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The Age of Inequity

Just over 100 years ago, the United States Supreme Court, in *Plessy v. Ferguson*, upheld segregated seating on railway cars and established the separate-but-equal doctrine that would continue to divide the nation for the next half century. From today's perspective, it's hard to imagine how such a doctrine could survive as long as it did.

And yet when I grew up in the South in the 1950s, restrooms and water fountains for whites only were part of the landscape, and I'm not sure I ever gave it a thought. When you're not on the receiving end, discrimination can become all but invisible. And even when you are the target, if discrimination is institutionalized into the culture, it can be deceptively hard to spot, especially in its subtler garb.

Despite the enormous progress that has been made during the past 30 years, the United States is still a divided nation. How can it even be an issue today that Joe Lieberman is a Jew? Why do we still need to talk about affirmative action? And why hasn't a woman stepped forward as a serious candidate for president? Hasn't Margaret Thatcher already proved the capability of women as political leaders? For that matter, didn't Elizabeth I prove it four centuries ago?

Environmental justice is one of those subtle kinds of discrimination that are so hard to perceive by those who are not subjected to it. When a toxic waste facility or polluting plant crops up in a low-income or minority neighborhood, we come up with easy explanations. It makes good economic sense to site such facilities where land values are low, we rationalize, or poor people are attracted to these sites because land is cheaper and jobs are more abundant.

Environmental justice is one of the topics FORUM addresses in this issue. More specifically, the journal focuses on transportation equity, which is proving to be a particularly hard engine to start. On closer inspection, the easy explanations don't always hold up, and the proposed solutions collapse under their own weight.

The law today is a complete muddle as it struggles to find workable solutions for transportation equity. A hundred years ago, the law struggled to find solutions for a similar issue. The separate-but-equal doctrine was the best the courts could come up with at the time. Let's hope our lawmakers and judges are wiser this time around.

Dennis M^cCarthy

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Third Rock

In 2003, NASA plans to launch not one, but two more Mars Rovers to search for evidence of surface water, and a hint of past life, amid the geological rubble of the fourth rock from the sun. Meanwhile, back on Earth, researchers armed with nets and traps laboriously document the incredible diversity of terrestrial life before it disappears.

Given the apparent abundance of life forms on earth, what does it matter if one more species—the ivory-billed woodpecker, say, or the Tecopa pupfish, both victims of habitat loss—is lost to the cumulative actions of modern humans? After all, as Doug Shedd notes, more than 99 percent of all species that ever existed on Earth are extinct today. Lest we forget, it took almost 2 billion years for life on Earth to evolve to its current rich diversity.

Until modern times, catastrophic extinctions have been attributed to dramatic natural events, such as the meteorite that doomed the dinosaurs. Today, a species in decline can succumb to a careless bulldozer, says David R. Given.

In April 2000, a small group of leading botanical scientists met in the Canary Islands and issued a warning that during the 21st century, two-thirds of the world's plant species will be in danger of extinction. They also

penned a declaration calling for a global strategy to promote plant conservation on local, regional, and international levels.

The Endangered Species Act of 1973 represented a giant step forward for conservation in the United States. Yet the act has become one of the more controversial environmental laws on the books. Property owners have seen an erosion of their rights to do as they please with their land, and yet they receive no financial incentives from the federal government to conserve prime habitat. Some foresters and developers are conducting preemptive strikes by destroying habitat before anyone finds an endangered species on their land, says Dean Lueck. The ESA needs a dose of empirical analysis to understand the unintended consequences of its performance, Lueck says.

Ironically, urbanites who seek more natural surroundings are flocking to the countryside and in the process transforming it into a suburban desert, precipitating the local equivalent of a mass extinction, says Michael McKinney. Pavement is an obvious blow to any species, but even expansive lawns are green only in color. The U.S. ritual of lawn mowing basically keeps the land in a constant state of disturbance. While national policy may help save some species, the fate of most native ecosystems is in the hands of local policymakers and private landowners.

The current mood of the environmental movement is distinctly Romantic: humans live in a state of disharmony with nature, and wilderness is the only cure for our ecological sins. A fresh historical look at some of our ancestors, however, reveals a different story. Not all prehistoric humans, while living off the land, left a minimal environmental footprint. In the first millennium A.D., ancient Native Americans in the Llanos de Mojos plains in the Bolivian department of the Beni cultivated a wide variety of tree species on artificially constructed mounds, leaving a legacy of diversity that the surrounding native savanna could not compete with, says William Balée. Modern humans don't suffer from some genetic mutation that keeps us at war with nature. Instead, sociopolitical forces can alter the destiny of our fragile planet, for better or for worse.

So what if we find microbial life on a remote planet? No one so far has found any shred of evidence that any other planet has produced such a diversity of life as we find today on Earth: not one indigo bunting, not one orchid, much less a human. If we don't act now to reverse the current extinction, we face a bleak, lonely future, Shedd says.

The Editors



Into Thin Air

*More than 99 percent of all species that have ever existed are extinct.
So does it really matter if another one is added to the list?*

BY DOUGLAS H. SHEDD

Extinguishment has conferred an almost legendary status on a number of species of organisms, especially certain species of birds. This is particularly true of the ivory-billed woodpecker (*Campephilus principalis*). The ivory-bill was never very abundant, but it was spectacular and conspicuous, and the early American naturalists Mark Catesby, Alexander Wilson, and John James Audubon each mention it in their writings. Unfortunately, by the early part of the 20th century, the ivory-bill was slipping into oblivion, mostly as a result of the cutting of the southeastern forests. The last confirmed sighting of an ivory-bill in the United States was in the late 1940s. Today, it is almost certainly extinct.

It surely must sadden us that, because of our actions, a beautiful and scientifically interesting species such as the ivory-bill no longer exists. Just how significant, however, is its disappearance? From the perspective of life's long tenure on Earth, the phenomenon of extinction is by no means rare or unusual. In fact, there is reason to think that 99.9 percent of all species that have ever lived are extinct.¹ The startling frequency of extinction can be seen throughout the paleontological record.

Time Travel

If we could walk across the plains of western North America 12,000 years ago, near the end of the Pleistocene, we would find them familiar in many ways. The diversity of the mammalian fauna, however, would astound us. Mammoths, camels, horses, giant bison, various species of antelopes, and several species of large carnivores, including a species of lion closely related to the modern African lion, were all abundant at this time.²

Of this once spectacular array of species, almost all are gone, vanishing in the space of less than 1,000 years. One of the few remnants of the Pleistocene mammalian megafauna is the pronghorn (*Antilocapra americana*). This antelope-like creature is capable of running at speeds approaching 90 kilometers, or 56 miles, per hour, an ability that seems to have evolved during a time when it was hunted by an extinct species of cheetah. That cheetah died out thousands of years ago, and now the pronghorn's great speed is just an echo from an age long past.³

Extinction events such as the one that affected the North American continent's great mammals are a recurring theme in the history of life on Earth. Major extinctions, some far more widespread and devastating than the one striking the mammalian fauna of the Pleistocene, have periodically rocked the planet's ecosystems.

Multicellular animal life under-

went its first widespread diversification 530 million years ago in the great Cambrian radiation, when nearly all modern animal phyla developed. Since that time, there have been at least five episodes of mass extinction. The most extensive, occurring near the end of the Permian period 230 million years ago, resulted in the disappearance of 96 percent of all animal species. The most recent, the Cretaceous extinction 65 million years ago, saw the dinosaurs and many of their close relatives vanish.⁴ Modern humans evolved less than 120,000 years ago, so it is clear that we need take no responsibility for the Permian or Cretaceous extinctions. The extinction of the great mammals of the Pleistocene may be a different story, however.

Modern humans seem to have evolved in Africa, and from the start we were intelligent and mobile. By 90,000 years ago, members of our species were living in the Levant and from there colonized the rest of the world. Unfortunately, it is increasingly clear that wherever humans have gone, a decline in species diversity soon resulted.

Whether we look at North America, Europe, Australia, the South Pacific Islands, or Madagascar, the arrival of modern humans always signals the onset of extinctions. Our ability to use weapons and sophisticated strategies when hunting and our ability to alter habitats has made us a worldwide factor negatively affecting species diversity.⁵

Seen in this light, it is apparent that the disappearance of the ivory-billed woodpecker is not an isolated event, but instead represents another step in a long series of extinctions caused by humans. While the loss of the ivory-bill, or

any other single species, probably has little immediate worldwide significance, what about the combined effect of the loss of many species from virtually every ecosystem on the planet? It is clear that the normal—or background—rate of extinction is much lower than the rate typical of a major extinction episode such as the Permian or the Cretaceous catastrophes. As

a human dominated world. Perhaps life will even recover some of its former diversity, as it has following previous episodes of catastrophic extinction, but this recovery will take millions of years.⁸ Such a time frame is all but meaningless for us, because people seldom live even 100 years, and our species is barely 100,000 years old. For the foreseeable future it

The world is in the grip of another mass extinction, one that is caused almost solely by our own actions.

extinction rates now approach those seen 65 million years ago during the Cretaceous, we have to face the fact that the world is in the grip of another mass extinction, one that is caused almost solely by our own actions.⁶

Survival of the Fittest

So what will be the fate of life on Earth? Will humans drive all but a few domesticated species into extinction? This is unlikely. Many species have survived earlier mass extinctions, and no doubt this will be true again. For some, such as various species of cockroach, survival may be the result of sheer numbers. Other species may find habitats that remain stable even when most places on Earth are being altered. In this way, the remarkable coelacanth (*Latimeria chalumnae*), a species of fish that is almost a living fossil, has survived virtually unchanged for millions of years.⁷

Still other species will combine durability with luck to cope with the effects of relentless human expansion. Life is resilient, and some species will find ways to adjust to

appears that the world will be the domain of species able to cope with a planet totally altered by humans.

Recently, as scientists have begun to focus on urban environments, they have discovered that a surprising number of species have been able to adapt to life in cities and the areas surrounding them. The nature of these species is revealing, however. For example, in metropolitan Phoenix, biodiversity is quite high, but a significant percentage of the species are not native, including 95 percent of plant species and one in four kinds of birds.⁹

Similar trends have been found elsewhere. Weed species fortunate enough to be well-adapted to the kinds of habitats humans produce are spreading worldwide. As a result, ecosystems everywhere are becoming more homogenous. Life will survive, but its full diversity will not.

Ecosystem health is undoubtedly related to this diversity, although the inherently complex nature of ecosystems often makes it difficult to demonstrate exactly how. There is increasing evidence,

however, that many characteristics of an ecosystem are based on the interactions of various species, and that the stability of an ecosystem requires a certain amount of ecological redundancy. This means that, in a sufficiently diverse ecosystem, if one species is lost, another may be able to assume its function.¹⁰

inhabit the Earth today, divided into as many as 3 billion local populations. Extinctions in tropical rainforests alone may be occurring at rates approaching 14,000 to 40,000 species per year—two to five per hour—with separate populations disappearing at a rate of 16 million per year—1,800 per hour.¹²

and, at least to a point, we do not have to accept the limitations imposed on us by our evolutionary history. We must develop “a new level of practical knowledge that is ethically informed.”¹⁴ And we may need to rethink the basis of industrialized society, dependent as it is on ever-spiraling levels of consumption. Most important, the responsibility for addressing the loss of biodiversity must not be passed on solely to developing countries. For the most part, those countries are not the ones consuming the resources that are leading to the impoverishment of our planet’s biodiversity. It is the industrialized countries that house the consumer-based societies that are such a crushing burden on the planet’s ecosystems.¹⁵

Extinctions in tropical rainforests alone may be occurring at rates approaching 14,000 to 40,000 species per year.

The loss of biodiversity and the resulting declines in the quality of ecosystems have economic, medical, social, ecological, and evolutionary consequences. For example, humans depend upon healthy ecosystems for food, water, minerals, timber, and regulation of weather and climate. In addition, we heavily depend upon biologically diverse ecosystems when seeking new pharmaceutical products and agriculturally important populations of organisms.¹¹

The increasing homogenization of plant and animal populations important to agriculture also represents a significant decline in biodiversity. Evolutionary change, whether driven primarily by human or natural selection, depends upon variation. As rare varieties and breeds of domestic plants and animals disappear, the chance declines for future—and at times much needed—change.

The same is obviously true in naturally occurring populations of plants and animals. Recent estimates suggest that as many as 14 million species of organisms may

Millennial Census

The year 2000 marks a new millennium only for some cultures, but it is an appropriate point in history at which to take stock. All around us we can see the results of our rampage through the world’s ecosystems. There will be consequences to not addressing the problems we have caused, and we must remember that taking no action, in itself, represents a decision.

So how do we address the problem? Management of endangered species is currently a crisis-driven discipline that usually focuses on individual, charismatic species.¹³ We must take a more broad-based and anticipatory approach to our management techniques. Currently, timelines for management are too short to be effective. Unfortunately, this is partly the result of our human minds, the product of the blind forces of natural selection, which cause us to make judgments on the basis of short-term self-interest. We are not oblivious to the long-term implications of our actions, however;

An enormous amount of research will be required if we are to make the right choices. For example, when trying to preserve a species, should we be more concerned about populations on the periphery of the species’ range, where genetic variation is generally the highest, or should we focus on populations in core areas, where numbers of individuals are generally higher and habitats are more suitable? Should we focus on trying to save individual species at all, especially the large vertebrate species that generally receive the most attention from the public? Perhaps we should direct our resources into studying and protecting the plant and invertebrate animal species that comprise most of the Earth’s vast genetic libraries.¹⁶

For the immediate future, we probably will continue to focus much of our effort on species with popular appeal. In some cases, this may be the appropriate choice. After all, each species, indeed each population within a species, is a

unique evolutionary response to the demands of living on Earth and an integral part of the ecosystem in which it lives. Also, these species are ones for which much public support can be mobilized. Most important, it is clear that to save such species requires us to protect the habitat in which they live. Species such as the bald eagle, blue whale, and spotted owl can serve as focal points for wider ecosystem-based conservation programs.

It is unlikely, however, that the problem caused by the rising tide of human-caused extinctions can be entirely addressed through conservation plans designed to save single species. Increasingly, conservation programs will have to be international in scope and will have to encompass the needs of more than a single species, or even a single ecosystem. (See “Vanishing Act” in this issue of FORUM.)

As part of this international effort, many believe a worldwide survey of biodiversity should be undertaken.¹⁷ One of the goals of this survey would be to define the ways in which the loss of species diversity affects humans—especially at the economic level. Behind this effort is the recognition that coordinated local, regional, national, and international plans will be required to stem the ever-increasing rate of extinctions.

This type of planning should accomplish specific goals.

■ **Reserves.** First, reserves must be established to protect hotspots—areas where species diversity is particularly high.¹⁸ Some regions—such as the tropical Andes, Brazil’s Atlantic Forest, and Madagascar—harbor disproportionate numbers of the world’s total species. Establishing reserves in these areas will have maximal impact.

■ **Corridors.** Equally important, these reserves should not become islands of habitat totally surrounded by agricultural areas and urban or suburban sprawl. Corridors of habitat must connect these reserves, even if the corridors are narrow, so that movement of organisms can take place between the reserves.¹⁹ This will allow for the maintenance of viable popula-

tioned that to raise the world’s standard of living to the U.S. level, assuming existing technology, would require two more planets the size of Earth.²⁰ Compounding this problem is a world increasingly influenced by a system of mass communication that constantly advertises excessive consumption. In the end, there probably is no hope of avoiding

To raise the world’s standard of living to the U.S.

level, assuming existing technology, would require

two more planets the size of Earth.

tions of organisms inhabiting the reserves. The need for corridors of suitable habitat should be addressed at the local and regional levels, as well as when designing major reserves. Ideally, in the future, a grid of reserves and parks, big and small, will be connected by habitat corridors.

■ **Coordination.** Obviously, the development of such a grid of reserves connected through corridors and greenways will require an enormous coordinated planning effort and will happen only if a sufficient number of people realize the costs of a human-induced mass-extinction event.

■ **Consumption.** Also critical to slowing the expanding wave of extinction is an understanding that the Earth cannot sustain the levels of consumption typical of most industrialized countries, especially when this consumption is coupled with an ever-increasing population of humans. E. O. Wilson, who has done as much as anyone to try to raise public consciousness about declines in biodiversity, has esti-

matized that to raise the world’s standard of living to the U.S. level, assuming existing technology, would require two more planets the size of Earth.²⁰ Compounding this problem is a world increasingly influenced by a system of mass communication that constantly advertises excessive consumption. In the end, there probably is no hope of avoiding

catastrophic extinction unless we can slow population growth and consumption.

■ **Pollution and invasive species.** Finally, we must address the effects of environmental pollution and of the introduction of nonnative invasive species. Progress has been made in many places in reducing the effects of pollution—even at the international level. Much less has been done, however, to halt the spread of invasive species. If the Earth is not to be overwhelmed by a relatively small number of highly successful species, more effort will have to be expended to combat this problem.

Book of Life

As humans, we have difficulty not being Earth-centered when thinking about the origin of life’s diversity. Some have suggested, however, that even if life on Earth declines in diversity, we will soon find the universe to be filled with extraterrestrial life. We should be careful about trying to find solace

in this thought, however. Although many scientists believe that life has evolved frequently in the universe, there is no hard evidence for this. Even if the evolution of life is a common event in the universe, it may turn out that life usually remains only at a point approximating the microbial or unicellular level of development—as it did on Earth for almost 2 billion years. Perhaps the evolution of complex life is rare, and the development of the spectacular diversity of life typical of Earth may be a seldom-repeated event.²¹ All the more reason to work to preserve the genetic heritage of our planet.

Over 1,600 years ago, much of the great library of Alexandria burned to the ground, destroying an appallingly large amount of information. Imagine how it felt to stand at the edge of that terrible ruin, and then imagine future generations standing at the edge of a much vaster ruin, the ruin of Earth's ecosystems, contemplating the loss of much of three and one-half billion years of genetic information.

The ivory-billed woodpecker was once a living, breathing organism, part of the ecosystems of the southeastern United States. It also was once part of the Earth's evolved biological wealth. Today, only the writings of various naturalists, drawings, old photographs, and a few mounted specimens remain to remind us of the ivory-bill's existence—and that its absence is our responsibility. The ivory-bill was but a single species, but Earth is losing its biological diversity one species at a time. The rate of loss

is increasing, and the time left for us to address the problem grows ever shorter. Finding and implementing successful solutions may well prove to be our greatest challenge as a species. Without decisive action, a bleak, lonely future awaits us. ■

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Vanishing Act

New figures on the escalating rate of extinction are spurring international efforts to document and save remaining plant species.

BY DAVID R. GIVEN

David Brackett, chair of the International Conservation Union's Species Survival Commission, insists that, "If you like to breath and you like to eat, you should care more about plants."¹ We share the world with perhaps as many as 30 million organisms, of which at least 235,000 are flowering plants and 325,000 are the nonflowering algae, lichens, mosses, and fungi. Although outnumbered by such animal groups as the insects, plants are the group that provides the vital link that allows life as we know it to exist on Earth. Plants, through photosynthesis, are the primary converters of the sun's energy to create forms of energy that can then be taken up by animals. In a real sense, all flesh is grass.²

Plants are essential to the existence of the fragile skin of life—the biosphere that surrounds our

planet—and to its rich diversity of landscapes. They play a primary role in ecosystem function, maintaining Earth's environmental balance and providing habitats for much of the world's animal life. Moreover, all people depend on plants for food, clothing, shelter, and fuel. Plants also supply medicines; the World Health Organization has estimated that up to 80 percent of the world's people rely primarily on many thousands of plant species for their health.

For many centuries, plant breeders and horticulturists have appropriated the infinite palette of flower colors and leaf forms to stock the gardens that beautify cities. The genes of wild species of plants provide the raw material for crop improvement. The giant redwoods and ancient bristlecone pines, the unearthly giant flowers of *Rafflesia*, the almost infinite variation of flowering orchids, and the intricate texture of ferns are

powerful icons of the rich diversity of plant life. Industrial designers, artists, and poets draw inspiration from the world of nature and especially its plant life.

Yet, the considered opinion of 14 leading botanical scientists, calling for a Global Program for Plant Conservation at a workshop in Las Palmas, Canary Islands, in April 2000, is that "as many as two-thirds of the world's plant species are in danger of extinction in nature during the course of the 21st century, threatened by population growth, deforestation, habitat loss, destructive development, over consumption of resources, the spread of alien invasive species and agricultural expansion."³

Now You See It...

Catastrophic or localized extinctions can occur without human intervention, but in many parts of the world and for vulnerable ecosystems generally, humans are primarily responsible for current extinctions. British scientists Sir Robert May, John Lawton, and Nigel Stork have estimated the mean background rate of extinction in the geological record as about one species per year.⁴ Nevertheless, it is extremely difficult to assess global extinction rates, much less make accurate predictions into the future. The same authors, using three analyses based on different scientific approaches, concluded that, "impending extinction rates are at least four orders-of-magnitude faster than the background rates seen in the fossil record."⁵ This figure does not take into account the observation of David Hawkesworth, director of the International Mycological Institute, that the extinction of an obvious, large organism such as a forest tree probably results in the

loss of at least 15 other species that depend on that single species.⁶

A further analysis of the extinction problem by Stuart Pimm of Columbia University and Peter Raven, director of the Missouri Botanical Garden, also paints a bleak scenario for the future of biodiversity unless markedly increased steps are taken to protect remaining species-rich regions and habitats.⁷ Using a model that examines the relationships among species in specific areas, the rate of fragmentation of habitat, and estimates of survival rates, Pimm and Raven forecast an accelerating rate of extinction peaking about half way through the 21st century at nearly 50,000 per million species of animals and plants per decade. Only near the end of the 22nd century, assuming that the rate of increase of the human population stabilizes or declines, is this rapid rate of extinction expected to decrease.

The most critical parts of the world are those regarded as biological hotspots—areas particularly rich in species found nowhere else. Recent analyses by the English global conservationist Norman Myers and collaborators show that roughly 30 to 50 percent of plants, amphibians, reptiles, mammals, and birds occur in 25 hotspots that occupy less than 2 percent of available land area.⁸ A disturbing feature of this analysis is that, in the 17 tropical regions designated as biodiversity hotspots, only 12 percent of the original primary vegetation remains. Applying the Pimm and Raven model, one can predict that, even if all the remaining habitat in these 17 areas were protected immediately, there would still be an 18 percent loss of their species, and if habitat depletion continued

at the present rate for a further decade, the loss would rise to 40 percent. These are frightening figures.

The Reconstruction Myth

Peter Raven cites three principle factors that accelerate the rate of extinction of plant species: habitat destruction, ecosystem fragmentation, and invasion of wild habitats by exotic species. There is, moreover, a finality to extinction, and the best way to avoid it is to preserve habitat. As Raven notes, whenever a rain forest is destroyed, at least 19 or 20 species are lost forever.

A second-best strategy is to reconstruct ecological communities, but that is rarely fully successful. Species can be restored to a system, but it is much harder and sometimes impossible to restore processes and interspecies relationships.

A third-best strategy is to preserve species as germ plasm. As Raven concludes, “We would rather have germ plasm than not have the species at all.”⁹

Invasive species are a particularly pernicious problem. They not only fragment plant and animal habitats but also alter water, nutrient, and fire cycles, and indirectly affect atmospheric composition and nitrogen deposition. Their effect is not confined to biophysical systems but extends into socioeconomic systems as well by supplanting economically valuable agricultural and forest resources. In speaking of the economic impact of invasive species, David Pimental points out that, for the United States alone, the current cost of invasive species overall has been estimated at \$138 billion per year.

Extinctions do not usually happen in one giant step, but rather a

little at a time. Many species are driven towards extinction by trends such as forest fragmentation and spread of disease that can be measured and projected with some statistical confidence into the future. However, once populations have become extremely fragmented and small, they become increasingly susceptible to random events. These stochastic events are akin to the throw of the dice. Thus the last few individuals of a species often finally disappear because of unpredictable accidents such as a misplaced bulldozer blade, a freak storm, or elimination of one or the other sex. Therefore, it is important that species not be reduced to such small numbers of individuals that the risk of being eliminated by stochastic events becomes unacceptably high.

The world’s diversity of plants is a unique evolutionary heritage that is under threat from human interference worldwide. One useful and measurable indicator of the degree of threat overall is the ecological footprint, which is a measure of the impact of humans on the total environment. Denise Church, secretary of New Zealand’s Ministry for the Environment, notes that “if everyone presently alive aspired to our New Zealand level of ‘land affluence’ the world would need 28 billion hectares of production land. That is twice the earth’s land area and about five times the area currently used for production.”¹⁰

Global Action

In April 2000, as a major move to reverse current trends, the Gran Canaria Declaration was formulated by a small group of leading botanical scientists at a workshop convened at Las Palmas, Canary

Islands, Spain. This declaration has now been adopted into the work program of the Convention on Biological Diversity by the Conference of Parties for the Convention, which met in May 2000, in Nairobi, Kenya. The declaration aims to facilitate on a global level plant conservation initiatives that halt the current and continuing unacceptable loss of plant diversity. It promotes collaboration and networking that will strengthen and support plant conservation locally, regionally, and internationally. This must involve a wide range of partners—government ministries, institutions, nongovernmental organizations, and local communities.

A global strategy must also develop working links between a number of ambitious programs with similar agendas. These include:

- *Diversitas*, a partnership of intergovernmental and nongovernmental organizations formed to promote, facilitate, and catalyze scientific research on biodiversity, with the goal of providing accurate scientific information and predictive models of the status of biodiversity and sustainability of the use of the Earth's biotic resources.

- The UNESCO Man and Biosphere Programme, an interdisciplinary program of research and training intended to develop the basis, within the natural and social sciences, for the rational use of the resources of the biosphere and for the improvement of the global relationship between people and the environment.

- The Millennium Assessment of the World's Ecosystems, a partnership of scientists, United Nations agencies, and international organizations established to mobilize scientific knowledge pertaining to ecosystems.

- The Botanic Gardens Conservation Strategy of Botanic Gardens Conservation International, which links botanic gardens as a cooperating global network for effective plant conservation and now includes over 450 member institutions in 100 countries.

- The International Conservation Union's Species Survival Commission's Plants Program, which is the world's largest expert network of specialists in management of animal and plant species.

A global strategy must also draw on the experience and resources of agencies implementing international agreements and conventions to achieve the goals of the massive *Global Biodiversity Assessment*, published in 1996, which built on the expertise of over 1,200 of the world's scientists as a summary of the science of biodiversity generally.¹¹

The challenge for such a strategy is to effectively integrate social, economic, and biological approaches to plant conservation. Unless this occurs, appropriate resources, technologies, and wisdom will not be used to full effect, and some important stakeholders are unlikely to buy into plant conservation as a priority. Futurist Ervin Laszlo points out that conservation is not just a matter for science; he suggests that the security of biodiversity in a future period of crisis, bifurcation, and chaos will also demand educative, religious, and cultural adaptation.¹²

Any global strategy for plant conservation must have well-defined and achievable goals for integrated preservation of plant diversity—both through on-site and off-site institutions such as botanic gardens—linked to targets for research, information management, public education, and awareness to

attain these goals. It should have a mechanism to monitor and coordinate its implementation and to maximize resources for plant conservation.

Creature Comforts

Can the fundamentals of the Gran Canaria Declaration be achieved? As futurists point out, the things that give people immediate comfort are political stability, employment, health and welfare institutions, community safety, reliable banking systems, and quality universal education. Politicians know that these are primary vote catchers. In times of chaos, biodiversity is likely to suffer highly because, in the short term, most people probably see it as dispensable, little realizing that even the most advanced of biotechnologies cannot yet create life and species *de novo*. Therefore, those who are passionate about the biological diversity of planet Earth and want it retained in its entirety face a future that will require all the ingenuity, educative effort, and tenacity they can muster.

Norman Myers and his colleagues warn that conservationists may not be able to assist all species under threat, if only because of lack of funding. Therefore, we must place a premium on setting priorities. This is part of the rationale of identifying biodiversity hotspots. Concerted efforts to achieve substantial and immediate protection of these regions, comprising only 1.4 percent of the land surface of Earth, would protect as many as 44 percent of all plant species.

Yet even such a focused approach is difficult to implement, as it merely represents good intentions. Protection on paper is one thing. The knowledge gap is another.

There is a surprisingly enormous lack of knowledge about the world of nature. Less than 20 percent of all living organisms have been scientifically described, and at the present rate of progress, it would take nearly 400 years to describe the rest. Despite over 100 years of ecological research, we still do not know the complete array of natural processes and relationships for even relatively simple ecosystems. Yet necessity demands that we manage natural systems sustainably in the absence of the knowledge of how this can be best achieved. As Michael Soulé, a U.S. conservation biologist, has observed, conservation biology is, of necessity, multidisciplinary, synthetic, and eclectic; it is both a science of crisis and a science of uncertainty.

Sharing Planet Earth

A tragedy for many people today is their dislocation from nature. The majority of the world's population lives in urban centers, often far removed from relatively undisturbed forests, grasslands, and waterways. This highlights the increasingly important role of educators in bringing people closer to nature through botanic gardens, school nature programs, and participation in habitat restoration schemes. It means informing city people of a world of nature, beyond the supermarket, that provides the basics of life.

Moreover, it may not be wilderness regions that will be the centers of attention for conservation issues in the future. As I noted at an Australian Conference in 1998:

In conserving biodiversity, a major battleground of the twenty-first century will be the interface between wilderness and production

lands. For many people this is where they feel most at home—in reach of nature yet not overwhelmed by it, and still in sight of familiar human elements. It is a hard landscape zone to manage and too often is neglected. The boundaries between production land and wildlands are often sharply drawn. The boundaries need to be blurred through meaningful dialogue and a genuine understanding of the natural heterogeneity and dynamism of most landscapes.¹³

There is an urgent need for syntheses between social sciences and biological and ecological sciences based on biology and the physical world. Land-use philosophy and practice must reflect that in every landscape there are appropriate patterns and scales of ecologically sustainable utilization and preservation. Sometimes, this may be achieved through planning of smaller-scale mosaics across large landscape units. This synthesis would help blur the demarcation between urban and rural lands and inspire greater recognition of the footprint effect of urban areas on remnants of natural habitat.

We need to underscore the importance of developing a real and lasting biodiversity ethic. Biodiversity has yet to see its Newton or Einstein. But in developing a biodiversity ethic, three challenges face us: the view that innovative technological solutions will always overcome problems; brinkmanship, the tendency not to act until motivated by crisis; and the varied fabric of human culture, which parallels that of biodiversity and makes it difficult to arrive at universal consensus.

These are major impediments to developing an acceptable ethic that balances necessary human

utilization of nature and protection of biodiversity within the context of the total landscape. (See “Elevating the Amazonian Landscape” in this issue of FORUM.) In practical terms, this means there is no single global prescriptive approach. Global visions lead to principles that only become prescriptive once we reach the unique social, biological, and economic mix of local community-based situations.

Jealous Guardians

What does the future hold? It is encouraging to work with community groups and landowners who, once aware of the need to conserve and cherish the plant life where they live, become its most jealous guardians. Inextricably, the history of humanity and development of civilization is the story of people's relationships with the diversity of plant life around them. The health and integrity of human communities cannot be isolated from the health of the biodiversity that characterizes the planet on which we live.

Technological advances do hold out hope of new and innovative possibilities for countering extinction. There is considerable interest, fueled by the vision of a Jurassic Park future, in the restoration of extinct species through use of DNA from dead individuals. This gives hope that extinct species may be brought to life. As Brent Mishler of the University of California-Berkeley's Jepson Herbarium suggests, “Who knows what future know-how and knowledge might make possible.”¹⁴ Despite the very promising advances in classical taxonomy and molecular biology that may eventually make this a reality, it is one thing to recreate a species and quite an-

other to recreate both its natural genetic variation and the complex web of relationships and processes that form its habitat.

Conservation is not a spectator sport, and no one can stand on the sidelines. Ervin Laszlo argues that there is a common societal responsibility leading to a necessary scenario where “everyone has got into the act, not just scientists and educators, governments and enterprises, but also ordinary citizens, eager consumers of the spin-offs of scientific knowledge and technological know-how.”¹⁵ Aurelio Peccei, Italian industrialist and founder of the Club of Rome puts further perspective on the problem, arguing that “precisely when mankind is at the peak of its powers, it lacks the wisdom to put its powers to proper use.”¹⁶ If we claim neutrality, argue that we are ignorant and hence have no opinion, or regard the status of plant life as an issue that does not concern us, then we are part of the problem. We are tolerating depletion and extinction with the inevitable and irreversible loss of part of our common global heritage.

People must believe that solutions to the extinction crisis are achievable. This means steps of faith, trusting people and institu-

tions, and being prepared to risk putting responsibility and stewardship in the hands of people who are close to the action. And above all it means hope. Without hope and a firm belief that rates of extinction can be slowed, the war against the erosion of biodiversity, whether at the ecosystem, species, or genetic level, will be lost. The conservation of that diversity and its wise use on a sustainable basis is one of the most important tasks entrusted to this and future generations.■

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NOTES

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Unintended Consequences

New data reveal the Endangered Species Act has created economic incentives for preemptive habitat destruction.

BY DEAN LUECK

The Endangered Species Act of 1973 was a watershed in federal policy on wildlife conservation. Prior to the act, the Secretary of Interior was authorized through the Fish and Wildlife Service¹ to list species considered to be in peril and to foster protection by banning the taking, or killing, of such species; prohibiting trade in endangered species; encouraging federal agencies to protect habitat; and establishing a federal fund for habitat acquisition.

The ESA broadened and deepened this policy. It expanded protection to a much larger set of species and populations, including invertebrates and plants. It required federal agencies to protect listed species at all costs. It broadly defined the term *take*, which originally meant kill or

catch, to ultimately include alteration of a species' habitat. And it extended federal protection of species to private lands.²

The ESA had almost no impact during its first few years, partly because the full force of the act's language was not clear in the law. Starting in 1978, however, with the famous snail darter case, *TVA v. Hill*,³ a series of federal court decisions and administrative rulings transformed the ESA into one of the most authoritative and wide-reaching federal environmental laws. The court said the ESA required that construction of a nearly completed federal dam be halted to save habitat for a tiny endangered fish, the snail darter, and it issued its famous mandate: "The plain intent of the statute was to halt and reverse the trend toward species extinction, whatever the cost." *TVA* is the most important

case for federal lands and federal agencies because, even though completion of the dam was eventually authorized by Congress, the ruling nevertheless established the unilateral authority of the ESA to control the actions of federal agencies.⁴

Although many of the high-profile conflicts over the ESA have involved public-land management, the majority of endangered and candidate species reside on private land. The ESA made it unlawful to take any endangered species within the jurisdiction of the United States. It further expanded the definition of *take* to mean "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect." In 1975, the Secretary of Interior went on to define *harm* as:

An act or omission which actually injures or kills wildlife, including acts which annoy it to such an extent as to significantly disrupt essential behavioral patterns, which include, but are not limited to, breeding, feeding, or sheltering; significant environmental modification or degradation which has such effects is included within the meaning of "harm."⁵

While the secretary's clarification suggested that private land use restrictions could be imposed under the ESA, the act was not used in this manner for several years. This changed in 1979, when the court sided with environmental groups who charged the state of Hawaii with taking an endangered bird, the palila, by maintaining populations of feral sheep and goats for sport hunting that adversely affected the palila's nesting sites.⁶ The court ordered the state to remove the animals after considering the ESA's definition of *take* and *harm*. By the mid-1980s,

a combination of administrative and court rulings combined to make habitat modification a violation of the ESA.⁷ Thus, under the ESA, it is not only illegal to destroy an endangered species, it is also illegal to damage its habitat.

Property Rights

The basic problem of wildlife conservation is the difficulty of deciding who owns live populations.⁸ Because it is costly to coordinate the actions of various landowners who provide habitat, wild populations often are managed as open-access resources, for which no one has exclusive rights. Predictably, this leads to over-exploitation through hunting, fishing, trapping and destruction of habitat. This lack of ownership makes it difficult for landowners to benefit economically either from providing habitat or from protecting threatened or endangered species.

During the 19th and early 20th centuries, wildlife populations in the United States plummeted under such open-access exploitation. Some species such as the passenger pigeon were extinguished, and many populations fell to dangerously low numbers. In perhaps the most alarming case, in less than a century, bison were reduced from a high of 25 to 30 million to just 2,000 animals by 1900. Similar, though less dramatic, stories of population decline occurred for numerous big-game species, including deer, elk, and pronghorn antelope, and many birds, including wood ducks, turkey, and many species of plumed waterfowl. As many populations declined and reached their lowest level, state, and to a lesser extent federal, governments began to create various agencies and game departments to dictate season closures, bag lim-

its, trade restrictions, and wildlife refuges. Today, nearly all of these species have recovered, and some—like the whitetail deer—are so populous as to be considered pests in many areas. Moreover, these recoveries took place either before the passage of the Endangered Species Act or did not fall under its jurisdiction.

There are two basic types of species conservation policy. The first is the ESA approach, which uses landuse restrictions in an attempt to lock in existing habitat and penalize landowners for adverse alterations. The second method, which prevailed before the ESA and still applies to species not governed by the ESA, is a pay-to-protect program in which landowners are compensated for providing habitat. For example, the federal government buys and leases land for waterfowl habitat. Similarly, private conservation organizations such as the Nature Conservancy purchase and lease habitat.

The pay-to-protect system does little to change the basic system of rights to land, in which the landowner may use property for conservation, agriculture, hunting, or development. In fact, such a system retains the rights of landowners but generates a market for wildlife habitat. The ESA, however, substantially alters the system of property rights to land and the incentives of many people and institutions, most notably environmentalists, private landowners, the Fish and Wildlife Service, and public land agencies.

Litigation-to-List

In the wake of *TVA v. Hill*, environmentalists have successfully forced several federal agencies—the Bureau of Reclamation, the Corps of Engineers, the Forest Ser-

vice, the Bureau of Land Management, the National Park Service, and the military services—to alter their land management policies to comply with the ESA. In the process, millions of acres of federal land have been managed as refuges for listed species. Litigation has also expanded federal authority over interests formerly governed by the states and broadened the definition of *take*. One strategy is to use lawsuits to force the listing of species that are widely distributed geographically so that the ESA can govern enormous expanses of land, both public and private.

The listing of the northern spotted owl is perhaps environmentalists' ultimate success thus far. The owl, which inhabits the old-growth conifers of the Pacific Northwest from northern California to British Columbia, requires a home range of 1,000 to 8,000 acres. By the early 1980s, environmentalists began to pressure federal forest managers with the U.S. Forest Service and BLM to limit harvest of old growth forests. Environmentalists challenged these agencies under a variety of federal environmental laws for failing to consider how proposed timber sales would affect the spotted owl. Ultimately, in a 1988 federal case—*Northern Spotted Owl v. Hodel*—the FWS was forced to re-examine the spotted owl as a threatened or endangered species throughout its range, and in 1990, the owl was officially listed as threatened.

As a result of these lawsuits and the settlements that followed, nearly 11 million acres of federal land in California, Oregon, and Washington are now considered as critical habitat and off limits to logging. This acreage represents a substantial fraction of public for-

ests in these three states, as much as 50 percent in Oregon and Washington. By invoking the ESA and related environmental legislation environmentalists have dramatically altered land uses on public forest land in the Pacific Coast states.

In recent years, environmentalists have become more open about the use of the ESA as a land management tool, not just a means to protect certain species. For example, in July 1998, after the National Wildlife Federation led a petition to force the FWS to list the black-tailed prairie dog, NWF President Mark Van Putten stated, "This is the best possible use of the Endangered Species Act. If we can help the prairie dog, we'll be saving grasslands that benefit all sorts of wildlife, and people too."⁹

Perhaps no group has pursued the litigation-to-list strategy as successfully as the Tucson-based Center for Biological Diversity.¹⁰ The Center has extensively used the ESA throughout the desert Southwest and currently is trying to get more than 100 new species listings or critical habitat designations in California. In 1995, it obtained a one-year injunction on all logging in national forests in Arizona and New Mexico by forcing critical habitat designation for the Mexican spotted owl.

But the Endangered Species Act not only allows citizen litigation on federal land, it also alters the property rights of private landowners when an endangered species is present or when there is a probability that a species will inhabit the land. Under the ESA, the FWS essentially controls wildlife—even on private land—at least for listed species, by virtue of its authority to enforce the ESA. Once a species has been listed, the ESA is in

force so that the land that provides habitat for the species is governed by the ESA. A landowner thus finds that a portion of his rights to the use and income of the land essentially is transferred to the FWS and those who are able to influence the agency through political or legal avenues.

Environmentalists can force the FWS to act by showing that federal agencies or private landuse harms listed species. Environmentalists can also encourage the listing of new species that inhabit land for which environmentalists want to change existing or planned land use. The record of extensive litigation under the ESA indicates that environmentalists have successfully used the citizen lawsuit provision to invoke and strengthen the ESA.¹¹

Because the ESA allows citizen lawsuits, environmental groups can sue for listing and implementation of the ESA and thus "claim" land, public or private, by prohibiting the landowner from making any changes that would alter wildlife habitat. In addition, the ESA places no limits on the number of species to be listed or the number of acres affected and does not require that landowners be compensated for losses; as a result, the landowner who suspects there might be endangered species has no economic incentive to preserve habitat. In principle, a group can claim large areas by seeking the listing of a species that requires a large territory to thrive, thus preventing uses of the land that might harm the listed species.

