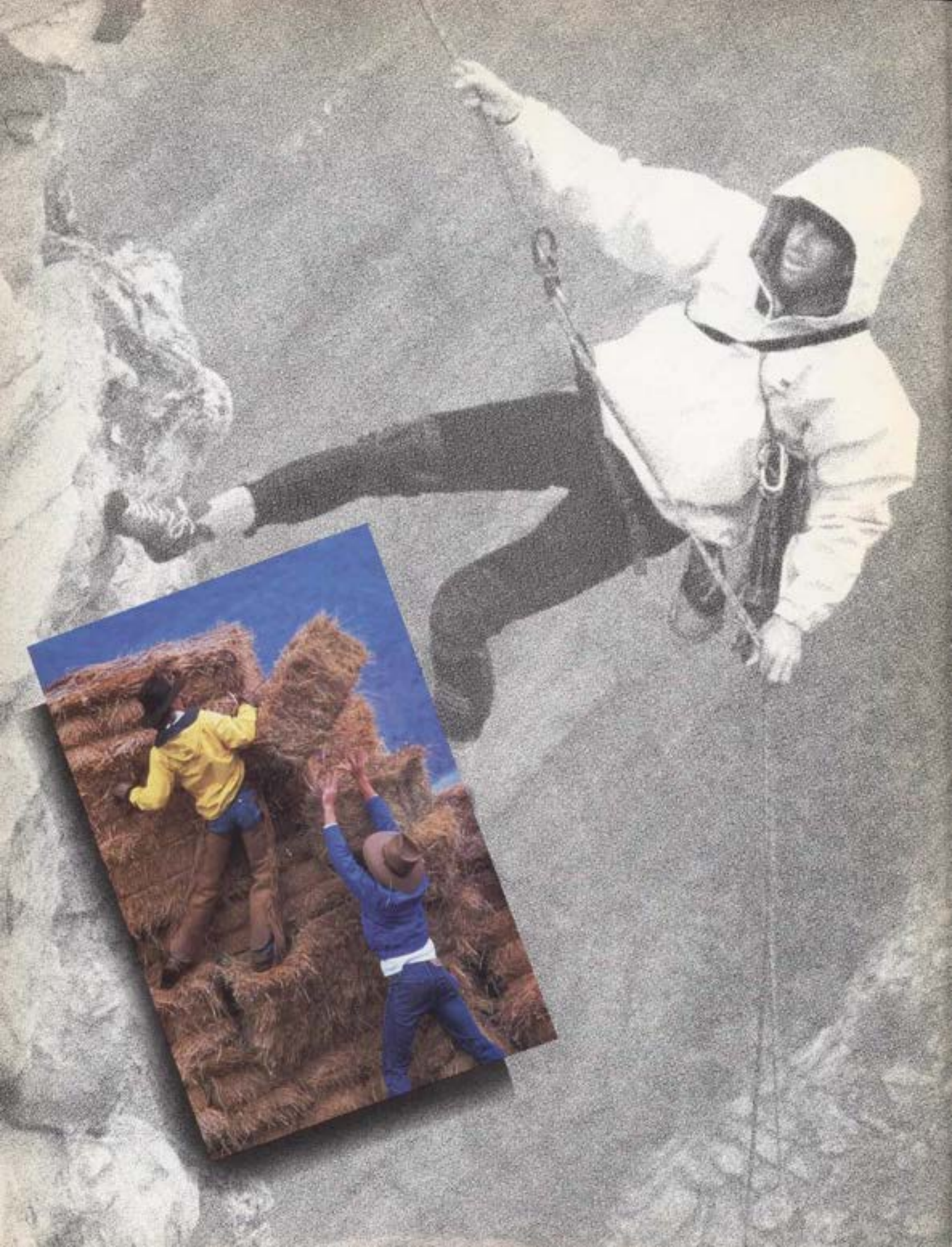


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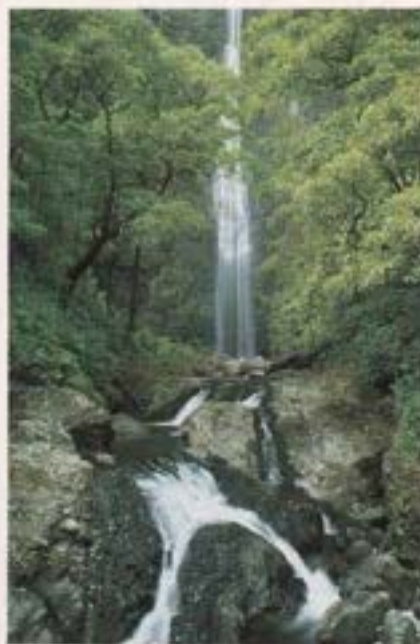
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BEYOND THE MOUNTAINTOPS

The magazine you're settling down with now, and whose editor-in-chief I have recently become, is a curious sort of creature.

On the one hand, *Sierra* is the official publication of an influential nationwide organization, sent automatically to each of the Sierra Club's 400,000-plus dues-paying members. But it is also a general-interest environmental magazine that has come to enjoy a measure of acceptance by the public at large. While we understandably shine a bright spotlight on the diverse activities in which the Club engages, we frequently look beyond those to focus on other relevant issues. This often means that we can devote less attention than we might wish to the many crucial and complex topics confronting today's activists, because we also serve as the primary source of environmental information for hundreds of thousands of nonspecialist readers. Finally, although *Sierra* deals with concerns of such gravity and magnitude that reading an issue from front to back can sometimes be an unsettling experience, our pages are full of encouraging, even inspirational, news about real people working toward real solutions to environmental problems.

These tensions and contradictions reflect the dynamism of both the Sierra Club itself and the greater movement within which it operates. That movement today confronts a range of problems that would have utterly astonished the Club's 19th-century founders. In response to this widening universe of challenges, the organization has expanded its view to embrace not just the meadows and mountaintops of the Sierra Nevada but the ocean floor far below them and the ozone layer high above.

The editors of *Sierra* take our charge seriously: to reflect that expanded view by alerting our readership to the complex and interrelated environmental dangers confronting the United States and the world. To do so requires that we distill, analyze, and package a sometimes bewildering array of facts relating to a whole menu of high-profile issues, many of which are the focus of the Sierra Club's priority campaigns. Beyond that, we must also draw attention to problems that have not yet received wide publicity, that are still "bubbling under" the Hot 100 of environmental consciousness. Many issues that seem fundamentally relevant today were once regarded as beyond both the Club's interests and its capabilities to address. It was always the role of the old *Sierra Club Bulletin*, just as it is now that of *Sierra*, to identify these bellwether issues, to promote their public debate, and to contribute to their resolution. That's how people become aware of the problems that confront them; that's how action is inspired and solutions are found.

