sun. UV radiation is the tanning component of sunlight, and has been linked to benign, non-melanoma skin cancers. UV radiation also can stimulate the body to produce Vitamin D, which can reduce the incidence of certain diseases, such as rickets and osteoporosis.

Cloud of Suspicion. Some research in the 1970s suggested that the normally inactive chlorofluorocarbons, or CFCs, used in many modern applications, including refrigeration, computer chip manufacture, and fire extinguishers, could percolate up into the stratosphere and there be decomposed and attack ozone. In 1980, the National Academy of Sciences estimated that the maximum possible reduction in stratospheric ozone due to CFCs was approximately 18 percent. Over the years, this number has been revised sharply downward, to as low as between 2 and 4 percent. But the initial estimate has held the public's attention. Under this cloud of suspicion, voluntary restraints on CFC use were adopted for some, noncritical applications. By 1978, the U.S. had unilaterally banned CFC use in all aerosol propellants.

In 1985, a British group at an ozone observing station at Halley Bay, Antarctica, announced that every October since 1975 they had found a short-lived decline in the amount of stratospheric ozone. The magnitude of the decrease had grown steadily, reaching nearly 50 percent of the total ozone. The finding was quickly confirmed by satellite instruments, which also indicated that the phenomenon covered a large geographic region. It seemed that a "smoking gun" had been found; linking ozone destruction with CFCs and chlorine, a chemical component of CFCs.

Limited Conditions. However, the precipitous decline observed in ozone levels around October is dependent upon the existence of a number of precise climatic conditions. For example, the stratospheric layers must be isolated from other air layers so that warmer air or chemical "contaminants" do not interfere with the ozone-depleting reaction. These conditions are limited to the South Pole and smaller pockets near the North Pole and even then only for short periods each year.

Further, G.M.B. Dobson, the Oxford University professor who started modern ozone observations, and for whom the measuring unit for ozone is now named, noted this temporary disappearance of ozone in 1956. Dobson noted that when the Halley Bay Antarctic station was first set up in 1956, the monthly reports

showed that "the values in September and October 1956 were about 150 [Dobson] units [50 percent] lower than expected....In November the ozone values suddenly jumped up to those expected...It was not until a year later, when the same type of annual variation was repeated, that we realized that the early results were indeed correct and that Halley Bay showed a most interesting difference from other parts of the world."

Tremendous Fluctuations. The discovery, or perhaps rediscovery, of the Antarctic ozone "hole" was combined with a March 1988 report by the National Aeronautics and Space Administration Ozone Trends Panel calling for a complete ban on CFCs. The NASA report indicated that global ozone levels had declined by a total of around 3 percent since 1969. This ominous report convinced many that CFCs were destroying ozone throughout the stratosphere. However, the report failed to mention that the year selected as the starting point for ozone measurements was actually a peak year for ozone levels. Since ozone's existence in the stratosphere is closely linked to the amount of solar radiation, it fluctuates tremendously over seasons and from year to year. Additionally, measurements of UV radiation at the earth's surface show that it actually has declined since 1974, even though theory predicts that it should increase when ozone is reduced.

Scientific caution was not followed by many in the international environmental community. Arising from the recommendations of the Montreal Protocol of 1987, drawn up by representatives of most of the world's industrialized countries, global controls for CFCs have been adopted by most of the major industrial nations, calling for a 50 percent reduction in world CFC output by the year 2000. Further demands are being pressed for total elimination of CFCs by the year 2000.

The case against CFCs is based on the scientific theory of ozone depletion, plausible but quite incomplete – and certainly not reliable in its quantitative predictions. There is even evidence that volcanoes, and perhaps salt spray and bio-chemical emissions from the oceans, contribute substantially to stratospheric amounts of chlorine, which minimizes the effects of manmade CFCs.

Even assuming the accuracy of the current theories, the actual threat would be quite small, to both humans and plant and animal life. Normally, UV radiation increases the closer to the equator, or the higher in altitude one goes. A 5 percent decrease in the ozone layer would, under the environmentalist's own theory, increase UV exposure to the same extent as moving about 60 miles south, the distance from Palm Beach to Miami.