Thwarting the ESA

Even under the ESA, a landowner maintains important influence over the land by virtue of his control over nonwildlife uses such as

farming and forest management. Moreover, because of the information advantage landowners have over the FWS, they may be able to take action to prevent the administration of the ESA and thereby reclaim their rights to wildlife habitat.

There are several ways to thwart implementation of the ESA. First, if the species is already present but unknown to the FWS, a landowner may secretly, and illegally, kill all listed species inhabiting his property. This is known by some landowners as the shoot-shovel-and-shut-up approach to land management. In so doing, the landowner is cleansing the land of the listed species and rendering ESA regulations moot.

Second, if the species is not yet present but the potential for inhabitation is high, he may destroy or damage habitat to preempt the ESA's regulations. Preemptive habitat destruction might be active—bulldozing junipers that provide habitat for endangered warblers, for example—or it might be passive—stopping the burning of understory, a practice that helps maintain pine forest habitat for endangered woodpeckers. Such preemption not only removes the potential for costly regulations, it also effectively reduces habitat for the endangered species.

Many students of the ESA, including biologists, bureaucrats, economists, environmentalists, and lawyers, have recognized the possibility of preemptive habitat destruction, and anecdotes and case studies abound.¹² In Texas, landowners have cleared and overgrazed juniper habitat for the golden-cheeked warbler and the black-capped vireo. Forest owners clearcut old growth Douglas fir in the Pacific Northwest to avoid log-

ging restrictions designed to protect the northern spotted owl. Farmers in California have switched crops to eliminate habitat for kangaroo rats. The National Association of Home Builders actually advises preemption, or what it calls scorched-earth management, to ensure that the property will be unsuitable for protected species.¹³

War on Woodpeckers

The evidence of preemption is strongest for the red-cockaded woodpecker, a non-migratory, territorial species that resides exclusively in longleaf pine ecosystems ranging from Virginia to Arkansas. This bird was listed as an endangered species in 1970 before the ESA was enacted, making it one of the longest listed species. A clan of red-cockaded woodpeckers requires 100 to 250 acres of mature pine forest for nesting and foraging, and the FWS's guidelines recommend parcels ranging between 60 and 300 acres. At roughly \$2,000 per acre of mature, unharvested timber, these regulations are potentially costly landuse restrictions that can stimulate preemption.

Perhaps the most famous reported preemption case is that of North Carolina landowner Ben Cone, who dramatically increased his harvest of old-growth pine in response to potential ESA regulations. In 1991, the FWS restricted Cone from harvesting timber on 1,500 acres of his 7,200-acre property to protect 12 colonies of red-cockaded woodpeckers. A consultant estimated the market value of timber on the 1,500 acres to be \$2 million, roughly \$1,300 per acre. In response, Cone proceeded to clearcut potential woodpecker habitat on nearby, but currently unregulated acres.¹⁴ Rather than

waiting to cut 80-year-old trees, he cut them at age 40 before they were prime nesting habitat. Cone also sent a letter to his neighbors describing the situation, and at least one soon began clearcutting his pine stands.

Recently, a colleague and I examined a detailed set of data on forest ownership and management, coupled with detailed data on the location of known colonies of red-cockaded woodpeckers, to examine how the potential for ESA regulation affects the probability that a particular forest plot will be harvested.¹⁵ We used data on more than 1,000 individual privately owned forest plots from a 1984-1990 U.S. Forest Service survey and from a 1997-1998 North Carolina State University survey of over 400 North Carolina forest landowners.

Controlling for other economic factors such as timber prices and stand quality, we found that the closer a plot is to red-cockaded woodpeckers, the greater the probability that the plot will be harvested and the younger the age at which the forest is harvested. For the 1984-1990 period, the probability that a 50-year-old stand of pine will be harvested increases from between 5 and 25 percent when there are woodpeckers within 5 to 15 miles of a site. For example, during this six-year period, the probability of harvesting a 50-year old stand with no woodpeckers within 15 miles was 31 percent, while the probability was 50 percent if there were high densities of woodpeckers within 15 miles.¹⁶

Out of a total pine acreage of 960,000 acres in North Carolina, we found that between 12,000 and 70,000 additional acres were harvested between 1984 and 1990 because of the potential of ESA regulations. These findings are the

first empirical evidence of systematic preemptive habitat destruction and confirm both the economic model of preemption and the dismay of some environmentalists who have noted that populations of red-cockaded woodpeckers have been declining on private land under the ESA.

Lobbying Limbo

Besides acting to preempt the ESA by altering habitat, landowners may form interest groups and lobby for changes in the ESA or in the way the FWS implements the act. Indeed, the emergence of the so-called "property rights movement" in the early 1990s came as a response to ESA regulations. In some cases, existing groups such as the American Farm Bureau Federation and the Forest Products Association were ready to champion the causes of landowners affected by the ESA. In other cases, new organizations such as the National Endangered Species Act Reform Coalition were formed to explicitly address the concerns of landowners with the ESA.

The property rights movement gained supporters in the Republican-led 104th Congress in 1994. It generated numerous bills to amend the ESA as well as anti-takings bills that would require compensation to landowners if some portion of land value were lost. Although none of these bills became law and the ESA remains in limbo, the political pressure undoubtedly is part of the reason for the development of recent "No Surprises" and "Safe Harbor" policies. "Both of these new policies develop baseline populations of an endangered species for a landowner, so he will be able to manage the land without the threat of expanding landuse regulations."¹⁷

Federal Agencies

Federal agencies have also been influenced by ESA's incentives. The FWS, for example, has faced competing forces, so its behavior has not been uniform. On one hand, the ESA offers opportunities to expand the reach and size of the agency beyond its traditional role of regulating primarily game species. On the other hand, using the ESA for these new efforts means alienating long-lived constituents, such as hunters and fishers, and risking political attack. Although FWS bureaucrats were active in expanding the role of the agency by assisting in writing endangered species legislation, the agency was extremely cautious in enforcing the ESA before *TVA v. Hill* and often has been since.

Even so, the FWS seems to have thrived since the ESA. Its total budget was \$160 million in 1974, but by 1995 had increased to a little over \$1 billion. The budget for its endangered species programs similarly increased from \$3.2 million in 1972 to \$87.9 million in 1995. This represents an increase in the share of the budget devoted to endangered species from 2 percent in 1974 to 8.7 percent in 1995. Meanwhile the number of listed domestic species has risen from 109 species in 1973 to over 1,100 species, of which 702 are plants.

The structure of the agency has also changed since the ESA. For example, there are relatively more biologists working in the Office of Endangered Species than at regional offices and wildlife refuges since the ESA. The FWS emphasis on serving primarily a hunting-fishing constituency has clearly diminished and has shifted toward a nonhunting environmentalist constituent base. There are often

close ties between Office of Endangered Species biologists and environmental groups, and many lawsuits forcing the agency to list or define critical habitat have been friendly suits initiated by its own biologists within the Office of Endangered Species.

Since enactment of the ESA, the agency has also seen the centralization of its bureaucracy, also as a result of the rising importance of endangered species. Before enactment of the ESA, the agency was highly decentralized among its seven regional offices and hundreds of refuges. Today, the agency is much more centralized because the Office of Endangered Species is headquartered in Washington, D.C. The FWS has been transformed from an agency almost exclusively concerned with migratory birds and wildlife refuges to one with a strong focus on the administration and enforcement of the ESA.

Public-land agencies have similarly been transformed by the ESA and its increasingly stringent interpretation. Since *TVA v. Hill*, federal agencies have been forced to enhance the conservation and restoration of listed species. This has meant that land uses and land management decisions have changed. Timber harvest has been reduced on national forests, grazing has been limited on public rangelands, water development projects have been eliminated or reduced in scale, and military bases have been modified to accommodate the habitat for listed species. It's not surprising that this has led to substantial increases in agency expenditures to study species and develop habitat conservation plans. From 1989 to 1993, annual expenditures for these purposes rose from \$7.5 million to

\$38 million for the Forest Service, from \$1.5 million to \$14 million for the Bureau of Land Management, and from \$5 million to \$11 million for the Department of Defense.¹⁸ Simultaneously, public land use has been diverted from revenue generating activities such as timber harvest, mineral extraction, and rangeland leasing and toward wildlife and recreational uses that do not generate revenues. As a result, lands that formerly provided a source of revenue for federal agencies, or at least offset the expense of maintaining these agencies, no longer do so, making these agencies more reliant on general revenue for their management.

Conservation, Past and Future

Many of the species driven to distressingly low numbers in the late 19th century have now recovered. For example, whitetail deer fell to just half a million by 1890 but are now estimated at 15 to 25 million and are often considered pests.

The pronghorn antelope, present in large numbers throughout the Great Plains during the Lewis and Clark Expedition, had been reduced to 26,600 in the United States and 30,320 in Canada in 1924. By 1964, just 40 years later, populations had increased more than 10-fold in both the United States and Canada and have increased steadily since then. Their numbers approach 600,000 in the United States today.

Similar recoveries have occurred for bison, bighorn sheep, and elk. And population recoveries for the bluebird, turkey, and wood duck have been at least as dramatic.

In all of these cases, similar forces were at work. State wildlife agencies and the FWS enforced season closures and restricted game trade. In addition, habitat was of-

ten enhanced through refuges, especially for migratory waterfowl. Animals were live-captured in the wild and raised in captivity before being transplanted to depleted areas.

Private landowners also cooperated in developing and protecting habitat. For example, conservation groups built nesting boxes for wood ducks and bluebirds on private land. In New Mexico, landowners who had opposed allowing game on economically valuable grazing lands consented to the reintroduction of elk and pronghorn on the condition of being able to control hunting regulations once populations increased. In most cases, there have been well-defined interest groups, such as Ducks Unlimited or the National Wild Turkey Federation, that have helped steer restoration by raising revenue and negotiating with wildlife agencies and landowners.

The ESA has been in effect only since 1973, so its success at species restoration is difficult to assess fully. We do not know, of course, what might have happened to certain species without the ESA, yet the evidence thus far does not suggest any dramatic recoveries for listed species like those mentioned above. Of the more than 1,200 domestic species that have been listed as endangered or threatened, only 24 were delisted as of February 1997. Of these, seven were extinct and nine were delisted because of "data error," indicating that the original listing was based on mistaken population estimates. The remaining eight species were considered recovered, although there is debate over the ESA's role in that success.

One study of the FWS contends that none of these recoveries is the result of the ESA.¹⁹ For example,

the improving status of the bald eagle is now mostly attributed to the ban on DDT and enforcement against poaching, neither of which are specifically ESA-based policies. Thus far, the ESA's success record is still quite limited compared with some of the impressive restorations that occurred without the ESA. No dramatic species recovery can be claimed as a result of the ESA; indeed such species as the red-cockaded woodpecker, which has been listed for 30 years, have declining populations.

Wildlife restoration policy before the ESA used season closures and game trade restrictions to limit open-access killing. Moreover, it used pay-to-protect methods to enhance wildlife habitat, by either purchasing or leasing land for refuges, and landowners were never penalized for altering habitat. Thus the preemption incentive was completely absent.

Under the ESA, the prohibition on taking amounts to a year-round season closure. This ban, combined with existing game trade restrictions, would make the ESA equivalent to pre-ESA approaches. But the broad definition of *take*, which includes harm to habitat, makes a crucial difference. Because of this, the ESA creates the incentive for preemption and also limits the potential for using the land market to allocate habitat.

The main distinction between the two approaches is how each alters the incentives of landowners to provide and enhance habitat. Under a pre-ESA policy, the landowner has an incentive to both provide and enhance habitat. Under the ESA, the landowner instead has an incentive to reduce or even eliminate habitat. Thus, the ESA will be most successful where habitat development is not

important or where the landowner's ability to manipulate habitat is limited.

It's the Incentives...

Although the ESA had the nearly unanimous support of Congress and the president in 1973, it has become one of the most controversial environmental laws in the United States. It has been lauded by environmentalists and vilified by landowners. Congressional authorization for the ESA expired in 1992, and gridlock has ruled since. All students of the ESA recognize that it was a major shift in federal wildlife law, dramatically altering the property rights to habitat that sustains endangered species. In the nearly 30 years that have passed, there have been so many adjustments to and investments in the ESA property regime that strong vested interests have been established. Thus the current gridlock is not a surprise.

Current dissatisfaction with the ESA reveals growing concern about some of the incentive problems with the current ESA that are becoming increasingly important. While landowners tend to be uniformly opposed to the ESA unless they can be sure they will avoid its force, the ESA has been a double-edged sword for environmental groups. On one hand, the ESA has allowed environmentalists to have great sway in the use and management of public lands and to attack large-scale federal development projects.²⁰ On the other hand, habitat is being destroyed, and species are losing ground on private land, most likely because of the ESA. These combined forces seem to be generating pressure to change the ESA, especially as it affects private landowners. Indeed, the FWS has recently imple-

mented more-flexible policies for private landowners.

Lessons Learned

Two lessons can be drawn. First, a focus on the property rights to land clarifies issues and motives of various groups in supporting or opposing various policies. Specific attention to the incentives of landowners, both private and public, is crucial in understanding the performance of various wildlife preservation policies.

Second, because of the discretion of agencies and the courts' deference to them, the passage of seemingly benign legislation can evolve into a set of largely unintended consequences. Along the way, institutions may become quite permanent, regardless of their merits, as vested interests also evolve to take advantage of the new regime.

More than anything, however, the ESA needs a dose of systematic empirical analysis of its impacts on landuse, its costs, and its success at achieving its own goals of species conservation. About all that is known for sure now is that the ESA has altered landuse on federal lands, crippled some development projects—including some that were “pork”—caused landowners to destroy habitat to avoid regulations, expanded the FWS's bureaucracy, fostered costly litigation, and spawn-ed lobbyists and consultants. Has it been worth it?■

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NOTES

1. The National Marine Fisheries Service administers the ESA for marine species. For the details of the history of the ESA and its implementation, see Michael J. Bean and Melanie J. Rowland, *The Evolution of National Wildlife Law*, 3rd ed. (Westport, CT: Praeger, 1997); Daniel J. Rohlf, *The Endangered Species Act: A Guide to its Protections and Implementation* (Stanford, CA: Stanford Environmental Law Society, 1998); and Steven Lewis Yaffee, *Prohibitive Policy: Implementing the Federal Endangered Species Act* (Cambridge, MA: MIT Press, 1982).

2. This history is examined in detail in Dean Lueck, “The Law and Politics of Federal Wildlife Preservation,” in Terry L. Anderson, ed., *Political Environmentalism* (Stanford, CA: Hoover Press, 2000).

3. 437 U.S. § 153 (1978).

4. The ESA, however, does not prevail in issues of national security.

5. 40 Fed. Reg. 44412, 44416 (1975).

6. *Paila v. Hawaii Department of Land and Natural Resources*, 471 F. Supp 985 (D. Hawaii 1979), aff'd 639 F.2d 495 (1981).

7. This policy was further solidified by the Supreme Court in *Babbitt v. Sweet Home Communities for a Greater Oregon*, 515 U.S. 687 (1995).

8. For an analysis of the economics of wildlife law, see Dean Lueck, “The Economic Nature of Wildlife Law,” *Journal of Legal Studies* 18 (1989), pp. 291-323.

9. Quoted in “NWF Seeks Prairie Dog Listing: Action Will Save Wildlife and Grassland Habitat” <<http://www.nwf.org/prairiedogs/prairied.html>>. To date, the prairie dog has not been listed, but the FWS gave a preliminary ruling in 1999 that it would be listed within a couple of years.

10. The Center's actions are described by Nicholas Lemann, “No People Allowed,” *New Yorker* (November 22, 1999), pp. 101-113.

11. Daniel J. Rohlf, in *The Endangered Species Act: A Guide to its Protections and Implementation* (Stanford, CA: Stanford Environmental Law Society, 1988), finds over 40

federal cases by 1988. From 1973 to 1998, the *Environmental Law Reporter* (various issues) shows 24 cases reaching the Supreme Court, 360 reaching a federal appellate court, and 488 reaching a federal district court.

12. For some of these cases, see Richard Epstein, “*Babbitt v. Sweet Home*: The Law and Economics of Habitat Preservation,” *Supreme Court Economic Review* 5 (1997), pp. 1-57; Charles C. Mann and Mark L. Plummer, *Noah's Choice: The Future of Endangered Species* (New York: Alfred A. Knopf, 1995); and H. Barton Thompson, Jr., “The Endangered Species Act: A Case Study in Takings and Incentives,” *Stanford Law Review* 49 (1997), pp. 305-380.

13. *Developers Guide to Endangered Species Regulation* (Washington DC: National Association of Home Builders, 1996), p. 109.

14. Cone also used the threat of logging and a fifth amendment lawsuit to limit the enforcement of the timber harvest restrictions.

15. Dean Lueck and Jeffrey A. Michael, “Preemptive Habitat Destruction under the Endangered Species Act,” working paper, Montana State University (April 2000).

16. *Ibid.*

17. Lueck and Michael, “Preemptive Habitat Destruction under the Endangered Species Act.”

18. For example, Eglin Air Force Base in Florida and Fort Bragg Army Base in North Carolina are home to numerous populations of the endangered red-cockaded woodpecker.

19. Robert E. Gordon et al., “Conservation under the Endangered Species Act,” *Environment International* 23 (1993), pp. 277-370.

20. In remarks celebrating the 25th anniversary of the ESA, Michael Bean, chair of Environmental Defense's Wildlife Program, notes the ESA “has sparked long-overdue changes in the management of our Federal forests. It has helped bring an end to the era of pork-barrel dam building.” He is remarkably silent on the ESA's species recovery record. See “The 25th Anniversary of the Endangered Species Act,” *EDF Column* 30(1), January 1999 at <http://www.environmentaldefense.org/pubs/newsletter/1999/Jan/j_endsp.html>.

21. This article was written while the author was an Olin Fellow in Law and Economics at Cornell University, Ithaca, New York.



There Goes the Neighborhood

Urban sprawl must be added to the long list of human impacts that threaten a massive modern extinction.

BY MICHAEL L. MCKINNEY

Population growth, wasteful patterns of consumption, and diminishing natural resources are rapidly pushing many species to the brink of extinction. Even biologists have difficulty assessing the complexity and speed of human impacts on the biological world.

In the United States, many native species were initially threatened mainly by overhunting: the killing of large game species beyond their capacity to reproduce. The buffalo disappeared from the eastern United States in the early 1800s, and elk, panthers, wolves, and a few other large species disappeared by the middle part of that century.¹ Though some species, such as wolves, are recovering, others, like the passenger pigeon, are gone forever.

The second stage of human im-

act in the United States, as in most nations, was the rapid transformation of the natural landscape by human settlements, especially the clearing of land for timber and agriculture. This led to extinction from habitat loss. Especially hard hit were species adapted to ancient, old-growth forests, prairies, river valleys, and other areas favored by farmers for growing foods.

The United States is now entering a third, and potentially much more devastating, stage of impact on native species. This is the transformation of the landscape by the geographic expansion of suburban areas into surrounding ecosystems, which is occurring at an alarming pace.² This urban expansion has many names, including urban sprawl, development, suburbanization, and counterurbanization. Whatever the name, it is driven by the migration of

people from very dense concentrations in cities to outlying areas where people are much more widely dispersed across the landscape. Urban sprawl therefore greatly magnifies human impacts per person on the environment because the dispersed inhabitants require a vast infrastructure of roads, parking lots, housing subdivisions, and many other physical transformations. It is not widely appreciated how much more harmful to natural ecosystems these urban transformations are than traditional farming and other rural land uses that allowed many native species to persist and even flourish.

Urban sprawl produces the local equivalent of a mass extinction. It eradicates over 90 percent of native species in the area, replacing them with a few non-native species that often become abundant pests because they lack natural enemies. Even worse, the impacts of urban expansion are so dramatic and persistent that it will take many decades and probably centuries for natural systems to recover, assuming they ever get the chance. In brief, the current model for the expansion of cities is the terminal—in both senses of the word—stage of human impact on natural ecosystems.

Ironically, urban sprawl is driven in large part by the desire of urban inhabitants to experience more natural surroundings. Indeed, there is a strong positive statistical correlation between household income and the number of native species still surviving in a housing development.³ People clearly prefer natural surroundings when they can afford them. Implicit in this irony, however, is an important source of optimism: if suburbanites can become more

educated, they are likely to take steps to reduce the harm done to native ecosystems. In fact, many of these steps are painless, even money-saving activities, such as resisting the urge to destroy small wetlands—which reduce storm flooding—and planting native species, which saves considerable lawn maintenance.

There is a growing realization that federal laws such as the Endangered Species Act, intended to protect species, have failed to fulfill their promise. Therefore, promoting biodiversity at local levels may be the strongest weapon against extinctions, since the policy decisions causing most extinctions in the United States are made at the local level by developers, individual landowners, conservation alliances, and local and state governments.

Asphalt Deserts

To natural ecosystems, the most devastating aspect of sprawl is so deceptively simple: pavement. Largely a result of the automobile's need for roads and parking space, pavement covers an increasingly large amount of surface area during urban expansion. While about 2 percent of the total U.S. surface area is now covered by roads, over 50 percent of many metropolitan areas is covered with pavement.

The main impact of pavement on aquatic species is a vast increase, from several hundred to a thousandfold, in the amount of water discharge, sediment, toxic chemicals, sewage, and other major water pollutants. When just 10 percent of the land is covered with pavement, local creek and lake ecosystems suffer profound species losses.⁴ The initial stages of development, for example, typically eliminate over half the fish, snail, and clam species in nearby streams.

The number of terrestrial species also declines as the amount of pavement increases. The most obvious reason for this is that plants generally cannot penetrate pavement to reach the soil. In widely paved areas such as parking lots, the landscape becomes a biological wasteland with a species diversity below that found even in the most barren deserts, and no habitat for most mammals and songbirds, which need trees, shrubs, and grasses for food and shelter.

Notable exceptions include the few species preadapted through evolutionary accident to inhabit highly urbanized habitats, such as pigeons, starlings, house mice, and black and brown rats. Such species, often called human commensals, or synanthropes, abound because humans have eliminated their natural competitors and enemies and supply them with large quantities of food.

Most of these species were originally from Europe or Asia and have become globally distributed via human transport. Their evolutionary preadaptations include an ability to reproduce in human edifices; urban pigeons, for example originally nested on rock cliffs. And they consume available foods; most suburban and urban birds are seed eaters that thrive on bird feed, or scavengers that subsist on food scraps. As global commerce increases, the rate at which such non-native species are introduced into local ecosystems is increasing exponentially.⁵ If current trends persist, this replacement of native species with the same few commensals will result in a monotonous, globally homogenized biosphere, a “planet of weeds.”⁶

Before we can mitigate impacts of sprawl, we must realize that these urban biological wastelands

are endpoints of a long process by which native species are removed from an area over a period of many years, usually decades. This process is obvious in the suburbs and the advancing fringes of cities where natural ecosystems are swallowed and transformed into concrete deserts.

The first step is fragmentation of habitat. Roads and other forms of development will fragment a formerly continuous wetland, forest, or other natural habitat into progressively smaller islands. Such fragmentation greatly accelerates the loss of habitat. The most direct and obvious effect is road-kill mortality, which accounts for the deaths of millions of small mammals and birds each year in the United States alone.

Another fragmentation effect is the isolation of populations so that individuals have a difficult time finding mates for breeding. This is seen in many endangered species, such as the Florida panther, where inbreeding is common and birth rates have dropped dramatically.

Finally, the rapid diffusion of housecats, people, and other sources of disruption infringes on fragments and produces “edge effects” in the remaining habitat caused by greater access to the interior of the fragment. Domestic cats, for example, have an instinctive fear of larger predators such as coyotes, which often include housecats as a main part of their diet. Therefore, cats will rarely prey on songbird nests that are more than a few hundred feet from the edge of a forested area. The smaller the forest fragment, the greater is this threat.

The fossil record shows that even mass extinctions had a few winners, species that benefited from

catastrophic environmental changes. Such species move into the areas vacated by the extinct species and transform the composition of the ecosystem. The rise of mammals, for example, could never have occurred without the extinction of dinosaurs, by a huge meteorite.

So it is with urban sprawl. As fragmentation proceeds, the creation of more open space attracts species adapted to such areas—robins and mockingbirds that forage for insects on the ground, for example—or those that forage for seeds, like cardinals and mourning doves. Such species are also able to nest in available shrubs.

Common mammals in fragmented suburban areas include rabbits, which prefer short grasses, deer that browse on shrubs, and a variety of middle-sized omnivorous species such as raccoons, opossums, coyotes, and skunks. These omnivores can reach population densities much higher than in natural areas because they have learned to take advantage of garbage, vegetable gardens, and other resources provided by humans. Indeed, studies show that there are now 10 times more deer, raccoon, and skunks in the United States than existed before European settlement began.⁷ Because humans provide food and remove natural predators and competitors, these suburban dwellers become superabundant pests.

Among plants, the winners of fragmentation include grasses, shrubs, and other species that colonize open areas after a disturbance. As with suburban animals, some of these winners become so abundant that they are pests in the form of weeds. Because development is accompanied by the widespread importation of non-native ornamental plants used in land-

scaping, many of these become weedy pests. Examples include kudzu, dandelions, and honeysuckle, which overgrow and kill native plants.

On the Fringe

What does this mean for preserving habitat? A key place to start is at the fringes, where urban sprawl is expanding. In most cases, the initial stages of urban expansion into surrounding regions actually increase the number of species in the area. While this may seem counterintuitive, it is a well-established fact of ecological theory: intermediate levels of disturbance tend to maximize biodiversity. In this case, the initial stages of fragmentation create a mosaic of habitats that allow a wide variety of species to coexist in the area, often more than before modern human intrusion. Examples are land at the fringe of suburban expansion, especially farmland sought by real estate developers.

This high species diversity outside urban peripheries is a crucial and largely ignored opportunity for planners and developers who wish to enhance the quality of life in the suburbs and simultaneously promote the conservation of biodiversity. Public opinion polls in the United States consistently show that a large majority of residents of suburban areas have a strong interest in preserving natural features of their area as well as a strong concern for the extinction of other species.

Fortunately, there is a growing awareness of this among planners.⁸ So the main question, as usual, is whether local governments will implement recommendations made by them or ignore them for short-term political or economic reasons.

On a regional scale, suburban development should therefore seek to preserve the high native species diversity that occurs in the initial stages of habitat fragmentation. This would require preserving some of the habitat fragments, such as wetland and forest habitat, that sustain populations of native species. Current regulations and environmental-impact assessments do not require this unless a threatened species is involved, and such species are so rare that they are generally not a factor in urban growth issues.

From an ecological standpoint, such wilderness set-asides need not be particularly large, especially if the preservation of birds, plants, fish, and invertebrates such as insects are the goal. Even a few acres can sustain adequate populations of many species of these groups. In addition, efforts should be made to connect the fragments with corridors of naturalized vegetation to reduce isolation.

In many areas, the best candidates for connecting corridors are riverbank, or riparian, ecosystems such as land adjacent to streams that serve as natural pathways for many species. Naturalized riparian zones greatly reduce water pollution by absorbing toxic runoff, serve as habitat for aquatic birds and other species found nowhere else, buffer the area from flooding by absorbing storm waters, and can serve as popular pathways for hikers and bikers.

Individual homeowners can also make substantial contributions to native species preservation. The rapidly growing literature on backyard biodiversity testifies to the importance of biological variety to the quality of life, as well as the biological and economic absurdity of traditional lawn ecosystems.⁹

Grand Illusions

Few homeowners realize that the suburban lawn landscape is historically rooted in a century-old attempt to emulate wealthy European estates. This emulation is so extensive that lawn grass is now the most widespread cultivated plant in the United States, covering an area greater than the state of Pennsylvania. What many homeowners don't understand is that the lawn of an estate was only a small part of a larger picture. European estates also included large forests and farmland that provided game, crops, and livestock for the owners, as well as good habitat for a variety of wildlife.

Biologically, a suburban lawn is an attempt to arrest the natural process of ecological succession. In succession, open spaces created by forest fires and other disturbances become colonized by grasses, which are soon replaced by shrubs and then trees. Similarly, birds adapted to open spaces, such as robins, gradually become replaced by birds adapted to shrubs and trees, such as warblers. The typical American lawn is an enormously expensive attempt to use lawnmowers, weed whackers, pesticides, and herbicides to prevent ecological succession and maintain the yard in a highly disturbed condition that is grossly out of equilibrium with its natural state.

Aside from expense, these lawn ecosystems are bad for native biodiversity. Lawn ecosystems are spatially monotonous, with very few plant species to create spatial diversity of habitat, while later successional stages attract more species because the addition of many shrubs and diverse tree species produces a greater diversity of habitat than is found in lawns. The most common plants in sub-

urban yards are non-native grasses, shrubs, and trees. Such plants as honeysuckle and English ivy can become invasive and displace native species. These non-native plants support a lower number of native bird and other native animal species because natives are not adapted to them.

With increasing awareness of these problems with lawn ecosystems, more suburbanites are finding alternative means of landscaping their yards. Homeowners can provide spatial variation in the vegetation by planting a variety of native shrubs and trees¹⁰ and by reducing or eliminating the area devoted to manicured grasses.

Success Stories

While individual homeowners can make a difference in their own neighborhoods, there is strength in numbers. Perhaps the most effective organization in the United States for promoting conservation in the face of rampant development has been the Nature Conservancy. This group has become adept at working with local officials and businesses, educating the public, and, most important, raising money to buy rare habitats in immediate danger of development. As yet, however, the total acreage being developed remains vastly greater than the increase in acreage protected by such private groups or government agencies.

There are also a few cases where enlightened developers have managed to combine development with conservation of native species. A good example is Spring Island, South Carolina, a 3,000-acre island located off the Atlantic coastline that was targeted for massive commercial development in the mid-1990s.¹¹ Fortunately, the developers, the Spring Island Com-

pany, realized that the relatively pristine nature of the island—including its bobcats, rare songbirds, gray foxes, and rare native plants—might be used to enhance overall value of the development. Careful biological surveys were used to identify key habitats to be preserved in an undeveloped state. As a result, about a third of the island is now set aside as wildlife habitat. Construction of new houses and other commercial developments was generally restricted to previously disturbed areas on the island, such as old farms and homesites.

Perhaps most important, the Spring Island Trust was created from a 1.5 percent fee on all homesites. The fee provides the money needed to maintain the integrity of the wildlife preserves. Rather than leaving maintenance of preserves to homeowners or a hodgepodge of poorly enforced regulations, the trust has established a professional organization that assumes responsibility for preserving habitat on the island.

The developers of Spring Island Trust have been able to charge premium prices for homes and building sites on the island. For example, homesites range in cost from \$250,000 to over a million dollars. While few homeowners can afford such prime real estate, other developers can learn to adopt the basic principles of conservation to more-affordable developments.

Tunnel Vision

Despite the perennially contentious and vehement debate over federal laws on endangered species (see "Unintended Consequences" in this issue of FORUM), the current mass extinction of native species in the United States is actually being driven by the sum of

many policy decisions being made at local levels of city, county, and state government.¹² There has been a clear and undeniable tendency for local policy in most areas to encourage urban sprawl and other forms of land use that are invariably catastrophic to the local native ecosystems.¹³ The cumulative results of this policy are not visible to the policymakers, who focus only on local desires for growth and operate on the assumption that locally extinguished native species will survive elsewhere. If, however, all local policymakers adopt that attitude, such species will eventually become extinct throughout their range.

Short-sighted policies that promote sprawl have huge economic and ecological costs. Many cities now spend millions of dollars practicing restoration ecology, which seeks to rebuild ecology parks, artificial wetlands, and other reconstruction efforts in areas where ecosystems have been destroyed for decades by intensive human activities.¹⁴ It costs much more to restore ecosystems than to preserve them; it would therefore make more economic sense to invest in preserving wildlife habitat that has not yet been destroyed.

Local policymakers need to shake off this tunnel vision. They need to make serious efforts to regulate urban sprawl. Specifically, developers should be required to set aside key habitats, such as wetlands, forests, and prairies in parcels large enough—at least several acres but usually much more—to support a viable population of native species. Public support for such efforts is generally very high, so the major obstacle will be the financial interests of real-estate developers and a few others who profit from ecologically disastrous land-use decisions.

Homeowners can also be educated to promote native biodiversity in their own yards. Experience shows that most homeowners will readily do so because a diversity of native species improves the quality of life for the human inhabitants.■

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NOTES

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12. David Gordon, ed., *Green Cities* (Montreal, Quebec: Black Rose Books, 1990).

13. Jessica B. Wilkinson, "The State Role in Biodiversity Conservation," *Issues in Science and Technology* (Spring 1999), pp. 71-77.

14. Benfield, "Once There Were Greenfields."



Elevating the Amazonian Landscape

In eastern Bolivia, human artifacts include a diverse flora, suggesting that human occupation in the past actually enhanced the landscape of today.

BY WILLIAM BALÉE

The conservation literature, for the most part, indicts a single species for the current deforestation and destruction of Amazonian rainforests. That species, of course, is us. This indictment—which is not just a rhetorical straw man but clearly a widely held view among conservationists, scientists, and lay persons alike—is a scatter shot that unfortunately takes down the innocent and guilty alike before there has been any trial by the evidence.

As a species, *Homo sapiens* displays fundamental sociopolitical variation. It is this variation, and not biological, linguistic, or cultural variations, that is relevant to environmental destruction in

our time. Simply stated, hunting-and-gathering bands, horticultural village societies, and chiefdoms have been less associated with species extinctions and extirpations on continental land masses, such as that of Amazonia—the watershed of the Amazon River—than have states, ancient and modern.

The Roman, Aztec, and Inca empires are examples of archaic states; the United States, Bolivia, and Brazil represent modern states. Archaic states rely mainly on taxation and tribute, whereas modern state economies are manifested by markets, prices, and finances that consistently transcend territorial boundaries. Both archaic and modern states accumulate surpluses, which to some extent have

come historically from unsustainable harvesting of nondomesticated resources and reduction in the variation of crop species in the fields.¹ Ironically, in today's world, it may be up to the state to ensure conservation.

Instinct for Survival

The background rate of species extinctions is merely a constant that reminds us that all life forms are doomed. Above and beyond this constant rate, the fossil record reveals cataclysmic events whereby large numbers of species—sometimes entire genera and suites of species—have perished together. The record of our own minuscule slice of geological time may one day prove to have been another cataclysm of species extinctions. Individual organisms harboring unique, unreplicable DNA, and all their fellow species members that shared the same code, in essence, vanished in these events.

Evolutionary forces alone probably would not have selected for a species that could be mostly or solely responsible for massive extinctions of other species, since one cannot show how species extinctions increase the fitness of individuals from other species. Massive disappearances of entire species, as are presumably occurring in the world's richest biomes—tropical rainforests and coral reefs—seem to bring no fitness advantages to any creatures. If a single species is responsible, that same species exhibits the variation on which natural selection does not act directly, if at all: sociopolitical and economic variation.

Assigning Blame

Some conservationists would not exempt the native peoples from some share of the blame in species

loss. Paleontologist Paul Martin, for example, has made the point, widely accepted by many, that extinction of scores of taxa of megafauna in the Americas coincided with the arrival of the first humans and that their hunting technology was chiefly responsible for a blitzkrieg on those fauna.² That view in a sense blames the entire human species for the modern extinctions that exceed the background rate.

The argument goes that the destruction of other species is a natural artifact of the ingenuity of humans, who make and use destructive weapons. There is also an assumption that humans are indifferent to the survival of other organisms in their environment. But not all human societies can be so easily classified. In fact, recent evidence suggests that the hunting technology of Late Pleistocene people in South America was not geared toward dispatching megafauna anyway. Instead, prehistoric native peoples depended for food on a wide range of resources, including plants, shellfish, and small game animals.³

The native peoples of Amazonia were no exception. Moreover, their social organization was characterized by villages, bands, and sometimes chiefdoms; they never developed a state.

One of the problems in writing about extinctions in Amazonia is the relative paucity of scientific documentation and identification of contemporary taxa of flora and fauna. This paucity is not due to the purposeful neglect of the region but to its proportions. Amazonia is roughly the size of the continental United States and displays extreme richness of species overall, which is sometimes called “beta” diversity.

Though it’s difficult to quantify with precision the rate of extinctions of organisms—since many of these species are endemic to the region, and because the area has such a rich diversity of species—deforestation and habitat conversion in many areas are causing extinctions of organisms above the background rate.

But there are other causes for declines in the diversity of species. In some cases, human population decline has resulted in losses of other species and losses in the varieties of species. Such species, to be sure, were domesticated by humans. That is, they either had their genotypes altered or in some way had become dependent on human technological interventions, including agricultural interventions, for survival. Plant geneticist Charles Clement has presented compelling evidence that the inventory of crops in Amazonia in 1492 stood at 138 species—about half the total of all crops in the Americas at the time. That is a higher number of domesticates than exist in that region today.⁴

Minding the Farm

Though high population densities in some parts of the world have been implicated in the loss of certain species, low population densities can also lead to species loss. The native population in Amazonia numbered in the millions at that time, whereas today it is only about 300,000. The rest of the non-native population of today are the townspeople and city-dwellers, who number in the millions.

Clement shows that genetic erosion has occurred within many domesticated crop species in Amazonia because the genetic variability of these species is quite low. Presumably, when people were

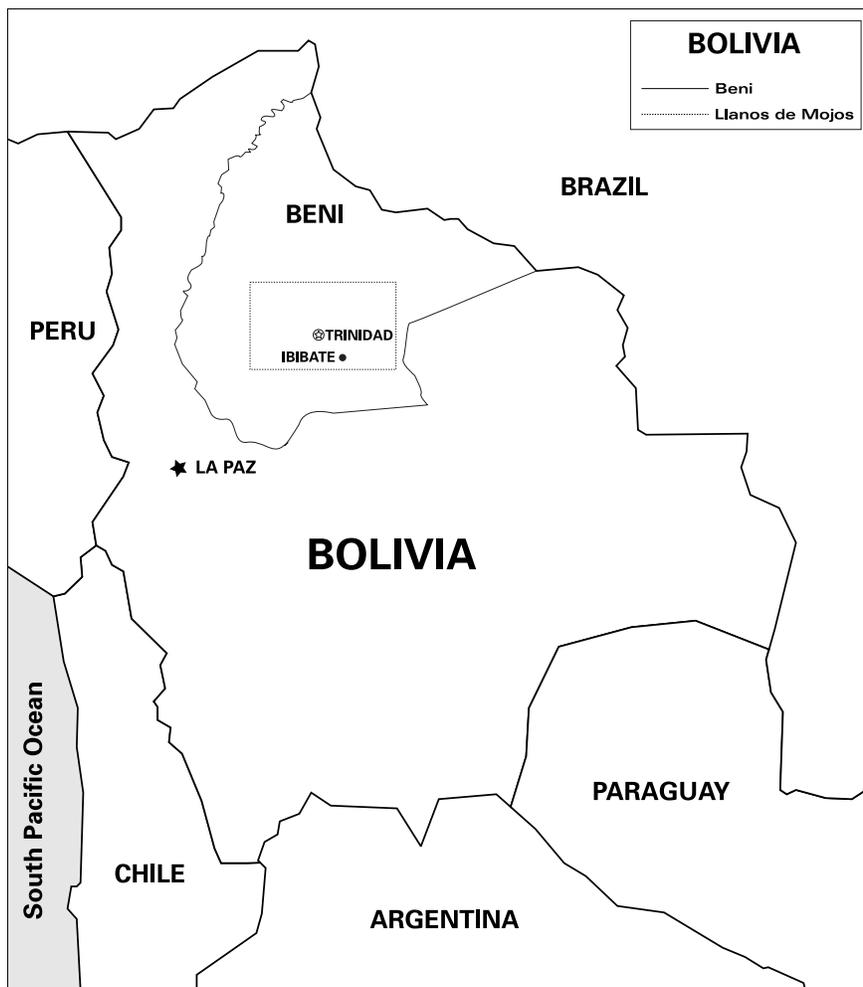
more numerous and their crops more disseminated across the Amazon Basin, variation within crops was also much higher. In many areas, some tree crops, including peach palm, genipapo, and caimito, have reverted to a wild state and, intriguingly, lost some degree of infraspecific variation, that is, variation within a crop. Clement’s point is that the great depopulation of humans in the Americas that followed from contact and the incidental introduction of Old World diseases, to which the native Americans had no acquired immunity, along with an urban revolution that had occurred about 2000 years before European colonization, left too few people to tend the existing diversity of crops that they and their ancestors had, in effect, created.⁵

Prehistoric Amazonian Indians accomplished more than simply domesticating wild species and diversifying genomes within crops. They also created forests where none had existed before.⁶ Evidence suggests that at least 12 percent of the Amazonian forests seems to reflect ancient human influences.⁷ More to the point, some forests are arguably artifacts—like potsherds and other refuse that people make and discard and which show up in the layers of time represented as strata in the ground that archaeologists, as a matter of course, excavate and reconstruct as cultural horizons and traditions. Such cultural forests can be found in the eastern Bolivian Amazon, in a region known as the Llanos de Mojos, or Moxos Plains, in the department of the Beni. (See figure 1.)