As a professional journalist, I look forward to the challenge of maintaining *Sierra's* commitment to these goals. As a citizen who has become an environmentalist through my four-year association with the Sierra Club, I am proud to help continue the work of those who have made this publication a voice for the conservation movement since 1893, even as the organization it speaks for has made its influence felt far beyond the mountains of California.


Jonathan F. King
Editor-in-Chief

Sierra

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LETTERS

SHRINKING FORESTS

My appreciation to Keith Ervin for "The Shrinking Province of the Primeval" (July/August, 1987), his article about the plight of old-growth forests in the Pacific Northwest and the decline of the northern spotted owl, the main indicator species of a healthy old-growth-forest ecosystem.

However, Ervin failed to mention the location where the spotted owl may be most threatened of all—the Olympic Peninsula in northwest Washington. There the old growth is surrounded by the Puget Sound on the east, the Strait of Juan de Fuca on the north, the Pacific Ocean on the west, and the expansive clearcuts of the Willapa Hills to the south.

Within the peninsula, the coastal strip is separated from the mountains of Olympic National Park—and the rain-forest valleys are separated from each other—by clearcuts. Each area represents an "island" of old-growth in an ocean of clearcuts.

When will the remaining old-growth parcels become too small to provide sufficient habitat? Will the breeding rates of the spotted owl decline faster as the islands of old growth become further separated? Can the spotted owls of the coastal strip survive the competition with the barred owl, whose range has now expanded beyond the clearcut pathways into the spotted owl's territory? Unfortunately, the answers may depend on the management practices of the United States Forest Service and the Washington Department of Natural Resources.

*Ron Smithrud
Clallam Bay, Wash.*

ACID RAIN REACTIONS

Mark Mardon provided a generally good overview of the problems involved in getting the U.S. and Canada to agree to do something meaningful about acid rain ("Priorities," July/August 1987). While many of the facts Mardon mentions are accurate, at least one detail is considerably off-base.

He makes the often-heard statement

that "acid rain is . . . the chief cause of spreading forest decline." I have found that there is so much disagreement among scientists about the possible causes for forest decline that it may be another ten years before a clear picture can be drawn. While many scientists suspect that air pollution, including acid-rain deposition, may be a contributing factor, almost no scientist will unequivocally state that acid rain is the "chief cause."

*Paul A. Doscher, Assistant Professor
of Environmental Science
New England College
Hemiker, N.H.*

In his explanation of Canada's acid-rain problem, Mark Mardon misstated two important principles.

First, sulfuric and nitric acids are not mild. They are two of the strongest of the common acids. Even minute quantities of them in natural waters effectively control the pH.

Second, Pleistocene glaciation did play an important part in setting the stage for the problems of lake acidification that Canada now faces. However, it was not by removing limestone, as Mardon implied in his article. Glaciation's most important contribution to creating poorly buffered lakes was scraping off the soil. The bare bedrock weathers very slowly, so the lake waters are very pure and very sensitive to atmospheric inputs. It is the lack of soil, combined with an igneous and metamorphic bedrock and a cold climate, that makes so many lakes of the Canadian Shield vulnerable to acid rain.

*G.D. Langstaff
Lander, Wyo.*

Your piece captured well the mood and attitude of Canadians on acid rain.

*E.R. Johnston, Consul
Canadian Consulate General
San Francisco, Calif.*

LIONS NOT FAIR GAME

Kathy Glass states in her article about open season on mountain lions ("Afield," July/August 1987) that "the



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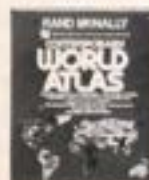


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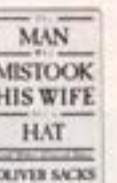
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controversy is rooted in the philosophical differences between hunters and non-hunters." Not true. I have hunted all my life, and responsible hunters and I condemn those who hunt the mountain lion. Ever since my grandfather made me eat the robin I shot with a BB gun in our backyard, I have learned that one kills only what one intends to eat or use. The mountain lion has a poor pelt and is hardly table fare.

I congratulate my fellow members of the Sierra Club who condemn the handful of hunters who still think it is sporting to track, exhaust, and tree this magnificent animal. Reducing the shy and noble mountain lion to an exhausted and cowering beast and then blasting him out of a treetop is not what hunting is all about.

R. DeWitt Kirwan
Los Angeles, Calif.

REACTOR CONTAINMENT FLAWS

In the July/August 1986 issue, *Sierra* stated that the ill-fated Chernobyl nuclear reactor had no containment structure at all. In the November/December issue, *Sierra* published a letter that claimed that the Chernobyl reactor did indeed have a containment structure, and that it "had walls one to two feet thick." Both statements are false.

The logical conclusion that *Sierra* readers could infer from the first falsehood is that Soviets/engineers/technologists/nuclear-power advocates (take your pick) are irresponsible or inept and, by extension, that we're all in danger from reactors designed by incompetents. The impression created by the second falsehood, a significant escalation in Chicken Little-ism, is that even though Chernobyl had walls of steel two feet thick, it still spewed radiation all over Europe. Moreover, since some U.S. reactors are designed to withstand less pressure than Chernobyl (30, as compared with 57, psi), we are, ergo, in even greater danger than the Russians.

But the Chernobyl reactor did, indeed, have a containment structure: The engineers recognized the potential danger and tried to protect us from it. But the subsequent claim that the structure had "steel walls one to two feet thick, and could withstand 57 psi" was ludicrous. There are no containment

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structures in the world that thick, and there is no way that such steel—if it existed—could be welded into a containment structure. Moreover, if one could ever construct such a structure, it would resist thousands of psi, not just a measly 57. Actually, Chernobyl had steel walls about three eighths of an inch thick, backed by three-inch concrete, rather than the "six- to eight-foot" thickness published in *Sierra*.

But what is wrong with 30 psi? Although it sounds like a far cry from the 2,000 psi that the reactor core must contain, such levels can be perfectly adequate for active containment systems. "Active containment" doesn't have to be very active: It need consist only of a containment structure large enough so that the 2,000 psi can expand to—and thereby be reduced to—10 psi. A more complicated containment system would pass high-pressure gases through water or ice, thus reducing their pressure even more. Therefore, the determination of whether a structure designed for 30 or 57 psi is adequate depends on the volume of the structure and the type of containment system employed.