Unnecessary Sacrifice. CFCs contribute greatly to the welfare of modern man. They are non-toxic, nonflammable, inexpensive compounds. Alternatives may turn out to be toxic to humans, corrosive to existing equipment, less energy-efficient in use, may decay over time requiring frequent replacement, and are certain to be more costly. With such important and direct consequences resulting from a ban, the scientific supports for a total ban need to be greatly enhanced. Otherwise society will be asked to sacrifice both public health and economic vitality for a threat that may not exist.

THE SCIENCE AND POLITICS OF GLOBAL WARMING

Patrick J. Michaels

In recent years environmentalists and others have seen "global warming" looming as an apocalyptic ecological disaster. Premature predictions include such catastrophes as droughts in some areas and floods in others caused by increasing concentrations of infrared or heat-absorbing trace gases, such as carbon dioxide in the atmosphere, accompanied by rapidly rising temperatures, sea level, and evaporation rates. This fear has been accompanied by the Worldwatch Institute's calling for "a whoelsale reordering, a fundamental restructuring of the world economy."

The scientific question critical to the policy implications of global warming however is not "How much will it warm?" Instead, the proper question is "Why has it warmed so little?" The answers now beginning to emerge will allow policy makers to avoid rash decisions based on incomplete knowledge or untested opinion.

Global Warming Prior to 1940. Because of the drastic alterations in the infrared-absorbing composition of the atmosphere due to human activities, some climate models suggest that the atmosphere should have warmed up some 2.0 degrees Celsius in the last century. In fact, the warming since 1880 has been 0.45 plus or minus 0.10 degrees. A calculation designed to show in which years changes took place found that 90 percent of this warming was prior to 1940. Yet it is since 1940 that the lion's share of the trace gases alleged to cause global warming have been emitted.

Assumptions in those models concerning oceanic warming patterns predict that the Northern Hemisphere should warm up first and most. In fact, there has been no net change in mean hemispheric temperature during the last half-century. The Southern Hemisphere, which should have warmed up the least and the slower, shows slight warming even though the magnitude of warming appears to be a factor of three under what is suggested by climate models.

Remote Likelihood of Disaster. The most alarming aspects of global warming are predictions of ecological and agricultural dislocations caused by increasing aridity or dryness and a disastrous sea level rise of a meter or so by the mid 21st century that could flood coastal cities. Recent findings indicate that the likelihood of both is becoming much more remote.

In the greenhouse projections, increased aridity in mid-latitude agriculture results not from lack of rainfall as much as it does from increased evaporation of water into the atmosphere owing to warmer temperatures, which is primarily a daytime phenomenon. Yet many temperature histories now show that, while daytime temperatures have either remained the same or declined, nighttime temperatures appear to be rising relative to the day values. This has the effect of minimizing any evaporation increase. A benefit of this effect is a longer growing season and better growing conditions. This phenomenon has now been observed in most locations where it has been looked for.

Satellite measurements now indicate rapid growth of the Greenland Ice Cap, and there is strong evidence of similar increases in Antarctica. As a result of this evidence, a panel of the American Geophysical Union in late 1989 reduced estimates of climate-related sea level rise to twelve inches. This is below the lower limit suggested in a National Academy of Sciences report used as the basis for many predictions of global floods.

Counteracting Global Warming. Other factors seem to offset some of the predicted causes of global warming. For example, dramatic increases in cloudiness have now been detected, with the increases concentrated in the more industrialized Northern Hemisphere. The cloud type that shows the most increase, with some regions showing growth of over 10 percent, is the ocean-surface stratocumulus, which is the most effective cloud type at counteracting the global warming effects of trace-gas pollution in the atmosphere. Calculations show that the increase in cloudiness could have produced a net global cooling of 1.5 degrees, perhaps offsetting warming from other sources.

Warmer nights and normal or slightly cooler days are consistent with both increased trace gases in the atmosphere, the elements said to cause global warming, and with increased clouds, which would reduce the rise in daytime temperatures.

Revisions of the earlier climate models that originally predicted disastrous global warming have reduced considerably the estimates of prospective warming said to occur because of a doubling of atmospheric carbon dioxide. Even so, the most conservative of these models still predicts that the world's land areas should have warmed up approximately 1.4 degrees since 1950. The actual net warming of these surfaces has been between 0.2 and 0.25 degrees, or a factor of six to seven times less than had been forecast to have occurred already.