Mound Builders

The Llanos de Mojos is about the size of Iowa and reminds me, a native Floridian, of the Everglades,

Figure 1. The Llanos de Mojos where the Ibibate mounds are located within the Beni department.



as it consists of two-thirds wetland savanna and one-third tropical forests that are located in a patchy distribution across the landscape.

Sometime in the first millennium A.D., the native inhabitants of the region began erecting large earthworks scattered across the savanna. Some of these earthworks, which are mounds like the Indian mounds of the Ohio River Valley, were linked to each other by means of causeways that stretched out for miles straight across the savanna.

In the summer of 1993, and off and on until 1997, I undertook a study of the vegetation on one of

these forested mounds. In the Sirionó Indian language, this mound is called Ibibate, meaning “high earth.” The mound is about 18 meters (59 feet) tall according to measurements taken by archaeologist Clark Erickson and his research team from the University of Pennsylvania, who conducted a preliminary survey of the prehistoric cultural characteristics of the mound.⁸ The 2.5 hectare (6-acre) mound is found inside Sirionó Territory, a federally recognized land reserve.

The Sirionó themselves, who number about 600 persons, have evidently lived in the vicinity of

Ibibate for the last several hundred years.⁹

I carried out an inventory of one hectare (2.5 acres) of the forest growing atop Ibibate mound. On this inventory plot grew 448 individual trees four inches or more in diameter; these trees accounted for 55 species in all. In contrast, the surrounding savanna is mostly composed of sedges and grasses of low diversity with an occasional palm or other tree growing on some slight, unusual relief. In other words, the forest grows where the ground is elevated and free or mostly free from seasonal flooding.

The forest grows not because it is on some naturally elevated surface—such as a berm or a hill—but because it is on an earthwork, an artificially constructed mound. There are many such Indian mounds and artificial forest islands found in the Llanos de Mojos, perhaps thousands, according to Erickson.

Some natural elevations above the low-lying savanna do occur. Besides forests growing on old river levees and gallery forests—forests on active river margins—occasional groupings of trees are found on termite mounds in the savanna.¹⁰ But these mounds are small and low in comparison with those built by prehistoric people in the area.

It may be that the mound of Ibibate began as a small complex of termite mounds that was used as a temporary campsite by fisherfolk or hunters. After several such encampments, some refuse may have accumulated, elevating the former termite mound complex even more.

At some point, the site may have seemed appropriate for a more or less sedentary village lifestyle.

Ensuing years of occupation and accumulation of refuse could have built it up higher. Later, people most likely deliberately built the mound up toward the sky, as it terminates in a peak or pinnacle that seems to have been planned, not a haphazard feature.

No rock occurs naturally in the savanna; had there been limestone as there is in such abundance in the lowland Maya area of Yucatán, Mexico, for example, perhaps pyramids would have been built here instead of earthen mounds.

The mound of Ibibate is littered on the surface, and potsherds are found in its stratigraphy; Erickson and his team encountered entire bowls and urns on and near the surface beneath the forest shade.

Since the mound was last occupied by a sedentary prehistoric people, perhaps in the period AD 1200 to 1600, an average precipitation of about 152 centimeters (60 inches) per year there has surely caused erosion. So at one time, the mound of Ibibate was even higher than 18 meters.

Because the mound builders made and used a large quantity of ceramics, as is obvious from casual inspection of the mound today, the geographer Roberto Lanstroth appropriately called Ibibate and mounds like it “ceramic forests.”

The long-time amateur student of the earthworks and causeways of the Llanos de Mojos, Kenneth Lee, told me in 1997—shortly before his death—that the soil composition of a mound he had studied near Ibibate was 13 percent pure ceramics.

Orchard Keepers

For obvious reasons, people do not tend to live in villages covered by large trees. Thus, if the people of

the mound had lived there without the forest cover now apparent, some tract of forest probably remained nearby. Even if they obtained most of their food from agricultural fields,¹¹ they probably also hunted, fished, and gathered nondomesticated fruits from trees in the forest.

But what forest? About one-fifth, or 12, of the 55 species I recorded were fruit trees for the Sirionó people of today and probably were gathered by earlier people also. These trees included genipapo with mildly sweet fruit; a variety of caimito with very sweet, pulpy fruit; several species of palms with edible fruits, one of them with a most desired palm heart, a real delicacy; a kind of mulberry with tart fruit; and hogplum with juicy, acidic fruits rich in vitamins A and C.

What is more significant, though, is that these 12 species accounted for 204, or 46 percent, of the 448 individual trees on the entire plot. In short, the Ibibate forest is an orchard—a cultural forest representing a substantial food resource for modern people, not only in terms of the numerous game animals that take refuge in it today, but because of the abundance of fruit trees.

The ancient people would also have needed firewood. They must have burned up large quantities of wood to fire their ceramics, to cook their food, and to produce enough heat to keep warm from the periodic Antarctic cold fronts, known as surazos, that sweep in from the south bringing the ambient temperature down to the low 40s Fahrenheit, even in the Amazon. I believe they used the lower part of the mound, where it begins to interface with the savanna, as a fruit tree and fuel reserve. In other

words, I suspect the mound was denuded, for the most part, of tree vegetation at its height, where people’s homes would have been located.

At the mound’s base, where it is surrounded by a moat, there was a general declivity toward the wetland savanna. On this declivity today, which is seasonally flooded, there is forest, and many of the species here seem to be the same as those that grow on the mound.

One fruit tree that grows on the mound but apparently not in the savanna is a member of the genus *Sorocea* in the mulberry family; it is called turumbúri by the Sirionó, who use its tart, grape-like fruits for making an intoxicating beverage drunk by all on ceremonial occasions.

My Sirionó consultants report that turumbúri is grown only on the mound. In fact, 20, or about 4 percent, of the 448 trees I sampled were of this species, whereas in another plot of one hectare in the low forest near the savanna that I surveyed in 1997, at the base of the mound, there were no turumbúri trees. In other words, turumbúri most likely does not tolerate flooding, even mild, seasonal flooding.

Perhaps it also has special soil requirements. Whereas the soils of the savanna are poor for agriculture, those of Ibibate are extremely rich in nutrients such as carbon, nitrogen, and phosphorous—essential to plant growth—according to soil samples I had analyzed in Santa Cruz in 1999.

In a sense, the ancient mound builders made a habitat for the growth and expansion of a species that was culturally very useful, at least to the Sirionó people. Whereas the turumbúri trees were probably not planted, as their

seeds are easily dispersed by birds,¹² these trees grow on Ibibate as a result of habitat modification by people in the past.

It is likely that many of the species at the base of the mound would not grow there if the area was not slightly elevated above the surrounding wetland savanna. The trees there, with the notable exception of the absent *Sorocea*, may have existed as a seed source for the forest on Ibibate after the original prehistoric mound builders abandoned it.

The Ibibate forest was arguably the source of fuelwood and fruit trees in the past for the people who lived on the mound; perhaps it served as a kind of forest reserve for that ancient culture.

In any event, by the time the Sirionó ancestors came into and occupied this area, Ibibate and many other mounds like it were covered in tropical forests that from the air seem indistinguishable from primary, or virgin, forests. And the Sirionó, who were traditionally a trekking people but had some agriculture despite their relatively high mobility, seem to have had a minimal impact on the forest cover over Ibibate.

The principal conclusion that can be drawn from this study is that people of the past did create structures—in this case, mounds that resembled enormous elevated platforms above the low-lying, wet savanna—that later accommodated tropical forests, in specific locales where there were no forests before the people were there. Thus, the ancient inhabitants of the Llanos de Mojos were not just mound builders, they were forest builders too. And the people who succeeded them in the savanna did not tend to convert these forest mounds into clear-cut areas for

agriculture and like purposes. Perhaps that could all change, and the forests of eastern Bolivia, as elsewhere in much of Amazonia, could be cut down for whatever economic purpose. My point is that the forests themselves would not be there to cut down today had people not created them in the past.

Human Nature?

The blanket statement that humans alone are responsible for the massive environmental degradation and loss of diversity seen in tropical habitats today needs to be tempered with lessons from history and prehistory. Just because humans alone as a species may be the ultimate agents of decreasing biodiversity in our own time does not mean that it is human nature to cause other species to go extinct.

It is debatable whether the first people in the New World, who arrived at least 12,000 years ago and probably long before that, had any major responsibility for the extinctions of the megafauna that occurred in the Late Pleistocene. The mound builders at Ibibate are at least one example of ancient Native Americans whose activities actually increased biodiversity in specific milieus.

These peoples prove that some sociopolitical systems very unlike our own, industrialized one—whose subjects spoke unwritten languages, lived on high hills above tropical savannas, and had no inkling of Western Europe, Christendom, and market exchange—were not threats to biodiversity, but rather contributed to expanding and maintaining it, wittingly or not.

The accurate assessment of Amazonian diversity, which has the most species in the world in relation to

comparable land masses, can never be completed until the historic, human factors that have also contributed to it have been taken fully into account. Perhaps it is time to recognize that one possible solution to vanishing biodiversity would be to leave Amazon forests in the hands of those who inherited them in the first place. If the state, or any state, did that, it could become a genuine agent of conservation in our time.■

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NOTES

1. Considerable documentation on this process in the Peruvian Andes, both in Inca and post-Inca times, has been provided by geographer Karl S. Zimmerer. See his *Changing Fortunes: Biodiversity and Peasant Livelihood in the Peruvian Andes* (Berkeley, CA: University of California Press, 1996).

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5. Francis Black, "Why Did They Die?" *Science* 258 (1992), pp. 1739-1740.

6. William M. Denevan, "The Pristine Myth," *Annals of the Association of American Geographers* 82(3) (1992), pp. 369-385.

7. William Balée, "The Culture of Amazonian Forests," *Advances in Economic Botany* 7 (1989), pp. 1-21.

8. Clark Erickson, "Archaeological Methods for the Study of Ancient Landscapes of the Llanos de Mojos in the Bolivian Amazon," in Peter W. Stahl, ed., *Archaeology in the Lowland American Tropics* (Cambridge: Cambridge University Press, 1995), pp. 66-95. The mound is connected to another 1.6-hectare (4-acre) mound. The entire complex, including nearby elevated surfaces, trails, and causeways, is about 6-8 hectares (15-20 acres) in extent.

9. William Balée, "The Sirionó of the Llanos de Mojos, Bolivia" in Richard Lee and Richard Daly, eds., *Cambridge Encyclopedia of Hunters and Gatherers* (Cambridge: Cambridge University Press, 1999), pp.105-109.

10. Roberto Langstroth, *Forest Islands in an Amazonian Savanna of Northeastern Bolivia*, Ph.D. dissertation (University of Wisconsin-Madison, 1996).

11. I do not yet know where these fields

were located, but I am rather certain the mound builders were an agricultural and not a hunting-and-gathering people, since other mound builders in the region were associated with the cultivation of a wide array of domesticates, as Clement and Erickson independently have noted.

12. Roberto Langstroth agrees with me on this point as to the likely dispersal agents of *Sorocea*.

Food for Thought



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The Butterfly Effect

When monarch butterflies in a Cornell laboratory died after eating toxic pollen from genetically modified corn, the reverberations were felt around the world. Soon, protestors dressed as butterflies raised the monarch to icon status in the United States.

But the lab study that caused the flap over crops engineered to resist a common pest, the corn borer, is considered by many to be “flawed in its design, unrealistic in its approach, and inadequately explained to the public,” say Tony Shelton and Richard Roush of Cornell University. Scientists, they say, should become more cautious in explaining the significance of their research to a lay audience.

Yet others urge caution of another kind. Martin Teitel with the Council for Responsible Genetics calls for an immediate moratorium on the introduction of genetically altered food—genfood. Only if objective studies find these crops safe to eat, safe for the environment, and economically beneficial to people in the developing as well as the developed countries should genetically altered foodstuffs be reintroduced to the marketplace, Teitel says.

European regulators have already taken a more precautionary approach to assessing the risks and benefits of new tech-

nologies than their American counterparts say Les Levidow and Susan Carr of Open University in the United Kingdom. Swift approval of genetically modified crops in the United States was based on a small number of studies that fell short of providing definitive proof of the crops’ safety. In the United States, value-laden decisions masquerade as “sound science,” while in Europe, the precautionary approach allows for public participation in a deeper discussion of the scientific unknowns, social risks, and legitimate benefits of these new crops.

Moreover, poor farmers in developing nations have little to gain from the large-scale application of genetically engineered crops that require expensive and scarce fertilizer and irrigation. Little research has been directed at the noncereal staple food crops cassava, plantain, sweet potato, taro, sorghum, and millet on which subsistence farmers depend. Genetic engineering to improve yield, nutritional value, and disease resistance in these crops may help close the agricultural divide that leaves much of the world’s population hungry, say Nigel Taylor and Claude Fauquet of the Danforth Center. Improved varieties of subsistence crops will allow farmers to remain independent from the international agricultural market, feed their families, and make a modest profit selling to local markets.

Subsistence farmers rely on local varieties of crops and animals,

which they have traditionally developed through generations of genetic tinkering to be adapted to the peculiarities of the local environment. In southern Africa, for example, Nguni cattle can thrive in tick-infested areas that would be anathema to European cattle. Nevertheless, misguided attempts to improve the lot of farmers in developing countries often include importing semen from select European stock to breed for characteristics valued in commercial agriculture. Such efforts rarely succeed in the long term and threaten the loss of valuable gene pools of hardy local breeds. “The fallacy of unrestricted intensification of agricultural systems as a secure basis for food production is being gradually exposed,” says Lawrence Alderson with the nonprofit organization Rare Breeds International.

Last-ditch efforts to save animal and plant genetic diversity are more than a passing fancy. These genetic time capsules allow consumers in the developed world to savor the distinctive flavor, for example of the White Park cattle knighted by England’s King James I as “Sir Loin.”

For the starving in the developing world, locally adapted, traditional crops may provide the best hope for sustainable agriculture.

The Editors



Pest Control, Rumor Control

Scientists need to be more media savvy if they are to communicate clearly to the public the real meaning of their research.

BY ANTHONY M. SHELTON AND RICHARD T. ROUSH

Certain crop plants such as corn, soybeans, and cotton have been engineered to produce a number of desirable traits, including pest resistance. Some are modified to express proteins of *Bacillus thuringiensis*. Bt bacteria, which occur naturally in the soil, have been used for more than 40 years as an organic insecticide, and their toxic proteins are considered safe to humans and the environment. Nevertheless, these bacteria have only limited use in commercial agriculture compared with other insecticides.

Most farmers simply believe Bt sprays are too costly and ineffective compared with other available synthetic insecticides. When the toxins of Bt are produced in a plant, however, they are far more effective than

even many of the synthetic insecticides. This is the reason Bt plants are now grown on more than 8 million hectares—nearly 20 million acres—in the United States, and their use has reduced the use of insecticides.¹

Bt corn is aimed at controlling the European corn borer, an insect that causes \$1.2 billion in crop damage annually in the United States,

and Bt cotton is aimed at controlling some of the most important pests of cotton in the United States.

Little Bits of Knowledge

In a recent commentary in *Nature Biotechnology*, we discussed three controversial laboratory studies, a small part of the growing body of research on genetically modified

crops. Though only preliminary in nature, these studies elicited a great deal of media attention and led to some misinformation in the public and scientific press. The most controversial study was a short correspondence in the journal *Nature* reporting on the death of monarch butterflies exposed to a toxin in pollen from genetically modified corn.²

To understand how easy it is for the public to misunderstand the significance of such an experiment, consider an analogy to one of William Shakespeare's tragedies, *Henry IV, Part Two*, which begins with a character named Rumor who enters the stage "painted full of tongues."

Rumor's first lines are, "Open your ears, for which of you will stop the vent of hearing when loud Rumor speaks...stuffing the ears of men with false reports." Rumor

then spreads false information about the battle of Shrewsbury and takes particular delight in raising false hopes by announcing Hotspur's triumph when, in fact, he had not only been defeated, but killed. In this play, Shakespeare describes a world in which Rumor creates false appearances that lead to a chaotic series of events.

In our article, we warned that "in many ways, Rumor seems to be playing a similar role in the current debate over the inherent risks of genetically modified plants. And this distortion, however entertaining, is having profound consequences in the real world of science and public policy." Our concerns about three recent studies ranged from questions about the validity of laboratory procedures to how a piece of scientific information could be blown out of proportion in the press.

Butterfly Suits

While activists in Europe were protesting the introduction of genetically modified organisms since the technology was first available, farmers in the United States were adopting Bt crops relatively unnoticed by the public. But in 1999, a controversial study published in the journal *Nature* fueled the flames of controversy over Bt crops in the United States. In this experiment, researchers at Cornell University set out to learn what would happen if the larvae of monarch butterflies ate pollen from Bt corn, which is toxic to the corn borer.

The concern is that pollen from Bt corn may fall on milkweed plants—the host for monarch larvae. Monarch larvae may then eat the pollen and die. To find out,

researchers placed an unspecified dose of pollen from Bt-transgenic corn on milkweed plants in the laboratory and then allowed monarch larvae to feed on the plants. Indeed, the larvae died.

This study attracted an unwarranted amount of coverage in the popular press and widespread rebuttals and criticisms in the sci-

bol of nature. Now, because of one high-profile article that many consider to be flawed in its design, unrealistic in its approach, and inadequately explained to the public, it has become the symbol of activists opposed to genetically modified organisms. After the monarch study hit the press and came under fire, the senior author

While activists in Europe were protesting the introduction of genetically modified organisms, U.S. farmers were quietly adopting Bt crops.

entific literature.³ It also led to a knee-jerk reaction in the public, including an immediate 10-percent drop in the value of the stock of Monsanto, one of the companies that pioneered Bt corn. European activists called for trade restrictions on the export of genetically engineered crops, and environmentalists in the United States called for freezes on further planting of Bt corn in the United States. Fallout generated from this one article continues; in November 1999, rallies against genetically modified organisms were organized in Chicago, where researchers were meeting to discuss recent findings, and the media broadcast images of children dressed up as monarch butterflies and feigning death before a mock ear of Bt corn. Further protests by environmental activists at the Seattle summit of the World Trade Organization essentially shut down that meeting.

Because of its threatened status, amazing migratory habits, and great beauty, the monarch butterfly has long been a powerful sym-

bol of the paper tried to put some balance on the situation by stating, "It would be inappropriate to draw any conclusions about the risk to monarch populations in the field based solely on these initial results."⁴ But by that time, the bell could not be unring: the public was alarmed, and many scientists questioned the ethics of publishing such a study without any field data.

Balance of Nature

It is important for scientists to evaluate studies critically and provide information to help the general public and elected officials who make policy. The central issue is whether the monarch is threatened by pollen from Bt corn. At a November 3, 1999, meeting in Chicago, researchers presented the results of 17 separate studies on monarch butterflies and the potential interaction with Bt corn.⁵ USDA researcher Rich Hellmich, reporting on these findings, discovered that most of the studies indicated Bt corn is not a threat to lepidoptera, including the monarch butterfly.

Entomologist Stuart Weiss agreed, saying a “toxic cloud of pollen” some feared might be a threat to butterfly populations “is clearly not the case.”

While some of those who attended this meeting still cautioned that more work was needed, the evidence clearly indicates that concentrations of Bt pollen high enough to cause damage to mon-

arches occur only one meter—about three feet—or less from the field border. Even more important, the pollen must land on milkweed plants, and these plants do not occur in abundance within or immediately adjacent to corn fields. Milkweed, regarded by farmers as a weed, is normally controlled in the corn by the use of herbicides and cultivation. Its primary habitat is in old fields and along roadsides, not in corn.⁶ This conclusion was further endorsed at a forum of the Entomology Society of America’s annual meeting in December 1999. The general scientific opinion is that destruction of their overwintering habitat in Mexico, not Bt corn pollen, is the real threat to monarch populations.⁷ This species occurs throughout much of the corn area in the United States where it feeds on weeds along roadsides and edges of cultivated fields, in a very similar habitat to that of the monarch butterfly. In this more detailed study, the authors found no relationship between Bt pollen deposition and mortality of the swallowtail larvae. Further discussions

in entomological circles questioned why such differences between the laboratory study in which the pollen dose was not specified and this study in which the pollen dose was quantified and representative of the field, indicate that the laboratory study used what can only be called an excessive and unrealistic dose.

Importance of Genes

Another laboratory study caused a stir among critics of genetically modified crops, but this one focused on the genetics of resistance to Bt toxins. Since this study lacked the visual appeal of a dying butterfly, however, it failed to gain media attention. F. Huang and colleagues at Kansas State University claimed in a 1999 paper in *Science* that the resistance to Bt toxins in the European corn borer was due to a dominant gene.⁸ While this may not raise many eyebrows in the public, it could cause havoc in the agricultural community.

Until the publication of this

study, the general consensus was that resistance was due to a recessive gene. Thus, if a resistant insect survived and bred, its offspring would be resistant regardless of the genetic makeup of its mate. The U.S. Environmental Protection Agency has allowed Bt corn to be grown under a management program geared for recessive, but not dominant, insect-resistance genes. Thus, this very preliminary report by Huang and colleagues led to claims by some people that the EPA strategy was doomed and that a moratorium on the planting of Bt corn should take place. But were the findings real or just another rumor?

Several leading scientists in this area are concerned that the methods the authors used in their study were flawed, and therefore the validity of the conclusions from the experiment is in doubt.⁹ For example, the researchers did not demonstrate that the corn borers could develop fully on Bt corn plants, and in fact a footnote to the article implied they couldn’t. Thus, the critics questioned the results and conclusion of this study.

Another study worth noting involves resistance in the pink bollworm, a pest that causes significant damage to cotton.¹⁰ The study, also published in the journal *Nature*, addressed resistance to Bt cotton in the pink bollworm. The most critical point of this study is that resistance in this pest is recessive, which means that the EPA resistance management plan should work. A secondary finding was that the resistant worms may develop more slowly. The press overlooked or ignored the critical finding that resistance is a recessive trait and latched onto the finding that resistant insects develop more slowly, which may

In areas of intense public interest, there is clearly a danger that the science will be misrepresented to the public and policymakers.

arches occur only one meter—about three feet—or less from the field border. Even more important, the pollen must land on milkweed plants, and these plants do not occur in abundance within or immediately adjacent to corn fields. Milkweed, regarded by farmers as a weed, is normally controlled in the corn by the use of herbicides and cultivation. Its primary habitat is in old fields and along roadsides, not in corn.⁶ This conclusion was further endorsed at a forum of the Entomology Society of America’s annual meeting in December 1999. The general scientific opinion is that destruction of their overwintering habitat in Mexico, not Bt corn pollen, is the real threat to monarch populations.

In a recent paper published in the *Proceedings of the National Academy of Sciences*, researchers conducted a detailed field study to assess whether another highly visible symbol of nature, the black swallowtail butterfly, would be unduly harmed by deposits of Bt corn pollen under field condi-

cause modifications to the EPA resistance management program. Contrary to public perception, the authors did not state that the EPA program doesn't work, only that this asynchrony in development times should be taken into consideration in designing the resistance management program.

The Rumor Mill

Why would researchers publish such laboratory studies in the absence of more detailed field work, or at least—as in the study by Huang and colleagues—on real Bt plants? Scientists understandably want to get their work before their peers as soon as possible. In areas of intense public interest, however, there is clearly a danger that the science will be misrepresented to the public and policymakers.¹¹ Based on the reaction of the public and fellow scientists to the monarch butterfly and European corn borer studies, those of us involved in research on controversial topics had better be doubly sure that we design realistic studies and write and speak cautiously and unambiguously about valid interpretation and limits of our work and the work of others. Training in how to deal with the media may become essential.

Shakespeare's Rumor is often more entertaining than the actual facts. We have to make sure that we don't give him any unwarranted ammo since the public often appears willing to accept uncritically any reports that fit its own perceptions. In a democratic society, it is important that the public "not be so easily swayed by laboratory reports that, when looked at with a critical eye, may not have any reality in the field...or

even the laboratory."¹² We live in a world made smaller by modern communication methods, including email and the Web, and in such a world rumor holds more power than ever before.■

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NOTES

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9. "Science Paper on Bt Resistance in Corn

Borers Challenged," *News Report* (1999) <<http://www.isb.vt.edu/>>.

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11. Just after this article was written, another paper on the effects of Bt corn pollen was published in the European journal, *Oecologia*. It purports to be the first field study that describes the effect of certain Bt corn pollen deposits on milkweed leaves and their effects on larvae of the monarch butterfly. As with the other monarch paper, many scientists are finding serious concerns with the methods, results, conclusions, and discussion sections of this paper, and strong critical evaluations of this paper are rapidly circulating through the scientific community. What is very surprising about the publication of this latest paper in *Oecologia* is that the authors must be aware of the international comprehensive effort on Bt corn pollen and monarchs. The results from the international effort have been discussed at scientific meetings, but the authors of this paper have decided to publish their limited study before publication of the comprehensive study. The data from the comprehensive effort provide information on many of the important questions not addressed in this very cursory study, such as whether natural populations of monarchs are actually exposed to lethal effects of Bt corn pollen in the field. The comprehensive study provides a much more complete and balanced assessment, which indicates that Bt corn does not pose a significant threat to monarch populations as implied in the *Oecologia* paper or as portrayed in some of the press. We believe caution and comprehensiveness should be exercised before publication of scientific data and applaud the international program's efforts and encourage them to publish their data in a timely fashion. For now, many in the scientific community are trying to provide proper balance to another small study that has created unwarranted public attention.

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Unsafe at Any Seed?

Claims that genetically altered foods are better for farmers, consumers, and the environment should be taken with a grain of salt.

BY MARTIN TEITEL

It may be that no major technology in history has been introduced as rapidly—and some would say as recklessly—as genetically engineered food. The speed at which this technological innovation is being developed and marketed bears investigation, since changes that can affect every person on the planet, as well as major portions of our ecosystem, ought to be thoroughly and objectively tested before these new inventions are applied in the real world.

While humans have been selectively breeding plants and animals for 10,000 years, most of this nonengineered agriculture has been evolving slowly and for the most part in the public domain. Genetically modified food, however, has been brought full-tilt into the marketplace in a remark-

ably short time. The first genetically engineered plants were created in 1983. By 1987, only a few short years later, these plants were already being grown in open fields, albeit under the supervision of the U.S. Department of Agriculture.¹ Three years later, plants bred for the commercial market were grown. By 1996, the United States grew 6 million acres of transgenic crops. A year later, the figure was 25 million acres, and in 1998, production more than doubled to 58 million acres, or nearly half of the entire U.S. corn production.²

Today, an American shopper in a local supermarket encounters genetically engineered substances in 60 percent of the food in the store, mostly in processed food but also in some of the fresh produce and dairy products from cows given

genetically modified hormones to increase milk production.³

The swirling debate over genetically engineered crops covers a wide range of issues. Some worry that genetically engineered crops may be less nutritional. Others are concerned about increases in antibiotic resistance, since genetic engineers sometimes use antibiotic-resistant “marker” genes as a way of finding out if their engineering got to the right place in the target organism.

The engineered plant is cultured and exposed to bacteria. If the bacteria die, this indicates that the inserted gene with its marker is present. Foods that contain antibiotic-resistant genes could pass this resistance on to disease-causing bacteria by passing their resistant genes to the naturally occurring bacteria they encounter in the human digestive system, which in turn share the genes with human pathogenic bacteria—a dangerous situation since our greatest weapons against bacterial infections are antibiotics.

Still others are disturbed that the same gene that provides resistance to harmful pests may also kill beneficial or endangered insects, such as monarch butterflies, or interbreed with weeds on adjacent lands and create a new species of superweeds. As real as these concerns may be, perhaps a major, and often underestimated, cause for concern is the rapid pace at which change is occurring long before the potential risks and benefits have been adequately assessed.

Speed Kills

A major reason for caution in this quickly developing technology is the great level of uncertainty involved in genetic engineering. Molecular geneticist Michael Antoniou writes,

The artificial nature of GM [genetic modification] does not make it dangerous. It is the imprecise way in which genes are combined and the unpredictability in how the foreign gene will behave in its new host that results in uncertainty. From a basic genetics perspective, GM possesses an unpredictable component that is far greater than the intended change.⁴

While people the world over have heard of the first cloned sheep, Dolly, many fewer know of the “Dollys” that didn’t survive prior to that successful feat of engineering. These first attempts at cloning produced 270 less fortunate sheep, many of which were deformed, disfigured, stillborn, or unable to mature; likewise genetic engineering techniques create many abnormal plants in the process of obtaining the few that live and function somewhat as intended. The plants that survive genetic recombination can then form the basis of commercial-grade seeds. One visitor to a Monsanto laboratory writes:

The whole operation is performed thousands of times, largely because there is so much uncertainty about the outcome. There’s no way of telling where in the genome the new DNA will land, and if it winds up in the wrong place the new gene won’t be expressed, or will be poorly expressed, or the plant might be a freak. I was struck by how the technology could be astoundingly sophisticated while also being a shot in the genetic dark.⁵

We might be willing to accept repeated failures on the part of industry, even with products that have come to market and then been withdrawn. Some genetically engineered products were withdrawn because they didn’t work as ex-

pected. Some of the problems are acknowledged only after the products are on the market. For example, “Innovator” herbicide-tolerant canola failed to perform consistently, while two other genetically engineered canolas made by Monsanto were withdrawn because of the appearance of an “unexpected” gene. DNA Plant Technology’s “Endless Summer” tomato, which was supposed to have had a longer shelf life, was withdrawn in field trials before it came to market. The most famous biotech plant failure, Calgene’s Flavr Savr tomato—later renamed the MacGregor—not only was a flop with consumers, it also had serious production problems; it failed for both scientific and economic reasons.

Yet the process of genetic recombination is not simply fraught with imprecision and repetitive attempts to produce the desired trait. It also produces a number of unintended side effects. Writer-researcher Brewster Kneen writes,

Genes for the color red placed into petunia flowers not only changed the color of the petals but also decreased fertility and altered the growth of the roots and leaves. Salmon genetically engineered with a growth hormone gene not only grew too big too fast but also turned green.⁶

This problem of unanticipated consequences in genetic engineering of food is not confined to the laboratory. One of the top genfood products is Monsanto’s Roundup Ready soybeans. Company-sponsored tests, accepted by an acquiescent government, showed the soybeans to be safe to bring to market. The U.S. Food and Drug Administration considered these soybeans, which are already in wide use in commercial agricul-

ture, to be “substantially equivalent” to their nonengineered counterparts in terms of nutritional value and toxicity.

Yet tests conducted by the independent environmental organization Center for Ethics and Toxics yielded different results. CETOS tested soybeans that were exactly the same as the engineered soybeans except for one difference, they lacked the gene inserted for resistance to the herbicide Roundup. CETOS found a 12 to 14 percent drop in phytoestrogens, chemicals that are an important nutritional component of soybeans. Among other things, phytoestrogens help prevent women from experiencing bone loss and help protect them from certain cancers. Since no one asserts that the manufacturer of the Roundup Ready soybeans was trying to create less nutritional soy, it seems reasonable to assume that this significant change in the genetically modified beans was an unintended consequence of creating the product. The two soybeans were identical except for the Roundup Ready gene. Thus, subjecting identical plants with one difference to the same test is a scientifically valid way of seeing if that one gene makes a difference.

Losing the Farm

Uncertainties and unanticipated consequences are not confined to the health arena. Consider the uncertain effects of genetic engineering of food crops on small farmers in Southern countries. The genfood industry has repeatedly asserted that its products will feed hungry people in the third world, yet data do not support this claim. Further, there is long-standing evidence that starvation is a function of poverty, poor food distribution,

and the conversion of farmland to other purposes, problems not addressed by genetically altered food products.

People in industrialized countries are so accustomed to seeing pictures of fields tended by gargantuan farm machines they forget that the vast majority of farmers in our world—1.4 billion—are very small producers who feed their families and maybe a few others in their communities. In the world's two most populous countries, China and India, small farming is the norm. What these farms lack in size they make up in diversity. This kind of agriculture involves a great deal of hard work, but it has successfully fed many millions of people for millennia.

Genetically engineered crops threaten the livelihoods and even the lives of millions of these farmers. Small farmers generally have little cash. They grow what they need and they need what they grow. Therefore, the higher cost of genetically engineered seeds, along with added charges like technology fees that the manufacturers claim cover the cost of development of these new products, might be a slight financial factor to a large-scale American soybean farmer but a major expense to a poor peasant in India.

An even greater expense is the cost of the required additional elements in genetically engineered farming. Some engineered crops require a great deal more water, a sometimes scarce commodity in some countries. Worse still, most genfood plants require expensive chemical amendments including fertilizers and pesticides. In one study the kind of monoculture necessary to grow genetically engineered crops required as much as 60 times as much expense in

terms of cash and labor to produce the same amount of food as traditional plant varieties.⁷

It is this huge capital investment mandated by genfood, together with the promise of high yield, that has already caused small farmers in some developing countries to give up their diverse agricultural ways so they can plant every square inch of their land with the biotech crop. Once they sell the crop, they must use the proceeds to pay off the loans they had to take to buy all of the amendments, and use the balance to buy food produced by someone else. If the price for the monoculture crop drops, however, farmers may not have enough money to buy food for their families. If the price drops low enough, as has happened in places like Mexico and India, farmers stand to lose their land and watch their children starve. Is this a model we want to export to subsistence farmers around the world?

As with the health effects of genetically modified foods, which may be less nutritional or could cause allergic reactions in some people, these economic, system-wide consequences of using this new crop are not intended or planned results on the part of the purveyors of the seeds. Rather, they are further examples of unanticipated consequences resulting from the uncertainties of introducing a radical new kind of culture in a very short space of time.

If we are seeing health and systemic economic consequences even at this early stage, it is reasonable to expect that as time goes by we will see even more undesirable results of the extensive use of this new technology. The list of environmental concerns about genetically engineered crops is still be-

ing developed as scientists observe what is happening in the field. A major concern is horizontal gene transfer, the movement of engineered genes into nontarget species, producing “superweeds,” “superbugs,” contamination of nearby organic crops, and possibly other effects as the genes migrate outwards. Other scientists are looking at changes in soil life that are occurring as plants engineered to produce pesticides from their cells, including roots, interact with soil fauna and insects.

In short, genetically engineered food does not cost less, look or taste better, or increase nutrition. It does not help feed the world's starving people, and there are no objectively demonstrated environmental benefits. Furthermore, there are excellent alternatives available. For example, a group of mostly backyard gardeners called the Seed Savers Exchange, based in Iowa, catalogues and preserves public-domain, open-pollinated food-producing seeds.⁸ This nonprofit group's members together stock three times the varieties of seeds offered in all the commercial seed catalogues in North America. This group's efforts show us that even though crop germplasm around the world is threatened with extinction, we still have good seed stocks with which to continue to develop new and improved—but nongenetically engineered—food crops.

Time-out

Genetically altered food is a radical new technology with major uncertainties and unanticipated consequences. These products have been rushed to market with few objective tests for safety and no tests of long-term consequences. This new form of agriculture con-

fers no benefits on consumers. Moreover, good alternatives exist. In view of these facts, prudence would dictate taking steps to reduce risk and ensure health and safety for all. These steps include:

- Immediate labeling of genetically altered food so that consumers can exercise free choice in what they eat and feed to their families.
- An immediate moratorium on the introduction of new genetically engineered crops.
- An immediate moratorium on the marketing of genetically engineered crops in Southern and non-industrialized countries.
- A one-year phase-out period for current genfood crops to give farmers already planting such crops time to find nonengineered seed varieties.

Short and long-term studies are needed, and these should be conducted by researchers, nongovernmental organizations, and government-sponsored scientists who are independent of the industry that is driving the marketing of genetically modified agriculture. When these studies have been completed, an objective commission compris-

ing scientists, farmers, ethicists, and consumer representatives needs to be established. This deliberative body would weigh the information from these objective studies to determine whether genetically altered foodstuffs are safe. Only if they are found safe for public consumption, safe for the environment, and economically beneficial to people in the developing as well as the developed world, should genetically altered foodstuffs be reintroduced.

In the meantime, the world will not starve for lack of traditional foodstock, nor will the public health suffer from eating grains, vegetables, and animal products raised in the traditional ways. ■

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NOTES

1. Martin Teitel and Kimberly A. Wilson, *Genetically Engineered Food: Changing the Nature of Nature* (Rochester, VT: Park Street Press, 1999).

2. *Ibid.*, p. 17.

3. *Boston Globe* (December 31, 1999), p. D4.

4. Michael Antoniou, "GM Foods: Current Tests Are Inadequate Protection," *London Sunday Independent* (February 21, 1999).

5. Michael Pollan, "Playing God in the Garden," *New York Times Sunday Magazine* (October 25, 1998).

6. Brewster Kneen, *Farmageddon: Food and the Culture of Biotechnology* (Gabriola Island, BC: New Society Publishers, 1999), p.206.

7. Vandana Shiva, *Betting on Biodiversity: Why Genetic Engineering Will Not Feed the Hungry*, report (New Delhi: Research Foundation for Science, Technology and Ecology, n.d., p.10; Francesca Bray, "Agriculture for Developing Nations," *Scientific American* (July 1994), pp. 33-35.

8. Seed Savers Exchange, RR3, Box 239, Decora, IA 52101 (319)382-5990 <<http://www.seedsavers.org>>.

9. This article is based on Teitel and Wilson, *Genetically Engineered Food*.



Sound Science or Ideology?

In disputes over genetically modified crops, the demand for “sound science” pre-empts debate on uncertainties about potential harm.

BY LES LEVIDOW AND SUSAN CARR

The controversy over genetically modified organisms in Europe and the United States reveals fundamental differences that have led to trans-Atlantic trade conflicts. There have been national differences and shifts in the criteria for scientific evidence that regulators require.

Genetically modified organisms have become a test case for the conflicting slogans of *sound science* versus the *precautionary principle*. The U.S. framework for genetically modified organisms has been termed risk-based regulation or science-based regulation, an approach that claims to base decisions on scientific evidence. The concept of sound science has been used to assign a weak burden of evidence for safety and a strong burden of evidence for risk, thus

facilitating commercial approval.

Although the term *sound science* is heard in Europe too, it co-exists with the *precautionary principle*, which generally acknowledges uncertainty or ignorance warranting more scientific information prior to decisions. Officially linked to regulation of genetically modified organisms, the precautionary principle has been widely invoked as grounds for delaying approval of many genetically modified crops. Using this more cautious approach, European regulators have cited new evidence of risk or uncertainty, or have requested more evidence of safety.

Some proponents of these crops maintain that precautionary regulation is misguided on several grounds: that it imposes an unrealistic burden of proof for safety, it discriminates against genetically

modified crops, and it ignores the lower risk of such products compared with the agrochemical risks of cultivating their nonmodified counterparts. In their view, precautionary controls are a proxy for issues that have nothing to do with risk, for example trade policy, agricultural production methods, or irrational fears. In short, regulatory delays are attributed to political rather than scientific reasons.

That diagnosis begs some questions. How can sound science be distinguished from unsound science? When research provides new evidence of risk or uncertainty, does the earlier science become unsound, retrospectively? Alternatively, is the new evidence to be discredited as unsound? Can there be an apolitical way of basing decisions upon science?

Starting from such questions, this essay analyzes how risk regulation frames the cause-and-effect uncertainties about potential harm from genetically modified crops. Insect-protected corn serves as a case study to illustrate the environmental issues surrounding genetically modified crops in the United States and Europe.¹

Insect-protected Crops

Since the 1980s, genetically modified organisms have been promoted as environmentally friendly products, while critics have disputed such claims.² Proponents assert that genetically modified crops offer a natural extension of traditional breeding, the ability to control precise genetic changes, and the promise of safe remedies for the problems caused by intensive agriculture. For example, built-in genetic information helps genetically modified crops protect themselves from pests and disease,

thus reducing farmers' dependence upon agrochemicals.³

Critics counter, however, that these crops impose unknown ecological risks, reduce the biodiversity of plant cultivars, drive research and development according to commercial criteria, and promote the further industrialization of agriculture. Such products, critics warn, will aggravate the hazards of intensive agriculture, for example by extending dependence upon agrochemical or genetic solutions, accelerating resistance to plant pests, and thus establishing a genetic treadmill, a scenario similar to the one encountered by farmers dealing with insects that have acquired resistance to chemical pesticides. Some critics argue that sustainability means reorganizing agricultural systems to avoid the monocultural conditions that attract pests and disease in the first place.

Among the earliest genetically modified products were insect-protected crops containing a gene from the bacterium *Bacillus thuringiensis*—Bt—that codes for a protein toxic to some insects. A prime target was the European corn borer, a serious pest in the United States as well as Europe. When the protein is ingested by the larvae of those species, their digestive enzymes cause it to bind to specific receptors on the intestinal lining; the insects soon stop feeding and may die. By producing the toxin continuously, the plant offers long-term protection.