What can *Sierra* readers learn from the publication of this blather in their flagship publication? I hope they would realize that conservationists need to understand the rudiments of the technology they would criticize, limit, or ban, and that even their spokesmen may sometimes be unable to tell an inch from a foot.

Richard G. Gould, P.E.
Washington, D.C.

[*Sierra regrets both the errors referred to in this letter and the delay in their correction.*]

SUSHI: ROUNDWORM NURSERY?

With respect to parasites in sushi ("Questions and Answers," May/June 1987), the reassurances provided in your column accurately reflect the conventional wisdom that has prevailed among parasitologists for many years—that only fish living all or part of their lives in fresh water carry parasites harmful to humans.

But, alas, conventional wisdom has been modified by the discovery that some of our marine cousins, the carnivorous cetaceans (whales, dolphins,

porpoises) and pinnipeds (seals, sea lions, walrus), harbor a roundworm in their stomachs that utilizes the muscles of our favorite sushi-bar fish as a nursery for its young.

When these hapless juvenile nematodes find themselves awash in the swirl of Kirin beer, sea urchin roe, and rice, they have no way of knowing that they are not in the belly of a briny beluga or the stomach of a saline sea lion. Accordingly, they attach themselves lip-first to the linings of our tummies and burrow in to await in vain their growth and transformation into adult worms. (Our body chemistry does not provide the hospitable environment needed for their continued development.)

Examination of recent parasitology texts reveals that a good deal is now known about these worms. They produce painful abscesses often initially mistaken for peptic ulcers or tumors. In addition, heavy infestation by the worms may occasionally cause intestinal obstructions, colic, or peritonitis. Of course, the frequency of infection is higher in areas such as the Orient and Scandinavia where raw fish is commonly consumed. As U.S. tastes change to include sushi, local incidence of this disease will doubtlessly increase. Infection rates of marine fish caught along the West Coast of the U.S. have not been systematically studied; however, one researcher found flounder from Connecticut and New Jersey to be almost 100-percent infected.

While the available information on these marine parasites is sketchy at best and may not warrant abstinence from sushi fish, it does suggest that a closer look at the muscle fibers of that raw morsel of sea fish might be prudent.

Dan Merritt, Professor of Zoology
Joel Paule, Student
University of La Verne
La Verne, Calif.

CORRECTION

In our July/August 1987 "Questions & Answers" column we reported on a treatment for snakebite that involves application of a high-voltage, low-amperage, direct-current shock to the bite area. Our sources have been called into question by experts in wilderness medicine, and we strongly recommend that bite victims do not attempt this treatment.

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IN BELIZE, COKE GOES BETTER

Just south of Mexico, nestled hard against Guatemala and soft against the warm Caribbean, lies Central America's newest nation, Belize. Within the boundaries of this tiny country is a dazzling array of rainforest environments where many plant and animal species that are endangered or extinct in other Central American nations still thrive.

But Belize, formerly British Honduras, suffers from the same growing pains that plague most developing countries: an overwhelming national debt, high unem-

ployment, and a large percentage of arable land owned by foreign interests. All of this has led to a desperate need for dollars. Thus, when Coca-Cola Foods bought 200,000 acres of mixed-pine savanna and subtropical moist forest in 1985 to grow oranges for its

Minute Maid subsidiary, hopes for profits rose like carbonated bubbles.

Historically, however, large-scale commercial agriculture has seldom coexisted peacefully with tropical forests. In response to Coke's initial development plans, Friends of the Earth-United Kingdom and the Rainforest Action Network in San Francisco organized sit-ins at bottling plants in West Germany, demonstrations in Stockholm, and a letter-writing campaign in the U.S.

Coke officials agreed to meet with conservationists and eventually offered to scale down the plans dramatically by preserving up to 166,000 acres in

their natural state. The company also began the process that will lead to an environmental impact report on the project. Coke has promised to hire a company recommended by conservationists to conduct this study and claims it will honor whatever recommendations the report contains before planting begins. Coke has also indicated that it will minimize the use of chemicals in



FLASHBACK



Olaus and Mardy Murie, shortly after their marriage in 1924. Bundled in what a friend of Mardy's referred to as the wedding trousseau, the two traveled throughout the Alaskan wilds. For more on the Muries, see page 69.

HIGHEST HONORS FOR JOHN McCOMB

Sierra Club members were few and far between in Arizona 22 years ago, and when then-Executive Director David Brower went looking for locals to testify against a proposal to flood the Grand Canyon, he could find only 50. One willing recruit was 27-year-old John McComb, a graduate student at the University of Arizona. His appearance at the congressional hearing would be the first of many; McComb's career for the wilds had begun.

McComb joined the Sierra Club staff five years after his Grand Canyon testimony, serving as Southwest Field Representative from 1970 to 1977. From Tucson, Mc-

—Denise Voelker

SCORECARD

- Legislation to overhaul the federal *high-level nuclear waste disposal program* was introduced in Congress in July. The bills would halt the Energy Department's current work to identify a site and would create a special commission to recommend a new approach.
- The *Endangered Species Act* is up for reauthorization this year. Conservationists hope to increase protection for species awaiting listing, for rare plants, and for endangered species in other countries.
- For the second time, a federal court has ruled in favor of *wilderness water rights*, thus protecting the streamflows needed to maintain the nation's designated wilderness areas.
- *Food irradiation* was zapped by lawmakers in Maine, making the state the first in the nation to ban the controversial technology.
- In June, Gov. Thomas Keane ordered an immediate 18-month moratorium on development of 300,000 acres of *New Jersey's wetlands*. Some 600 projects are affected.

Comb went to Washington, D.C., where he worked as a Club lobbyist and eventually as director of the Conservation Department.

McComb left the Sierra Club in the fall of 1986. During his 17 years on the staff he was an unfaltering leader in efforts to establish Capitol Reef and Arches national parks, to expand Grand Canyon and Canyonlands national parks, to protect 100 million acres of wildlands in Alaska, and to enact dozens of other pieces of environmental legislation.

CLEAN AIR ADVOCATES: STILL (WHEEZING, GASPING, CRYING) TRYING AFTER ALL THESE YEARS

The Clean Air Act, first passed in 1970, was the product of a nascent environmental movement and a hopeful Congress. America's air, lawmakers announced confidently, would be safe for everyone by 1977.