Some policy makers have been criticized for not enthusiastically supporting expensive programs to reduce emissions said to cause global warming. These individuals, however, merely are responding to well tested and scientifically proven facts rather than to incomplete models and dated analyses.

ENDANGERED SPECIES PROTECTION

Randy T. Simmons

Although hunting elephants has been illegal in Kenya for over a decade, the country's elephant population fell from 65,000 in 1979 to 19,000 last year. Kenya's wildlife managers blame this on the international ivory market. Yet in Zimbabwe, shops openly sell ivory and hides. These goods come from elephants that are culled from large herds in that country's game parks. Animals must be removed from these herds periodically to prevent overly rapid population growth that could result in too many elephants and not enough food. Zimbabwe has found that the best way to protect elephants is to give its citizens the opportunity to benefit from their presence. The result: the elephant population has grown from 30,000 to 43,000 over the past decade.

Increasing Herds. There are two conflicting approaches to elephant protection in Africa today. Kenya's ban on hunting and its efforts to suppress the ivory trade are typical of most of Central and Eastern Africa. The results have been disastrous. From 1979 to 1989, Central Africa's elephant population declined from 497,000 to 274,800 and East Africa's from 546,650 to 154,720.

By contrast, the elephants of Botswana, South Africa, and Zimbabwe are increasing, and now account for 20 percent of the continent's elephants. These southern African countries all support conservation through utilization, allowing safari hunting and tourism on private, state, and communal lands, and the sale of ivory and hides. Because individuals and local communities can own and profit from elephants, they have an incentive to make certain that elephants on their preserves are not wiped out.

The Kenyan approach to wildlife protection is typical of the international effort to save many species from extinction. The Convention on International Trade in Endangered Species and Wild Flora and Fauna (CITES) establishes two levels of "protection." If listed on Appendix I, all trade in products from that species is banned. If listed on Appendix II, some trade is allowed, with official permits, under a quota system administered by CITES.

The problem with this approach, using the elephant example, is that it attempts to answer the question "How do we stop the market in ivory in order to remove the incentive for poaching elephants?" The question it should ask instead is, "How do we make elephants valuable enough that people have an incentive to be careful stewards rather than careless exterminators?"

Failing to Eliminate Demand. Economic theory teaches that a government ban on the supply of a valued commodity can never wholly eliminate demand. It usually accomplishes three things, however: 1) prices increase, 2) people with a comparative advantage at avoiding detection, usually criminals and corrupt public officials, take over the formerly legal market, and, 3) if the resource is publicly owned, it is rapidly consumed.

Legalizing trade and protecting property rights reverses these outcomes: 1) prices drop as legal supplies grow; 2) there is no premium price due to criminality or corruption; and 3) property rights encourage wise stewardship of

the resource, because any loss will fall on the owner rather than be spread among the millions of public "owners" of the resource.

Trade bans on wildlife products have failed to protect species for which there is a commercial demand. Many species of Latin American parrots, for example, are "protected" by a CITES Appendix I listing. Rather than reducing the decline in native parrot populations, prohibition has accelerated it. The profit in trading in "protected" birds is often greater than that in producing illegal drugs.

Protected by Commercialization. Prohibition has completely failed to protect Africa's black rhinoceros. Rhino horn is so highly prized by Arabs for ceremonial dagger handles and by Asians as a medicine and an aphrodisiac that a ten-pound horn can sell for $80,000. About 50,000 rhinos existed in Africa when the 1976 CITES ban went into effect. These rhinos dwindled to 14,800 by 1980, and to about 3,500 today, most of which are in Zimbabwe and South Africa. In South Africa, in fact, rhino populations have dramatically increased. Contrasting with the poor record of trade bans, commercialization protects a broad variety of species. Seabirds are farmed in Iceland, crocodiles and butterflies are raised in Papua, New Guinea, and crocodile farming is a multimillion dollar business in Zimbabwe.

U.S. policies affecting commercialization of native-endangered species have been contradictory. In 1979, for example, the U.S. Fish and Wildlife Service revised its own regulations to allow commercial foreign trade in American alligators. It was hoped that trade in alligator products would help reduce the threat from poachers against other endangered crocodile species. Ten years later, alligator farming is so successful that wild populations have exploded, even as profits from hides and meat have reached record highs.