It is precisely that persistence that troubles critics, who highlight two types of risk. First, the widespread use of Bt corn could generate selection pressure for insects resistant to the toxin, thus jeopardizing the benefits of the crop and

perhaps undermining the efficacy of naturally occurring Bt, which is used in organic farming. Second, the insecticidal gene could harm non-target insects, including beneficial ones that prey on the target pest.

Under pressure from public protest and regulatory authorities, companies have devised strategies for insect-resistance management, notably the high-dose/refuge strategy. This strategy calls for planting a crop designed to produce enough toxin to kill nearly all resistant insects; meanwhile, a non-Bt crop planted nearby allows some susceptible insects to survive and breed with resistant ones, thus diluting the resistance gene in subsequent generations. This strategy assumes that Bt resistance is a semirecessive trait; in other words, that heterozygously resistant individuals—insects carrying two different alleles, one resistant and one non-resistant for Bt—will be killed by a high dose.

In regulating Bt corn, the United States and the European Union have devised criteria that overlap in some respects and differ in others. The differences arise partly in response to the different cultural meanings of agriculture. U.S. farms are widely considered to be like factories, sharply demarcated from wilderness and nature conservation areas. Although European agriculture also uses chemical-intensive methods, farmland there is widely regarded as an integral part of the environment: it provides an aesthetic landscape and wildlife habitat, and preserves the local heritage. This explains why protests by environmental nongovernmental organizations have led to a more stringent regulatory approach in Europe than in the United States.

Challenge to "Sound Science"

The U.S. regulatory system for genetically modified organisms was shaped in the 1990s around the slogan *risk-based regulation*. Federal agencies were required to provide strong evidence for risk before regulating these organisms at all. Like the proponents of agricultural biotechnology, regulators adopted the *sound science* slogan, partly to defend their new role from antiregulatory pressures.⁴

Initially, the U.S. Environmental Protection Agency planned to regulate genetically modified microbial pesticides, which would be applied to the crop like a conventional pesticide. EPA did not, however, necessarily plan to regulate plants genetically modified to provide their own resistance to pests. Environmental nongovernmental organizations, however, eventually pressured EPA to regulate insect-resistant plants by extending its authority under the Federal Insecticide, Fungicide, and Rodenticide Act. FIFRA requires EPA to balance the risks against the benefits when approving pest-control agents.

In that vein, EPA officials declared that insect-protected crops would significantly reduce the risks associated with the use of synthetic pesticides. As they also acknowledged, however, the prospect of insect resistance could undermine the longevity of the presumed benefits. The agency eventually accepted the responsibility for preserving the efficacy of Bt as "a public good" through efforts to minimize insect resistance. Moreover, harm to nontarget insects became a prominent issue only after many Bt toxins were approved. For those reasons, the criteria for *sound science* were disputed and changed, as the following story shows.

Tighter Rein

In 1995, EPA approved the genetically modified toxin in three different Bt crops, on successively more stringent terms. For the first, a potato developed by Monsanto, EPA imposed no specific obligations on the company. In response, environmental organizations and organic farming groups issued an action alert, calling on supporters to demand tighter controls. As a result, EPA received several hundred letters criticizing it for prematurely allowing the commercialization of the Bt potato and thus potentially undermining the effectiveness of microbial Bt, which organic farmers had been using for decades.

This campaign led the agency to adopt a more stringent approach in subsequent applications for commercializing Bt corn. EPA officials mentioned several grounds for this policy shift. The corn earworm is also the cotton bollworm, so resistance in cornfields could affect cotton too. A program of insect-resistance management was necessary to preserve the efficacy of Bt foliar sprays as well as that of the Bt crop itself. EPA required close monitoring of the plant pesticide to determine if resistance is developing, that is, to determine if there were any surviving pests.

Mishaps with Bt crops soon reinforced doubts about their long-term benefits. In July 1996, Monsanto's Bt cotton succumbed to bollworm in some southern states. The management plan had presumed that a high dose would kill virtually all the target pests, so critics questioned whether this Bt cotton had adequate toxin to delay resistance. A leading entomologist argued that the bollworm is less sensitive to the Bt toxin than are other pests, "so it is mis-

leading to use this cotton in a high-dose/refuge approach." To prevent resistance in the corn earworm and thus preserve the Bt toxin, EPA soon restricted the cultivation of Bt corn in the South.⁵

The argument over insect-resistant management strategies became more contentious as scientific evidence accumulated and the debate intensified. At first, Bt resistance was thought to be a semi-recessive trait, which would make resistance unlikely to develop since offspring of any surviving insects would not express the trait. But resistance was found to be a dominant trait in some insects, so resistance could spread more rapidly in target insects.⁶ Some insect pests were found to develop resistance to four different types of Bt, all located in a single gene.⁷ Citing this cross-resistance, experts questioned the contingency plan of substituting alternative Bt genes if insects developed resistance to the initial one.

Consequently, EPA advisors recommended tightening the insect-resistance management strategies, and nongovernmental organizations publicized these arguments.⁸ In May 1998, EPA's Scientific Advisory Panel recommended even stricter requirements for refuges. Heeding that advice, EPA tightened its controls in granting further authorizations for Bt corn. It mandated that non-Bt refuges should occupy a larger proportion of fields than before. Soon, some companies were also promoting the larger refuges.

The guidelines for insect-resistant management measures were widely promoted as being based on sound science. However, their acceptance had a reverse logic. Industry became more cautious in responding to public and regula-

tory pressures. In practice, "sound science" was defined by that more cautious view, which was formalized by regulators.

Monarch Studies Disputed

For evaluating harm to nontarget insects, the original safety claims prevailed until new research undermined the official basis of "sound science" in 1999. Initially, the U.S. public engaged in little debate on this risk, mainly because environmental nongovernmental organizations had given priority to demands for insect-resistant management, rather than for protecting non-target insects. Then, a laboratory study conducted at Cornell University indicated that monarch butterfly larvae were harmed by feeding on milkweed that had been dusted with genetically modified Bt corn pollen.⁹ The official risk assessment by EPA had ignored this potential pathway for harm to nontarget species. The Environmental Defense Fund then petitioned EPA to require farmers to plant buffer zones around Bt corn, mainly to protect the monarch butterfly.¹⁰

In response, many scientists criticized the Cornell experimental design and its findings. The chief regulatory officer at Novartis, a leading producer of genetically modified Bt seed, claimed that force-feeding Bt to monarch larvae does not represent reality in the field, where insects might avoid Bt-coated leaves in favor of other leaves.¹¹ The chief scientist for Bt corn at Monsanto announced that Bt toxin in pollen is below 0.1 parts per million, a level too low to kill cornborers, so monarch larvae should not be affected in the field.¹²

The public debate drew attention to a field study previously

done at Iowa State University. Leaf samples taken from within and at the edge of the corn field were used to assess mortality of monarch larvae exposed at the first instar stage of development to Bt or non-Bt corn pollen. "Within 48 hours, there was 19 percent mortality in the Bt corn pollen treatment, as compared to 0 percent on non-Bt corn pollen exposed plants and 3 percent in the no-pollen controls."¹³

Although the Iowa researchers studied real-world conditions in the field, their results drew skeptical interpretations. For example, entomologists Anthony Shelton and Richard Rouse argued that "pollen levels were highest within the field—where monarchs are scarce—but even there, monarch mortality was only 16 percent."¹⁴ (See "Pest Control, Rumor Control" in this issue of FORUM.) An industry spokesperson emphasized that the monarch butterfly is not an endangered species, thus implying that considerable harm would be acceptable.

A frequent argument for Bt corn is that it will significantly reduce the amount of pesticide sprayed and thus be better for the environment. This argument rests upon two dubious assumptions: that non-Bt corn otherwise would be sprayed with insecticides, and that Bt corn will eliminate the need for spraying. But not all corn fields are sprayed with insecticides.¹⁵ Even before Bt corn existed, only 20 percent of U.S. corn fields were sprayed with chemical insecticides, partly because the treatments are not very effective. So, realistically, that fraction should be compared with the 30 percent of corn fields now planted in corn expressing the Bt toxin. Eventually, perhaps half of all corn crops will be planted in Bt corn;

that is, crops of Bt corn could become far more widespread than the use of agrochemical pesticides. Yet proponents of Bt corn exaggerate present-day insecticide spraying by citing chemical-intensive methods as an environmental standard for comparison. Thus "sound science depends on an unsubstantiated comparison with non-GM maize.

European Precaution

The statutory basis for regulating genetically modified organisms in the European Community is the 1990 Deliberate Release Directive 90/220, which was intended to provide "a high level of protection for the environment and human health," and to "establish harmonized procedures and criteria" for Europe-wide market approval of GM products.¹⁶ Although the directive was called *preventive*, the term implicitly meant *precautionary*. After mass protests occurred in the late 1990s, European governments imposed further controls on genetically modified crops at the national level after they had already gained Europe-wide market approval.¹⁷

In 1994, for example, Ciba-Geigy submitted a marketing application for a Bt corn to the French authorities, which accepted the company's safety claim, thereby making France the advocate of Europe-wide market approval. Member states raised questions not only about the Bt gene but also about the two marker genes that were used to identify the plant at the laboratory stage. One of these marker genes conferred resistance to the antibiotic ampicillin. Critics warned that antibiotic resistance could spread from unprocessed food or animal feed to gut pathogens in humans and animals

alike, thus undermining the clinical efficacy of this antibiotic.

Despite objections from most countries, the European Commission approved the application under Directive 90/220. In doing so, it accepted safety advice on the ampicillin-resistance gene from a Europe-level scientific committee. It also accepted the French authorities' judgment that the emergence of insect resistance "cannot be considered an adverse environmental effect, as existing agricultural means of controlling such resistant species of insects will still be available."¹⁸ Insect resistance was deemed an agricultural problem, not an environmental threat. In effect, the Bt toxins would be treated as dispensable, ultimately replaceable by chemical insecticides.

By 1998, however, there was an intense public controversy over genetically modified crops in France. After gaining approval throughout the European Union, Ciba-Geigy's Bt corn encountered further delays under the National List procedure, which requires registration for any new crop variety. In February 1998, the French government finally registered the Bt corn produced by Ciba-Geigy, which by then had merged into Novartis. In an unusual move, the registration was granted for only three years and required monitoring for various environmental effects, including the efficacy of the Bt toxin, insects' resistance to it, harm to non-target insects, and spread of the ampicillin-resistance gene. Spain imposed similar requirements on the Bt corn, along with a general monitoring requirement for all GM crops listed in the future.

Some regulators pressed for further research to inform insect-re-

sistant management strategies. Meaningful laboratory testing depends on knowing the previous level of Bt susceptibility in the insect population, so Novartis commissioned entomologists at the University of Milan to establish a baseline. The refuge design required in the management plan depends on assumptions about the distance traveled by insects to feed and breed, so biotechnology companies also contracted with entomologists to study these behaviors.

Commercial cultivation in France was still criticized by environmental nongovernmental organizations. Nevertheless, some representatives accepted a government invitation to participate in a biovigilance committee, to evaluate the monitoring methods for all risks. The government likewise included critics of genetically modified crops when choosing its advisory committee on genetically modified products.¹⁹

Lacewing Studies Disputed

Potential harm to nontarget insects became an issue early on in the European regulatory procedure. Critics challenged the safety inferences being drawn from available knowledge.

When requesting approval of Bt corn from the European Union, company applications cited field surveys of potential harm to beneficial insects that found no fewer beneficial insects in Bt-crop fields than in non-Bt fields. Companies also cited laboratory tests of microbial Bt on several insect species, which showed no evidence of harm.

Critics proposed that the applicant redo the tests with a larger number of beneficial insect species, using Bt of the type produced by the Bt plant instead. Subse-

quent tests used microbe-derived Bt of the same type that is inserted into crops.²⁰ Other tests used pollen from Bt plants, with the conclusion that the pollen “does not have acute toxin effects on three prominent predators found in corn.”²¹

Those laboratory tests used carnivorous insects such as the lacewing, which is known to prey especially on aphids in corn fields. After lacewing larvae were fed moth eggs coated with a Bt concentration for seven days, the larvae showed no adverse effects.²² However, lacewings in the field normally suck out the contents of eggs, rather than ingest the eggshells. Also the seven-day test does not replicate the 30-day life cycle of the larvae. Despite the unrealistic experimental conditions, the test method was not challenged at that time.

An alternative and more methodologically complicated test method is a tri-trophic study, which involves the plant, a pest, and a predator species. In a Swiss study, lacewing larvae ate cornborers that had been fed Bt or non-Bt leaves. Larvae that ate Bt leaves had a lower survival rate and slower development. According to the researchers, the reduced fitness was directly associated with the Bt toxin, while the prolonged development time was caused by both the Bt exposure and a nutritional deficiency from eating sick prey. If predators were harmed in Bt corn fields, the researchers argued, then farmers would lose a useful means of controlling Bt-resistant insects.²³

There ensued further debate over the appropriate methods for testing cause-and-effect scenarios along the insect food chain. The Swiss experimental design was

criticized as unrealistic, for example, because lacewings normally eat aphids rather than cornborers. However, aphids feed on the nutritious phloem in corn stems, where Bt was not reliably known to be expressed; consequently, Bt-fed aphids would not necessarily provide a more realistic test than other prey.²⁴

In evaluating all these experimental trials, double standards were applied. At least initially, few regulators questioned whether microbial Bt provides a realistic test of harm to nontarget species from Bt corn. When that method came under criticism, regulators failed to question the adequacy of the eggshell-coat method or a seven-day exposure period.

In the regulatory procedure, double standards were also applied when evaluating mortality rates. The European Union’s Scientific Committee on Plants raised methodological doubts about the Swiss study, especially the high mortality of the control insects that ate non-Bt corn. However, control insects have had even higher mortality rates in other laboratory studies. In one such study, moreover, the Bt-exposed insects had 17 percent higher mortality than the controls, yet the researchers reported “no significant difference,” thus implying evidence of safety.²⁵ Neither their interpretation nor their experimental method was challenged. Thus a study convenient for safety claims escaped scrutiny, even though it warranted even stronger criticism than that directed at the Swiss study.

As in the United States, also at issue is the appropriate baseline for comparison between genetically modified crops and those that are not modified. The Scientific Committee on Plants argued that any

harm to nontarget insects would be less than the present harm from chemical insecticides.²⁶ In other words, the committee accepted the present effects of chemical-intensive agricultural methods as the baseline for evaluating the potential effects of genetically modified crops—even though not all corn is sprayed with chemical insecticides.

Further debate ensued over the predictability and acceptability of harm to nontarget species. These arguments came to a head with the widespread publicity over the results of the Cornell study of monarch butterflies.²⁷ In response, the European Commission delayed approval of a Bt corn from Pioneer Hi-Bred in mid-1999; no additional genetically modified crops have been approved to date. In bending to political pressures by opponents of these crops, the authorities could cite test results whose design was no less realistic than the earlier “sound science” underpinning safety claims.

Ideology of “Sound Science”

As these instances of scientific studies show, their interpretation depends upon various sociopolitical influences. Risk regulation makes judgments about what environment must be protected, what uncertainties matter for risk assessment, what research is needed to clarify them, and what counts as meaningful evidence. For genetically modified crops, the *sound science* slogan has tended to restrict and conceal such political judgments, while the *precautionary principle* has tended to open them up.

In early decisions to approve Bt corn, the United States and European Union procedures framed the risk issues within the model of in-

tensive agriculture. Both accepted the inevitability of a genetic-pesticide treadmill, as if Bt toxins were dispensable and could be replaced by other pesticides. Harm to nontarget species was deemed implausible. And superficial laboratory tests were accepted as evidence of safety.

Public protest led to a change in this initial framing. The protest stimulated further scientific research on cause-and-effect uncertainties that had been previously neglected. As a result, the risk debate stimulated new bodies of knowledge, rather than simply shifting the burden of evidence within existing knowledge.

For example, new research has undermined optimistic cause-and-effect models of Bt resistance mechanisms and of available alternative genes. Under public pressure, regulators adopted more stringent measures for insect resistance management. In both the United States and Europe, these changes also offered some opportunity for public participation, for example in evaluating the environmental monitoring methods and norms of acceptable effects.

For potential harm to nontarget insects, however, new evidence of risk has been disparaged as unsound, for example, the monarch and tri-trophic lacewing studies. Such evidence has been criticized on various grounds—for example, that the studies impose unrealistic experimental conditions, or that the data have statistical anomalies. Such criticisms could apply just as well to evidence of safety. Yet some regulators selectively accepted the evidence of safety. Thus double standards have served to protect claims that genetically modified crops are safe.

Moreover, some proponents of

these crops have implied that any plausible harm would be acceptable, for example by favorably comparing the harm from Bt corn to that from the use of agricultural chemicals. Such arguments are promoted as if they were purely technical comparisons. Yet it presumes a specific vision of future agriculture as a socially acceptable framework for technical evidence.

In sum, the slogan *sound science* tends to conceal value-laden features of safety claims, their weak scientific basis, their normative framing, and their sociopolitical influences. Those who demand regulatory decisions based on sound science are in fact promoting an ideology, which represents political decisions as “science.” In so doing, their slogan preempts debate on how science could or should clarify the cause-and-effect uncertainties of potential harm. By contrast a precautionary approach can more readily identify scientific unknowns, while acknowledging the agricultural and environmental values that inform risk assessment. The choice is not between science and politics, but rather between ways of linking them. ■

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NOTES

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Biotechnology's Greatest Challenge

Can the great potentials of biotechnology ensure food security and economic development in the developing world?

BY NIGEL J. TAYLOR AND CLAUDE M. FAUQUET

The human race recently passed two milestones that captured brief international press coverage. Late in 1999, the world's population passed the 6 billion mark, having doubled in only 40 years, and just a few months later, India's billionth citizen was born. These milestones drew public attention to an issue of international importance: continued population growth and the threat this growth poses for global food security and Earth's ecosystems.

Presently, 80 percent of the world's population resides in developing countries. Despite declining birth rates, the world populations will continue to rise, reaching between 8 and 10 billion

people by the year 2050. Almost all this increase will occur in the developing countries, where population density is expected to nearly double from approximately 55 people per square kilometer (142 persons per square mile) at present, to 90 to 100 people per square kilometer (260 per square mile) by 2050.¹

These statistics highlight a reality that may constitute the single most important challenge facing humankind for the coming decades: how can all the world's citizens be assured access to food supplies, health, and economic well-being, and how can these people be sustained without destruction of the remaining forest and wilderness regions?

Malthusian Optimism

The Declaration of Human Rights, Article 25 (1), states that "everyone has the right to a standard of living adequate for health and well-being for himself and of his family, adequate food, clothing, housing and medical care...." Despite these idealistic words, the Food and Agricultural Organization (FAO) of the United Nations recently estimated that approximately 800 million people in the developing world do not have enough to eat. A population equivalent to North America and Western Europe combined does not have access to sufficient food to maintain body weight and perform light activities such as preparing food, caring for family members, or attaining employment. Children suffer most from undernutrition, which leaves them susceptible to disease and hinders their full physical or mental development.

Surprisingly, that figure is viewed as a partial success. It actually represents a drop in real numbers and a significant reduction since the early 1970s in the percentage of the population in developing countries that suffers malnutrition. Nevertheless, the rate of progress in addressing food insecurity in the developing countries is below that set at the World Food Summit in 1996, which demands that 20 million people per year be removed from the trap of persistent hunger. Regional inconsistencies are also cause for concern. While some regions have seen significant improvements, sub-Saharan Africa is regressing, with the actual number of Africans suffering from insufficient nutritional intake increasing since 1992.²

Present and future access to sufficient food depends not just on

increasing crop yields—the so-called Malthusian optimism—but is dependent on a complex interaction of factors. The most important of these are the price and availability of agricultural products, access to employment, and the income or purchasing power of any given individual. These in turn are determined by large and small-scale economic factors, international trade policies, and uncontrollable parameters such as weather patterns. Some commentators in the industrialized North currently believe there is enough food in the world and that it just needs to be distributed better. That, in our opinion, is dangerously misleading. It is a delusion to seriously consider that the surpluses of the North can or will be sustained indefinitely to feed present and future populations in the South.

Market Forces

Agriculture is the foundation of human nutrition and health and the major economic activity in most developing countries. Reliance on subsidized food imports from the North would undermine the stability and integrity of one of the most important systems of generating wealth in the tropical and subtropical regions. Furthermore, assuming that donations of agricultural commodities can cure hunger in developing countries distracts from the central issue, which is how and where must investment be made to ensure that developing countries can support their own populations. Even in regions where access to food is not a problem, increasing yields from staple crops frees land, time, and resources for small farmers to invest in cash crops or other income-generating activities. While im-

proving crop production in the developing countries will not by itself mean an end to poverty or malnutrition, it will be an essential contributing factor for ensuring the future well-being of the vast majority of the world's population.

It is estimated that keeping pace with growing demand will require a 70 percent increase in agricultural productivity by the year 2025. The scale and urgency of the situation is compounded by several factors. Increased crop production in the developing countries has traditionally been achieved by bringing more land under cultivation. For example, the area committed to cultivation of the tropical root crop cassava has increased 43 percent since 1970, while production per hectare has risen by only 20 percent over the same time. Carving out new cropland from desert or rain forest is not a sustainable or desirable practice and will result in severe depletion of the world's remaining natural ecosystems. Indeed, most of the world's high-quality farmland is already under cultivation, especially in Asia, where land and population pressure is greatest. In some regions the amount of available farmland is actually decreasing as prime agricultural areas are lost to urban sprawl, soil erosion, and desertification. In addition, the tropical and subtropical regions contain approximately 80 percent of the world's biodiversity. Loss of this resource to unchecked expansion of agriculture would have disastrous consequences for future crop improvement and pharmaceutical discoveries.

Demographic transitions within the developing countries add another twist to the overall picture. Throughout the developing countries, migration to urban areas is

increasing dramatically. In the coming decades, the FAO predicts that rural populations will remain roughly at present levels, and more than 90 percent of population growth will take place in the burgeoning cities of the developing countries.³ Thus, significant changes are occurring in the types of demand placed on agricultural systems in the developing countries. The major market for agricultural products will clearly be in the cities. Supplying this growing demand in a consistent manner requires transportation infrastructure, storage facilities, and post-harvest technologies that are underdeveloped in many tropical countries.

It is clear, therefore, that significantly increased production from the agricultural systems of the developing countries must be generated and sustained over the coming decades and that this must be attained largely from the land already under cultivation. Achieving these aims on the scales required is a daunting prospect.

Improving Yields

Over the last 30 years the practices of the Green Revolution have helped achieve higher crop yields. In this strategy a combination of plant breeding, agrochemical applications, and irrigation is used to maximize yields in the cereal crops, especially rice and wheat. By most assessments, this has been a measurable success, leading to a 130 percent increase in wheat yields in the developing countries since 1970.⁴ Over the same period, food prices have fallen on international markets, and the proportion of chronically undernourished people has declined significantly. These agricultural practices have allowed India, the world's second-

largest and fastest-growing country, to greatly increase its food self-sufficiency, reduce its financial commitment for food imports, and curb destruction of its natural habitats.

There are also, however, a number of acknowledged negative aspects to the Green Revolution. Reliance on agrochemicals is environmentally damaging, and overuse of irrigation has resulted in loss of soil fertility and consequent reductions in yields in some regions. In addition, the majority of small, resource-poor farmers, who still constitute 75 percent of the land users in developing countries, cannot afford to purchase the required chemicals. The major beneficiaries of the Green Revolution have therefore been the larger land owners, whose increased affluence has resulted in even greater divisions between the rich and poor in the developing countries.

Another shortcoming of the Green Revolution was its emphasis primarily on rice and wheat and a failure to address many of the most important food crops of the tropical and subtropical regions. These noncereal staple food crops have received relatively insignificant research investment over the last 50 years and as a consequence have not attained comparable improvements in yield. Known as orphan crops, these include cassava, the plantain and cooking bananas, sweet potato, taro, sorghum, and millet. Yield increases for these crops lag significantly behind rice, wheat and maize.

For example, for plantain, the fourth most important source of calories in the tropics, yields have improved by a total of only 3 percent over the last 30 years. Hundreds of millions of small farmers cultivate these orphan crops, rely-

ing on them as their primary source of calories and as a source of income when traded in local markets. Billions more will rely on them in the coming decades.

Biotechnology: Doubly Green?

Since the mid-1990s, evidence has accumulated that annual increases in rice and wheat yields are declining, indicating that the strategies of the Green Revolution are nearing their limits and will not by themselves provide the increases in crop production required to supply future demands.

Scientists, agronomists, and policymakers have been looking for the next revolution in agriculture. This has optimistically been termed the doubly green revolution, which, it is hoped, will boost crop yields with minimum impact on the environment and will benefit the small farmer as well as the larger commercial producer. For many, it is biotechnology—the application of DNA or gene technologies for the agronomic improvement of crop plants—that holds this promise.

Genetic engineering is the best known and possibly the most powerful of these techniques, holding great promise for improving crop yields and the quality and value of agriculture products. Biotechnology allows the DNA, the genetic code imparting a specific trait—for example, resistance to a disease infection or drought—to be identified and isolated from a given organism. Once reduced to a few microliters of sticky fluid, this genetic material can be adjusted as required and introduced into the cells of a given plant to become an integral component of the crop's genetic makeup. As a result, this new transgenic plant acquires the beneficial trait coded

by the introduced genetic material and passes the novel characteristic to its offspring.

The great power of this technology lies in its ability to take genes from any given organism and insert them into crop plants. This capability is rooted in the biological reality that the genetic codes, or genes, for all living organisms are organized in a similar manner and can, with minimal changes, be made to operate in a nonnative genetic background. It is possible, therefore, to transfer genetic information from algae, bacteria, viruses, or animals to plants, or to move genes between sexually incompatible plants species. For example, certain genes isolated from viruses, when inserted into the plant's genome and expressed by the plant, impart resistance to that virus. Crop plants can be engineered to produce their own pesticides, to have resistance to previously toxic chemicals, to be resistant to disease, or to have higher nutritional qualities.

Technical advances over the last five years have pushed plant genetic engineering into new areas by demonstrating the possibility to simultaneously transfer as many as 12 genes into a plant genome.⁵ This greatly enhances the potential to engineer complex disease and pest-resistance pathways to produce more-robust crop plants. Biosynthetic pathways can also be manipulated to produce high-value pharmaceuticals and other chemical compounds within the plant tissues. These are then available for direct consumption or for subsequent extraction on commercial scales. A recent example of this application is the expression of the human growth hormone somatotropin in genetically engineered tobacco plants. Production in this

manner should reduce the costs of pharmaceuticals, bringing medical treatments within the economic reach of more people in the industrialized and developing countries. The ability to transfer beneficial agronomic traits across species boundaries, within and outside the plant kingdom, opens a multitude of possibilities limited only by our imagination and by ethical and certain biosafety considerations. If handled in a responsible manner, biotechnology represents a revolution with immense potential impact for the well-being of mankind.⁶

The greatest need for improved crop production lies in the developing countries. A major challenge is to ensure that the huge potential of biotechnology benefits those who need it the most: small farmers in the developing countries and the people they feed.

Recent advances in scientific research and proven performance of genetically modified crop plants in the field suggest that this new technology could be applied to increase food production in the developing countries. However, harnessing biotechnology to enhance food security and economic development in these countries is problematic. Working with poorly understood tropical and subtropical crop species certainly provides challenges, but the major obstacles to applying biotechnology that fits the needs of developing countries are less biological in nature and more economic and political.

The rapid adoption of the first generation of transgenic crop plants in the industrialized North represents the most successful application of a new technology in the history of agriculture. Trans-

genic crop plantings have risen from zero in 1995 to 39.9 million hectares, almost 100 million acres, in 1999. In just one year, between 1998 and 1999, the area committed to transgenic crops increased by 44 percent. Slightly more than 50 percent of this area consists of soybeans genetically engineered with a bacterial gene that imparts resistance to the herbicide glyphosate. Nineteen percent is maize engineered to be resistant to European stem borer, an insect that is difficult to control by conventional methods and can cause widespread yield losses in this crop. The remainder is composed of cotton, canola, potato, squash, and papaya containing transgenic genes resistant to herbicides or viral diseases. The present market for transgenic crops is estimated at \$2.3 billion per year but is pro-

ILTAB: SMALL PLAYER IN A BIGGER PICTURE

The International Laboratory for Tropical Agricultural Biotechnology (ILTAB) is one of a relatively small number of research organizations dedicated to applying biotechnology for the improvement of tropical subsistence crops. Based at the Donald Danforth Plant Science Center in St. Louis, Missouri, ILTAB is located within a center of research excellence. This provides ILTAB with immediate access to cutting edge science, allowing new technologies to be applied to tropical crops in a manner otherwise difficult to achieve. Activities at ILTAB are directed towards three major scientific areas to advance the application of agricultural biotechnology for tropical crop improvement. These include:

- **Basic research** to discover genes with potential benefits for tropical agriculture, including research into the causes and controls of the plant viral diseases that severely reduce crops yields in the developing countries;
- **Development of genetic engineering technologies** required to insert genes into tropical crop plants; and

- **Technology transfer** from industrialized plant species to the orphan crops and from developed countries to developing countries.

ILTAB has made contributions both to the technical and training aspects of tropical crop biotechnology. In addition to developing transgenic rice containing the *Xa 21* gene, ILTAB has developed efficient genetic engineering protocols for *indica* and *japonica* rice; produced rice plants genetically engineered for resistance to rice tungro disease, one of the most severe viral diseases of that crop, now being tested in Malaysia; recovered the first genetically transformed cassava plants; and produced rice plants genetically engineered with 12 transgenes. Most recently, significant progress has been made at ILTAB towards producing cassava plants resistant to African cassava mosaic disease, a complex of virus infections responsible for the loss of millions of tons of food each year on that continent.

Technology transfer is a significant component of

jected to reach \$25 billion by 2010.⁷

Currently, genetically engineered crops are cultivated mostly in North America, with the United States and Canada harvesting 72 percent of the planted acreage. Yield improvements have not been dramatic, but these first generation transgenic crops were designed primarily to improve pest and weed control and to reduce requirements for agrochemical applications. To this end, their success has been dramatic. Monsanto Company claims that 2 million gallons of pesticide applications have been saved in the four seasons since the introduction of corn and cotton expressing a gene from the bacterium *Bacillus thuringiensis*. When expressed by the plant, this gene produces a protein toxic to insects eating the plant tissues but

is completely nontoxic to the human consumer.

In the developing world this first generation of transgenic crops has had less impact, in part because these products were conceived, developed, and marketed specifically for release within the economic realities of the industrialized countries, not to address the requirements of developing countries. Nevertheless, enthusiastic adoption of transgenic maize and soybean by farmers in countries such as Argentina, China, Mexico, and South Africa show that they can be of relevance in at least some scenarios. Eighteen percent of all transgenic crops worldwide were planted in developing countries in 1999. Argentina, for example, committed 90 percent of its soybean crop to genetically transformed plants last year.

Targeting Small Farmers

The developing countries will likely continue to benefit from crop biotechnologies developed in the North. For example, India will start cultivating transgenic cotton in the near future. However, as noted above, transgenic crop development has been restricted to a few commercial species grown on a large scale and to date has not been applied to the tropical and subtropical food crops that sustain local and regional communities within the developing countries. Using biotechnology to sustain food security requires targeting the specific needs of small farmers in the tropical and subtropical regions, where small-scale and subsistence farmers still constitute the majority of the land users.⁸

To have an impact on world health, we must direct resources

ILTAB's missions. These activities include training scientists from the South and providing them with the tools, equipment, and expertise required to generate indigenous capacity for biotechnology research and development in the developing countries. A number of research institutes within the developing countries, most notably the larger research centers of the Consultative Group on International Agricultural Research (CGIAR), are well equipped to carry out biotechnology research and its development on tropical crops. However, increasing this capacity is essential for the successful application of biotechnology in the developing countries.

For the near future it is likely that most genetically engineered plants will be developed and produced in the advanced laboratories of the North and transported to the developing countries for field testing and evaluation.⁶ However, it is important that these countries do not purely become recipients of finished products, but instead participate fully in applying these technologies to their food and cash crops. Each developing country, and even regions within countries, has its own combination of agricultural constraints to address. They must be em-

powered to address the issues of yields, improved post-harvest qualities, or nutrient deficiencies specific to their particular needs and to use these as they see fit. An indigenous capacity will empower the developing countries to establish their own biotechnology industries and to negotiate on equal terms with companies and research entities in the North.

As part of its continuing efforts and with support from the Rockefeller Foundation, the Institut de Recherche et de Développement in Paris (IRD), the Donald Danforth Plant Science Center, and a number of other national and international funding agencies, ILTAB has trained 135 scientists and technicians from 19 developing countries in the technologies required to produce genetically transformed rice, cassava and tomato plants.¹ ■ *NJT and CMF*

NOTE

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at producing improved varieties of the important local corn and rice varieties. Genetic engineering technologies must also be developed for the orphan crops such as cassava and plantain on which a large proportion of the population depends.

To date, there has been relatively little improvement in the yield of the orphan crops through conventional breeding, which is often both difficult and time consuming. For example, in Africa, cassava produces on average 7 to 8 tons per hectare, (less than 3 tons per acre) of harvested product. Field trials performed under optimized conditions—eliminating pressure from weeds, insects, and virus infections—have demonstrated that yields upwards of 80 tons per hectare (32 tons per acre), are possible. Even under more realistic field conditions, achieving and sustaining production improvements of only a fraction of this will have significant impact on food supplies in many parts of Africa.

Yet progress towards the application of biotechnology to the world's subsistence crops has been frustratingly slow. DNA technologies and the gene transfer protocols required to find, analyze, and insert transgenes with potential agronomic interest into crop plants were first developed in research laboratories in North America and Europe. The technologies required to initiate research programs and develop new genetically engineered crop plants are relatively expensive and capital intensive. The heavy investments required and high-tech nature of these activities have hindered easy transfer to the developing countries. More importantly, lack of public investment in agricultural research from the late 1980s to the present

time has ensured that the majority of research and development has been, and continues to be, directed at crops adapted to temperate climates or at tropical cash crops such as cotton, rubber, coffee, papaya, and pineapple, from which a financial return is expected.

As a result, the majority of biotechnology research and expertise resides within the private sector in the industrialized countries, most especially the United States. By definition, subsistence crops such as cassava, sweet potato, plantain, sorghum, and millet have little or no place in these market-driven activities. Commercial enterprises have protected their significant investments through the application of patents and intellectual property rights, restricting access of emerging technologies to developing country applications. Either the genes, technological tools, and expertise are not made available for application to tropical crops, or release of the genetically engineered products to farmers in developing countries is blocked or delayed by unresolved property rights issues.

Food for the Future

Despite these problems, there are encouraging indications as to what can be achieved when resources are focused on applying biotechnology for the improvement of developing country food crops. Consider the following advances:

- A bacterial gene genetically engineered into a plant can improve the plant's ability to take up phosphorous, an essential plant nutrient that is often chemically fixed in tropical soils. A deficit of phosphorous can significantly reduce yields and has historically been a limiting factor in crop production.

- A much publicized "golden rice" genetically engineered to synthesize and accumulate vitamin A in grains has been developed. This product is an excellent example of how the new technologies can help improve the health of people in the developing countries, where vitamin A deficiency commonly causes blindness and susceptibility to serious diseases, especially among children.

- Genes that produce dwarfing characteristics in plants have been identified and isolated. If transferred to millet and sorghum such traits could have a significant impact on yield enhancement in these neglected tropical cereals by reducing the energy the plant invests in non-edible plant organs.

- A gene from the photosynthetic system of maize has been transferred into rice, where it is able to boost productivity in the genetically engineered plants by up to 30 percent.

- Our own laboratory, the International Laboratory for Tropical Agricultural Biotechnology (ILTAB), in collaboration with the University of California, Davis, has produced a gene—*Xa21*—from an African wild relative of rice which imparts resistance to a severe bacterial blight disease. This gene was isolated and transferred by genetic engineering directly into breeding lines of Chinese rice, which are highly susceptible to this disease.⁹ When crossed with local Chinese varieties, the presence of the new transgene has resulted in plants with significantly increased resistance to the pathogen.

- ILTAB has genetically engineered cassava plants to have increased resistance to African cassava mosaic diseases, the most important threat to a crop plant in Africa and responsible for the loss of up to 50 million tons of food each year.

Agricultural biotechnology is a relatively young discipline, with few resources being dedicated to addressing the problems of the developing world for little over a decade. More time and investment will ensure much greater and far-reaching discoveries. The full genetic sequences of rice and *Arabidopsis thaliana*—a model plant for genetic research—are now completed and will be published later this year. Coupled with vastly improved systems for analyzing how genes control development, metabolism, defense, and all aspects of biosynthesis in plants, this new information will fuel the development of biotechnology applications for improved crop production.

Time for A Change

The successes outlined above represent only a small fraction of the effort required to ensure that biotechnology will fill the needs of the world's growing populations. ILTAB, for example, is one of only five laboratories actively engaged in developing and applying genetic transformation technologies for the improvement of cassava, a food crop consumed by approximately 600 million people, twice the population of the United States, every day. There are more than 1,700 cultivars of cassava grown in Africa, South America, and Asia, and the crop suffers from severe yield reductions due to viral and bacterial diseases and insect pests.

The story is the same for plantain and, indeed, all the other "poor man's" crops, indicating that the resources presently being committed to the orphan crops are clearly out of scale with the task at hand.

Much greater investments also

need to be made in research and development of these food crops. The network of the Consultative Group on International Agricultural Research (CGIAR),¹⁰ which is charged with crop improvement for the developing countries, receives an annual budget of around \$400 million per year. These resources are thinly spread among 16 research centers scattered around the world. Furthermore, CGIAR's activities are spread across a range of socioeconomic and agronomic requirements. Clearly, the resources currently being committed to the new century's most pressing problem are insufficient. If we are serious about meeting the basic rights of 4.6 billion people in the developing countries, we need to face the challenge more realistically.

Biotech No Panacea

Despite the recent negative public reaction to biotechnology, we remain convinced that the genetic engineering of crop plants can play a vital role in addressing the world's present and future agricultural requirements. The risks of not utilizing this new technology to help the developing countries secure their own food supplies and economic development far outweigh the inconclusive evidence of any environmental damage attributable to genetically modified organisms.

As for most complex issues there is no single simple remedy. Biotechnology is not a panacea for world hunger. However, combined with traditional breeding, good agricultural practice, and sound economic policies, biotechnology can improve standards of health and economic security for all the world's people and close the gap between the rich and poor nations.

We believe that the impetus for successful application of both traditional methods and biotechnology to address world crop production must come from the industrialized countries, which possess the vast majority of the world's financial and technological resources. The mobilization of these substantial resources to address the needs of the developing world is fundamental to the future well-being of the world, its natural resources, and its people. This considerable challenge must be sustained over several decades.

There are no easy answers, no quick fix; instead serious commitments are required from all who can contribute.

■ **Western governments**, especially the United States, need to devote much greater funding for research and development towards food security in developing countries. Despite its enormous wealth, the United States currently contributes less per capita to developing world issues than any of the other industrialized countries.

■ **Private corporations** can play a significant role by releasing products and providing technical expertise to meet the needs of small farmers in the developing countries. Monsanto's recent decision to freely release all their property rights issues concerning "golden rice" is a welcomed step in this direction.

■ **The developing countries** must also come forward, as many are now doing, and make commitments to train their scientists and provide them with the incentives and support required to sustain effective research programs. They should seek to enter into collaborations with the public and private research sectors and development organizations in the North. They must work towards

establishing the proper legislative regulations to allow genetically crops to be developed, tested, and cultivated within their respective countries.

■ **Global and regional coordination** is necessary to foster development of crop biotechnology. Coordinating organizations and structures are necessary to facilitate communication and collaboration with all the organizations capable of making a contribution to this effort and to raise public awareness in the industrialized countries of the issues involved. This will allow more-efficient use of limited resources and ensure that improved products reach farmers in the tropical and subtropical regions.

A massive challenge faces mankind in the first half of the new century. There is no doubt that we have the resources, knowledge, and tools to feed the world's burgeoning population. The question is whether those of us in the North, most of whom have never gone to bed hungry, are willing to share a portion of our wealth with people who suffer from daily hunger,

chronic malnutrition, and the threat of famine.■

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Genetic Diversity Blueprint

Conservancy advocates are bringing some domestic farmyard animals back from the brink of extinction.

BY LAWRENCE ALDERSON

Disregard for the environment was an alarming feature of the 20th century. The catalogue of incidents of soil erosion, degradation of the atmosphere, water pollution, and destruction of forests might almost be interpreted as a death wish by the human race. But it is disregard for other species, many of them driven to extinction, that carries the most poignant message.