The optimism was sweet but short. Air pollution was far from controlled in 1977, and when Congress amended the law that year, it gave the Environmental Protection Agency new, more specific instructions on how to deal with what was by then recognized as a very complex problem. The law's new goal was for almost all areas of the nation to have healthy air by 1982. Those areas that couldn't comply with the new

standards would be granted extensions until the end of 1987.

That deadline is only a few months away. And there are not just a few areas that will fail to meet clean air standards, there are 80. Since the law was not reauthorized in 1982 as scheduled, policies enacted in 1977 are still in effect. However, there are now more polluting sources, more emissions—and more pressure on Congress to develop a strategy that works.

Seventeen years after passage of the law, the problems have only intensified:

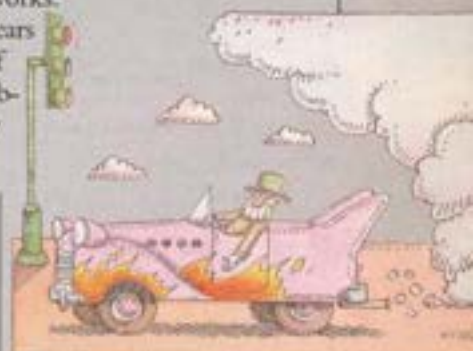
OZONE, while undesirable on Earth, is essential in the stratosphere, where it shields our planet—and our bodies—from the sun's harmful ultraviolet rays. Recent research suggests that the natural stratospheric ozone layer is being destroyed by chlorofluorocarbons and other industrial compounds used in many nations in refrigeration, insulation, packaging, and aerosol propellants. These compounds rise slowly to the stratosphere, and no one knows exactly how long it will take to stop the ozone depletion process.

This July, "with gratitude for his innovation, wise counsel, and leadership," the Sierra Club gave its highest honor, the John Muir Award, to John McComb.

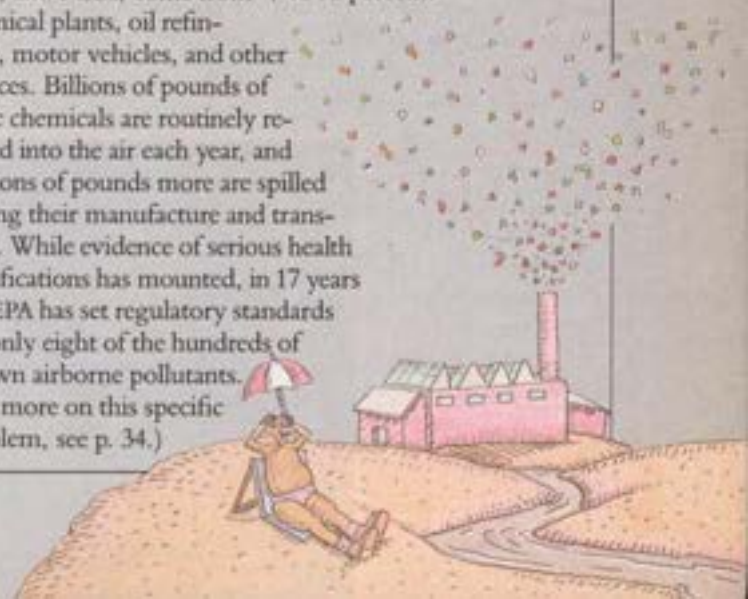
—A.S.



TOXIC AIR POLLUTANTS, which include cadmium, dioxin, and PCBs, come from chemical plants, oil refineries, motor vehicles, and other sources. Billions of pounds of toxic chemicals are routinely released into the air each year, and millions of pounds more are spilled during their manufacture and transport. While evidence of serious health ramifications has mounted, in 17 years the EPA has set regulatory standards for only eight of the hundreds of known airborne pollutants. (For more on this specific problem, see p. 34.)



URBAN AIR POLLUTION still burdens the breathing of more than 100 million people in America. Cars, buses, trucks, gas stations, sewage-treatment and solid-waste plants, industrial boilers, and dry cleaners are responsible for the primary culprits, carbon monoxide and ozone. Some of the areas that will not meet the December 31 deadline for attaining clean air require emissions reductions of up to 75 percent.





ACID RAIN, long the bane of lakes, forests, and buildings, is now suspected of aggravating human respiratory diseases; the same pollutants that are eroding the Taj Mahal, it turns out, can also harm lung tissue. Acid rain falls when sulfur dioxide and nitrogen oxide emissions from coal-burning

power plants, industrial boilers, and motor vehicles combine with other chemicals and water in the atmosphere. Environmentalists are working to establish a national program to reduce emissions from all these sources.

KIM CALDWELL ILLUSTRATIONS

LIFE AND DEATH IN THE FAST LANE

While traffic roars up and down the nation's roadways, creatures large and small still have the need to get across. Many never make it.

One million animals are killed on the nation's roads every day, according to the Humane Society. But a new safety feature developed for humans—the solid concrete divider—is making the fur fly as never before. The three-foot-high device, known as the "Jersey Barrier" in New England, separates opposing lanes of traffic, effectively preventing head-on collisions. However, it also traps smaller animals such as raccoons, turtles, squirrels, rabbits, and skunks in the middle of the road.

"They hit the barrier, panic, and then dart back out into the traffic," says biologist Tom French, director of the Non-Game and Endangered Species Program of the Massachusetts Division of Fisheries and Wildlife. "Along the stretches that have barriers we're finding many more road kills."

The barrier's first cropped up in New Jersey in the late 1950s; today they are found in virtually all states. "In some areas they can devastate local wildlife, especially turtles," says French. "It's a long trip

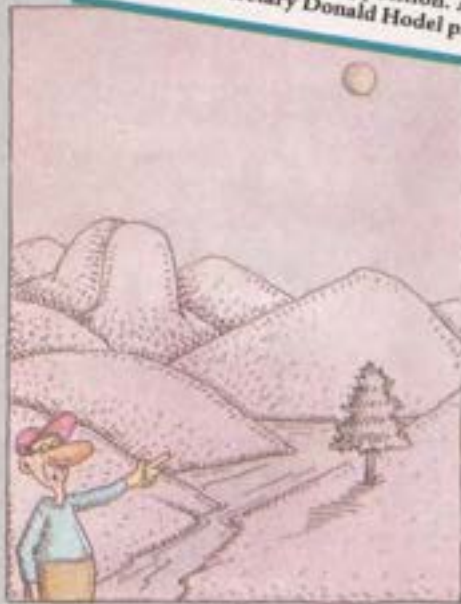
GEOFF MANABE WILDLIFE PHOTOGRAPH



FIELD NOTES

"Hetch-Hetchy Valley . . . is a grand landscape garden, one of Nature's rarest and most precious mountain mansions. As in Yosemite, the sublime rocks of its walls seem to the nature-lover to glow with life. . . . [T]his is the mountain temple that is now in danger of being dammed and made into a reservoir. . . ."