Green Sea Turtles. Yet contrary to its policy on alligators, the Fish and Wildlife Service rejected a 1983 request to allow commercial use of captive-bred green sea turtles. These animals remain endangered, as do other sea turtle species that farmers are capable of raising. Farms could be used to replenish natural stocks as well as to supply the commercial trade. Without a change in the philosophy of banning trade, the world will continue to lose species. America should take the lead in promoting this market alternative to the continuing decline of endangered species.

SUPERFUND

Bruce Yandle

The Comprehensive Environmental Response, Compensation, and Liability Act, popularly known as Superfund, was passed in December 1980 to create a regulatory scheme and a $1.6 billion account to clean up hazardous waste sites. Funds were to be collected between 1981 and 1986 primarily from a special tax on petroleum and chemical feedstocks, that is, raw materials such as petroleum-based materials, used in industrial processes and products.

Everyone Pays. Superfund is only loosely based upon the principle that "the polluter should pay" for cleanup. In fact, all producers pay the identical rate of tax on feedstocks regardless of present or past pollution practices. The cleanest and most careful chemical firm pays the same tax per pound of chemicals as the most negligent polluter.

The original Superfund law required that the Environmental Protection Agency specify at least 400 cleanup sites, which is about one project for each of the 435 Congressional districts, and stipulated that every state must have at least one Superfund site with a priority designation. The EPA would then seek to identify any businesses contributing to pollution at a given site and sue them to cover the cost of cleanup. The money in the Fund would be used if the identified polluter could not be found or could not pay.

The law had the immediate and politically valuable effect of generating a large demand for what were recognized as huge pork barrel projects. Local lobbying efforts were organized in response to the availability of large federal grants. Like most large environmental programs, Superfund became ensnarled in bureaucratic red tape and severe management problems and has been heavily criticized for ineffectiveness and waste, even by its proponents.

This failure to relate the Superfund tax directly to the areas affected by pollution is demonstrated by the fact that Superfund tax collections under the 1980 law were highest in the Southwest where the petroleum industry is concentrated. Yet Superfund site expenditures were highest in the more polluted and politically stronger Northeast.

Full Liability. Superfund is premised upon the principle of joint-and-several, retroactive, strict liability. This means that all firms presumed to have contributed any amount of pollution to a Superfund site, no matter how small, would be legally responsible for the full cost of any cleanup. In addition, a firm using state-of-the-art techniques acting in a perfectly legal manner at the particular site could become liable for the entire site later.

EPA often acts against the wealthiest firm, to saddle it with the cost of each Superfund site. Some firms have been included in Superfund lawsuits even though they produced only nonhazardous wastes that later were placed at a site that included another firm's hazardous wastes. EPA also can target the transporters of waste, who neither control its production nor its disposal. This forces the victimized firm to find other responsible parties to share the blame, and the cost. In some cases almost 300 other firms and insurance companies are being sued by

the company chosen by EPA. This aspect of the law has hindered the development of private pollution insurance since no insurer can determine that a client will not be held liable for another company's pollution.

Although the problems with Superfund were great, its political and porkbarrel benefits were even greater. The Superfund program was expanded by the Superfund Amendments and Reauthorization Act of 1986 (SARA). SARA extends these programs until 1991 and increases the Fund to $8.5 billion by creating a new excise tax on almost every industry. SARA even provides federal funds to private groups so that they may sue the EPA should it fail to place a particular site on the Superfund list.

Disappointing Results and Limited Benefits. After ten years, Superfund should be graded not on its good intentions, but on its disappointing results. The Congressional Office of Technology Assessment last October found that about 50 percent of Superfund cleanups addressed "speculative future risks" and about 75 percent of all cleanups were "unlikely to work over the long term." The benefits of Superfund activities are not spread throughout society, as may be argued for air quality, but instead are local, often limited to very small numbers of individuals.

Cleaning local hazardous waste sites should be a function of the states or local communities rather than the Federal government. Therefore the states might well assume an increasing share of Superfund taxes, which must be reauthorized in 1991. Any Superfund money remaining in the Federal Treasury could be put into a revolving state loan fund, as is the case currently with the Wastewater Treatment Plant federal grant program.

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