A few well-known and dramatic events in the history of species extinction are indelibly imprinted in the debit record of biodiversity. In 1627, illegal hunting in Jaktorowka Forest in Poland led to the demise of the last wild aurochs, ancestor of our domestic cattle. In New Zealand, settlers eliminated

the dodo—a large flightless bird that had no natural predators—in the late 17th century.

These events have left a psychological legacy of guilt that is expressed in futile attempts to recreate extinct species. Between the two world wars, the Heck brothers in Berlin and Munich pursued their joint dream of restoring aurochs to the inventory of genetic diversity by combining appropriate characteristics of some modern breeds of domestic cattle. Similar attempts are being made with the quagga—a close relative of the zebra—in South Africa, and Chantecler poultry in Canada. Researchers in Japan are even trying to recreate the long-extinct woolly mammoth with DNA found in a specimen preserved in the permafrost of Siberia. In all

cases, these are vain attempts, for the loss is irretrievable. The common factor is the failure to recognize the finality of extinction.

Many other species, breeds, and varieties have a lower profile and pass into extinction without any fanfare or outcry. In the British Isles alone more than 30 breeds of large domestic livestock have become extinct during the 20th century. These losses represent significant and unnecessary genetic erosion—a waste of genetic material with a potential value that never will be known. The losses are significant because some vanished breeds possessed distinctive characteristics. The losses were also unnecessary because the last animals were killed or allowed to disappear even though people knew perfectly well what they were doing and recognized the finality of these extinctions.

Conservation Groups

In 1973 the Rare Breeds Survival Trust was established as a prototype for organizations devoted to preserving rare breeds. Since then, no further breeds have become extinct in Britain.

The work of the Rare Breeds Survival Trust in the British Isles was a catalyst for the creation of similar groups in many other countries during the late 1970s and 1980s. Several followed the nongovernmental organization model of RBST, but in other cases conservation programs grew from government initiatives, and in a few instances there were state/private hybrids. By 1989, national organizations to conserve domestic livestock had been established in more than 20 countries, and in that year, a global conference was called at the University of Warwick in England to identify progress

and compare experiences.

The result was the formation of Rare Breeds International as an umbrella organization to coordinate international activities and spread the message of genetic conservation. RBI was given legal status at a meeting in Budapest in 1991, and subsequent global meetings were held in Kingston, Canada, in 1994; Kathmandu, Nepal, in 1998; and the Millennium Congress in Brasilia in 2000.

An increasing awareness by governmental agencies of the importance of genetic conservation paralleled activities by nongovernmental organizations. Early expressions of concern during the 1970s led to a conference—Expert Consultation on Animal Genetic Resources Conservation and Management—sponsored by the Food and Agriculture Organization/United Nations Environmental Programme in Rome in 1980. As a representative of the United Kingdom at this meeting, I noticed a fundamental shift in FAO's policy, from its focus on increasing production to a recognition of the need for conservation of animal genetic resources.

Subsequently, in 1995, FAO published the second edition of the *World Watch List for Domestic Animal Diversity*, which detailed breeds at risk and estimated that more than 30 percent of all breeds of livestock in the world were severely endangered. The authors warned that “biodiversity is essential for efficient and sustainable production of food.”¹ The document also echoed the strengthening chorus that “domestic animal diversity, which has evolved over more than 12,000 years, is also an integral part of our heritage, to be nurtured for future generations.”²

Some are concerned, however,

that FAO still appears to support the short-term philosophy of commercial producers, which gives economic considerations a higher priority than genetic diversity, and accepts the erosion of genetic variability through the extinction of some breeds.³

Native Breeds

The first major treatise on the conservation of rare breeds, *The Chance to Survive*, was published in 1978, and an updated edition, published in 1994, remains a standard work.⁴ The treatise details four important reasons for conserving domestic animal genetic resources:

- Endangered native breeds are part of the national heritage.
- They are an important resource for scientific work because of their genetic distance from popular breeds.
- They are insurance against changing requirements in the future.
- Their distinctive characteristics frequently are associated with efficiency of production.

Each breed of livestock comprises a unique genome that has evolved in a particular environment. At various times, certain breeds have become popular and expanded their range, while others have remained in the region where they originated. It might be expected that commercial breeders would choose a breed because of its suitability for contemporary agricultural systems, but often the popularity of a breed depends on speculation or fashion. As a result, many native breeds suffer neglect not justified by their genetic merit.⁵

The survival of these breeds often depends on their historical significance as part of the local heri-

tage, but this is not sufficient to provide reliable ongoing support in times of changing values, especially when short-term gain is a major motivation.

A more compelling argument for conservation programs is that specific breeds are adapted through evolution to their natural habitat. This provides a foundation for the development of ecologically based agricultural systems that allow efficient production while paying due attention to the quality of life for both animals and humans.

Consider the extreme specialization of breeds such as North Ronaldsay sheep on the Orkney archipelago a few miles northeast of mainland Scotland. These animals have characteristics not duplicated in other breeds. North Ronaldsay sheep on their native island, for example, are excluded from areas used for crops and grass by a high stone wall that restricts them to the shore. As a consequence, they have adapted behaviorally and physiologically to rely exclusively on a diet of seaweed. Likewise, Nguni cattle in southern Africa are able to thrive in areas infested with ticks. Their thick hide, which twitches and secretes a repellent exudate, gives them a tolerance not shared by other breeds.

Attempts have been made to substitute both these specialized breeds with exotic livestock that thrive in more benign environments. By the 1970s, they were seriously endangered, as breeders were tempted by speculative experimentation or current fashion to introduce poorly adapted substitutes.

Simultaneously, another misguided attempt to improve the quality of livestock in developing countries was supported by FAO and local governments. The pro-

gram provided semen from Holstein/Friesian bulls for artificial insemination of local livestock and intensified the threat to native breeds. Rare Breeds International has recommended that governmental livestock agencies adopt a procedure for genetic impact studies before import licences are granted for exotic breeds or semen, and a pilot procedure has been adopted in South Africa. The minimum safeguard to protect animal genetic resources should be an evaluation of each breed's compatibility with its intended environment and its estimated effect on native breeds.

Genetic Erosion

The loss of plant genetic material—from the destruction of the rainforest, disappearance of valuable medicinal plants, and the decline of old domesticated varieties of vegetables and other plants—is well publicized, and most people are aware of the inexorable advance of overwhelming monoculture. Less well known is the loss of animal genetic diversity, which has equally serious implications for efficient and sustainable systems of food production.

Many breeds have become extinct not because they lacked genetic merit, but because they were unfashionable or evolved in remote areas. It is precisely because they were not in the mainstream of the livestock industry, however, that they would have made a valuable contribution to genetic diversity. Galloway horses from southwestern Scotland, for example, were a famous trotting breed; and Suffolk Dun cattle in eastern England were the superior dairy breed of their time. Both are now extinct. Their valuable and distinctive characteristics could not save them from the

ultimate fate of peripheral breeds in a world where their destiny was dictated by transitory whims rather than intrinsic merit.

Invisible Death

The crushing finality of extinction of a species or breed can obscure our understanding of the threat of the erosion of genetic diversity, which occurs in other ways. Extinction of a breed is obvious and dramatic. But the cumulative loss of the paired alleles that determine a particular characteristic such as hair color or milk production is equally damaging.

Genetic variability in any static, closed population is continually augmented by mutation, but it is simultaneously depleted at a much greater rate by changing frequencies of individual alleles. As a result, some disappear. Traditional Hereford cattle, for instance, have declined from a globally popular breed with a rich genetic diversity in the 1960s to a small nucleus group in the 1990s, and the genes of a few dominant animals have exerted a disproportionate influence on the breed. The combined effect of these two factors has reduced the number of alleles at nine loci from 57 in the 1960s to 48 in the 1990s—a loss of 16 percent of the original genetic material in five or six generations.⁶ Thus, the Hereford still has the distinctive markings of the breed, with a reddish coat and white head, but it has lost much genetic variability that previously made it resilient in the face of environmental challenges.

The last few decades of the 20th century saw shrinking populations of most breeds, while advanced reproductive technologies in increasingly intensive systems of production have led to the emergence of

a few dominant breeds. The race to achieve more-rapid change underlies the development of techniques such as cloning and sexing of semen. These techniques allow breeders to replicate favorite animals or eliminate births of unwanted bulls, for example, in a dairy herd.

The search for higher production from individual animals has also led to the use of antibiotics as growth promoters, hormones such as bovine somatotrophin (BST) to stimulate milk production, slurry lagoons to treat large amounts of animal waste from large commercial operations, and battery cages that restrict laying hens to extremely small cages. These techniques represent the unethical and inhumane face of livestock farming, and they have encouraged the expansion of the few breeds that are able to tolerate such unnatural conditions.

Some sectors of the livestock industry have implemented monoculture systems of production like those that prevail in arable farming. In the dairy industry, for instance, the process of Holsteinization has seen a wave of black-and-white cattle sweep over many parts of the world. In the case of poultry, the three industrial breeding companies that control global turkey production rely on a standard type of bird and have created even greater uniformity. When these ubiquitous breeds become genetically derelict, as they inevitably will in a constantly changing environment, viable alternatives may no longer be available. Other breeds, particularly of dairy cattle and turkeys, are being marginalized to such a degree that their ability to contribute variety to the livestock industry—an essential element of adaptation—is significantly jeopardized.

Critical Evaluation

The debate on such subjects as genetic diversity can become quite emotional, but these issues deserve critical and clinical scrutiny. It is understandable that major retailers want access to standard products, and a uniform population of animals allows more precise standardized management and more predictable results. Similarly, the development of genetically modified plant organisms gives large companies greater control over all stages of crop production.

Uniformity certainly has short-term financial advantages, but it is a cul-de-sac of danger. It makes a whole population vulnerable to the same diseases. Indeed, uniform performance means uniform susceptibility. It places the future of food production in the hands of those whose motivation is profit and wrests control from small producers who provide variety and quality. This state of affairs sits uneasily on those who are increasingly aware of other, more altruistic, considerations such as animal welfare, variety in the food supply, protection of the environment, and food security based on a local supply of products not subject to the vagaries of agribusiness.

Currently, supporters of animal welfare not only condemn intensive production methods, they also disapprove of expectations that cows yield more than 15 gallons of milk per day or that hens lay every day throughout the year. Beef bulls and turkey stags, distorted by muscular hypertrophy so that they are unable to mate naturally, excite equal dismay and censure. Overcrowding in feedlots also threatens human health through proliferation of *E coli*, salmonella, bovine spongiform encephalopathy, and similar disease organisms.

The linked triumvirate of intensive farming, dominance of big business, and loss of biodiversity has exerted a powerful influence that consumer interests and the general public only now are beginning to resist.

A Noble Feast

The change in attitude that has occurred in the last few years has probably been triggered by health scares more than by awareness of the loss of genetic diversity. Renewed awareness and evaluation by consumers of the food presented to them has led to a resurgence of traditional values and traditional breeds. It is this sequence of events that offers the greatest hope for maintaining the diversity of animal genetic resources.

In Britain, the rejection of beef from mainstream production during the bovine spongiform encephalopathy crisis of the early 1990s demonstrated the determination of consumers not to accept food that might be unsafe or lethal. This period saw the growth of niche markets and the purveying of food by small producers direct to the consumer. Integral to this process was the role of old-fashioned native breeds.

In 1994, the Rare Breeds Survival Trust launched the Traditional Breeds Meat Marketing scheme, which was intended to publicize the quality of native breeds and expand a market for their distinctive products. The success of this scheme depended on the high quality of meat from breeds that had flirted with extinction, such as White Park cattle, which produced beef preferred by consumers. It was a joint of beef from this breed that so impressed James I in 1617 that he knighted it "Sir Loin."⁷ Yet the White Park

had been reduced to only 65 breeding cows in 1970. In the sheep category, it is found that the best quality mutton comes from Balwen sheep, a breed that survived in only one flock at the head of the Tywi valley in Wales at the end of the great storms of 1947.

The meat from primitive breeds such as these is high in healthy polyunsaturated fatty acids and has superior taste and texture. The public is now beginning to understand that good-tasting meat can be healthy for you, as well as good for the environment and the local farmer.

The final turn to complete the revolution to preserve genetic diversity in livestock is the realization that the interests of the consumer are served by variety rather than uniformity. There are large differences among breeds, and these must be encouraged. The adaptation of traditional breeds to natural systems gives them an ecological advantage, and the combined result of genetic merit and environmental effect is the key to products that are both healthy and of high quality.

Rare pig and poultry breeds in Britain are suited to outdoor systems and thus enjoy a better quality of life than those raised in intensive agricultural operations. White Park cattle roam throughout the year on the top of Salisbury Plain, while Portland and Norfolk Horn sheep continue to graze the sweet sward of their native heath. Tasting panels and guests at prestigious banquets and other gourmet gatherings generally favor meat from these breeds. What better vindication could there be of the need for biodiversity?

But good quality meat is only one food product that benefits from local production and less in-

tensive farming. Genuine Parmesan cheese manufactured from the milk of local Reggiana cattle in Italy is superior in both texture and taste to its ersatz cousin sold in many grocery stores. And connoisseurs of color will appreciate the hues of naturally colored wool produced by primitive breeds of sheep that have survived in isolated areas in many parts of the world. In addition, genetic conservation can also be justified based on health reasons. An anti-carcinogenic factor has been discovered in the milk of rare Shetland cattle, for instance.

Back to the Future

Despite the huge loss of genetic material that has occurred already and the continuing damage being inflicted as a result of short-term profit motivation, the opportunity exists to save and conserve the genetic variability of remaining domestic breeds. But time is a critical factor. The awareness that we are curators of a vital legacy for future generations must be expressed in a philosophy of responsibility for the environment and its genetic diversity. Are the necessary resources for this task available? Breeders, educators, policymakers, and the general public urgently need to develop active programs of conservation. These programs must acknowledge that breeds adapted to native climates and cultures are a fundamental element of sustainable production. The necessary expertise for guiding appropriate programs exists in organizations such as Rare Breeds International.⁸

Further research needs to be applied in evaluating the benefit of locally adapted breeds in the

sustainable development of agriculture. In Britain, a blueprint for nonintensive beef production has been demonstrated by a herd of White Park cattle that remains outdoors throughout the year in an upland area without any supplementary feed. This experimental herd, raised entirely on pasture, has proven that these cattle are less expensive to maintain and produce a higher quality product than more popular breeds that need shelter in bad weather and supplemental feed. But more important, their management is compatible with animal welfare and enhancement of the environment. Similar systems need to be developed in other areas.

Intensive production of livestock is not sustainable. Indeed, intensively bred livestock compete with humankind for food. Consider, for instance, that feed-lot animals require 3 kilograms (6.6 pounds) of grain to produce 0.5 kg (1.1 pounds) of beef. As world population increases, grain will be diverted from animal feed. Meanwhile, native-adapted breeds that produce beef from grass will become increasingly critical for future food security, especially since much of the rangeland worldwide used for cattle raising is unsuitable for intensive cropping.

The essential contribution of native breeds needs to be protected against damage from ongoing genetic erosion caused by exotic livestock breeds. National governments should be encouraged to require the preparation of genetic impact studies before importation of exotic genetics is permitted.

The conservation of animal genetic resources epitomizes the need for responsible long-term

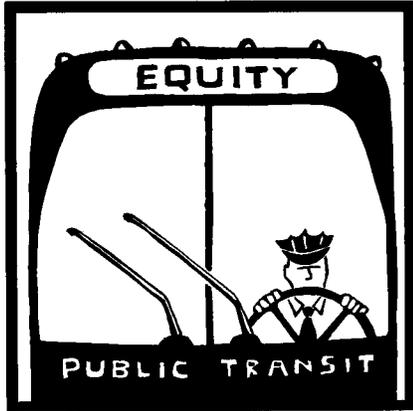
planning to replace the current focus on maximizing production and profit. The fallacy of unrestricted intensification of agricultural systems as a secure basis for food production is being gradually exposed. The alternative policy places greater emphasis on efficiency of production and seeks to exploit the adaptation of native breeds and the insurance of biodiversity as the measures best calculated to maintain quality of life into the third millennium. ■

Lawrence Alderson is trustee and founder president of Rare Breeds International, Shropshire, England. He is a consultant specializing in animal breeding and genetic conservation.

NOTES

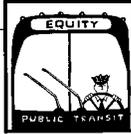
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Just Transportation



The Routes of American Apartheid

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Separate and Unequal

In 1955, a Montgomery bus driver asked a black seamstress to give up her seat to a white man. Thanks to Rosa Parks' refusal to subject herself to one more act of racial humiliation, such blatant discrimination no longer exists in America. Subtler discrimination is still with us, however, and transportation is still at the heart of the fray.

Consider, for instance, Atlanta, which racism has kept geographically divided. MARTA, Atlanta's public transit system, was intended to serve the 10-county region but, in fact, serves only the two core counties, Fulton and DeKalb, say Robert Bullard, Glenn Johnson, and Angel Torres. The mostly white suburbanites in the surrounding counties, the authors note, feared MARTA "would lower their property values, increase crime, and bring 'undesirable' elements into their communities."

Atlanta's solution has been to build roads rather than improve public transportation. But public transportation is what the poor and minorities need. As a result, a coalition of environmental groups sued the Atlanta Regional Commission. Following settlement of the suit, which eliminated a number of road projects and freed up funds for alternative solutions, an environmental justice coalition began negotiations with local, state, and federal agencies

to correct transportation discrimination within the city. These negotiations are ongoing.

Robert García considers another case study: Los Angeles' separate but unequal transit system. In 1996, a broad-based coalition sued the Los Angeles County Metropolitan Transportation Authority on behalf of low-income and minority bus riders. In contrast to MARTA, the MTA had been devoting most of its budget to light rail to serve the mostly white suburban communities, while neglecting bus riders in the inner city. As a result of the settlement, the MTA agreed to invest more than \$1 billion in the bus system.

In a sidebar to García's article, Kikanza Ramsey provides a behind-the-scenes account of the development of the coalition that sued the MTA and the eventual outcome of the suit.

While improvements have followed in the wake of the settlement, García notes that L.A.'s transportation policies are still far from providing equality. Nonetheless, he is confident that transportation justice can be achieved.

Atlanta and Los Angeles provide two clearcut examples of transportation discrimination. In murkier cases, however, the legal and ethical pillars of justice begin to lose their mortar.

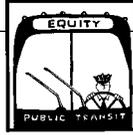
Michael Steinberg looks at the complex legal structure of transportation justice—Title VI of the Civil Rights Act of 1964, the Na-

tional Environmental Policy Act, President Clinton's executive order on environmental justice, and a series of guidance documents from the Department of Transportation, the Council on Environmental Quality, and other agencies—and for the most part finds the edifice shaky. As Steinberg notes, "Unfortunately, the law is in such an early state of development that it is easier to pose the questions than to suggest the correct answers."

Finally, Ralph Perhac looks at the philosophical foundation for environmental justice; he too is not encouraged. Environmental racism, Perhac argues, should be eliminated. Unfortunately, most of the tools for attacking it focus strictly on the outcomes in which minorities and the poor carry the burden of environmental risk. The disproportionality, however, may be the product of other social forces unrelated to discrimination—for instance, low-income people may be attracted to high risk neighborhoods because of reduced land prices or proximity to jobs.

Our primary concern, Perhac concludes, should be to find ways to "preclude imposing high levels of risk on people without their consent . . . regardless of racial identity or socioeconomic status."

The Editors



The Routes of American Apartheid

*America's transportation policies, at least in the figurative sense,
still relegate people of color to the back of the bus.*

BY ROBERT D. BULLARD, GLENN S. JOHNSON, AND ANGEL O. TORRES

For more than a century, people of color have struggled to end transportation discrimination in the form of unequal treatment on buses and trains. This form of apartheid, which clearly violates constitutionally guaranteed civil rights, was decreed in 1896 by *Plessy v. Ferguson*, a U.S. Supreme Court decision that upheld Louisiana's segregated "white" and "colored" seating on railroad cars. This decision ushered in the infamous doctrine of "separate but equal." *Plessy* not only decreed apartheid in transportation facilities but also served as the legal basis for racial segregation in education until the Supreme Court's *Brown v. Board of Education of Topeka* decision overturned it in 1954.

The modern civil rights movement has its roots in transportation.¹ In 1953, over half a century after *Plessy vs. Ferguson* relegated blacks to the back of the bus, African Americans in Baton Rouge, Louisiana, staged the nation's first successful bus boycott. Two years later, on December 1, 1955, Rosa Parks refused to give up her seat at the front of a Montgomery, Ala-

bama, city bus to a white man. In so doing, Parks ignited the modern civil rights movement. By the early 1960s, young "freedom riders" risked death by riding Greyhound buses into the deep South. This was their way of fighting transportation apartheid and segregation in interstate travel.

Today, despite those heroic efforts, transportation remains a

civil-rights and quality-of-life issue. All communities are still *not* created equal. Indeed, some communities accrue benefits from transportation development projects, while others bear a disproportionate burden in paying the costs. Generally, benefits are more widely dispersed among the many travelers who use new roads, while costs or burdens are more localized. Having a seven-lane freeway next door, for instance, is not a benefit to someone who does not own a car.

Lest anyone dismiss transportation as a tangential racial issue, consider that Americans spend more on transportation than any other household expense except housing. The average American household spends a fifth of its income—or about \$6,000 a year—for each car it owns and operates. Americans also spend more than 2 billion hours a year in their cars.

According to the latest figures published in the Federal Highway Administration's *Highway Statistics*, total vehicle miles traveled in the United States increased by 59 percent from 1980 to 1995.²

Federal tax dollars subsidized many of the roads, freeways, and public transit systems in our nation. Many of these transportation projects had the unintended consequences of dividing, isolating, and disrupting some communities while imposing inequitable economic, environmental, and health burdens on them.

Clinton Weighs in

On February 11, 1994, President Clinton signed Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." This executive order reinforces what has been law for three decades. Indeed, the Civil Rights Act of 1964 prohibits discriminatory practices in programs receiving federal funds.

Environmental requirements also reinforce a number of regulatory laws and statutes, including Title VI of the Civil Rights Act of 1964, the National Environmental Policy Act of 1969 (NEPA), and the Federal-Aid Highway Act of 1970. Title VI of the Civil Rights Act states,

No person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or subjected to discrimination under any program or activity receiving Federal financial assistance.³

The 1994 executive order also focuses on NEPA, a law that es-

tablished policy goals for the protection, maintenance, and enhancement of the environment. NEPA's goal is "to ensure for all Americans a safe, healthful, productive, and aesthetically and culturally pleasing environment." NEPA requires federal agencies to prepare a detailed statement on the environmental effects of proposed federal actions that signifi-

Achieving Equality

Transportation is a key component in addressing poverty, unemployment, and equal opportunity goals while ensuring equal access to education, employment, and other public services. Many poor people and people of color who are concentrated in central cities are demanding better transportation

The average American household spends a fifth of

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it owns and operates.

cantly affect the quality of human health.

The executive order calls for improved methodologies for assessing and mitigating health effects from multiple and cumulative exposure. It provides for collection of data on low-income and minority populations that may be disproportionately at risk. It calls for environmental health impact studies on people who subsist on fish and wildlife, and it encourages those affected populations to participate in the various phases of assessment and mitigation.

On April 15, 1997, the U.S. Department of Transportation issued its Order on Environmental Justice, requiring the U.S. DOT to comply with the executive order within the framework of existing laws, regulations, and guidance.⁴ In December 1998, the Federal Highway Administration issued an order requiring the agency to incorporate environmental justice in all its programs, policies, and activities.

that will take them to the job-rich suburbs. It would be ideal if job centers were closer to the inner-city residents' homes, but few urban core neighborhoods have experienced an economic revitalization that can rival the current jobs found in the suburbs.

In the real world, costs and benefits associated with transportation developments are not randomly distributed. The inequitable effects of transportation projects can be subsumed under three broad categories: procedural, geographic, and social inequity.

■ **Procedural inequity** results when transportation decisions are not carried out in a uniform, fair, and consistent manner with involvement of diverse public stakeholders.

■ **Geographic inequity** results from the geographic and spatial impacts—both positive and negative—of transportation decisions. These impacts affect rural, urban, and central-city neighborhoods differently. Some communities are physically located on the wrong

side of the tracks and often receive substandard services. Environmental justice concerns arise when transportation systems disproportionately favor one geographic area or spatial location over another.

■ **Social inequity** results when transportation benefits and burdens are not randomly distributed across population groups. Generally, transportation benefits accrue

levels of inaccessibility and adverse impacts, improved methods for assessing the mobility of various population segments, air pollution and noise models capable of analysis on the neighborhood scale, more-effective methods of gathering information from affected populations and gauging neighborhood needs for historic preservation, better approaches for assess-

lic transit spend twice as much time traveling as those who travel by car. Consider, for instance, that the average commute takes about 20 minutes in a car, 38 minutes on a bus, and 45 minutes on a train. People of color are twice as likely as their white counterparts to use non-auto modes of travel—public transit, walking, bicycles—to get to work.

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counterparts to use non-auto modes of travel—

public transit, walking, bicycles—to get to work.

to the wealthier and better educated segments of society, while transportation burdens fall disproportionately on people of color and individuals at the lower end of the socioeconomic spectrum.

How transportation is defined and measured can often determine how equity is evaluated.⁵ The use of vehicle mileage, as a measure of travel and traffic congestion, tends to favor more spending on infrastructure improvements and less on other transportation alternatives.⁶ Also, transportation planners use other variables in their transportation modeling such as vehicle miles traveled, which favors people who drive their automobile more miles than average, or passenger miles traveled, which favors people who travel more than average.

Researchers at the University of Iowa, among others, have identified a dearth of data measuring the impacts of transportation investments on environmental justice.⁷ The researchers call for, among other things, improved baseline assessments that estimate current

ing travel needs of low-income populations and minority populations, and improved techniques for communicating probable impacts of proposed changes to transportation systems.

Old War, New Battles

Rosa Parks' now-famous challenge to the practice of segregated seating on buses, the Montgomery bus boycott, and the freedom riders constituted a frontal attack on discriminatory transportation policies and practices. Nevertheless, today, millions of Americans are fighting to just get on the bus. They are also struggling to get public transit systems linked to jobs and economic activity centers.

Currently, only about 5.3 percent of all Americans use public transit to get to work.⁸ Most American workers opt for private automobiles, which provide speed and convenience, and most of them forgo car pooling. Indeed, nationally, 79.6 percent of commuters drive alone to work.⁹ Generally, people who commute using pub-

lic transit spend twice as much time traveling as those who travel by car. Consider, for instance, that the average commute takes about 20 minutes in a car, 38 minutes on a bus, and 45 minutes on a train. People of color are twice as likely as their white counterparts to use non-auto modes of travel—public transit, walking, bicycles—to get to work.

From New York City to Los Angeles, grassroots leaders are demanding an end to unjust and unequal transportation policies and practices. They are demanding an end to the kind of transit racism that, for example, killed 17-year-old Cynthia Wiggins of Buffalo, New York. Wiggins, an African American, was crushed by a dump truck while crossing a seven-lane highway because Buffalo's Number Six bus, an inner-city bus used mostly by African Americans, was not allowed to stop at the suburban Walden Galleria Mall. Cynthia had not been able to find a job in Buffalo but was able to secure work at a fast-food restaurant in the suburban mall. The bus stopped about 300 yards short of the mall.

The Wiggins family and other members of the African American community charged the Walden Galleria Mall with using the highway as a racial barrier to exclude some city residents. The high-profile trial, argued by Johnnie L. Cochran Jr., who had also represented O.J. Simpson, began on November 8, 1999. The lawsuit was settled 10 days later when the mall owners, Pyramid Companies of Syracuse, agreed to pay \$2 million of the \$2.55 million settlement to Wiggins' four-year old son. The bus company, Niagra Frontier Transportation Authority, agreed to pay \$300,000, and the

truck driver, John P. Bunch, agreed to pay \$250,000.¹⁰

The Buffalo case is not an isolated incident. Residents in Los Angeles also led a successful frontal assault on transit racism. In *Labor/Community Strategy Center v. Los Angeles Metropolitan Transportation Authority*, a class action lawsuit filed on behalf of 350,000 bus riders, the plaintiffs argued that the Los Angeles Metropolitan Transit Authority had used federal funds to pursue a policy of raising costs for bus riders—mostly the poor and people of color—and reducing quality of service in order to fund rail and other projects in predominately white, suburban areas (see “Mean Streets” in this issue of FORUM).

In 1996, the Labor/Community Strategy Center won an historic out-of-court settlement against the Los Angeles MTA.¹¹ In the process, the group was able to win major fare and bus pass concessions. They also forced MTA to spend \$89 million on 278 new buses that run on clean-burning compressed natural gas. The struggle epitomizes grassroots groups’ challenges to transit racism.

Transit racism is also under siege in Macon, Georgia, a city whose population is evenly divided between blacks and whites.¹² Over 90 percent of the bus riders in Macon are African Americans, and more than 28 percent of Macon’s African Americans do not own cars, compared with only 6 percent of the city’s whites.

A disproportionate share of transportation dollars in Macon and Bibb County, however, have gone to road construction and maintenance at the expense of the bus system. In 1993, Macon and Bibb County devoted more than

\$33 million of federal, state, and local funds for roads, streets, and highways, of which some \$10 million came from federal funds. During the same year, local officials accepted no federal funds for the Macon-Bibb County Transit Authority and budgeted only \$1.4 million for public transportation. Overall, the bulk of federal trans-

where public transit is almost nonexistent. Between 1990 and 1997, the Atlanta region added 475,600 persons.

Population growth was slow in the city of Atlanta, increasing by only 2,647 or less than one percent of the total population gain. On the other hand, the northern portion of the region gained

For years, I-20 served as the racial demarcation

line in Atlanta, with blacks located largely to the south and whites to the north.

portation monies received by Macon and Bibb County have been accepted to support road construction in mostly white suburban areas outside the reach of many African Americans.¹³

In 1994, African Americans in Macon filed a class action lawsuit challenging Macon and Bibb County’s use of federal funds under the Intermodal Surface Transportation Efficiency Act. In 1998, the lawsuit was settled out of court, with the city of Macon and Bibb County agreeing to accept federal funds for the first time to support their bus system.

Metro Atlanta

Racism has kept the Atlanta region geographically divided. Indeed, race is at the heart of Atlanta’s regional transportation dilemma. For years, I-20 served as the racial demarcation line in the region, with blacks located largely to the south and whites to the north. The bulk of the region’s growth in the 1990s occurred in Atlanta’s northern suburbs—areas

325,939 residents or 68.5 percent of the region’s population growth; the southern part of the region gained 147,014 persons or 30.9 percent of the population gain during the period.

In just one 12-month span—from April 1998 to April 1999—metro Atlanta grew by 94,300 people. This was the second-largest increase in the region’s history. On the other hand, the city of Atlanta grew by only 900 people during this same period.¹⁴ In 1998, population growth was 100 times greater in Atlanta’s suburbs than in Atlanta’s urban core.

Although the Atlanta Regional Commission predicts some population slowdown in the coming years, Gwinnett, Cobb, and Fulton counties added large numbers of people in the later 1990s.¹⁵ Gwinnett County’s population of 499,200 grew by 6.6 percent, Cobb County’s population of 550,000 grew by 2.7 percent, and Fulton County’s population of 773,000 grew by 1.7 percent during 1997 and 1998. Experts forecast the region to grow by a mil-

lion more people by 2025. Most of this population increase is expected in Atlanta's sprawling suburbs.

MARTA

The 10-county Atlanta metropolitan area has a regional public transit system only in name. In the 1960s, the Metropolitan Atlanta

With its \$270.4 million annual budget, MARTA operates 700 buses and 240 rail cars, and the system handles over 534,000 passengers on an average weekday. MARTA's 154 bus routes cover 1,531 miles and carry 275,000 passengers on an average weekday, while its rail lines cover 100 miles and carry 259,000 passengers.

Just how far MARTA lines ex-

the remainder of Fulton County, 25 percent live in DeKalb County outside the city, and 16 percent live in outlying counties.

MARTA provides nearly 21,000 parking spaces at 23 of its 36 transit stations, and parking at MARTA lots is free except for the 1,342 overnight parking slots that cost \$3 per day. All of the overnight lots are located on MARTA's North Line, where they serve affluent, mostly white, suburban communities. For example, the far-north stops on the orange lines—Doraville and Dunwoody stations—have proven to be popular among suburban air travelers. It is becoming increasingly difficult to find a parking space in some MARTA lots.

A license tag survey from 1988 through 1997, revealed that 44 percent of the cars parked at MARTA lots were from outside the Fulton/DeKalb county service area.¹⁸ It appears that Fulton and DeKalb county taxpayers are subsidizing people who live in outlying counties and who park their cars at the park-and-ride lots and ride on MARTA trains into the city and to Hartsfield Atlanta International Airport, the busiest airport in the nation.

Both the Doraville and Dunwoody stations provide fast, comfortable, traffic-free rides to Hartsfield Airport. By paying only \$1.50 for the train ride—but not the MARTA sales tax—many suburbanites who live outside Fulton and DeKalb counties get an added bonus since they don't have to park in airport satellite parking lots, which have fees that range from \$6 dollars up.

On the other hand, poor blacks who live in Atlanta pay the MARTA sales tax, as well as the \$1.50 MARTA fare, and help subsidize

For years, MARTA's acronym was jokingly referred to as "Moving Africans Rapidly Through Atlanta."

Rapid Transit Authority was hailed as the solution to the region's growing traffic and pollution problems; but today, MARTA serves just two counties, Fulton and DeKalb.

The first referendum to create a five-county rapid rail system failed in 1968, and the vote was largely along racial lines. In 1971, the city of Atlanta, with a minority population of 68 percent, and Fulton and DeKalb counties, with about 50-percent minority populations each, approved a referendum for a 1-percent sales tax to support a rapid rail and feeder bus system, but voters in the mostly white suburban Cobb County, with a 13-percent minority population, and Gwinnett County, with a 10-percent minority population, rejected the MARTA system.

Nevertheless, MARTA has since grown from 13 rail stations in 1979 to 36 rail stations in 1999, and two additional stations—Sandy Springs and North Springs—along the north line are under construction and are expected to open in December 2000.¹⁶ These two northern rail stations are the only MARTA lines currently under construction.

tend has proved to be a thorny issue. Talk of expanding the MARTA system into the northern, mostly white, suburbs raises a red flag among many suburbanites. Many suburbanites object to MARTA for fear it would lower their property values, increase crime, and bring "undesirable" elements into their communities, parks, and shopping centers. For years, MARTA's acronym was jokingly referred to as "Moving Africans Rapidly through Atlanta."

Even who pays the tab for MARTA's budget is debatable. MARTA's operating budget comes from sales tax (46 percent), fares (34 percent), and the Federal Transit Administration and other sources (20 percent). But only Fulton and DeKalb county residents pay for the upkeep and expansion of the system with a one-cent MARTA sales tax.

A recent rider survey revealed that 78 percent of MARTA's rail and bus riders are African Americans and other people of color.¹⁷ Whites make up 22 percent of MARTA riders. More than 45 percent of MARTA riders live in the city of Atlanta, 14 percent live in

MARTA's operation for riders who live outside the service area.

Between 1990 and 1997, Atlanta's northern suburbs reaped the lion's share of new jobs and economic development. During that period, Atlanta's northern suburbs added 273,000 jobs. This

accounted for 78.4 percent of all jobs added in the region. Another 70,500 jobs or 20.3 percent were added in the southern part of the region. Only 4,500 jobs were added in the region's central core of Atlanta, representing only 1.3 percent of all jobs created during

the height of the region's booming economy.

Clearly, Atlanta's people of color and the poor could benefit by having public transit extended into the job-rich suburbs. Public transit, however, does not go where most of the region's jobs are located.

ASTHMA AND BAD AIR

Although air pollution is not thought to cause asthma and respiratory-related illnesses, bad air is a major trigger to asthma sufferers. A recent study from the Clean Air Task Force—a coalition of environmental and consumer groups—linked asthma and respiratory problems with smog.¹ High smog levels are associated with rising respiratory-related hospital admissions and emergency room visits in cities across the eastern United States. Metropolitan Atlanta, for example, had 69 days of unhealthy air in the summer of 1999.

A 1996 report from the federal Centers for Disease Control and Prevention shows hospitalization and death rates from asthma increasing for persons 25 years old or less.² The greatest increases occurred among African Americans. African Americans are two to six times more likely than whites to die from asthma.³ The hospitalization rate for African Americans is 3.4 times the rate for whites.⁴

Asthma has reached epidemic proportions in the Atlanta region. Atlanta area residents are paying with their hard-earned dollars as well as with their health. A 1994 CDC-sponsored study showed that pediatric emergency department visits at Atlanta Grady Memorial Hospital increased by one-third following peak ozone levels.⁵ The study also found that the asthma rate among African American children is 26 percent higher than the asthma rate among whites. Since all children with asthma in Atlanta may not have visited the emergency department for their care, the true prevalence of asthma in the community is likely to be higher. Asthma is the leading cause of emergency childhood hospital visits in most major cities.

The American Lung Association estimates that 73,610 people out of a population of 1.3 million metro Atlantans suffer from chronic obstructive pulmonary disease.⁶ Of this total, 44,258 are adults and 23,011 are children suffering from

asthma. The number of cases of childhood asthma in the four counties in the Atlanta metropolitan region that exceed national ozone standards is 11,234 in Fulton, 9,509 in DeKalb, 1,272 in Douglas, and 996 in Rockdale. Thus nine out of 10 childhood asthma cases in the Atlanta region occur in Fulton and DeKalb, the two counties with the largest share of people of color. ■ RDB/GSJ/AOT

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Driving and Air Quality

The Atlanta metropolitan area is in violation of the Clean Air Act. The region exceeds the National Ambient Air Quality Standards for ozone by 33 to 50 percent. Cars, trucks, and buses are the largest source of this pollution. After making some progress in reducing nitrogen-oxide emissions in

would conform to federal standards. Because of the region's severe ozone nonattainment, the commission developed an interim transportation improvement plan, which the federal government criticized, claiming that the plan concentrated too heavily on roads and failed to show how it would improve the region's poor air quality.²⁰ Federal officials have also

dominated Atlanta Regional Commission plan would disproportionately and adversely affect the health and safety of African Americans and other people of color. More roads translates into more cars, more congestion, more pollution, and more respiratory illnesses such as asthma.

The environmental groups followed through with a lawsuit that resulted in a settlement that eliminated 44 of the 61 grandfathered road projects.²³ The remaining 17 projects were allowed to proceed because the Georgia Department of Transportation had already awarded contracts to construct the roads. The 1999 settlement freed up millions of dollars for transportation alternatives that could improve air quality and enhance mobility in the region.

The settlement restricts projects from proceeding until the state includes them in a regional transportation plan that meets federal clean-air standards and boasts several requirements. First, it requires the Atlanta Regional Commission to make its computer traffic modeling public. Second, it requires the Georgia DOT to conduct a major study of transportation and congestion in the northern suburbs. And third, it requires the U.S. DOT to study the social equity impacts of transportation investments in the region.

Moving beyond Race

Shortly after settlement of the environmental groups' lawsuit against the Atlanta Regional Commission, the environmental justice coalition entered into informal negotiations with the U.S. DOT, the state of Georgia, and local agencies, including the Atlanta Regional Commission, to begin addressing trans-

People of color account for less than a third of the

Atlanta region's population and nearly two-thirds of all the pedestrian fatalities in the region.

the early 1990s, as a result of cleaner-running cars and tighter emission inspections, the region is now experiencing reversals in air quality. Nevertheless, in the summer of 1999, the Atlanta region experienced 37 consecutive ozone alert days.

On average, people in the Atlanta region drive 34 miles per day—50 percent farther than residents in the Los Angeles area. The Atlanta region had more than 2.5 million registered vehicles in 1995, up from 1.9 million in 1986. The largest increase in registered vehicles during this period came in the northern suburban counties of Gwinnett and Cobb. These two counties alone added more than 261,000 vehicles to the region's crowded roads between 1986 and 1995.¹⁹

The Atlanta Regional Commission is the metropolitan planning organization responsible for land-use and transportation planning in the region. To receive federal transportation funds, the commission was required to develop a transportation-improvement plan that

identified public participation as a major problem in the Atlanta Regional Commission's planning and decision making.²¹

In 1998, two coalitions of citizens' groups challenged the Atlanta Regional Commission's leadership, planning, and decision making, which is tilted toward building new roads rather than expanding public transportation services. Several environmental organizations and a coalition of African American environmental justice groups, along with neighborhood and civic groups, filed a notice to sue the commission and state and federal governments under the Clean Air Act for approving 61 new road projects funded under the interim transportation improvement plan. The groups contended that the new roads, which were grandfathered under recent Clean Air Act amendments, would exacerbate the region's already severe problems with air quality.²²

In addition to challenging the illegal exemption of these grandfathered road projects, the coalition charged that the highway-

portation equity, environmental justice, and Title VI of the Civil Rights Act of 1964. The transportation equity concerns revolve around the way environmental justice issues are addressed in the planning process as well as the way the benefits and burdens of transportation investments are distributed across various populations.