John Muir, "The Hetch-Hetchy Valley," *Sierra Club Bulletin*, January 1908. Congress approved building O'Shaughnessy Dam in the valley in 1913 despite Muir's opposition. As this issue of *Sierra* went to press, Interior Secretary Donald Hodel proposed tearing down the dam.



VISIBILITY IN PARKS AND WILDERNESS AREAS is decreasing as automotive and industrial pollution spread beyond city limits. The hundred-mile views from the Grand Canyon, for example, are marred by dirty air one hundred days each year, and in 1980 the National Park Service identified air pollution as the foremost external threat to the parks.

—Annie Stine

across a road for a turtle, anyway. If dividers block a critical travel lane, as they do for diamondback terrapins in some places along the East Coast, it's a lost cause."

There may be a simple solution, though. French suggests that highway departments design dividers with openings along the bottom that would allow small animals to pass through, but would not affect the barriers' ability to keep cars in their place.

In the meantime, the British are carrying wildlife-management engineering to new depths: English conservationists have built a tunnel under a roadway in the Thames Valley, 35 miles west of London—so toads can cross in safety.

—Michael Kantor

WHAT WAS THAT?

Confronting the serious problem of wildlife slaughter on the highway head-on (and presumably



tongue in cheek), Iowa biologist Roger M. Knutson has produced a parody of the familiar nature guide—and of the naturalist who holds it. "Much of our usual ap-

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Mozart, The Piano Quartets Beaux Arts Trio; Bruno Giuranna, viola. "Absolutely indispensable."—Stereo Review Philips DIGITAL 115271

Beethoven, Symphony No. 3 (Eroica) Academy of Ancient Music/Hogwood. "Best of 1986"—Time L'Oiseau-Lyre DIGITAL 115535



Dvořák, Symphony No. 9 (New World) Chicago Symphony/Solti. London DIGITAL 115168

Rimsky-Korsakov, Scheherazade Vienna Philharmonic Orchestra/Previn. Philips DIGITAL 115415

Ravel, Daphnis et Chloé (Complete) Montreal Symphony/Outlot. London DIGITAL 115520

Mozart, Requiem Leipzig Radio Choir; Dresden State Orchestra/Schreier. Philips DIGITAL 115039

Music Of Spain, Vol. 5 Julian Bream, guitar. "Electrifying."—Gramophone RCA DIGITAL 114746

Handel, Water Music Eng. Concert/Pinnock. Archiv DIGITAL 115306

Wagner, Orchestral Highlights From The Ring Vienna Phil./Solti. London DIGITAL 115426

Slatkin Conducts Russian Showpieces Pictures At An Exhibition, more. RCA DIGITAL 154358

Mozart, Clarinet & Oboe Concertos Pay Piquet; Academy of Ancient Music/Hogwood. L'Oiseau-Lyre DIGITAL 115523

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Bach, Goldberg Variations Trevor Pinnock, harpsichord. "Definitive."—Stereo Review Archiv 105318

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preciation of an animal—in any condition—depends on our ability to identify and name it," writes Knutson in *Flattened Fauna: A Field Guide to Common Animals of Roads, Streets, and Highways* (Ten Speed Press, 1987.) "For flattened fauna, however, that can be a problem. Most of these animals have been pressed to the road for several days and may have assumed unrecognizable shapes. . . . This guide is meant to answer the oft-asked question, "That wasn't a dog or a cat—what was it?"

Animal species commonly found run over by cars and trucks are listed for identification in four groupings: road snakes, legged reptiles and amphibians, road birds, and road mammals. Knutson's text, which is accompanied by silhouettes of the flattened animals, describes the habits (while living) and markings (when dead) of the various species.

Knutson suggests that, in the interest of safety, the guide not be used by the solitary driver. And he notes that since the average observation time is about five seconds, identification will be difficult even with a copilot. "Better to know that a particular specimen is possibly a vole," he cautions, "than to be certain it is *Microtus pennsylvanicus* and join it on the road."—A.S.

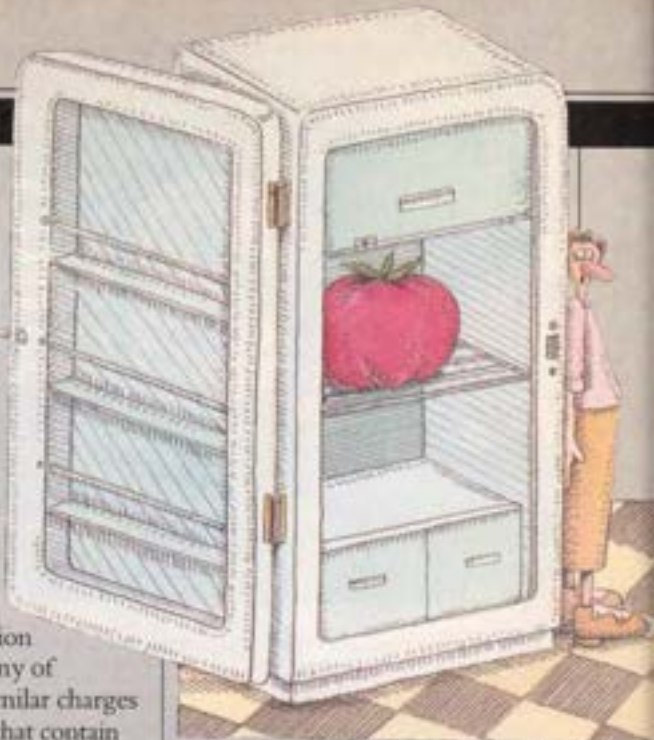
PASTA AL PESTICIDIO, WITH A SIDE OF SALMONELLA

Plump, scarlet, succulent. . . and possibly poisonous is the verdict the National Research Council has given that innocent tomato on your window sill. An EPA-commissioned report by the Council, a division of the National Academy of Sciences, has leveled similar charges against 14 other foods that contain residues of at least one of 28 pesticides commonly used in American food production. Data collected by the panel indicate that if concentrations of the pesticides were consistently as high as legally permitted, they could cause up to 400 cancer deaths each year.

The Council chose the 28 pesticides it studied from a list of 55 that have been identified by the EPA as probably or possibly oncogenic (tumor-causing). The other foods

named, in order of presumed risk, are beef, potatoes, oranges, lettuce, apples, peaches, pork, wheat, soybeans, beans, carrots, chicken, corn, and grapes.

A recent publication from Americans for Safe Food, a coalition of consumer, environmental, and rural organizations, notes that residents of the nation's stockyards are also victims of a drug epidemic. More than 20,000 animal drugs used to stimulate growth and help



LOW-LEVEL NUCLEAR WASTE: WHO MAKES IT, WHO WILL TAKE IT

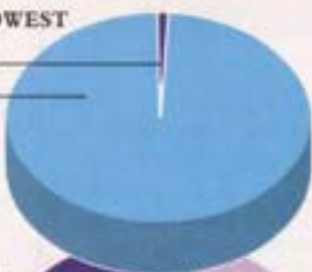
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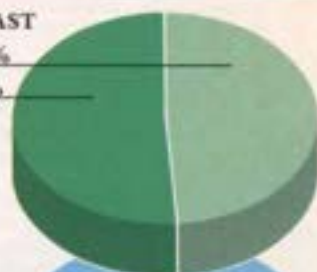
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OR 41.9%
MT .05%



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MO 5.7%
MI 28.4%
OH 17.5%
WI 8.3%
IA 15.2%
IN 0.6%



SOUTHEAST

TN 26.8%
VA 16.6%
AL 11.6%
SC 15.4%
FL 6.7%
GA 8.9%
MS 2.5%
NC 11.6%²



¹Colorado designated to become host in 1993

²North Carolina designated to become host in 1993

*Proposed

prevent disease are now on the market. Half of all the antibiotics manufactured in the U.S. are given to livestock. The coalition estimates that antibiotics are given to 80 percent of the poultry, 75 percent of the swine and dairy cows, and 60 percent of the beef cattle raised in America. Such widespread use of these drugs can result in human illness caused by strains of bacteria that do not respond to routine medical treatment.

For a copy of *Guess What's Coming to Dinner*, the Americans for Safe Food booklet about the invisible undesirables that may be lurking in your refrigerator, send \$3.80 to the Center for Science in the Public Interest, 1501 16th St., N.W., Washington, DC 20036. —Mira Katz

BABY, YOU WERE BORN TO LIVE

More than 14 million of the world's children under the age of five die every year. As nations work to reduce that figure, the question of what increased child survival will do to the population crisis hovers in the background. Fortunately, population control doesn't need to rely on child deaths. In the complex population debate, one thing holds true: Significant and sustained drops in birth



rates are always preceded by a significant and sustained fall in child mortality rates. Parents have fewer children when they know the ones they have will survive.

"Improving their



children's health can generate the confidence—the feeling of having control over their own life—which is at the heart of the population question and the acceptance of family planning," writes James P. Grant, head of the United Nations Children's Fund.

Thanks to such programs as oral rehydration therapy and full immunization, child deaths have been reduced significantly in Sri Lanka, China, Costa Rica, South Korea, and Thailand. And so have births. Grant notes that if all developing countries had achieved the same lower child mortality rate and the same birth rate as the average for these countries, there would have been 9 million fewer child deaths in the world this year—and nearly 22 million fewer births. —A.S.

TUNA IN...

Buy albacore, which is caught by methods safe for dolphins.



... TUNA OUT

Avoid light tuna, which is caught in nets that also kill dolphins.



DOWN IN THE DUMPS

By 1979 the governors of Washington, Nevada, and South Carolina had had enough. Their states, they declared, would no longer be the only dumping grounds for the entire nation's low-level nuclear waste. The crisis prompted Congress to pass the Low-Level Nuclear Waste Policy Act one year later. The act put the responsibility for low-level waste disposal on the shoulders of all the states by requiring them to form interstate compacts and to build regional burial grounds. The compacts were to be ratified by Congress, and approved regions could refuse to accept waste from outside their compact area as of January 1, 1986.

But the legislation has encountered familiar pitfalls. The compact-making became mired in politics, and by 1984 it was clear that additional disposal sites were not going to be chosen within five years as planned. In 1985 the act was amended, and Congress

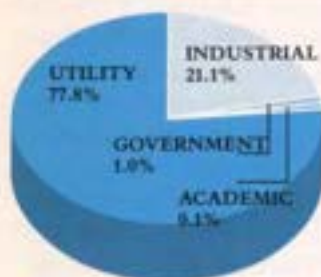
extended the 1986 deadline for operating regional dumps to 1993.

So far, 43 states are members of ratified or proposed compacts. Massachusetts, Maine, New York, Texas, and Vermont have formed single-state compacts, and New Hampshire, North Dakota, and Rhode Island, along with the commonwealth of Puerto Rico and the District of Columbia, remain uncommitted. California and North Dakota may enter into a compact with Arizona and South Dakota.

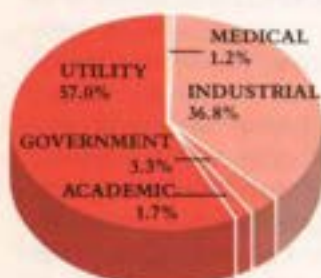
The two graphs at the immediate left show the quantity and radioactivity of commercial low-level waste generated nationally by category. The other graphs show the current composition of the compacts and the percentage of waste each state will contribute to its regional dump. The host state, where determined, is colored blue.

—A.S.