Preliminary negotiations called for a two-phase analysis of transportation equity in the Atlanta region. Phase one consists primarily of addressing the "procedural aspect of the planning process, focusing on how public participation of low-income and minority communities can be enhanced and how the concerns of these communities can be better identified and addressed in the planning process."²⁴ Phase two will focus on the "substantive outcomes of the planning process, examining the distribution of transportation burdens and benefits to low income and minority communities and expanding effective participation by low-income and minority communities in the planning process."²⁵

Beyond seeking equal transportation opportunities, environmental justice efforts also strive to improve safety. Sidewalks, for instance, could greatly improve pedestrian safety. This is not a small issue, because people of color generally have higher pedestrian fatality rates than whites. The differences in fatalities by ethnicity may be due in part to differences in walking patterns. For example, national studies show that African Americans walk 82 percent more than whites, and Hispanics walk 58 percent more than non-Hispanic whites.²⁶

In a study conducted by the CDC, the Atlanta metropolitan region ranked third, just behind Fort

Lauderdale and Miami, Florida, for pedestrian fatalities. Over 300 pedestrians were killed in Cobb, DeKalb, Fulton, and Gwinnett counties from 1994 through 1998.²⁷

People of color account for less than a third of the Atlanta region's population and nearly two-thirds of all the pedestrian fatalities in the region. Rates for non-Hispanic blacks and Hispanics were two and six times greater, respectively, than for non-Hispanic whites. These statistics clearly point to safety issues that, once again, seem to disproportionately burden African Americans and Hispanics.

Transportation is a key component of building economically viable and sustainable communities, and the federal government has a major responsibility in ensuring that publicly funded transportation programs do not discriminate against or adversely affect the poor and people of color.

Transportation concerns raised by environmental justice groups revolve around fairness and equity, and these concerns are well-founded. Historically, racial bias has worked against developing unified, coordinated regional transportation systems, and transportation apartheid has relegated millions of Americans to impoverished and poorly served neighborhoods.

Past transportation policies have hit people of color especially hard because of their heavy dependence on public transit. Indeed, these policies have subsidized, reinforced, and exacerbated residential segregation and economic isolation while they have concentrated areas of poverty. They have also played a major role in shaping low-density suburban developments, creating congested free-

ways, and contributing significantly to poor urban air quality.

Citizen's groups have responded by challenging governmental agencies to open up their planning processes, to diversify their boards, and to begin addressing land-use, air quality, and equity issues that disproportionately and adversely affect the region's low-income communities and communities of color. Community leaders are also calling for transportation agencies to identify and address inequitable distribution of transportation benefits and burdens.

The process of bringing equity to transit policies began with an end to separate-but-equal apartheid. America still has a long way to go, however, before it finds true equity for all who travel on the nation's transportation networks.■

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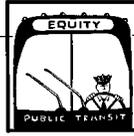
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Mean Streets

Transportation equity improves social justice, economic vitality, and environmental quality.

BY ROBERT GARCÍA

Martin Luther King Jr. recognized that urban transit systems in most American cities are a genuine civil rights issue.¹ Today, close to half a century later, urban transit systems remain largely untouched by the reforms of the civil rights movement. However, a growing movement is working to make equal justice for all a reality in the transportation field.

Consider the case of Kyle, a 26-year-old single Latina mother of two and a bus rider in Los Angeles. She works at a drug prevention program after having come off of welfare, which she describes as hell. Now she faces the new hell of her daily commute.

At 6 a.m. Kyle is at the bus stop with her children. Fourteen-month-old Ishmael is asleep on her shoulder; five-year-old Mustafa holds her hand. Two buses later

she drops off Mustafa at school in Inglewood. Then she rides two more buses to get Ishmael to his baby sitter in Watts. From there it is half an hour to work. Kyle arrives about 9 a.m., three hours and six buses after starting. “The boys and I read. We play games, we talk to other people, we spend the time however we can,” she said. “In L.A. County, it’s very difficult to live without a car.”²

Kyle’s story is all too common. It illustrates the need for a national transportation equity agenda—one that provides choices to people who currently lack them.³

The typical bus rider in Los Angeles is a Latina woman in her 20s with two children. Among riders, 69 percent have an annual household income of \$15,000—which is below the federal poverty line—and no access to a car; 40 percent have household incomes under \$7,500.⁴ Elsewhere in the

United States, the statistics may change but the stories are similar.

Consider the case of Dorothy Johnson, 50, who lives in Detroit and commutes to her job in the suburbs, cleaning office buildings. She leaves home about 3 p.m. on weekdays and gets to work two buses and two hours later. She leaves work at 11 p.m. and gets home by 12:30 a.m. “There aren’t too many jobs here in Detroit,” she said. Jobs closer to home have another drawback: “The city sort of pays less.” If she had a car, the drive would take only 25 minutes. But folks like her cannot afford a car. Only one in four residents owns one.

Ruthie Walls, a single mother looking for affordable housing for her children, bought a house in Atlanta surrounded by freeways on three sides. Cleaner cars have not stopped the harm she and her neighbors still suffer from the air, water, and noise pollution of increased traffic congestion. Their children play in toxic brake and tire dust collected in the creek that often floods their homes with runoff from the roads. They breathe the diesel exhaust from dirty buses. But they pay higher taxes for storm water cleanup caused by roads that serve suburban commuters and truck drivers.

Because those who most rely on transit services are disproportionately poor—people of color, women, children, the elderly, and the disabled—transportation is a social justice issue. Because better transit service can increase the mobility of such people, enabling them to reach jobs, schools, training, shopping, and other activities, transportation is also an economic issue. Finally, because cleaner, better, cheaper transit service offers an alternative to the single-user au-

tomobile and reduces congestion, pollution, and consumption of energy and other natural resources, transportation is an environmental issue.

What these women and others like them throughout the nation who have limited or no access to cars need—indeed, what we all need—are transportation policies that promote equity, economic vitality, and environmental quality.

Equity into Action

If the Kyles, Dorothys, and Ruthies of America are to be helped and transportation equity is to be achieved, transportation agencies need a plan of action. As part of that plan, these agencies should gather and analyze the information necessary to understand the impacts of transportation decisions on all communities. They need to follow the money: Who benefits? Who is left behind?

Transportation agencies also need to ensure the full and fair participation by all communities in the transportation decision-making process.

Finally, they should adopt non-discriminatory policies and practices. This means no intentional discrimination and no unjustified adverse impacts against selected groups, such as the poor and minorities, when there are less discriminatory alternatives.

The historic 1996 case *Labor/Community Strategy Center v. Los Angeles County Metropolitan Transportation Authority*, filed on behalf of low-income and minority bus riders, illustrates the need for such a three-part framework. The plaintiffs in this lawsuit alleged that MTA operated separate and unequal transit systems that discriminated against low-income and mi-

nority populations, violating Title VI of the Civil Rights Act of 1964.

MTA settled the case through a court-ordered consent decree and agreed to invest over a billion dollars—the largest-ever civil rights settlement—to improve the bus system. The settlement improved not only equity, but also economic efficiency and environmental quality by increasing personal mobility while reducing congestion, pollution, and energy use.

The Power of Information

The lawsuit allowed the plaintiffs to present a well-documented story about MTA's pattern and history of inequitable, inefficient, and environmentally destructive allocation of resources.

■ **Racial disparities.** While 80 percent of the people riding MTA's bus and rail lines were minorities, most of the minorities rode only buses. On the other hand, only 28 percent of riders on Metrolink—MTA's commuter rail line—were minorities.⁵ Thus, the percentage of minorities riding Metrolink varied by 173 standard deviations from the expected 80 percent. The likelihood that such a substantial departure from the expected value would occur by chance is infinitesimal.⁶

■ **Subsidy disparities.** While 94 percent of MTA's riders rode buses, MTA customarily spent 70 percent of its budget on rail. Data in 1992 revealed a \$1.17 subsidy per boarding for an MTA bus rider. The subsidy for a Metrolink commuter rail rider was 18 times higher, however, or \$21.02. For a suburban light-rail streetcar passenger, the subsidy was more than nine times higher, or \$11.34; and for a subway passenger, it was two-and-a-half times higher, or \$2.92.

For three years during the mid-

1980s, MTA reduced the bus fare from 85 cents to 50 cents. Ridership increased 40 percent during the period, making this the most successful mass transit experiment in the post-war era. Despite this increase in demand, MTA subsequently raised bus fares and reduced its peak-hour bus fleet from 2,200 to 1,750 buses.

■ **Security disparities.** While MTA spent only three cents for the security of each bus passenger in fiscal year 1993, it spent 43 times as much, or \$1.29, for the security of each passenger on the Metrolink commuter rail and the light rail, and 19 times as much, or 57 cents, for each passenger on the subway.

■ **Crowding disparities.** MTA customarily tolerated overcrowding levels of 140 percent of capacity on its buses. In contrast, there was no overcrowding for riders on Metrolink and MTA-operated rail lines. Metrolink was designed to have three passengers for every four seats so that passengers could ride comfortably and use the empty seat for their briefcases or laptop computers.

■ **Impacts of discrimination.** Such disparate treatment has devastating social consequences. The Governor's Commission on the 1964 Los Angeles riots found that transportation agencies in Los Angeles County "handicapped minority residents in seeking and holding jobs, attending schools, shopping, and fulfilling other needs" and that the inadequate and prohibitively expensive bus service contributed to the isolation that led to the Watts riots and rebellion.⁷

Thirty years later, following the riots and rebellion in Los Angeles in the wake of the acquittals in the Rodney King beating, MTA com-

missioned a new study on inner-city transit needs that echoed the recommendations of the Governor's Commission. MTA, however, did not comply with the recommendations of either report.

The MTA case highlighted the complexities of race, ethnicity, and class that is common in transportation equity issues around the nation. Racial and ethnic exclusion is often symptomatic of a larger, structural unfairness that affects all people who are powerless to protect themselves, including disadvantaged whites. Indeed, the definition of the class of bus riders in the MTA case included white bus riders because discrimination against any one diminishes everyone. People of color with power

and money, on the other hand, were among the defendants.⁸

The consent decree settling the MTA case contained two provisions critical to achieving transportation equity. First, it required MTA long-range plans, major capital projects, and annual budgets to include a section on meeting the transit needs of people with little or no access to cars. Second, it required participation of bus riders in the decision-making process.

The MTA case was settled with help from a broad coalition of support that included Republican Mayor Richard Riordan, the libertarian Reason Foundation, free-market efficiency advocates at the University of Southern California, self-described liberal transporta-

tion and statistics experts at UCLA, and grassroots and community-based groups such as the Labor/Community Strategy Center, the Bus Riders Union, and the Southern Christian Leadership Conference.

Indeed, the MTA case is a good example of how a highly organized grassroots campaign can team up with creative, civil-rights lawyers and academic experts to achieve social change. Together, the participants collected and analyzed the data, organized the community, made the political connections, presented the case to the media, and won the groundbreaking lawsuit that brought transportation equity to Los Angeles.

RIDING THE FREEDOM BUS IN L.A.

BY KIKANZA RAMSEY

In 1992, when a jury acquitted three LAPD officers and admonished a fourth for the beating of Rodney King, Los Angeles erupted in violence. More than 50 people were killed, thousands were injured, a billion dollars in property was destroyed, and burning palm trees along the 405 lit up the night sky.

In the shadow of this urban uprising, community and political leaders called for the residents of L.A. to settle down and try to get along with one another, but very few people or organizations could recommend a coherent strategy to get to the roots of the riot.

At its heart, the rebellion represented a struggle against institutional racism and economic devastation that was two decades in the making. During his five terms in office, Mayor Tom Bradley embraced the Reagan-Bush-Clinton strategy of economic development for the rich and the flight of corporate capital from working-class communities. In the late 1970s and early 1980s, this strategy took hundreds of thousands of jobs from well-paid unionized workers, a large number of whom were women and people of color who had only recently won access to such jobs through

the civil rights and women's movements.

In 1993 in the wake of the riots, the Los Angeles-based Labor/Community Strategy Center—a multiracial, anticorporate organization committed to democratic social change led by working-class communities of color—began exploring one source of the frustration that was still simmering: mass transit. As an organizer with the Strategy Center, I was a participant in that exercise. We developed a transportation study group comprising Strategy Center organizers, bus riders, progressive transit planners, and representatives from other community groups like Concerned Citizens of South Central Los Angeles.

At the time, the L.A. bus system was being systematically defunded and dismantled to build a tiny but wildly expensive urban subway and to fund suburban commuter trains. This strategy was driven, not by mass transit needs, but rather by billions in corporate profits made from rail construction contracts (roughly 15 billion dollars will have been spent on L.A.'s rail system when it's finally paid off). Consequently, low-income and mostly of-color bus riders faced service cuts, fare increases, and

Beyond MTA

Outside of Los Angeles, others are working toward transportation equity. In 1998, for example, the Southern California Association of Governments adopted a regional transportation plan that is committed to complying with Title VI of the Civil Rights Act. While the Southern California Association of Governments is the only transportation agency in the country that explicitly analyzes the impact of transportation proposals on low income communities and communities of color in its regional transportation plan, it shows how agencies should incorporate transportation equity and public participation into the planning process.

In Atlanta, the U.S. Department of Transportation is pursuing transportation equity with the help of Environmental Defense⁹ and local environmental justice advocates. Specifically, DOT is analyzing:

- how environmental justice issues are addressed in the planning process,
- how transportation benefits are distributed across various populations, and
- how the burdens of transportation investments—including adverse environmental, health, and interrelated social and economic effects—are distributed across various populations.

DOT hopes to increase awareness of the issues and encourage

actions to increase equity in transportation.

New guidance from DOT makes clear that transportation agencies need to examine the cumulative effects of transportation investments to consider how alternatives would promote equity while cutting pollution and congestion. The President's Order on Environmental Justice affirms the principle of using the planning process to implement civil rights and environmental laws, including Title VI of the Civil Rights Act of 1964 and the Transportation Equity Act for the 21st Century (TEA-21). TEA-21 reaffirmed the 1991 ISTEA reforms, which helped open the planning process to greater public scrutiny. TEA-

highly polluting buses—allegedly because of a public transportation budget crisis—while Los Angeles County's Metropolitan Transportation Authority board members spent hundreds of millions of dollars on rail at every monthly meeting right before our eyes.

Adding insult to injury, as the MTA opened new rail lines, it significantly cut bus service in communities along the rail lines, forcing people onto the rail system even when that required thousands of riders to make extra transfers and to walk further, given the much longer distances between rail stations.

Put yourself in the shoes of one of these bus riders. During the 15 years of rail construction, you watch as the bus fares nearly triple, your average wait time doubles, overcrowding turns the buses into sardine cans, and bus pass-bys and breakdowns become daily routines while the most expensive subway in the world is built with your money—using a regressive 1-percent sales tax.

As usual, you grab the 31 east bound toward downtown where you are a janitor. Halfway through the ride, the bus line ends. You pile out with 50 others and jostle your way down stairs and escalators to the subway that will take you the final leg into downtown. The closest subway station to your job, however, is five blocks further than when you took the bus that dropped you at the corner. But the MTA is happy because subway ridership is up. And yet

you are considered one of the lucky ones because the vast majority of L.A.'s 450,000 bus riders make bus trips that never come close to the region's tiny rail system.

Building a grassroots movement to redistribute public wealth away from corporate power and back to oppressed people presented a considerable challenge for Strategy Center organizers, particularly since Los Angeles is sharply segregated along racial and class lines. But there's no better place to unite such a movement than around the government and corporate collusion that produced what we call transit racism. The city's daily bus riders represent a diverse population—60 percent female, 85 percent people of color, 60 percent below poverty income, and another 25 percent low income—united by shared political interests and a common mode of transportation.

From 1992 to 1994, we worked with several transit experts, read volumes, and attended every MTA public meeting to educate ourselves on the details of mass transit history, technology, and policy. In 1994, we launched the Bus Riders Union and the Billions for Buses campaign. "Fight Transit Racism" was our slogan and we rode the buses for thousands of hours, mobilizing bus riders from South Central to Pico Union to East L.A. to Koreatown who had experienced the MTA's institutional racism first hand. Bus Riders Union members developed a set of core demands: a 50-cent bus fare; a \$20 monthly bus pass;

21 contains incentives that encourage employers to pay employees more money, instead of providing a free parking space, and to pay for transit and van pool services. The 1990 Clean Air Act conformity provisions, which hold transportation investments accountable as part of state plans to protect the public from air pollution, and the National Environmental Protection Act of 1970 can also serve as tools for transportation equity.

Highways and Land Use

Just as transportation decisions affect social equity, economic vitality, and environmental quality, those decisions are affected by other factors, such as highway

spending.¹⁰ Investing in highways rather than transit may produce unjustified adverse impacts on low-income and minority populations, even though less discriminatory alternatives may be available.

In Atlanta, for example, Environmental Defense challenged \$700 million in highway projects that were exempted from current requirements of the Clean Air Act. Environmental Defense gathered a coalition of environmentalists and civil rights activists and asserted that the projects violated the Clean Air Act, Title VI of the Civil Rights Act of 1964, and other environmental laws. The coalition claimed that proposed projects would not serve the transportation

needs of minority and low-income people who had limited access to cars. In addition, it claimed that the projects would pollute the air, harming all residents but having the greatest harm on African American children, who are five times more likely to suffer from asthma than whites or other ethnic groups. (See “The Routes of American Apartheid” in this issue of FORUM.)

Land-use planning and patterns also affect transportation policies and vice-versa. Consequently, they should be addressed together. For example, sprawl in Los Angeles was initially generated not by the freeway system, which started in 1943, but by the Los Angeles and Pacific Electric Railway system,

2,000 new, low-polluting, compressed natural gas buses; a moratorium on all rail spending; and an elected, rather than appointed, MTA board.

The MTA board—composed of the most powerful politicians in the region from both political parties, many of whom are people of color—treated us with disdain and ridicule if they bothered to notice us at all at public hearings. At one fateful monthly board meeting in the summer of 1994, the board members declared a fiscal crisis in the face of a \$60 million deficit and voted to raise bus fares and eliminate altogether the monthly bus pass—the transit lifeline for tens of thousands of bus riders.

At that same meeting, the board members voted \$60 million to begin constructing an extension of the Blue rail line from downtown to affluent and mostly white Pasadena. The arrogance of MTA power and rail corruption had reached a new level. In response, the Bus Riders Union and Strategy Center launched a federal civil-rights lawsuit against the agency, based on Title VI of the Civil Rights Act of 1964, which prohibits state and local agencies from using federal funds in a racially discriminatory manner.

We won an immediate restraining order against the fare hike and elimination of the pass. Two years later, the lawsuit far surpassed anyone’s expectations. At the end of 1996, it was settled with a 10-year consent decree in which the union won nearly a billion dollars in conces-

sions for women, communities of color, and working-class people. MTA even committed to an “on-time performance warranty,” which offers free rides if buses are more than 15 minutes behind schedule. Of course, before the ink was even dry, the MTA began to delay, subvert, and try to have the entire consent decree overturned. So the union is still working to enforce the conditions of the consent decree. Still, hundreds of millions of dollars to date have been successfully returned to low-income bus riders.

It is in the realm of practice that analysis and theory can be tested, affirmed, or revised. So it is with direct grassroots organizing. After nine years as an organizer with the Strategy Center—five of which I spent building the Bus Riders Union—I have grown more comfortable with the reality that the work of fighting for social justice and structural social change is largely an experiment. Our experiment challenged the policies and structures that govern our market-driven society. It showed that institutionalized racism and oppression can be successfully attacked head on and that we can have a more just society, predicated on social policy that is built around human need, not profit motive.■

Kikanza Ramsey, an activist with the Labor/Community Strategy Center, was the lead organizer of the Bus Riders Union in Los Angeles, California.

which served Southern California from Long Beach to San Fernando, and from Riverside to San Pedro, from 1901 through the mid-century. The light rail system made residential sprawl possible far from the urban core of Los Angeles.¹¹

Los Angeles also pioneered the use of racial covenants in deeds, which restricted African Americans from buying homes in white neighborhoods. Through the 1930s, the Federal Housing Authority subsidized racially homogeneous neighborhoods. Some economists have estimated that the federal government has spent more than \$2 trillion subsidizing the flight of white people from central cities. As a result, Los Angeles and other cities today face a spatial mismatch between jobs, homes, and transportation.¹² By planning for multicultural, multiuse communities that are better suited to transit, walking, and biking, we can create healthier communities with more mobility, greater access to jobs, reduced congestion, cleaner air, and more-equal justice.

It is also necessary to recognize that orders of magnitude of more low-income people and people of color depend on the automobile than on public transportation. Many minority people live in rural areas, small towns, and other out-of-the-way places, nowhere near transit services. We cannot define transportation equity solely in terms of the experience of large, metropolitan areas. We must also look at the delivery of transportation services in small towns and rural areas and elsewhere.

For many highway projects, transit is not a viable alternative. The questions of which communities are harmed by the negative aspects of highways and which

communities get service are relevant even in communities where no transit service exists. For example, highway projects generally do not displace houses and businesses in upper middle class neighborhoods to connect lower income minority residents to jobs. Instead, highway projects displace lower income and minority residents.

Finally, airports raise transportation equity issues that fall squarely within the transportation equity framework. For example, the proposed expansion of Los Angeles International Airport will affect not only communities of color and low income communities but all the people of Southern California. Major issues of concern include human health, air pollution and climate change, water quality, biodiversity, open space, noise pollution, job creation, ground transportation to flights and jobs, and displacement of communities and homes.

Continuing Struggle

Clearly, transportation equity is about more than concrete, asphalt, and steel. It's about investing in people and providing the opportunities to pursue better lives, as DOT Secretary Rodney Slater noted recently.¹³ In fact, it's part of the continuing struggle for equal justice that goes back more than 100 years to the 1896 *Plessy v. Ferguson* decision upholding segregated railroad cars and legitimizing the "separate but equal" treatment of whites and people of color.¹⁴

Indeed, the modern civil rights movement has roots in the Montgomery bus boycott led by Rosa Parks and Martin Luther King Jr., who recognized transportation as an issue that lies at the intersection of civil rights, economic vi-

talinity, and the environment. Addressing the need for structural reforms to deal with race and poverty, Rev. King wrote:

When you go beyond a relatively simple though serious problem such as police racism...you begin to get into all the complexities of the modern American economy. Urban transit systems in most American cities, for example, have become a genuine civil rights issue—and a valid one—because the layout of rapid-transit systems determines the accessibility of jobs to the black community. If transportation systems in American cities could be laid out so as to provide an opportunity for poor people to get meaningful employment, then they could begin to move into the mainstream of American life.¹⁵

Decades later, the experience in Los Angeles demonstrates that some transportation policies continue to nurture an environment that is not only separate, but starkly unequal. Nonetheless, as efforts in the wake of the MTA case show, there is hope. Transportation equity can be achieved and with it improvements in social justice, economic vitality, and environmental quality.■

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NOTES

1. James Melvin Washington, ed., *Martin Luther King, A Testament of Hope: The Essential Writings and Speeches of Martin Luther King, Jr.* (San Francisco: Harper, 1991) pp. 325-26.

2. Eric Bailey, "From Welfare Lines to Commuting Crush," *Los Angeles Times* (October 6, 1997).

3. Norman Krumholz, "A Retrospective View of Equity Planning," *Journal of the American Planning Association* 48(2) (1982), p. 163. Quoted in Mark Garrett and Brian Taylor, "Reconsidering Social Equity in Public Transit," *Berkeley Planning Journal* 8 (1999).

4. MTA Service Planning Market Research Program, *FY 96-97 Bus On-Board Passenger Survey* (March 1998), p.16.

5. The typical Metrolink rider was a white male who had an annual household income of \$64,000 and owned at least one car.

6. See *Castaneda v. Partida*, 430 U.S. 482, 496 n.17, 97 S. C. 1272, 51 L. Ed. 2d 498 (1977).

7. Governor's Commission on the Los Angeles Riots, *Violence in the City: An End or a Beginning? A Report by the Governor's Commission on the Los Angeles Riots*, December 2, 1965 (New York, 1969).

8. More information about the MTA case appears at <<http://www.environmentaldef>

<http://www.environmentaldefense.org/programs/Transportation/Equity/>>. See also Bill Lann Lee, "Civil Rights and Legal Remedies: A Plan of Action," in R. Bullard and G. Johnson, eds., *Just Transportation: Dismantling Race and Class Barriers to Mobility* (Gabriola Island, BC: New Society Publishers, 1997).

9. The Environmental Defense Fund, or EDF, recently changed its name to Environmental Defense. See <<http://www.environmentaldefense.org>>.

10. Bullard and Johnson, *Just Transportation*.

11. See Martin Wachs, "The Evolution of Transportation Policy in Los Angeles," in A.J. Scott and E.W. Soja, eds., *The City: Los Angeles and Urban Theory at the End of the Twentieth Century* (Los Angeles: University of California Press, 1997).

12. See R. Waldinger and M. Bozorgmehr, eds., *Ethnic Los Angeles* (New York: Russell

Sage Foundation, 1992); John Powell, "What We Need to Do about the 'Burbs'," *ColorLines* (Fall 1999); "Timeline of Environmental Justice in Los Angeles" at <<http://www.environmentaldefense.org/programs/EJ/>>; Robert Garcia, "Riots & Rebellion: Civil Rights, Police Reform, and the Rodney King Beating" at <<http://www.ldfla.org/riots.html>>.

13. US DOT, Office of the Secretary, Office of Public Affairs, "Secretary Slater Applauds Southwest Alameda Corridor," DOT press release (July 8, 1999) (DOT 102-99).

14. *Plessy v. Ferguson*, 163 U.S. 537 (1896), was overturned 59 years later in *Brown vs. Board of Education*, 347 U.S. 483 (1954).

15. Washington, ed., *Martin Luther King, A Testament of Hope*.

16. The author was one of the lead attorneys on the MTA litigation, while working for the NAACP legal Defense and Educational Fund. He retains the copyright to this article.



Making Sense of Environmental Justice

Environmental justice advocates face cantankerous legal questions as they come to grips with transportation issues.

BY MICHAEL W. STEINBERG

Environmental justice has become a major issue for planners, funding agencies, and local communities involved with transportation projects. Today, such projects as highways, urban mass transit systems, and airports cannot pass muster without first coming under the watchful eyes of environmental justice advocates. A highly visible example occurred this summer when a federal appeals court stayed Atlanta's \$19 billion, 25-year transportation plan, which the U.S. Environmental Protection Agency had already approved.¹ Environmental and civil rights groups had filed the lawsuit, complain-

ing that the plan focused too much on the mostly white, affluent northside of Atlanta and too little on older urban neighborhoods, in violation of the transportation conformity provision of the Clean Air Act.²

Since President Clinton issued an executive order on environmental justice in 1994, requiring federal agencies to make environmental justice a part of their mission,³ and especially since the U.S. Department of Transportation issued its own order in 1997,⁴ expanding on the executive order, federally funded or approved transportation projects have come under increasing scrutiny over environmental justice concerns. This scru-

tiny will only increase in the future as environmental justice reviews of transportation projects will be routinely conducted, pursuant to a recent order issued by the Federal Highway Administration and the Federal Transit Administration.⁵ In short, understanding and achieving environmental justice in transportation projects will be a critical challenge for many years to come.

Defining Terms

Environmental justice is one of the most loaded expressions in the political lexicon. It is also notoriously difficult to define. In theory, environmental justice involves the "fair treatment and meaningful involvement of all people regardless of race, ethnicity, culture, income or educational status, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."⁶ In practice, environmental justice demands that federally funded transportation projects with negative environmental impacts not be dumped in areas where the local residents are predominantly minority or low-income citizens.

Applying environmental justice to transportation projects is an especially difficult proposition, perhaps best illustrated by considering highway projects. Highways are not discrete facilities that fit into relatively small, circumscribed areas. On the contrary, highways are large, sinuous structures that traverse many neighborhoods and affect members of various ethnic groups. Determining whether particular groups, such as minorities or those who live on low incomes, are disproportionately harmed by these projects can be extremely difficult.

Fortunately, three sets of legal rules help shed some light on environmental justice issues:

- Title VI of the Civil Rights Act of 1964,⁷
- the National Environmental Policy Act of 1969 (NEPA),⁸
- a series of administrative documents issued by DOT and two of its agencies, the Federal Highway Administration and the Federal Transit Administration.

Given the high profile of environmental justice issues, it is increasingly important for planners, funding agencies, funding recipients, and local communities to understand just what the law requires. Unfortunately, the law is in such an early state of development that it is easier to pose the questions than to suggest the correct answers.

Title VI

The current prominence of environmental justice as an issue for transportation projects stems in part from a recent wave of “disparate impact” litigation under Title VI, which prohibits discrimination on the basis of race, color, or national origin under any activity receiving federal funds. Although the use of Title VI to oppose construction of transportation projects is not new,⁹ the use of Title VI to address the alleged disparate impacts of such construction is rapidly accelerating.

Disparate impacts have been defined as impacts that disproportionately affect certain groups such as racial minorities.¹⁰ This broader conception of discrimination has far-reaching implications and is highly controversial. In a recent challenge to a highway project, a federal appellate court characterized as an “unmanageable proposition” the claim that antidiscrimi-

nation laws assure an “equal distribution of benefits” and a “proportional burden” on each ethnic group. As the court recognized, a multicultural society cannot site highways or other transportation projects without imposing somewhat different burdens on different groups.¹¹

A series of difficult but fundamental questions must therefore be answered before Title VI can be used to evaluate disparate impacts of transportation projects:

- Although the Supreme Court has upheld federal agency authority to prohibit disparate impacts caused by recipients of federal funding, it still remains to be seen whether private citizens may sue to enforce those prohibitions against recipients of federal funds.¹² Enforcement ultimately may depend upon the willingness of federal agencies to terminate funding for highly popular transportation projects.
- Whether enforcement occurs through the courts or through DOT, federal courts have yet to develop clear standards for determining when a disparate impact exists and what facts might justify imposing such an impact.
- DOT’s order is likewise unclear about disparate impacts, and it addresses many issues that are not encompassed by Title VI, such as prohibiting disparate impacts on low-income individuals.¹³
- Title VI may also be used to redress disparate impacts on *majority* ethnic groups.¹⁴ Thus transportation projects that impose disparate impacts on whites, for instance, are prohibited by regulation, unless the projects qualify as permissible affirmative action to remedy the effects of past discrimination against minorities.¹⁵ Increased efforts to prevent or mitigate impacts on minorities therefore are likely

to engender disputes alleging that such efforts constitute impermissible affirmative action because they are not healing old discrimination wounds. At a minimum, the increased focus on disparate impacts is certain to force transportation planners to look both ways as they seek to navigate through this uncertain terrain between permissible and impermissible affirmative action.

Complex Decisions

Title VI explicitly prohibits recipients of federal funding from intentionally discriminating on the basis of race in ways that are impermissible under the Equal Protection Clause of the 14th Amendment to the U.S. Constitution.¹⁶ A seriously divided U.S. Supreme Court in 1983 held that Title VI also authorizes federal agencies to prohibit disparate impact racial discrimination.¹⁷

In the wake of this decision, DOT, along with other federal agencies, issued regulations that prohibit discrimination on the grounds of race, color, or national origin by recipients of federal transportation funds or other assistance.¹⁸ This prohibition applies to all activities, including the siting of highways and facilities.¹⁹

DOT’s regulations also prohibit disparate impact discrimination. The disparate impact, moreover, must discriminate because of race rather than some other, permissible factor.²⁰ Racial imbalance alone is not enough to show disparate impact. The courts note that there are too many innocent causes that can lead to racial imbalance.²¹ The disparities in impact among the races must be severe enough to create an inference that race, color, or national origin is the cause of the imbalance.²²

This point is critically important: disparities in treatment are not discrimination although they may result from discrimination. Racial disparities are not necessarily prohibited and do not necessarily show that discrimination is occurring. Consequently, DOT's regulations do not require that every person or ethnic group be treated the same; they require only that differences in treatment are not the result of intentional discrimination on the basis of race.

Determining whether disparities of treatment result from racial discrimination is difficult, because it may be hard to prove what effects would result in the absence of discrimination. The Supreme Court and Congress laid the groundwork for such a determination when they developed a "burden-shifting" approach to proving disparate impacts on the basis of race in employment discrimination cases under Title VII.²³ Federal district and appellate courts have applied this approach to Title VI.²⁴ A plaintiff can show disparate impact discrimination by proving that:

- a practice has a disparate impact on a protected racial group,
- the practice causes the disparate impact, and
- the disparity is significant enough to provide an inference of racial discrimination.

Once the plaintiff—who believes she has been the victim of discrimination—has established a disparate impact case, the burden then shifts to the defendant to prove that the difference in treatment caused by the practice is justified on a legitimate basis rather than on race. The plaintiff may then show that the justification is a pretext by showing that less discriminatory alternatives are reasonably available.²⁵

A state transportation department, for example, might justify a proposed highway route through poor black communities on the basis that the land through the poorer neighborhoods was cheaper to buy. A plaintiff might then show that while land prices per acre for an alternative route, which cut directly across a mostly white, affluent neighborhood, would be higher, the total cost to purchase land for the two routes is not significantly different, because the alternative route through the richer neighborhood is much shorter.

Arbitrary Controls

Although this burden-shifting approach is relatively clear in its basic conception, it is extremely complex in its application. Traditionally, disparate impacts were proven by comparing the race of persons applying for, say, a particular job with the race of those who were hired.

Applying such an analysis to transportation projects is much more difficult. For example, if the purpose of a project is to widen an existing highway to alleviate congestion, there are no alternative sites. Unless the highway happened to be located in an area that was demographically homogenous, it would necessarily impose disparities of treatment on different ethnic groups. Normally, in determining whether a particular ethnic or socioeconomic group is disproportionately affected by a project, the affected group is compared to a control population that is not affected, or is only nominally affected, by the project.

In the case of a highway project, the control population might be the population of the city or county that the highway passes

through. Thus, if the population of the city is 30 percent minority, while the population of the urban neighborhoods that the highway passes through is 70 percent minority, then the proposed highway route would seem to have a disproportionately high impact on minorities. In the case of a highway widening project, however, there is essentially no choice about who will be affected by the project. Thus, comparisons with a control population are meaningless.

Moreover, different disparate impacts may be revealed depending on what control population is arbitrarily selected for comparison. Consider, for example, the construction of a highway through a hypothetical city. If the entire city, which in this case happens to have a high minority population, is used as the control population, the project may indicate no disparate impacts on minorities. If, however, either the county or the state—both of which have much lower minority populations in this example—is used as the control population, disparate impacts may appear significant.

Disparate impacts in the more-usual contexts of employment and education differ from those in the realm of transportation in other ways as well. The very factors that make it hard to find an appropriate reference population, such as concentrations of minorities in the central city, may in fact be a legitimate justification for a particular project.

For example, transportation planners may site public transit systems in poorer neighborhoods where automobiles are relatively few because such neighborhoods would provide the greatest ridership and generate the greatest revenues. The same factors that jus-

tify the need for the system—such as low family income, few automobiles per family unit, and low rate of home ownership—would also be used to justify any disparate impact found to result. In such a case, it would make little sense to evaluate whether disparate impacts exist. Thus, the burden-shifting approach used in employment and school admissions cases simply may not work for transportation projects.

Even if an appropriate reference population can be identified, however, the plaintiff still must prove that discrimination has actually occurred.²⁶ And this can present a sizable challenge since the effects of transportation projects are often highly speculative or difficult to measure. Moreover, demographic information typically is either inadequate or nonexistent. In employment or admission decisions, on the other hand, there is rarely any question about the outcome, and sufficient demographic information frequently exists to determine the racial distribution, even if it may be difficult to assess whether particular practices caused those decisions.

In sum, evaluating disparate impacts of transportation projects under Title VI is a morass of complex, discretionary judgments. In particular, transportation project managers must exercise discretion when evaluating the legitimacy of qualifying criteria and choosing the required levels of statistical and practical significance that will evidence discrimination. Absent trust in the decision makers in whom such discretion is vested, judgments of disparate impacts under Title VI will inevitably breed conflict. Unfortunately, such trust is unlikely to exist in the highly charged political atmosphere sur-

rounding environmental justice disputes.

NEPA

In addition to Title VI analysis, DOT also evaluates transportation projects for environmental justice concerns by reviewing environmental impact statements (EISs) required under the National Environmental Policy Act. Today's EISs demand detailed demographic comparisons that are quite unlike the evaluations performed in the past. Although prior EISs required general evaluation of impacts and comparisons of alternatives, the new focus on environmental justice requires planners to quantify more precisely and to place a monetary value on impacts and benefits to determine whether net impacts are disproportionately high and adverse.²⁷ These evaluations are likely to be particularly contentious because the participants in the disputes often have very different understandings of the existence, magnitude, and value of the impacts and benefits.

Unlike Title VI, NEPA does not impose any substantive requirements on decision making.²⁸ NEPA is essentially a procedural statute; it requires a careful evaluation and consideration of alternatives to assure that decision makers make better decisions, but it does not require decision makers to choose the best alternative.²⁹ Under NEPA, federal agencies must consider adverse effects—including disparate impacts on the grounds of race—of major federal actions.

The Department of Transportation has issued regulations to assure compliance with NEPA for proposed transportation projects that have some federal involvement but that may or may not require a

commitment of federal funds.³⁰

Although NEPA itself does not allow citizens to sue to enforce its requirements, citizens can nonetheless sue under the Administrative Procedure Act³¹ to enforce NEPA violations by challenging final agency actions undertaken without the required NEPA evaluations.³² Numerous cases have sought to block transportation projects under NEPA, claiming that the required evaluations were not performed adequately or at all. The courts will now also have to address cases alleging that environmental justice analyses were inadequately performed under NEPA.

Federal Guidance

The Council on Environmental Quality (CEQ)—the president's chief environmental policy advisor and the agency designated to ensure compliance with NEPA—has issued a detailed guidance document on how to address environmental justice concerns under the act.³³ The document helps evaluate the environmental justice concerns expressed by the executive order while recognizing the basic limitation that NEPA neither requires nor prohibits any particular actions.

CEQ provides guidance on how to determine disproportionately high and adverse effects and how to evaluate whether such effects occur for a minority or low-income population. CEQ does not actually define *disproportionately high and adverse effects*, but rather requires consideration of such factors as whether

- significant health effects are above “generally accepted norms,”
- the risk of hazardous exposure to a racial or low-income group is significantly greater than the risk

to the general population, or ■ there are “cumulative or multiple adverse exposures” to environmental hazards.³⁴

CEQ states that a *minority population* within the impact area of a transportation project should be scrutinized to see if it is the subject of disparate impacts if it constitutes more than 50 percent of the population of the impact area or its percentage is “meaningfully greater” than the minority population percentage in the general or reference population.³⁵ As a practical matter, CEQ does not define what is “meaningfully greater.”

CEQ defines a *low-income population* as “either a group of individuals living in geographic proximity to one another, or a set of individuals . . . where either type of group experiences common conditions of environmental exposure or effect.”³⁶

CEQ’s guidance thus avoids important questions and raises additional concerns. For instance, CEQ does not provide any real guidance regarding how to determine an appropriate reference population for evaluating whether a proposed project has a disparate impact on the basis of race, income, or other distinguishing criteria.

CEQ’s logic also falters when it suggests that effects above “generally accepted norms” may be disproportionately high and adverse. The fact that impacts of a project are high says nothing about whether they are disproportionate. The impacts of a project may be excessive but may affect minority and nonminority individuals equally when compared with an appropriate reference population. Moreover, if the effects of a project are above “generally accepted norms,” good reasons other than

environmental justice are likely to raise questions about proceeding with the project. For instance, a project might be scrapped because it creates excessive air pollution—which affects all populations equally—and the cost of correcting the pollution is too high.

Similarly, CEQ implies that environmental justice impacts of particular projects should trigger mitigation and other corrective measures if there are “cumulative or multiple exposures” that cause adverse effects. Again, the fact that exposures are cumulative does not necessarily mean that they are disproportionate. Even if background cumulative exposures are disproportionate, the impacts of the particular project may not be. For example, if a new highway would add the same amount of air pollution in both minority and nonminority neighborhoods along its route, but the cumulative effects on the minority neighborhood would be greater because of existing pollution-producing plants and factories in the minority neighborhood, should the new highway project be scrapped?

Moreover, if mitigating the impacts of the highway project will not remove the pre-existing disparate effects, why should mitigation occur? Conversely, even if the disparity would be reduced, it seems highly unfair to single out a highway project unless the impacts from the other sources of the cumulative exposures—such as factories—are also mitigated.

Disproportionate Effects

As noted earlier in regard to Title VI, the fact that certain impacts are higher for minorities than for nonminorities cannot by itself demonstrate that the impacts are disproportionate. Using the earlier

example of expanding a highway, disproportionately high and adverse effects do not result simply because the highway is located in a predominantly minority community where expansion would result in more minority than nonminority individuals being displaced. Nor would the effects be disproportionate simply because a greater number of minority individuals live next to the highway than live in some larger geographic area surrounding the highway.