Source: EGG Idaho, for the Energy Department



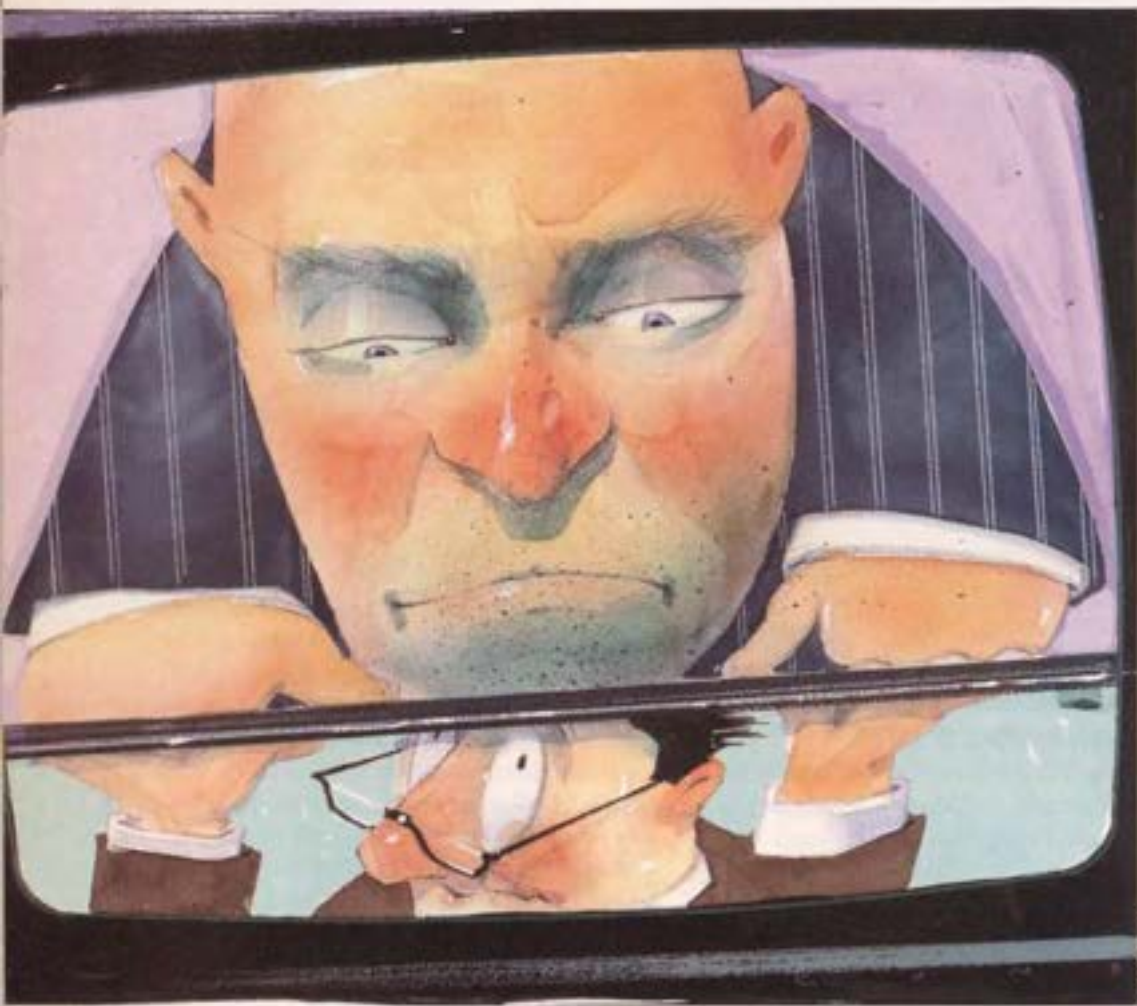
RADIOACTIVITY PERCENTAGE BY SOURCE



VOLUME PERCENTAGE BY SOURCE

A Fight for Time on the Air

Now that the administration has abolished the Fairness Doctrine, citizen groups are looking to Congress and the courts for help.



David Bollier

IT'S A CLASSIC mismatch: Underfunded citizen groups trying to sway public opinion must resort to door-to-door canvassing, meetings, and demonstrations. Meanwhile, the well-heeled opposition finances slick television campaigns that instantly reach into the living rooms of thousands, sometimes millions, of viewers.

Unequal access to the media has always plagued environmental and other public-interest groups. But now the

mismatch could grow worse—much worse. In August, the Reagan administration abolished the Fairness Doctrine—"a vital tool in gaining citizen access to the media," according to Scott Denman, executive director of the Safe Energy Communication Council, a coalition that includes the Sierra Club.

The Fairness Doctrine, an outgrowth of the Communications Act of 1934, imposed two basic requirements on all radio and TV broadcasters: They had to provide a "reasonable amount" of coverage for "controversial issues of public

importance," and they had to air contrasting views on those issues. Its provisions allowed viewers and listeners to make formal complaints about unbalanced coverage to broadcasters. If necessary, the Federal Communications Commission (FCC) stepped in to enforce the rule.

Not surprisingly, most broadcasters never liked the Fairness Doctrine. They claimed that it infringed on their free speech rights and that it was difficult to administer. "The Fairness Doctrine idea—that government can improve the American media—is in brutal confrontation with the First Amendment," complained former NBC News correspondent Bill Monroe.

Citizen groups responded that no broadcaster has a right to monopolize radio or TV coverage. By law, the airwaves belong to the public, and every broadcast station is licensed to serve the "public interest, convenience, and necessity." Historically, the Fairness Doctrine had been one of the few specific ways in which broadcasters must serve the public interest.

Now broadcasters have convinced the administration to repeal the Fairness Doctrine. Their first big breakthrough came in August 1985, when the FCC issued a report claiming that the Fairness Doctrine infringed on broadcasters' First Amendment rights and was therefore "constitutionally suspect." The mere threat that citizen groups might lodge an official complaint "creates a climate of timidity and fear," the FCC report stated, ultimately discouraging the coverage of controversial issues. In August the agency took the final step, abolishing the doctrine on

constitutional grounds in a 4-0 vote.

Senator Ernest F. Hollings (D-S.C.), whose bill to codify the Fairness Doctrine had been vetoed by President Reagan in June, called the decision "wrong-headed, misguided, and illogical." Hollings vowed to attach his Fairness Doctrine provisions to some must-pass legislation this fall.

But the courts will probably have the last word. At presstime in August, Fairness Doctrine advocates were planning to take the FCC to court for alleged violations of the Communications Act. If Congress passes a Fairness Doctrine law, broadcasters will also go to court, questioning its constitutionality.

The FCC became the focal point of the current controversy earlier this year, when an appeals court panel asked the agency to rule on the doctrine's constitutionality in *Meredith Corp. v. FCC*. The case involved a New York television station that was asked to provide airtime for countering utilities' pro-nuclear advertising. When the station refused, the FCC ruled that the station had violated the Fairness Doctrine.