If there is no other location where the highway can be expanded, then there simply is no reference population from which to conclude that the adverse impacts are disproportionate. Conversely, if there are a number of alternative highways that could be expanded, then further evaluation of the demographics and the choices is required before deciding that the effects of the chosen location are disproportionate.

Finally, if the highway runs through many communities, expansion may not impose disproportionate effects when the project is compared to an appropriate reference population for the range of choices for locations. Overall, minority individuals may suffer precisely the same degree of effect as nonminority individuals, even though—almost by definition—more minority individuals will be affected in the minority communities. This may be true even if the adverse effects are appreciably more severe in a particular minority community than in any other community.

Even more than Title VI—which at least protects individuals from discrimination on the basis of race—NEPA was not intended to assure that different communities receive substantively

equal treatment. Given the innumerable differences among communities, it would be impossible to do so. CEQ's focus on communities thus is likely to inject unsubstantiated and improper claims of racial discrimination into the already volatile mixture of regional or state taxation, land use, and resource allocation disputes.

DOT Guidance

In its environmental justice order, DOT requires agencies undertaking transit projects to weigh and balance human health and environmental effects that may have a disproportionately high and adverse effect on minority or low-income populations.³⁷ It also requires the agencies to implement procedures for public involvement of affected populations during the project planning and development stages.

Like CEQ, DOT defines a *disproportionately high and adverse effect* on minority and low-income populations as an adverse effect that

- predominantly affects a minority or low-income population, or
- is "appreciably more severe or greater in magnitude" than the adverse effect that the nonminority or moderate-to-high-income population will experience.³⁸

In turn, DOT defines *minority population* as "any readily identifiable groups of minority persons who live in geographic proximity, and if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who will be similarly affected by a proposed DOT program, policy, or activity."³⁹ The definition for *low-income population* is virtually identical.⁴⁰

Again, as was the case with

CEQ, the fact that a minority community is subject to more than 50 percent of the effects—or at least appreciably more severe or greater effects—says nothing about whether those effects are disproportionate for that community, much less for minority individuals.

DOT, however, offers a uniquely inconsistent approach for finding a disproportionate effect. DOT suggests that the minority population should be identified as those individuals subjected to adverse effects and that the reference comparison should be drawn to nonminority individuals who are also affected rather than to the general population which is unaffected. This approach mandates that the adverse impacts should have approximately equal effects on minority and nonminority groups—under the "appreciably more severe or greater in magnitude" standard—in place of the proportional treatment according to race that should be required and determined based on appropriate reference comparisons.

In other words, if 5,000 minority individuals will experience adverse effects, then the project has a "disproportionately high and adverse effect" on them unless about 5,000 nonminority individuals also experience roughly the same adverse effects. DOT's approach seems likely to exacerbate racial tensions, particularly as the mandate to equalize treatment is provided only for minorities and not for majority racial groups.

On the bright side, DOT defines *adverse effects* as "the totality of significant individual or cumulative human health or environmental effects, including social and economic effects."⁴¹ DOT acknowledges that projects can be

evaluated only in regard to their overall effects and as part of larger transportation programs. So long as the overall effects of the project do not disproportionately disadvantage a particular minority or low-income population, transportation planners do not have to assure that each particular impact is not disproportionately imposed on the basis of race or income.⁴²

Income vs. Race

Finally, DOT provides different criteria for evaluating adverse effects on minority populations than it provides for low-income populations. In an apparent effort to track Title VI standards that permit disparate impacts under some circumstances, DOT standards allow projects with disproportionate effects on minorities to be carried out if

- they exhibit a substantial public-interest need, and
- alternatives that have less adverse impacts on minority populations would have more severe social, economic, environmental, or human health impacts or would be extraordinarily more costly.⁴³

This standard, however, is much more restrictive than the standard that courts have applied to find disparate impacts justified under Title VI—that is that the disparate impacts do not constitute impermissible discrimination.⁴⁴ It limits the possible justifications for a project to two, restricts at least one of those justifications—by requiring extraordinary costs—and imposes a public interest justification that does not appear in the Title VI cases. DOT provides no explanation of its reasons or basis of its authority in imposing these stringent restrictions.

DOT standards for low-income populations, on the other hand,

provide that a project with a disproportionate impact may be carried out if mitigation or alternatives that would reduce the disproportionate impact are not “practicable.” Social, economic, and environmental factors can all be considered in determining whether an alternative is practicable.⁴⁵

Similarly, the Federal Highway Administration has issued an order that requires that projects avoid, minimize, or mitigate disproportionately high and adverse environmental, public health, social, and economic effects affecting minority and low-income populations.⁴⁶ Although the order allows balancing of relevant factors, the authority for imposing such requirements for low-income populations is wholly unclear.

As CEQ recognized, addressing disproportionately high and adverse effects under NEPA may increase sensitivity to mitigation and other measures, but NEPA does not require that any such action must be taken. Thus, for low-income populations, DOT and the Federal Highway Administration may simply be acting in excess of their legal authority.

Upping the Ante

Beyond a doubt, environmental justice in transportation projects is here to stay. Three critical questions remain: Will the courts and the agencies fashion a set of legal standards that provides the clarity and predictability so vital to the successful planning and completion of these multi-billion-dollar projects? Will those legal standards effectively prevent odious discrimination? Will they mandate an artificial numerical “equality” of impacts that is neither desirable nor achievable? For our so-

ciety, the stakes could scarcely be higher. ■

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NOTES

1. *Georgians for Transportation Alternatives v. EPA*, No. 00-12187 (11th Cir. decided July 18, 2000).

2. 42 U.S.C. § 7506 (1994).

3. Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations” (February 11, 1994). Section 1-101 defines agency responsibilities: “To the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report on the National Performance Review, each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Marian Islands.”

4. “Department of Transportation (DOT) Order to Address Environmental Justice in Minority and Low-Income Populations,” 62 *Federal Register* 18,377 (1997).

5. Gordon J. Linton and Kenneth R. Wykle, “Implementing Title VI Requirements in Metropolitan and Statewide Planning,” TOA-1/HEPH-1 (October 7, 1999).

6. EPA, “Guidance for Incorporating Environmental Justice Concerns in EPA’s NEPA Compliance Analyses” (April 1998).

7. 42 U.S.C. § 2000d et seq. (1994).

8. 42 U.S.C. §§ 4321-4370d (1994).

9. See, for example, *Nashville I-40 Steering Comm. v. Ellington*, 387 F.2d 179 (6th Cir. 1967).

10. *Ibid.*

11. *Jersey Heights Neighborhood Assn. v.*

Glendening, 174 F.3d 180, 193-94 (4th Cir. 1999).

12. Compare *Jersey Heights Neighborhood Assn. at 192* with *Chester Residents Concerned for Quality Living v. Seif*, 132 F.3d 925 (3d Cir. 1997).

13. DOT Order to Address Environmental Justice, § 8. Title VI prohibits discrimination on the basis of race, color, or national origin. It is silent about low-income people.

14. See *Regents of the University of California v. Bakke*, 438 U.S. 265 (1978).

15. See *Adarand Constructors, Inc. v. Peña*, 515 U.S. 200, 215-24 (1995).

16. *Bakke*, 438 U.S. at 278-80.

17. *Guardians Association v. Civil Service Comm’n of City of New York*, 463 U.S. 582, 592 (White, J., 1983).

18. 49 C.F.R. § 21.5 (1998).

19. 49 C.F.R. § 21.5(b)(3) (1998).

20. *Powell v. Ridge*, 189 F.3d 387, 395 (3d Cir. 1999). The plaintiffs alleged that Pennsylvania’s formula for allocating funds to school districts resulted in less funds going to schools that had higher percentages of minority students. The students in the districts receiving less funds suffered because they had higher student-to-teacher ratios, reduced curricula, fewer textbooks and supplies, and less equipment.

21. *Wards Cove Packing Co. v. Atonio*, 490 U.S. 642, 657 (1989). The plaintiffs were cannery workers, who were nonskilled, poorly educated, and mostly minorities, while the managers were better educated and mostly whites. Skill level and education were factors that affected hiring decisions. The Supreme Court also noted that nepotism and rehiring preferences were objective criteria that could have a disparate impact on minorities.

22. *Watson v. Fort Worth Bank & Trust*, 487 U.S. 977, 994-95 (1988).

23. 42 U.S.C. § 2000e-2(k).

24. See, for example, *Elston v. Talladega County Bd. of Educ.*, 997 F.2d 1394, 1407 (11th Cir. 1993); *New York Urban League, Inc. v. New York*, 71 F.3d 1031, 1036 (2d Cir. 1995).

25. See *Wards Cove*, 490 U.S. at 659 (Title VII); see also *Griggs v. Duke Power Co.*, 401 U.S. 424 (1971) (Title VII); *Georgia State Conference of Branches of NAACP v. Georgia*,

775 F.2d 1403, 1420 (11th Cir. 1985) (Title VI); *National Association for the Advancement of Colored People v. Medical Center, Inc.*, 657 F.2d 1322, 1336-37 (3d Cir. 1981) (Title VI).

26. *Flores v. Arizona*, 48 F. Supp.2d 937, 951 (D. Ariz. 1999) (citing *Rose v. Wells Fargo*, 902 F.2d 1417, 1421 (9th Cir. 1990), and *Garcia v. Spun Steak Co.*, 998 F.2d 1480, 1486 (9th Cir. 1993)).

27. See, for example, Executive Order 12,898 § 1-101; DOT Order to Address Environmental Justice § 8.b. & App., § 1.g.

28. See, for example, *Vermont Yankee Nuclear Power Corp. v. NRDC*, 435 U.S. 519 (1978); *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332 (1989).

29. 42 U.S.C. § 4332 (1994).

30. 49 C.F.R. Part 622 (1998); 23 C.F.R. Part 771 (1998) (applicable to FHWA and the Urban Mass Transportation Administration).

31. 5 U.S.C. § 706 (1994).

32. See, for example, *Lujan v. Nat'l. Wildlife Fed'n*, 497 U.S. 871 (1990).

33. CEQ, "Environmental Justice Guidance under the National Environmental Policy Act" (December 10, 1997). The U.S. Environmental Protection Agency, the other federal agency responsible for implementation of NEPA, also

published a NEPA guidance document—see endnote 6—which parallels in many respects CEQ's guidance document.

34. *Ibid.* at 26-27 ("Appendix A, Guidance for Federal Agencies on Key Terms in Executive Order 12898").

35. *Ibid.* at 25.

36. *Ibid.*

37. DOT Order, § 5(b)(1).

38. *Ibid.*, App. § 1.g.

39. *Ibid.*, App. § 1.e.

40. *Ibid.*, App. § 1.d.

41. *Ibid.*, App. § 1.f.

42. *Ibid.* § 8.b.

43. *Ibid.* § 8.d.

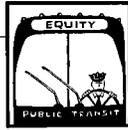
44. See, for example, 42 U.S.C. § 2000e-2(k)(1)(A) (adopting for disparate employment impacts a standard that a practice is "job related," is "consistent with business necessity," and no less discriminatory alternatives that would serve the purpose); *Georgia State Conference Branches of NAACP*, 775 F.2d at 1418-19 (adopting an "educational necessity" standard for pedagogical criteria for grouping students, but analyzing the practices in regard to their "desirability" and finding that the alternative was not "equally sound"); *New York Urban League, Inc.*, 71 F.3d at 1039

(adopting a "substantial legitimate justification" standard for minimizing traffic congestion and pollution levels; encouraging business to locate; providing additional fare-paying passengers to other activities of the funded entity); *Ferguson*, 186 F.3d at 481 (adopting a "legitimate, nondiscriminatory reasons" standard encompassing providing a socially desirable service, and finding alternatives involved "excessive costs" and were not "equally effective"); *Medical Center, Inc.*, 657 F.2d at 1336-37 (standard did not require adoption of the least disparate alternative); *ibid.*, 491 F. Supp. 290, 316, 339-42 (D. Del. 1980) (finding sufficient that the practice would lower costs and allow better services, without a showing that costs would be excessive).

45. DOT Order to Address Environmental Justice, note 2, § 8.c.

46. FHWA, FHWA Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, No. 6640.23, § 5c(2) (December 2, 1998).

47. The author gratefully acknowledges the assistance of Ms. Shira Rosenblatt, an associate in the New York office of Morgan, Lewis & Bockius LLP, in preparing of this article.



Environmental Quagmire

Environmental justice raises legitimate concerns, but these need to be rooted in solid ground.

BY RALPH PERHAC

Our environment poses a myriad of threats—some natural, some of human origin. Of those having human origins, some are intentional and some are the unintentional by-products of otherwise beneficial activities. Some threats issue from the isolated actions of individuals, some issue from the actions of business or government. Some—air pollution, for instance—are caused by disruptions of the natural environment. Others, such as consumer-product design flaws, are not.

The environmental justice movement, by and large, is concerned only with actions of big business and government that disrupt the natural environment—for example, constructing landfills and allowing factories and power plants to produce toxic or hazardous

emissions. Furthermore, the environmental justice movement, by and large, is concerned only with threats to minorities and the poor.

Thus, the movement taps into two deep undercurrents of American social conscience: environmental protection and civil rights. The movement was destined for success on these grounds alone. But if success is measured in terms of curbing the greatest threats facing minorities and the poor, some redirection of effort may be required.

Christopher Foreman—a senior fellow at the Brookings Institute—argues that if we are truly concerned about the environmental plight of the poor and minorities, we should look beyond the degradation of the natural environment.¹ The socio-political environment of drug use, violent crime, inadequate prenatal care,

broken homes, and poor education poses far greater threats to these groups, he asserts. And if justice means the fair treatment of all, then an exclusive focus on minorities and the poor must give way to a more inclusive notion of environmental justice.

Roots of Justice

The environmental justice movement was spawned by socio-demographic studies of communities—especially low-income black communities in the South—living in close proximity to hazardous waste sites. These studies concluded that racial minorities and the poor are disproportionately represented among those living in such neighborhoods.² Despite subsequent challenges to the statistical validity of this conclusion, the early studies purporting disproportionality—disparity in treatment among groups—established the focus of the environmental justice movement.³

In 1994, President Clinton's Executive Order 12898—which promotes environmental justice by protecting low-income and minority populations from toxic and other environmental assaults—institutionalized this focus by ordering federal agencies to "make achieving environmental justice a part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies and activities on minority populations and low-income populations."⁴

Executive Order 12898 is couched in terms of adverse human health effects, whereas the studies that gave rise to the environmental justice movement focused on the proximity of disen-

franchised populations to such hazardous sites as toxic waste dumps, landfills, and nuclear plants.

While it is widely assumed that proximity to hazardous sites is associated with increased human health risks, scientific support for this assumption is weak. Epidemiological support, in particular, is almost totally lacking.⁵ As a result, when environmental justice advocates speak of health risks such as cancer clusters and increased incidence of asthma, they are speaking largely of postulated and mostly unproven risks.

Executive Order 12898 also refers to “environmental effects,” which are often taken by environmental justice advocates to include adverse psychic effects, disruptions to community integrity and cultural identity, and aesthetic factors such as unpleasant sights and odors that permeate the environment.

What sorts of adverse effects, then, should properly be considered matters of justice? If justice is equated with maximizing social welfare, as utilitarian philosophers contend, then every effect that diminishes welfare counts, whether it is tangible physical harm, diminution of quality of life, or merely a belief—even a false one—that risk exists.

If, on the other hand, justice includes only those harms that transgress certain specific individual rights, then we must look circumspectly upon claims that intangible harms and the mere perception of harm constitute injustice.

Virtually everyone would agree, for example, that we have a right to be free of physical harm; governments support a police to ensure this right. And most would accept that we have a rightful

claim to relatively unadulterated water and air, even if only for their aesthetic value. The claim that we have a right to be free of psychic distress, however, is far more contentious, and it is easy to see why. Psychic distress is not a publicly observable effect. Ignoring that fact makes confirmation problematic and places inordinate burdens on individuals and society to avoid any actions that might give offense to others or that might induce fear, even if unfounded.⁶

Disproportionality

Executive Order 12898 narrows the scope of environmental justice by focusing on disproportionality and by restricting concern only to minorities and the poor.

The focus on disproportionality is significant in two respects. First, it represents a concern with relative risk among various groups, as opposed to absolute risk. When the concern is that a higher percentage of minorities and the poor than the public at large are exposed to a risk, the issue of possibly greater risks shared equally by different groups gets ignored. A preoccupation with ensuring a just—that is, proportional—distribution of risk may allow the injustice of having excessive levels of risk to persist so long as they are equally distributed.

Second, the focus on disproportionality represents an apparent concern with outcomes instead of procedures that might account for those outcomes. There is a longstanding philosophical tradition of distinguishing justice as it pertains to procedures, processes, or mechanisms from justice as it pertains to outcomes or results. Some philosophers place greater, or even exclusive, emphasis on one or the other form of justice.

For example, some judge the fairness of income distribution largely on the basis of outcomes—who has what when all is said and done. Others judge the fairness of income distribution on the basis of the fairness of mechanisms that brought it about—for instance, free market mechanisms—without direct concern for who gets how much in the end.

Where unjust processes that might lead to disproportionate risk are evident, the term *environmental racism* is often applied. Examples include

- the failure to enforce environmental regulations as stringently in minority neighborhoods,
- greater willingness to issue permits to polluting industries in such neighborhoods,
- a slower pace of cleaning up Superfund sites in such neighborhoods,
- the decision to site industrial facilities in such neighborhoods because political opposition there is weak.

There is reason to believe, however, that disproportionality is not always, or even often, the result of environmental racism. Socioeconomic analyses, for instance, have revealed that in many cases minorities and the poor voluntarily move into higher-exposure neighborhoods, where property may be less expensive or jobs more plentiful, thus creating disproportionality.⁷ The courts, in fact, have almost universally rejected claims that disproportionality is the result of racist intent.⁸ So while the environmental justice movement remains vigilant for environmental racism, as it rightfully should, its emphasis on disproportionality may be misplaced.

Executive Order 12898 emphasizes disproportionality without

considering whether it is the result of environmental racism. And researchers widely rely on geographic information systems and statistical data to identify areas of disproportional risk, without seeking out the underlying cause for the disproportionate risk.

Theories of Justice

The idea that disproportionality in and of itself is unjust is surprisingly difficult to sustain on the basis of traditional philosophical theories of justice.⁹ Environmental justice is often framed as an issue of individual rights—everyone, regardless of skin color or socioeconomic status, has a right to a healthy environment. And yet, such a right does not speak to the issue of risk distribution. If it is the case that everyone, regardless of race or socioeconomic status, has certain rights, then it is also the case that all rights violations, regardless of the racial or socioeconomic status of those affected, count equally.

Thus, the distribution of risks along racial or socioeconomic lines is, in and of itself, morally irrelevant. The morally relevant issue from the perspective of individual rights is simply the number of individuals—regardless of race or socioeconomic status—subjected to risk and the magnitude of those risks.

If the theory of individual rights cannot sustain a case against disproportional risk, can the notion of group rights do so? For instance, it might be argued that blacks as a group, by right, should face no greater exposure on average than other racial groups. Philosophers, however, have not been receptive to the notion of group rights. It seems to many that groups are not the sort of entities that can be said

to possess moral status apart from the individuals that comprise the group. And even if one accepts the possibility of group rights, an almost infinite number of groups—racial, socioeconomic, political—can be fashioned from the population of the United States, which raises the question of which groups have rights and which do not.

Along with rights-based theories of justice, the other dominant normative theory that undergirds public policy is utilitarianism, which is concerned with maximizing aggregate social welfare—the greatest good for the greatest number. Utilitarianism, however, is similarly of little help in making a case against disproportionality. Total welfare losses may actually be minimized when harm falls disproportionately on certain groups, such as the poor, who have less to lose in terms of income, property value, and other amenities when subjected to environmental harm.

A focus on disproportionality, whatever its merits, raises the question of the scope of environmental justice. Does justice require that disproportional risk be avoided along every mile of a proposed new highway? Should disproportional risk be avoided every time a permit is issued? Or is it sufficient that disproportionality is avoided when all risk-imposing decisions and affected locations are considered collectively?

And what is the appropriate reference population for determining disproportionality? Must the siting of a landfill avoid disproportional risk when the affected population is compared to the population of contiguous neighborhoods? Or should the affected population be compared to the region? To the state? A concern with disproportionality raises the prospect of an

injustice appearing—or disappearing—on the basis of nothing more than changing demographics.

Suppose, for instance, that the California Department of Transportation plans to locate a highway through a predominately Hispanic community. The disruption in lives would be disproportionately borne by Hispanics. If the project takes 20 years to move from the drawing board to the field, however, an increase in the Hispanic population in the region by the time construction begins may eliminate the disproportionality and, hence, the injustice.

The Disenfranchised

Executive Order 12898 is flawed not only because it is limited to disproportional outcomes; it also restricts the concern to only two groups affected by such outcomes: minorities and the poor. This restricted concern is widely evident in the environmental justice movement.

Policymakers, advocates, and academics rarely articulate the rationale for restricting concern to minorities and the poor. Restricting concern to these groups would be reasonable if they were the only ones facing higher than average risks. But, of course, this is not the case. The people most at risk from, say, a Superfund site are those who live downwind or down-gradient from the site, not those who are poor or black. The environmental justice movement, however, does not demand justice for those at greatest risk unless they are people of color or poor.

Since race and socioeconomic status, in themselves, are not morally relevant considerations, any special considerations the poor and minorities deserve as a matter of justice must lie with morally

relevant reasons related to race and socioeconomic status. Several possibilities suggest themselves:

■ **Coercion.** Environmental justice advocates often claim that minorities and the poor are disenfranchised politically and economically and, hence, are not able to fend off hazardous waste facilities and other pollution sources in their neighborhoods. Yet, if others are also subject to higher than average risk levels—nuclear workers, for example—this would seem to be grounds for thinking that they too cannot fend off sources of risk and, hence, are worthy of equal moral consideration with minorities and the poor. The alternative is to assume that those who are not disenfranchised willingly accept higher than average risk levels.

But if it is legitimate to infer consent in the case of the enfranchised, then why not in the case of the disenfranchised? In fact, the poor may be more willing than the affluent to accept societal risks for economic reasons. Property may be less expensive around, say, a pulp mill and accessible jobs more plentiful. People living downwind of the malodorous mill may shrug and say, “It smells like money to me.”

But environmental justice advocates will have none of this. This is not consent at work, they argue, it is economic coercion. For this reason, the disenfranchised are rightfully the focus of environmental justice, or so the argument goes.

But is it coercion? Do minorities and the poor fail to fight the placement of pollution-causing industry in their neighborhoods and even move into polluted areas because they are coerced by the lure of jobs or cheaper property?

Consider the nature of coercion. Coercion involves the threat of harm for failure to comply with a demand or offer. With what do polluters threaten minorities and the poor who refuse to allow a pollution source to move into their neighborhood? Do the polluters threaten to take their polluting plant and its associated jobs elsewhere? Perhaps, but one is hard-pressed to argue that the loss of prospective jobs because a polluting industry decides not to move into a neighborhood counts as a genuine threat of harm. People who were unemployed beforehand are still unemployed afterward. They certainly are no worse off; and without substantive threat of harm, there is no coercion.

■ **Paternalism.** Even if coercion is absent, it might be argued that minorities and the poor simply lack the political savvy or power to fight pollution sources in their neighborhoods and therefore need extra protection. This argument is not entirely without merit, nor is it totally convincing. Protection of minorities and the poor from their own political impotence must begin with the assumption that they do not, in fact, desire pollution sources in their neighborhood. But as noted, this may not always be the case; they may welcome the new jobs near their homes and readily accept the potential risks.

Protecting these groups can often amount to unwanted paternalism. The Mescalero Apaches, for instance, clearly wanted to build a monitored retrievable storage facility on their reservation in central New Mexico because they realized the storage of nuclear wastes could be an economic boon. Environmental justice advocates tried to shut down the project, however, even though the tribe

was pushing for the facility.

But what about the cases where minorities and the poor do not want pollution sources in their neighborhoods? There is a presumption in our system of government that the political process is open to all. A certain amount of individual responsibility for availing oneself of opportunities to affect political processes is also assumed. These considerations should make us wary of acting to secure outcomes that we think are more just, efficacious, or politically inclusive.

The real solution to unequal political power is reforming the political process, not dictating preordained outcomes as Executive Order 12898 does. Furthermore, to the extent that lack of political power is really just lack of initiative, there is absolutely no case for protecting the interests of those wielding little political power. There are too many instances of those without social status or wealth effecting desired political outcomes to dismiss this possibility. Rosa Parks’ refusal to give up her seat to a white man on a bus in Montgomery, Alabama, is just one small example. Her defiance ignited the civil rights movement and changed the face of America.

■ **Righting Old Wrongs.** Alternatively, the explanation for the focus on minorities and the poor may lie with the feeling that these groups have already suffered discrimination at the hands of society and that exposure to greater than average environmental risks only adds insult to injury. Of course, this rationale is primarily applicable to racial minorities, since discrimination is far more prevalent among minorities than it is among the nonminority poor.

This rationale bears some of the

earmarks of reverse discrimination. Just as those with higher qualifications may be passed over in an effort to provide greater opportunity for minorities, those at higher risk may at times be passed over in an effort to reduce risks to minorities.

This phenomenon likely occurs as a result of implementing Executive Order 12898, which strongly opposes siting a pollution source in an area with a greater than average minority population but is silent about the siting of a more serious pollution source in an all-white neighborhood. Again, whether this is justified as a matter of righting old wrongs is a complex question.

■ **The Rich Get Richer.** Still another rationale for the concern with the poor is suggested by the fact that activities that generate environmental risks often benefit affluent members of society more than they benefit the poor. A new highway, for instance, will be more beneficial to those who own automobiles than to those who cannot afford them. Moreover, the affluent consume proportionately more goods, which in turn generate greater volumes of consumer waste.

Since the affluent use more electric power, drive more automobiles, and consume more goods that produce toxic wastes, it is fundamentally unfair that the poor should face greater risks than those who enjoy the greater share of the benefits of these risk-generating activities. In fact, even proportional risk is unfair to the poor if they receive disproportionately fewer benefits than the affluent.

If, in fact, injustice exists when the poor are subjected to risks out of proportion to the benefits they

receive from risk-generating activities, however, then injustice exists whenever anyone—rich or poor—faces risks that are proportionally more beneficial to others. Neither federal policy nor environmental justice advocates do anything to address such an expansive scope of environmental justice.

Implications

What then are the policy implications of assessing the requirements of environmental justice from a broad perspective and in a manner consistent with traditional philosophical theories of justice?

First and foremost, justice would seem to preclude imposing high levels of risk on people without their consent. What constitutes “high” is open to debate, but policymakers have a clear obligation to consider absolute, and not simply relative, levels of risk. True justice should not be concerned with equalizing small risks across racial or socioeconomic groups whenever anyone—regardless of color or economic level—faces much higher risks.

Furthermore, the greatest obligation lies in lowering risk to those—regardless of racial identity or socioeconomic status—who do not benefit from the activities that generate risk.

Any policy aimed at promoting justice must concern itself with processes and procedures, not simply with outcomes. Environmental racism—understood as prejudicial and discriminatory decisions, actions, and policies—is the most pernicious form of environmental injustice, and yet Executive Order 12898 does not even address the need to look at whether environmental racism un-

derlies any disproportionate distribution of risk.

Finally, even the best-intentioned efforts to avoid siting pollution sources and hazardous waste facilities in low-income neighborhoods may be nullified by the dynamics of the housing market. If undesirable facilities are placed in more affluent communities, the affluent will leave and will be replaced by the less affluent. The only way to prevent this outcome is to limit people’s freedom to relocate, which, of course, is unacceptable in a free society.■

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NOTES

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INSIGHTS

Sensational News

Scientists serious about reaching the public should bypass the media.

BY SUSAN M. FITZPATRICK

A growing number of important policy debates—such as those about access to medical care, global climate change, genetic engineering, or Internet commerce—hinge on scientific and technical arguments. The benefits of having the pros and cons of such debates carefully considered by a scientifically literate and informed society are obvious. But how can the non-scientifically trained public access the information it wants and needs to guide informed decision making?

A popular notion among scientists is that public understanding of science would be enhanced if the popular press increased coverage of science news. But is enhanced public *understanding* of science the true driving force behind the scientific community's push for increased media coverage of science? Or might the true aim be generating public *enthusiasm* for science? Does all the media buzz truly educate the public on complex scientific issues, or does it merely generate noise? Why do

scientists consider pitching stories to the popular press as the major route for public education?

Over the past five years, I have participated in several retreats, panels, workshops, and roundtable discussion groups that brought together scientists and journalists with the aim of increasing science news coverage. The standard agenda for such gatherings is journalists, editors, and media consultants telling scientists how they can successfully package their stories. Journalists and editors explain, quite bluntly, that they are not in the education business. They are looking for news, and they are primarily interested in stories that have an element of controversy. The take-home message is that scientists need to become more media savvy. The translation of the word *savvy* as used by editors is that researchers must learn to play the game and become adept at crafting scientific findings, no matter how arcane or mundane, into news. (See "Pest Control, Rumor Control" in this issue of FORUM.) I have wondered if it

might not be time to reexamine whether or not scientists should continue doggedly down the media track.

Lost Illusions

In a 1993 letter to the editor of the *Chronicle of Higher Education*, I naively argued a point of view about relations between science and the media that was opposite to that expressed by the noted sociologist of science Dorothy Nelkin.¹ In a 1993 essay published in the *Chronicle*, which unfortunately remains relevant today, Nelkin took molecular biologists and geneticists to task for the rather irresponsible way much of the news about basic research in their fields was packaged for popular consumption.²

Nelkin was particularly concerned that the metaphors and analogies scientists use to discuss their findings were often inappropriate and promised more than the data actually delivered—describing the genome as "The Book of Man," for example. The views I expressed in my letter probably reflected what many laboratory

scientists thought seven years ago. I wrote at the time that scientists owed the public information and should be encouraged to speak out, not discouraged from it. If a researcher's enthusiasm for her published findings outpaced her skill for generating apt metaphors, it was the responsibility of the journalist to temper the tone and balance the story.

I was working from the assumption that a good science journalist, like any good journalist, should approach a science story with healthy skepticism. I believed good writing about science should explain or take into account the process of science, the way a body of scientific knowledge is built slowly by fitting together individual bits of information.

The stereotype of scientists as generally incomprehensible, unable to communicate without excessive use of jargon, didn't ring true. Many of the scientists I knew could explain their research quite clearly, and it seemed that any skilled journalist who took the time to ask careful and thoughtful questions could successfully negotiate the technical gaps.

If researchers, as had often been claimed, were unwilling to publicize the results of scientific research, I thought that could only be explained by intellectual snobbery, elitism, and sheer hubris on their part.

Today, with 20/20 hindsight, I also think that researchers' earlier reluctance to talk about their work can be attributed to honest reticence—and both the scientific community and the general public could benefit from a resurgence of that reti-

cence. Who could have guessed, eight years later, that much of what concerned Nelkin would become commonplace, and that scientific “breakthroughs” would be trumpeted in news headlines almost daily.

Consider the media hoopla generated in response to the June announcement of the completion of the human genome map. The joint press conference convened by President Clinton, the Human Genome Project, and the biotechnology company Celera was a publicity stunt orchestrated to shift public attention away from a recent spate of stories on the competition between the publicly funded and privately funded research teams. In fact, the map—to use one of the metaphors that are common currency in reporting on this research—will not actually be completed for several years, and the real work of translating the map into information that could actually benefit human life is yet to be done. There has also been a steady stream of progress reports from all the major research groups involved. One has to wonder—what was the news? And what did any of the resulting press coverage add to the public's understanding about genetics? In this case, as in many others, journalists should have more seriously heeded Nelkin's sage warnings.

Courting the Press

So why does the scientific community now court the popular press? For issue-oriented advocacy groups, institutional public-relations offices, and public-awareness lobbying campaigns such as those spawned by the Human Genome Project

and the Decade of the Brain, communicating scientific findings to the public is an important part of their overall agenda.

Adept at shaping and pitching stories to the press, these groups helped make science accessible to journalists, stimulated public enthusiasm for science, and convinced scientists of how beneficial public support garnered through such exposure could be during national budget wars. Lobbying and marketing professionals emphasized that the public, or, perhaps more accurately, those members of the public elected to Congress or involved in making public policy, were weary of the oft-repeated message that more studies and more funding for basic science were needed.

Scientists were told that the time had come for emphasizing their accomplishments and the relevance of their work. Scientists, supported by their institutions, grew increasingly eager to have their work discussed in the pages of newspapers and newsmagazines and mentioned on television news shows. In response to public—and special—interests, many media outlets, including the average daily papers that are read by many people, created a dedicated medical/science slot. But filling the slots on a daily basis requires a steady stream of scientific “breakthroughs.”

Hot Tips

In retrospect, it is difficult to conceive how the incremental nature of scientific progress, fundamentally at odds with the pace of news, could possibly meet the demand. But somehow science obliges. The American

Association for the Advancement of Science sponsors a “comprehensive website about the latest advances in science, medicine, health, and technology.” Each day, *EurekAlert!* posts an average of 22 new press releases crafted by institutional public-relations offices and funding agencies.³

Many prestigious science journals, such as *Science*, *Nature*, and the *Proceedings of the National Academy of Sciences*, also release weekly or monthly media tip sheets highlighting and summarizing soon-to-be-published papers. University administrations, associations like Research!America—a group dedicated to increasing federal funding for biomedical research—professional scientific societies, and disease-specific lobbying groups actively encourage media coverage of scientific results and encourage scientists to produce press releases and to hold press briefings. Federal funding agencies such as the National Institutes of Health and the National Science Foundation have personnel responsible for publicizing research.

Today, moreover, many scientists want their work published in the international weekly science journals *Science* and *Nature*, not only because of the broad interdisciplinary readership, but because of the potential for capturing media attention.

Basing editorial decisions on press releases and media tip-sheets raises serious doubts as to whether a majority of the scientific findings highlighted are so novel, important, and timely that they require being reported as *news*.

The coverage generated from

press releases is formulaic, and examples can be found in every daily paper. The typical science news story consists of an attention-grabbing headline—Scientists Create New Life Form!—accompanied by 500 words or less superficially covering the science, mainly repeating what was emphasized in the release. The piece will usually contain some exuberant quotes from the featured researchers with the final paragraph seasoned by banal quotes from individuals, whose credibility the average reader has no way of evaluating, saying that the finding is interesting but more research is needed.

If the story manages to be sensational enough—even if the science actually falls short of that adjective—television news might pick it up, and from there it can get some play in the weekly newsmagazines. Radio and television talk show interest then follows. In general, there is nothing inherently wrong with this system. News evolves to features, where there is theoretically more opportunity to explain the details of the science. Unfortunately, the science often becomes less and less central as the message is honed towards some public issue. Lost in the ensuing discussion is what precisely made the original scientific finding news in the first place.

Just Say No

What does anyone get out of this system? The public gets a sense that progress is being made. Universities and funding agencies enjoy free publicity. Journalists are satisfied that they are doing their part to inform the public.

Advocacy groups garner validation for the significance of their particular cause. Good scientists, usually dissatisfied with the depth of the coverage, feel that, if their universities and funders are happy and they have not been seriously misrepresented, they have no reason to complain. But there is a dark side.

The media, overwhelmed with press releases, arbitrarily cover stories that can most easily be made sensational or controversial without regard to the actual value of the science.⁴ Institutions must continually crank up the hype so their researchers' stories pop out of the noise. The conditions for a dangerous spiral are in place. How long will it take a wearying public to tune out scientific breakthroughs that in the absence of context make less and less sense? This is already happening with medical news. It doesn't take long for public enthusiasm to make way for public apathy.

Maybe the time has come for scientists who are truly interested in communicating their work to broader audiences to just say no and stop participating in an activity out of kilter with its professed goals. When reporters call, scientists should evaluate how serious the writer is about the quality and depth of the piece before agreeing to provide background or be interviewed.

Granted, this strategy runs the risk of leaving the media with no one to call except those only too happy to provide the gratuitous quote or wild extrapolation. But most journalists do not want to cover something that really is not news, and a well-known scientist at a prestigious research center can, when called about what is

essentially a nonstory, try to persuade a writer that “there is no there there.”

Most important, scientists should carefully evaluate why they think the publication of a paper, or a presentation at a meeting, should be accompanied by a press release designed to attract media coverage. Institutions and funding agencies should carefully consider why they are encouraging the proliferation of press releases.

When science is truly news, and can be reported as news, that’s fine. Newsworthy science might be the discovery of a new planet or the unraveling of a previously misunderstood disease mechanism. But most science stories require more work.

Increasingly, when listening to calls for more coverage of science by the popular press, I find myself wondering if what is truly needed is *less* science news and *fewer* media-savvy scientists. I do not want less communication between scientists and the public, but I think there should be less reliance on the media.

Scientists serious about educating and informing the public about their work should write articles for magazines or websites. When advocacy groups or public policy experts misuse scientific findings, scientists should respond with opinion pieces and commentaries. In short, scientists should make more of an effort to help nonscientists understand the nature of scientific discovery so that the nonscientists can be more educated consumers of science news. We need more forums where scientists and the public meet face to face, without intermediary translators with hidden agendas such as selling newspapers, promoting positions, or fundraising.

Public enthusiasm and public understanding are not mutually exclusive goals. The *Beyond Discovery* series published by the Office of Public Understanding of the National Academy of Sciences is one good model of how to achieve both.⁵ Rather than more “media savvy” scientists, we need more scientists

seriously considering careers geared towards public outreach. If the scientific community and its supporters truly believe it is in everyone’s best interest to have a scientifically literate society, it is time to become more *savvy* about precisely what reaching that goal requires. And it is time to become more reflective about what stands in the way.■

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NOTES

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■ ■ ■ DIALOGUE

Shermanizing Electricity

The United States has been a leader in showing other nations the way to a free marketplace. Since the late 1970s, we have truly undergone a revolution in our attitudes toward markets, and beyond a doubt, today there is less reliance on central decision making. As Daniel Yergin and Joseph Stanislaw demonstrate in their book *The Commanding Heights* (New York, NY: Simon and Schuster, 1998), this revolution is global and has brought widespread benefits. But there is a paradox: deregulation driven by ideology rather than by careful governmental planning and antitrust oversight can bring significant harm to society, as Alan H. Richardson shows in "Public Power as Protector," (FORUM, Summer 2000).

The restructuring of the electricity industry that is unfolding on a state-by-state basis is the most important U.S. deregulation effort yet. Not only will it have the largest economic impact, but it can have the most serious consequences if we don't get it right: people can literally die in the name of deregulation, if they lose their electricity. We

should have learned a lesson from prior deregulation efforts: it is not enough to substitute competition for regulation. Too many institutions stand in the way; too many new institutions need to be created to assure that competition can actually fulfill its intended role. Put another way, markets do not just happen; they are intrinsically embedded in institutional structures. Thus, paradoxically, careful governmental planning is needed to make electricity markets work.

Changes in technology have made possible deregulation of parts of the highly regulated electricity industry. Congress and the states are working out the details, which will determine the future structure of the industry. In the meantime, privately owned utilities have not passively awaited deregulation, but have engaged in an industrywide consolidation that effectively preempts much of the competition upon which the deregulated regime will be premised. Even if Congress gets it right with respect to the market power issues Richardson describes, important questions remain concerning which public entities will have what roles in maintaining a competitive

environment. The bottom line is that a "Shermanized" antitrust mentality must replace the regulatory mentality that has shaped the thinking not only of regulators, but of the companies we now expect to act like free-market competitors.

When we deregulated other industries, the promise was that the federal antitrust program would ensure competition. But this has not always been the case. While the federal antitrust workload increased as a result of deregulation and a wave of mergers, resources were actually cut far back. In the last few years, the budgets for the Federal Trade Commission and the Antitrust Division of the Department of Justice have been gradually increasing; but antitrust is a labor intensive activity, and Congress has not provided anywhere near enough resources to keep up with the need. Given the complexity and central importance of electricity, those who hope deregulation will work must also commit themselves to fighting for the expansion of antitrust resources in our economy.

Albert A. Foer
President

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Future Shock

Technology plays a historic role in the evolving American electric power system. In “Revamping and Repowering,” Richard F. Hirsh shows how the availability of new generating options in the 1990s helped undercut the rationale for regulated natural monopolies, provoking free-market ideologues, large industrial power users, and others to call for restructuring the system by introducing competition among suppliers (FORUM, Summer 2000).

Will technological innovation continue to drive change in the electric power sector? That’s less clear. Two technology-driven tectonic shifts are altering the energy landscape. First, constructed-energy projects are giving way to manufactured-energy products. In the past, energy firms relied on centrally located nuclear, fossil, and hydropower facilities that benefited from economies of scale. Today, however, customers are turning increasingly to smaller technologies located at or near where they use power. These devices include gas-fired combined-cycle turbines and microturbines, fuel cells, energy efficiency and storage measures, photovoltaic panels, and biomass and fossil-fueled combined-heat-and-power plants. Unlike conventional power plants, these new technologies benefit from economies of mass production. Analysts predict that such distributed energy resources will provide a large fraction of future capacity and may weaken the control of established utilities over the energy sector.

In a second momentous shift, power providers face the corporate and technological convergence of several regulated and unregulated network industries. These potentially include energy producers, telecommunications services, Internet and cable providers, water utilities, and burglar alarm services. For instance, several firms are working feverishly and in secret to perfect technologies that can transmit data over power lines. In short, even as utility managers struggle to adapt to a world in which customers are won, rather than granted by regulatory fiat, the advent of new technologies has shaken the basis and stretched the boundaries of the products and services they provide.

Yet the energy sector invests ever less in research and development—some 0.5 percent of revenues in R&D, a rate similar to that of the primary-metals sector and the stone, clay, and glass industries, according to a July 30 report by Robert Margolis and Daniel Kammen in the journal *Science*. By contrast, high-tech industries such as telecommunications typically channel 10 percent of revenue into R&D. Moreover, total energy R&D investments plummeted between 1980 and 1996, as R&D investments in the economy as a whole soared. Alarmingly, rising competition has impelled many electric companies to crop R&D budgets further and to focus on conservative innovations that will pay off in the short term.

As an observer and analyst of the renewable energy industries, I find these trends troubling. Several generating technologies now in ascendancy—notably combined-cycle gas turbines—

are cleaner than the conventional coal and nuclear units that preceded them. Yet in coming decades, billions more people will require energy than have access today, thanks to world population growth and rising demand for a better standard of living. Burning natural gas to provide that energy will add an unsustainable burden to the climate and local ecosystems, in addition to the geopolitical cost of producing, protecting, and transporting gas. In short, we will probably need the zero-emission and waste-free energy that, so far, only renewables can provide.

Who will undertake the R&D? Even if one could count on the public sector to subsidize the necessary technology development—a dubious assumption—governments have an awful record of moving ideas out of the lab into stable, market-ready firms. Yet the private-energy sector may not see the market for clean power as enough of an inducement to invest the necessary resources. Thus, the next installment of Hirsh’s work may make an interesting read: What kind of firms will sell electricity? What will their products look like? Where will they get their ideas? Will we group electricity with high-tech industries, or with low-margin commodities? Will restructuring and deregulation drive innovation and change, paying off in customer-friendly products and a cleaner environment, or will firms become conservative purveyors of unnoticed commodities?

Adam Serchuk
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Heat Wave

Although, I disagree with some of her conclusions, C. Clark Leone gives a succinct and comprehensive history of public power in the Northwest as well as an excellent assessment of the current turmoil, challenges, and opportunities (“Quo Vadis?” FORUM, Summer 2000).

Since 1981, The NW Energy Coalition has been challenging public power to meet its own high goals for clean and affordable energy in the northwestern region and to work for a healthy economy and a healthy environment. We advocate energy conservation, renewable-energy sources such as wind and solar, fish and wildlife restoration, and protection of low-income consumers.

Some public power utilities have responded magnificently. Eugene Water & Electric Board and Seattle City Light, to name just two, have shown both tenacity and innovation in delivering energy-conservation resources through education, technical assistance, and financial incentives to their customers over the last 20 years. Emerald People’s Utility District also invests aggressively in energy conservation and renewable resources and is the first public utility to endorse removal of the four Lower Snake River dams to restore endangered salmon and steelhead.

I must, however, take issue with Leone on the cost of dam removal to save endangered salmon. The cost is approximately \$280 million per year for power replacement, not the \$1 billion she says environmen-

talists are demanding from the Bonneville Power Administration. Moreover, environmentalists are not alone in maintaining that removing dams will save fish. Two hundred scientists have signed a letter to President Clinton supporting removal of the dams to save salmon. Oregon Governor John Kitzhaber, the U.S. Fish and Wildlife Service, the Environmental Protection Agency, and the *New York Times* agree that dam removal will restore endangered salmon on the Snake River.

Some public power utilities have chosen to exert political influence, jealously guarding their prerogative to purchase power at cost from BPA—and a very low cost it is. The proposition that powerful industrial customers and nine aluminum smelters should receive low-cost federal power while residential and small-farm customers of investor-owned utilities are left out should not be easy for public power to swallow. But over the last 50 years, most public power utilities in the Northwest have not only swallowed but insisted upon subsidizing large industries to protect their own share of the golden goose.

This summer some of the chaotic forces Leone describes, such as partial deregulation on the wholesale and the retail level, have brought the region and our large neighbor to the south—California—to the brink of massive blackouts. On June 26, a combination of events totally unpredicted by power forecasters brought BPA close to collapse. Its first response was to reduce in-river flows required for salmon migration in an effort to boost hydroelectric production and

meet the demand for power. Six hours later when it became clear that BPA could not meet demand even after water flow was low enough to kill the salmon, BPA began to buy power at 75 cents per kilowatt-hour. It then turned around and sold that power for a little over 2 cents per kilowatt-hour to publicly owned utilities and aluminum smelters. Aluminum smelters, pulp mills, and cold-storage facilities that had decided to buy from the market rather than from BPA or from their local utilities shut down because of the spike in prices.

This environmental and economic catastrophe raises the question of how the region should allocate its valuable heritage of inexpensive hydroelectricity. The question becomes even more critical as our powerful neighbor California tallies up the sums sent north during its unusual early heat wave to buy power from BPA, not at cost but at market rates. And those market rates were sometimes even higher than 75 cents per kilowatt-hour.

California may join the coalition of Northeast and Midwest Congress members who have long insisted that BPA should sell at market cost to all buyers. If the region is to keep its golden goose, all regional stakeholders must find common ground. Democratically controlled public power can lead the way with its superior commitment to consumer protection and environmental stewardship. I very much hope it will.

Sara Patton
*Coalition Director
NW Energy Coalition
Seattle, Washington*

Bright Future

The 20th century story of public power in the Pacific Northwest is every bit as colorful as C. Clark Leone describes in her article “Quo Vadis” (FORUM, Summer 2000). Of course the “who did what to whom, when, and for what reason” part would have a different spin if written by an investor-owned utility, an environmental organization, or one of the Bonneville Power Administration’s direct-service industrial customers, rather than by the manager of the Public Power Council.

Leone accurately describes the winds of change facing consumer-owned electric utilities and the importance of their ties to consumers and their local communities. However, the distinctions between consumer-owned and investor-owned northwest utilities are not as sharp as she portrays.

For example, Leone asserts that, unlike IOUs, public power has a statutory priority right to federally generated power at cost. Yet in the Pacific Northwest, all citizens—regardless of the serving utility—have priority rights, or *preference*, to power provided by the Federal Columbia River Power System. While *public* preference applies to federally owned Northwest power resources in a similar fashion to other regions of the United States, *Northwest* preference applies as well. Northwest preference dates to the period in the 1960s when the modern western U.S. interconnected grid was constructed, including major connections between the North-

west and California. The combination of BPA’s requirements to sell power at cost, Pacific Northwest preference, and more recent (1980) action to ensure that residential and small-farm customers of investor-owned utilities continue to share in the benefits of Pacific Northwest federal power, ensures *all* citizens access to northwest federal hydropower benefits.

To ensure a winning formula for both consumer-owned and investor-owned utilities in the Northwest, utilities should

- Work toward preserving the benefits of the Pacific Northwest hydroelectric system for all the citizenry of the region. This includes optimizing the system for future power production and salmon restoration.

- Capture the efficiencies of scale, reliability, and increasingly competitive power markets that come from coordinated operation and improvements in reliability on the transmission system, such as those suggested by the Federal Energy Regulatory Commission, whether the transmission is owned by the federal government, investors, or consumers.

- Continue to make customer relationships the cornerstone of ongoing business for all utilities.

- Find ways to give access to competitive power markets to all customers who want it.

Through these actions all our Northwest citizens will continue to enjoy low-cost, reliable power in the future through their local utility.

Walter E. Pollock

Senior Vice President

Power Supply

Portland General Electric

Portland, Oregon

Asphalt Jungle

During the past 20 years or longer, as our nation has continued to mindlessly pour billions of dollars into more asphalt and concrete highways, Gil Carmichael has been a voice in the wilderness crying out for America to tap its underused rail system to provide a meaningful transportation alternative.

Today, our nation’s clogged highways, longer and longer commute times, jammed airports, urban sprawl, and the accompanying decay of the center city all attest to the fact that we should have been listening. Carmichael’s insightful article “Interstate II” (FORUM, Spring 2000) deftly makes the case for a high-speed rail system that will revolutionize travel in America, expand travel options for people, save countless acres of green space from paving mania, and reduce the threat of pollution.

As Carmichael points out, 13 high-speed corridors have been approved for development. In addition, Amtrak has just adopted an aggressive network growth strategy designed to significantly increase ridership and expand the already successful U.S. mail service and express-shipping business. The plan calls for 11 added route segments, service between 975 new pairs of cities, and expanded or improved service in 21 states. Coupled with the high-speed rail initiatives, these strategies will make rail service vastly more accessible, practical, and economical for millions of travelers and businesses.

Amtrak is also creating significant partnerships with state and local governments, helping to address such critical issues as grade-crossing improvements or closings, and the development of transportation centers that meet the needs of the traveling public and contribute to the economic vitality of the local communities they serve. In addition, the Great American Station Foundation awards grants to encourage cities to undertake station renovation or restoration projects.

The argument for a significant increase in rail transportation is not an esoteric one. The reasons are all around us. In cities across the country, rush "hour" no longer exists; it goes on all day. The term *road rage* has become a familiar part of our vocabulary as weary and frustrated commuters explode with violent behavior. Airports are bursting at the seams but have nowhere to expand. Air-travel horror stories have taken on legendary proportions. Our cities are decaying, and their local character is being destroyed, replaced with the numbing sameness of suburban malls and fast-food outlets.

We have the opportunity and the means to act—if we have the will.

John Robert Smith

*Mayor
Meridian, Mississippi
Member
Amtrak Board of Directors
President
Great American
Station Foundation*

Rural Report Card

There is almost universal recognition of the importance of education for personal economic well-being and political and civic health. Indeed, while disagreements have heated over the strategies to develop rural and urban educational programs, almost everybody agrees that education is a legitimate function of government at every level. A fundamental economic principle states that people, enterprises, or public entities without the necessary skills and knowledge are not likely to fare well in a highly competitive, knowledge-intensive world.

In the 20th century, the basic process of economic progress was the substitution of ideas, skills, and knowledge for physical labor and resources. Yet, in spite of the increasing importance of these skills, we still know too little either about how to teach them in our schools or measure them effectively.

In "The Challenge Ahead for Rural Schools," (FORUM, Spring 2000), Robert Gibbs has used the latest available assessments to examine the strengths and weaknesses of rural, metropolitan, and suburban education and to compare the relative success of different geographic regions.

In addition, Gibbs maintains that knowledge and skills alone will not improve productivity. Improvements in education must be embedded in a comprehensive strategy to create the demand for skills and knowledge by encouraging job creation and economic development. This is particularly important in rural

areas with few job opportunities.

Gibbs says that "rural schools are generally performing as well as urban schools," as measured by standardized test scores. This outcome, which is contrary to conventional wisdom, is the result of the advantages of many rural schools, especially their small size and close ties with local communities.

As Gibbs stresses, however, rural schools also have serious weaknesses, including the lack of specialization, the downside of their small size, and "the socioeconomic milieus that distinguish many rural areas from urban areas." As a result, rural workers are "less prepared for and less likely to attend college." Lower income and a lack of educational opportunities for rural people also contribute to this socioeconomic environment, as does the fact that people who remain in rural areas traditionally expect to find primarily low and middle-income jobs. Indeed, while the job market has generally improved during the 1990s, jobs that require skills and knowledge are still harder to find in rural than in urban areas. Rural areas also have fewer extracurricular resources such as libraries and cultural opportunities, and their schools are older, though this is also a serious problem for many central city schools.

There is not much comfort knowing that rural schools compare favorably with those in central cities, because both lag behind suburban schools and are grossly inadequate for what is required to sustain economic growth and prosperity. School restructuring for these purposes must be based on what we know

about learning, guided by internationally benchmarked standards, and buttressed by assessments and curriculum frameworks by professional educators. Gibbs and his colleagues' work provides a valuable base for this important undertaking.

Ray Marshall

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Sanction the Villains

Policymakers, with good reason, prefer economic coercion to the direct application of military force in pursuing their objectives, but in "The Costly Remedy," Bernard Griffard shows that economic sanctions have mixed results (FORUM, Spring 2000). Griffard provides an excellent assessment of the effectiveness and costs of implementing economic sanctions in general, and those imposed by the United Nations under Chapter VII, Articles 41 and 42, in particular.

Yet, as persuasive as his case may be, specific experiences he cites—for example that of the United States with its near neighbors Cuba and Haiti—may not be suitable ones from which to generalize. Nonetheless, his point is undeniable: enforcement of economic sanctions is almost always by, and at the expense of, the military.

To be effective, planning for enforcement of economic sanctions must be comprehensive; it must anticipate all possible reactions from the targeted

group. Planning must also be thorough; it must identify the conditions and end-states that would justify economic sanctions and quantify the costs of implementation. As Griffard puts it,

Sanctions use is and will continue to be a serious drain on the readiness and resources of our armed forces....The increased demands on the military are... due to the inability of foreign policy executors to define an end-state or exit strategy for many of their engagement activities.

I would offer a clarification to that. The term *executors* should be interpreted to mean policy developers—that is, politicians—and not, in the sense of the accepted definition, those who enforce policy. The executors charged with enforcing sanctions are the designated military commanders who, although they participate in the planning process, do not make the decision of determining the political end state.

This is a key distinction because, following Griffard's logic, if each decision made by the executive branch for the enforcement of sanctions were adequately funded and supported with manpower at the time of implementation, the readiness of the military to respond to contingencies would be reduced only by the intense and irregular operational tempo of sanctions enforcement. The armed services can reasonably be expected to manage that problem. But in enforcing economic sanctions, it has seldom been in the interests of the legislative branch to concur with adminis-

tration policy in a timely manner, or even after due deliberation, without seeking some quid pro quo for control of the country's military establishment. As a result, funding is held up and sometimes never granted, which puts a severe strain on the military budget.

So if Griffard's assessment is correct, and I am persuaded it is, must we not do more than merely remain aware of the enduring challenge of maintaining a balance between peacetime requirements—enforcing economic sanctions—and military preparedness? Indeed, we should, and keeping the issue on the table as Griffard has done is the first order of business. I believe the concept and nature of economic sanctions must come under increasing scrutiny by all concerned. As Mary-Wynne Ashford noted in "Genocidal Sanctions" in the Fall 1999 "Dialogue" section of FORUM, such scrutiny would put an end to the travesty in Iraq and prevent similar episodes.

Commander John Corray with the U.S. Navy has offered new suggestions that bear further examination. In his U.S. Army War College Strategic Research Project, "Military Enforcement of Economic Sanctions," Corray notes that the U. N. Security Council has never mandated financial sanctions against individual members of a transgressor state. In Iraq and Serbia, the personal bank accounts of Saddam Hussein and Slobodan Milosevic remain untouched. Why?

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Through the Glass Darkly

When I was a pre-teen, more years ago than I care to contemplate, I was very much taken with predictions for new technology—jet packs with which we would soar effortlessly to school or work, submarines to seek out undersea treasure, skin-tight outfits that actually look good on you, and the like. Looking back on those predictions, I find it striking that most of them actually happened, except for the skin-tight suits—which is a great mercy. But they happened in a way that was not, and indeed could not have been, derived from the facts available at the time.

Take jet packs, for example. Enough motorists are challenged driving in two dimensions that the prospect of adding a third would seem perilous in the extreme. But the good news is that we don't have to. Instead of a jet pack, we commute effortlessly to school, work, or shopping through the Internet. Or consider submarines. Instead of personally traveling to the deep oceans, we have robots to create a virtual presence there. Such machines allow the exploration of previously unvisited domains, such as volcanoes or other planets, affordably and safely.

Thus, the power of the visionary is less in specifying how things will get done and more in articulating a better future, a place bright with promise for a more humane world. This is

what the Electric Power Research Institute has created in its research roadmap, described by Kurt E. Yeager and Brent Barker in "A Roadmap for the 21st Century" (FORUM, Summer 2000).

The Roadmap is the product of a significant investment in intellectual capital by the U.S. electric industry, guest experts, and critics. This investment was all the more remarkable because it was led by the industry at a time of transition from a regulated monopoly to a competitive structure. Usually, the more intense the competition, the greater the impetus to parsimony on the part of the competitors.

The importance of the Roadmap derives not so much from any specific technology forecasts as from the possibilities it offers for creating wise public policies in the electric sector. The Roadmap articulates a vision of the societal possibilities afforded by ample, environmentally sustainable energy that meshes well with the needs of an increasingly digital society. It points out what we in the United States too often forget—that people in the poorest parts of the world are not delivered from the curse of Adam, and that a well-designed global energy system can relieve much human misery. Such vision is the foundation of political will.

But the Roadmap merely reports what is achievable. Whether any of it gets done depends on mustering that will, an inherently political act. For-

tunately, the news is better than it might appear. The advantage a free society enjoys over other forms of social organization is its ability to innovate, to create the institutions it needs when it needs them.

Now is the time to apply that skill to electric energy. Public policy must establish reasonable incentives for research, innovation, and investment within a competitive market structure and encourage entrepreneurial activity to make the results of this research widely available in new products and services. In the United States, there must be a uniform and predictable pathway to deregulation, rather than the current patchwork of individual state policies. We must regain a skill that now appears lost—the effective public-private partnership of the kind that founded the Internet. And globally, we must seek an energy trading regime that balances fair and predictable safeguards for the global environment with private incentives.

None of this will be easy. Indeed, the technological challenge looks simple beside the political one. But we must not fail to try. Besides, the problem must surely be more tractable than squeezing a 50-something into one of those skin-tight suits.

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BOOKS

Bucking the Tides

BY JAMES W. GILTMIER

Supreme Court Justice William Brennan used to say that the Bill of Rights to the Constitution was designed to protect the citizens from the government. Unfortunately, however, the Founding Fathers did little to protect civil servants who buck the political tides.

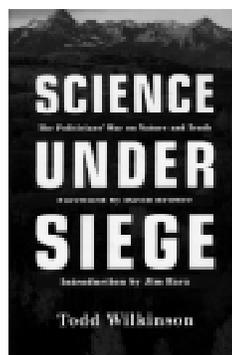
Science under Siege: The Politicians' War on Nature and Truth shows that federal employees have very little protection if they try to vigorously enforce environmental laws. In seven incendiary exposés, Todd Wilkinson explains how federal land managers paid with their money—in legal fees—their jobs, and their sanity because they were advocates for environmentally sound management of government-owned lands.

Readers should be warned that the heroes of these stories are people whom some would label environmental zealots. They made the wrong people angry and in some cases violated the cultures of the agencies that they worked for.

One of these heroes was said to have been fired because “he wouldn’t let science get corrupted by political science.”

Another called himself a “combat biologist.” Bad guys—agency villains—abound throughout this book, and their names and misdeeds are listed for all to see.

The oldest rule of politics is if you want to get along, you have to go along, and that is how federal agencies have operated for many decades. Although Wilkinson soundly roasts politicians for their undue influence on the careers of civil servants, he also points an accusing finger at federal agencies and their collusion with private industry. Federal land-holding agencies such as the National Park Service, Bureau of Land Management, and the U.S. Forest Service are supposed to obey national laws as written, yet they also have to be good neighbors to people and institutions nearby—mostly in the far West. As a consequence, deep subsidies are available for federal grazing, mining, and timber. Western industries had become accustomed to having their way with the public lands, and the elected officials they sent to Washington



to represent them acted as enforcers.

The past munificence of federal agencies, for instance the U.S. Geological Survey, is illustrated by this quote from recently retired Sierra Club Chairman Robert

McCloskey:

For a long time the Survey has allowed USGS employees to tell the owner of a mineral property the unpublished results of its geological investigation and thus cause a mine to be opened, but apparently they cannot tell an environmental group anything about how a mine there might harm the environment. Unpublished maps can be given to miners, but apparently not to environmentalists.

Since the 1960s, however, federal agencies have come under increasing public pressure to adhere more closely to the laws to protect and enhance public lands. Furthermore, the courts have largely upheld the environmentalists by demanding strict enforcement of the letter of the law. In addition, a whole new generation of scientists and technicians have taken the reins

at the federal agencies. These new “ologists” largely believe they have a moral responsibility to protect the natural resources in their care.

But they do so at their peril. In 1991, 63 of 120 forest supervisors signed a petition to the Chief of the Forest Service pointing out that public and personal values of Forest Service employees were changing, that the public no longer viewed these employees as environmental leaders, and that many worried the Forest Service was an agency out of control.

At about the same time, the Forest Service summarily cashiered Northern Regional Forester John Mumma, who complained that timber harvest targets were too high. The petition and dismissal of Mumma ultimately led to the early retirement of Chief Dale Robertson and his deputy George Leonard, who had allowed unsustainable harvests on federal lands. Since then

timber harvesting on the national forests has been reduced from about 12 billion board feet per year to about three billion.

There are other signs that federal land-management agencies are changing the way they do business. In a speech to all Forest Service employees, current Forest Service Chief Mike Dombeck said

Ours are not easy jobs. We often find ourselves caught in the midst of social changes, shifting priorities and political cross-currents. We can sit back on our heels and react to the newest litigation, the latest court order, or the most recent legislative proposal. This would ensure we continue to be buffeted by social, political and budgetary changes. Or we can lead by example. We can lead by using the best scientific information based on principles of ecosystem management that the Forest Service pioneered.

Good words to live by, but western members of Congress and the interests they represent

will continue their efforts to make life miserable for those trying to lead through good science. Good science is not always a useful foundation in a political system based on accommodation and compromise, and where the donors of large political gifts are a little more equal than the rest of us.

In *Science under Siege*, Wilkinson has given us a well-written and well-documented set of stories about how government employees can be harmed by the system. Lay readers will find themselves astonished at what can happen to good people who are just trying to do their job.■

Todd Wilkinson, *Science under Siege: The Politicians' War on Nature and Truth* (Boulder, CO: Johnson Books, 1998); 320 pp; paper, \$18.

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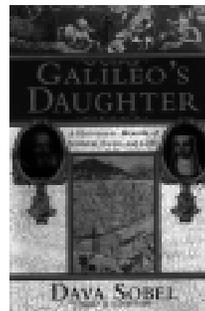
Beloved Father

BY JOSHUA A. CHAMOT

If only all children began their letters “Most Illustrious and Beloved Lord Father.” It was a different time when Suor Maria Celeste crafted her correspondence to her father Galileo Galilei. In the hands of Dava Sobel, the letters have become *Galileo’s Daughter*, a chronicle of Galileo’s life and the

era in which he lived.

Translated by Sobel from the original Italian, the letters intermingle family crises with daily business and are replete with references to 17th century Italian living, from sweetened citron to candied quince. Before Galileo’s conflict



with the Roman Catholic Church reached its apex, the correspondence generally deals with news of the Galilei estate or Maria Celeste’s needs at the convent of San Matteo d’Arcetri. Entering the convent at an early age—a common practice for unbetrothed

young women of the day—Maria Celeste often asked her father for provisions to add spice to her sparse surroundings.

The writing style of the time is verbose and can grow tedious, particularly the extended *thank yous* for items we today might consider mundane, like fish or cloth. However, these details do provide historical insight into the fabric of everyday life. And when the letters refer to more profound events, such as the Inquisition or the plague, they effectively evoke the pervasive fears of the time. Sobel's additional research on the plague in particular, complete with gruesome descriptions and period illustrations, recreates that horror for the reader.

The penultimate tragedy in Galileo's story is his appearance before the Holy Office of the Inquisition for publishing a work that too strongly endorsed Copernican views for planetary motion. It is here that the tone of *Galileo's Daughter* shifts from a story of the great scientist's family and teachings to a tragedy that might have been averted. Unlike near-mythical depictions of Galileo's struggle against Pope Urban VIII, which portray Galileo as a heroic heretic, Sobel portrays the scientist as a devout Catholic whose troubles are more political than theological. Sobel

suggests that Galileo's conflict was not with the Church's interpretation of the Bible but with misguided and possibly jealous scientists who happened to be ranking members of the Church. Indeed, other ranking church members actually endorsed Galileo's work.

The correspondence between father and daughter continues through the trials and punishments, and Maria Celeste at times offers touching support for her father. Early letters offer optimistic pleas that he guard his good spirits and take "care not to jeopardize your health with excessive worry, but to direct your thoughts and hopes to God." Later correspondence is far darker.

Galileo's ordeal isolates him from his daughter for several years. As Maria Celeste's optimism is shaken, her letters become troubled, yet ever more eloquent.

If ever I fail to make a great demonstration of the desire I harbor for your return, I refrain only to avoid goading you too much or disquieting you excessively. Rather than take that risk, all through these days I have been building castles in the air, thinking to myself, if...I had been able to appeal to Her Ladyship the Ambassador, then she...might have successfully

implored the Pope on your behalf. I know, as I freely admit to you, that these are poorly drawn plans, yet still I would not rule out the possibility that the prayers of a pious daughter could outweigh even the protection of great personages.

Her devotion, to God and Galileo, never falters.

Popular depictions of Galileo versus the Church are simplified caricatures of what transpired, and Sobel applies her clear, yet detailed, narrative skills to create a more complete picture of the pioneering scientist's life. By saturating the text with the letters of Suor Maria Celeste, Galileo, Johannes Kepler, and others, Sobel adds a perspective that is absent from many biographies. The effect truly transports the reader into the story, not just into events. Visually beautiful in text, illustration, and decoration, and supplemented with a useful set of appendices, *Galileo's Daughter* is a worthy addition to any library.■

Dava Sobel, *Galileo's Daughter: A Historical Memoir of Science, Faith and Love* (New York: Walker & Company, 1999); 448 pp; cloth, \$39.95.

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As California Goes

BY MARTIN A. NIE

Perhaps nowhere in the United States is the debate between popular and representative democracy more germane than in California. The use of the voter initiative and referendum, which the state's Progressives fought for and won in the early 20th century, is as casual as its stereotypical populace.

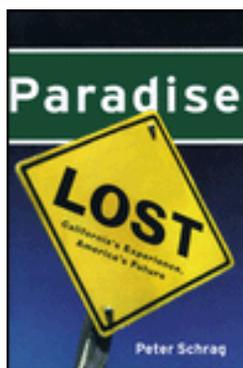
Beginning with Proposition 13 in 1978, perhaps the most portentous vote in the history of direct democracy, Californians have voted to end public funding for illegal immigrants—adults and children—abandon affirmative action, and ban bilingual education. These initiatives, driven in large measure by changing demographics, represent to Peter Schrag the volatility and retrenchment produced by changing demographics in the state and its plebiscitary politics.

In *Paradise Lost: California's Experiment, America's Future*, Schrag, who for 19 years was an editor at the *Sacramento Bee*, provides an interesting and well-researched polemic on the ways the initiative and referendum have been used as a tool by the voters of California. Schrag notes that since a majority of Californians are white, affluent, and elderly, they use this tool to secure themselves from an increasingly diverse population that often fails to vote but nevertheless uses the state's public

resources. Schrag maintains that such neopopulist measures as term limits have resulted in a state legislature that is inexperienced and makes public policy by autopilot, with many unintended consequences. The legislature has put limits on taxation, imposed spending cap initiatives, specified minimum spending formulas for schools, supported land conservation measures, introduced three-strikes-you're-out sentencing laws, and required a supermajority to pass budget proposals.

Proposition 13 certainly achieved what it was set up to do—cut property taxes by 30 percent and cap the future rate of tax increases. But it has also led to a deterioration in public services, a dilapidated infrastructure, a shift of political power from local government to the state legislature, a tax cut for the state's largest corporations, and endless efforts by local governments to replace lost revenue with a smorgasbord of fees and a search to attract businesses that may not provide quality jobs but do provide sales tax receipts.

Schrag contends that such policymaking by plebiscite has not only led to private affluence and public squalor, but is also susceptible to demagoguery,



xenophobia, and suburban resentment. Romanticizing the legendary statecraft of California's past political leaders, Schrag, like the Federalists before him, makes a case for representative democracy to salvage the

state's precarious budgetary future in general and its minority populations in particular. Schrag maintains that the current wave of populism is not practiced in a participatory spirit of civic engagement; rather its prime objective is to take care of an issue with a quick-fix remedy while sparing the voter the necessity of politics and its accompanying deliberation, engagement, and compromise.

While Schrag makes his point well, I am left wondering whether he would be as vehement in his denunciation of popular will if Californians would just vote as he does. Admittedly, there are more than a few serious problems in California's current political process. While the referendum/initiative process may not be working well in California—and many would claim the opposite—California is not the only state practicing participatory democracy.

California may indeed be a national bellwether, but voter fatigue from confronting so many choices—for example, San

Francisco voters faced more than 100 decisions in a recent election—is not always a problem in other states that allow voter initiatives.

While Schrag curiously directs much of his antipathy towards those who do vote, he spares those who do not. His reasoning about who votes and why, moreover, is misleading. For example, one poll after Proposition 13 showed that it won approval among all ethnic groups except blacks.

The corporatization of democratic processes is the major problem. The widespread use of ballot initiatives has created an “initiative industrial complex,” professional firms that gather signatures, misleading advertising, and the domination by business, all of which have indelibly altered the Jeffersonian vision of democracy.

Although I disagree with Schrag’s diagnosis, he has certainly provided an ageless debate with an interesting

update. He has, furthermore, added well-researched examples and specifics to a debate that is often waged in highly theoretical and abstract terms. Let the debate begin—or continue.■

Peter Schrag, *Paradise Lost: California’s Experience, America’s Future* (New York: New Press, 1998); 344 pp.; cloth, \$25.00.

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Risk Aversion

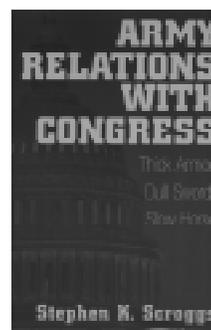
BY JONATHAN M. HOUSE

In a democracy, military leaders are expected to follow civilian guidance, even when civilians reject the professional advice of the officers involved. Moreover, successful military leaders have learned the value of close cooperation with the other armed services and are therefore reluctant to disagree publicly with their counterparts about the needs of national defense.

In dealing with Congress, however, this admirable spirit of cooperation often prevents senior Army officers from arguing effectively for the genuine needs of national defense. Stephen Scroggs, a former U.S. Army liaison officer with extensive information on the subject, concludes that the Army is even

more ineffective in communicating to Congress than other branches of the armed services, for a number of reasons.

Throughout their careers, soldiers dread congressional inquiries because they are often required to respond to complaints, frequently unjustified, against their fellow soldiers. Thus, Army officers learn to view any contact with Congress as burdensome and potentially disastrous to their mission. While other services assign rising young officers to congressional liaison duty, the Army regards such assignments as undesirable and tends to assign officers on the verge of retirement.



In addition, Army leaders often fail to make their case on budgetary matters because they are unable or unwilling to explain their programs to legislators with no military experience or expertise. Finally, top Army officers generally have much less experience in Washington politics than do their counterparts in other services because desirable career patterns involve remaining with troops rather than serving in Washington. When they become senior leaders, these officers therefore avoid dealing with Congress until a military crisis or budgetary shortfall occurs. By that time, the civilian heads of the

Army and Defense Departments, as well as the more politically astute officers of the other armed services, have often convinced legislators to take decisions that run counter to the interests of national security.

Scroggs bolsters his case with a wealth of anecdotes and statistics. In a telling case study, he reports on the 1994 transfer of M1A1 main battle tanks—the premier ground weapon of Desert Storm—from the Army to the Marine Corps. Even though leaders of the Marine Corps had previously decided not to buy these tanks, they outmaneuvered their Army counterparts at every turn, convincing Congress to give them tanks—already paid for out

of the Army's budget—necessary for valid Army missions.

Scroggs is not biased, however, in favor of the service in which he served. Throughout the book, he is highly critical of the Army's institutional culture, which, he contends, discourages risk-taking in peacetime. This tendency causes the Army to remain silent rather than warn civilian leaders of the military consequences of its decisions.

Army Relations with Congress provides an excellent description both of institutional culture and of a key problem in civil-military relations. The author also provides a useful analysis of how members of the executive branch of government can provide vital

information to Congress without improperly pressuring legislators or violating the policies of the presidential administration. For all these reasons, this work will be rewarding reading for anyone interested in the relationship between the military forces and the federal government.■

Stephen K. Scroggs, *Army Relations with Congress: Thick Armor, Dull Sword, Slow Horse* (Westport, CT, and London, UK: Praeger Publishers, 2000) 288 pp.; cloth, \$69.50; paper, \$27.95.

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Planning in the 21st Century

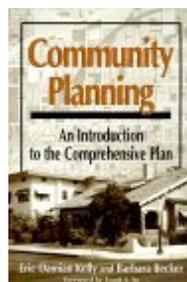
BY MARY R. ENGLISH

Part of a growing series on land use planning published by Island Press, *Community Planning* is modestly titled. It provides much more than an introduction: it gives the reader a working acquaintance with community planning.

In the United States, the concept of comprehensive local planning dates back to the City Beautiful movement spawned by the 1892 Columbian Exposition in Chicago. In the late 1920s, the concept took off on a grand

scale with the Standard City Planning Enabling Act published in 1928 by the U.S. Department of Commerce as a companion to its 1926 Standard Zoning Enabling Act. Both were the culmination of the work of a commission appointed in 1921 by Herbert Hoover, then Secretary of Commerce.

While the Department of Commerce's model acts were simply that—models—they provided helpful guidance to



states. In 1926, local land use zoning had received the blessing of the U.S. Supreme Court in *Village of Euclid v. Ambler Realty Co.*, which sanctioned the use of public regulatory power to specify how private land may be used. To enable and provide direction for local zoning and planning, states passed legislation patterned on the Department of Commerce models. Now more than 70 years old, these models have been scrutinized and alternatives

have been proposed—by the American Law Institute and the American Planning Association, for example—but virtually all state zoning and planning legislation harkens back to these two standard acts. They are premised on the idea that good government requires professionalism grounded in fact-based analysis and dispassionate forecasting.

Just as you can take a trip without an itinerary, you can zone without a comprehensive plan. Properly done, however, a comprehensive plan brings logic, foresight, and defensibility to zoning and other community decisions. Sometimes called a master plan or a general plan, a comprehensive plan is, as Kelly and Becker note, “a tangible representation of what a community wants to be in the future.”

Today, full-blown comprehensive plans typically include inventories of existing conditions, statements of needs and goals, and implementation strategies. Comprehensive plans also broach topics such as population, housing, land use, economic development, public facilities and infrastructure, natural resources, and cultural resources. These are often described in some detail, accompanied with maps and information on historic trends and projections. The comprehensive plan may also detail more

specific plans for special areas such as a city’s downtown, or special topics such as open space and recreation.

Community Planning is contemporary in its orientation. Kelly and Becker frequently note the need for early and continued involvement of citizens and elected officials in community planning processes. Nevertheless, the book is in keeping with the rationalist, “good government” spirit that motivated the U.S. Department of Commerce’s model acts. It provides a systematic, well-thought-out guide to the community planning process.

Kelly and Becker’s book was written to serve as a text for introductory classes in planning at the undergraduate or graduate level, and it moves from the general to the specific of tangible plans, the nuts and bolts of developing and implementing plans. The book wraps up with practical information useful not just to students, but also to community leaders with no formal training in planning on what work to expect from planners and on ethical issues to consider in planning. To assist the teacher or the self-taught reader, each chapter concludes with exercises, discussion questions, and annotated suggestions for further reading. The book also has an extensive bibliography.

Over the past few decades,

debates have arisen about the utility of comprehensive plans. Are they worth the effort? Is the process of planning really more important than the document itself? Does anyone actually use the plan? As federal subsidies for local comprehensive planning processes dwindled in the 1980s, the popularity of massive plans waned. Kelly and Becker acknowledge this shift, and they also point out that planning is inevitably political:

... despite the best efforts of the government reformers, planning remains political with a small *p*. At its best, it transcends politics and builds consensus across political coalitions. At its worst, it can become so embroiled in local political issues that it loses its credibility and effectiveness.

Nevertheless, this book is testimony to Kelly and Becker’s conviction that planning and comprehensive plans, properly done, can and should make a positive difference.■

Eric Damian Kelly and Barbara Becker, *Community Planning: An Introduction to the Comprehensive Plan* (Washington, DC: Island Press, 2000); 478 pp; paper, \$35.00.

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The Green House

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Over the last 30 years, environmental concerns have come to play a larger role in American society; consequently, the literature on U.S. environmental policy has grown steadily. Yet relatively few of these books have focused on the actions of American presidents. Dennis Soden, who directs the Public Policy Research Center at the University of Texas, El Paso, attempts to address this deficit in *The Environmental Presidency*.

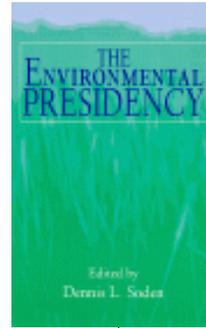
The 16 political scientists who contributed to the book argue that presidents have often proved instrumental in the formation, interpretation, and implementation of environmental policy through their various roles: as executive leaders, promoters of legislation, diplomats, commanders in chief, and opinion makers. They also explain the limits to a president's power and influence in the area of environmental policy and suggest ways a future president might overcome these limitations to make a real difference.

Given the nation's rich natural resources, it is somewhat ironic that the environment has been trumped unflinchingly by economic and national security concerns. Perhaps this is because, as Janet Conary of the University of Texas, El Paso, explains, presidents tend to

mirror the dominant values of their time. Prior to 1900, presidents shared the common assumption that America's natural resources were essentially limitless. Moreover, since natural resources were believed to fuel economic growth, any problems of environmental degradation—such as polluted waterways, smoke-laden skies, and loss of soil fertility—were seen as the price society paid for prosperity. As a result, resource sustainability was simply not a White House consideration.

During the 20th century, those attitudes began to change. Theodore Roosevelt, for example, aggressively asserted executive authority in the realm of natural resources conservation. In addition to enlarging the nation's forest reserves by over 193 million acres, Roosevelt used the newly enacted National Monuments Act to set aside important scenic landmarks and wilderness areas. This activist approach proved, according to Andrea K. Gerlack of Guilford College and Patrick J. McGovern of the University of Arizona, to be one of his "most lasting and constructive achievements as president" (p. 50).

In the 1930s, Franklin D. Roosevelt also took a strong



stance on conservation. His New Deal legislation—which Congress readily passed—established the Tennessee Valley Authority, the Civilian Conservation Corps, and the Soil Conservation Service, and it promoted a vast expansion of public works projects for the use and management of the nation's natural resources.

Most scholarly attention to this topic concentrates on how post-World War II presidents have exercised their managerial powers—for example, through appointments, budget decisions, and executive orders—in implementing environmental policy. Although such tools can be influential under certain circumstances, Jonathan West of the University of Miami and Glen Sussman of Old Dominion University emphasize that a president's ability to control executive branch agencies is inherently limited by the employment protections enjoyed by career civil servants and by congressional prerogatives in funding and oversight. The greatest impact of most presidents has therefore been through legislation.

In assessing the stances various presidents have taken on legislation during their administra-

tions, Sussman and Mark Andrew Kelso of Queens College in Charlotte, North Carolina, conclude that party affiliation alone may not determine a given administration's approach to environmental policies. "Other factors," they argue, "including the ideology of the president, the level of public support for environmental protection, and the ideological division of the Congress exert greater influence on a president's environmental policy than partisan affiliation." Although Sussman and Kelso looked only at the passage of pro-environmental legislation—not the enforcement of environmental laws or the shaping of public opinion—they, nevertheless, demonstrate that wide variations have existed within both political parties with regard to environmental policy. Conventional wisdom credits the Democratic Party with clearly outdistancing the Republican Party in the area of environmental protection, but Sussman and Kelso's analysis shows that the highest average amount of pro-

environmental legislation since 1960 was passed during the Republican administration of Richard M. Nixon, while the lowest average amount was passed during the Democratic administrations of John F. Kennedy and William J. Clinton.

Raymond Tatalovich of Loyola University, Chicago, and Mark J. Wattier of Murray State University support Sussman and Kelso's contention that party affiliation alone is insufficient to predict presidential action in the area of environmental protection. By scrutinizing the party platforms during presidential elections, Tatalovich and Wattier explain how Democrats and Republicans have each postured on the issue of environmental quality over time, framing environmental concerns in relation to economic growth during the 1980s, for example.

Other essays in this collection explore the relationship between environmental policy and national security—which were traditionally separated in the policy process—and suggest that

future presidents will increasingly view environmental problems in a global rather than local context, broadening the definition of national security to include environmental security.

Although the authors generally succeed in placing the environmental presidency within a theoretical framework, many of the authors, unfortunately, fail to transcend the academic bounds of political science. Nevertheless, this collection provides a valuable perspective on an important topic and offers a provocative agenda for future research.

Dennis L. Soden, ed., *The Environmental Presidency* (Albany, NY: State University of New York Press, 1999); 366 pp.; cloth, \$73.50; paper, \$24.95.

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