Rather than comply with the FCC order, the station's owner, the Meredith Corporation, decided that the time was right to test a powerful new argument: that the Fairness Doctrine was obsolete because of the dramatic growth in broadcast outlets. The suit was, in effect, a challenge of the 1969 case that first declared the doctrine constitutional, *Red Lion Broadcasting Co. v. FCC*. In this era of cable TV and satellite dishes, broadcasters argued, the voices on the airwaves are much more diversified than they used to be.

Andrew Schwartzman, executive director of the Media Access Project, has a simple reply to this claim: "The fact is that broadcasting is the most powerful means of shaping public opinion ever created. As long as the supply of broadcast stations does not meet the demand, there is scarcity."

At stake in the controversy are dozens of citizen campaigns that have been using the airwaves to reach the public. One example is the bottle-bill initiative campaign in the District of Columbia, which has rallied voter support for a five-cent deposit on all beverage cans and bottles. Jonathan Puth, director of

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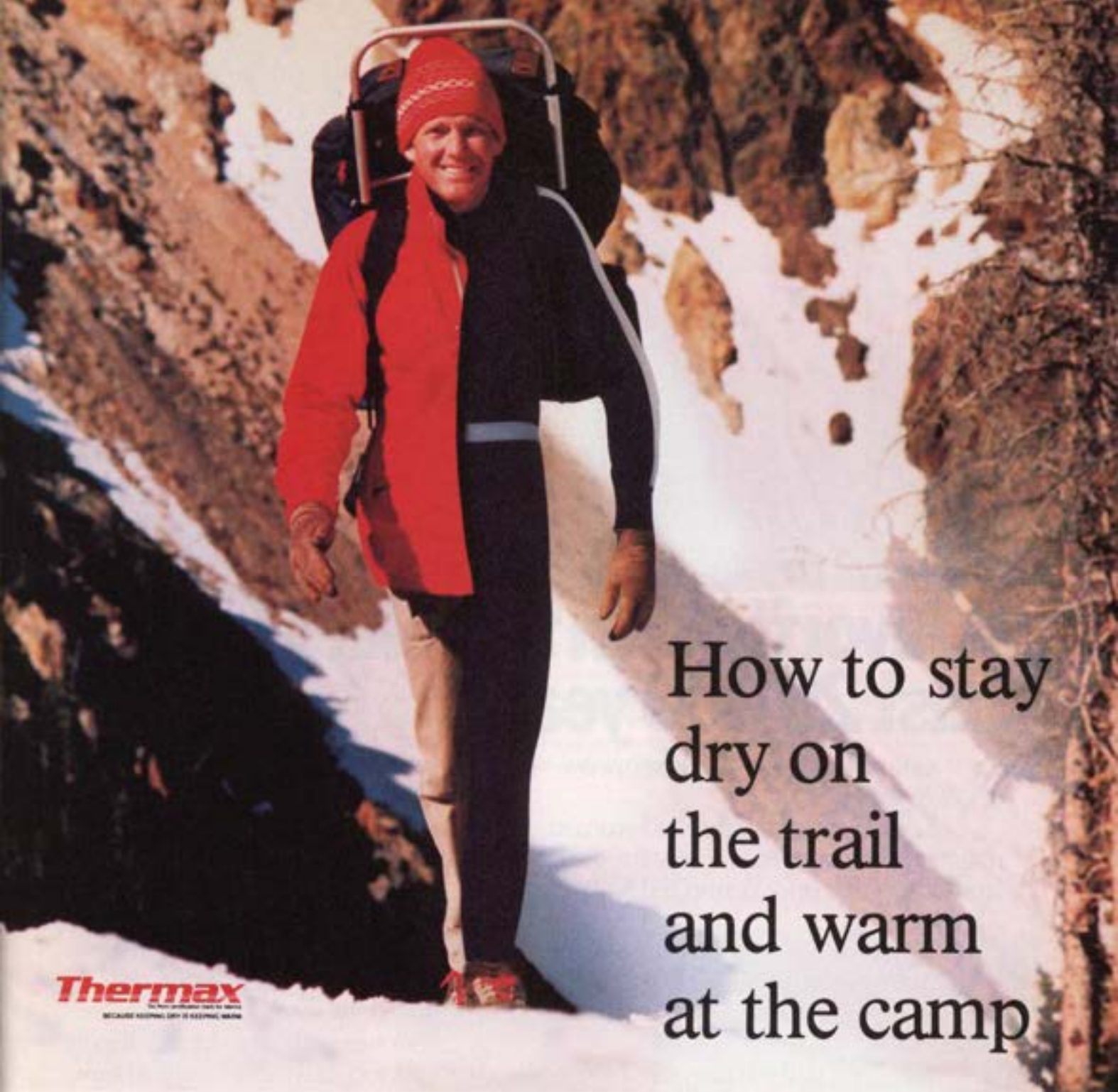
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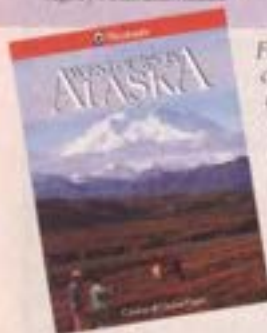
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fuel to generate steam and electricity, while reducing the volume of trash by 60 to 90 percent. At least 200 of these facilities are now being planned, built, or operated nationwide. Most are "mass burn" plants, which burn waste without first separating its components.

But along with electricity the plants are generating concern among environmentalists, who say the ash the plants produce and the emissions from their stacks are serious—and virtually unregulated—health hazards. Environmentalists also worry that efforts to reduce waste and to create or expand recycling programs will go up in smoke along with the trash.

The issue of incinerator ash—in particular, how to dispose of it—has drifted to the forefront of the burn-plant debate. In EPA tests, every sample of fly ash, the fine particulate matter trapped in the plants' air-pollution control devices, showed unacceptable levels of toxic metals such as lead and cadmium. Tests of bottom ash, the unburnt residue that collects on an incinerator's grate, showed unacceptable levels of these elements in 10 to 30 percent of the test cases. Concentrations of the potent carcinogens dioxin and furan are also present in fly ash.

In short, incinerators turn bulky garbage into compact, toxic waste. While one would expect to find ash disposal strictly controlled, this isn't the case. Under the Resource Conservation and

Recovery Act, it's up to plant operators to identify their hazardous materials. Because ash content varies from day to day, testing must be continuous. Yet operators aren't eager to adopt costly control devices and monitoring programs, and the EPA does not force compliance.

As a result, ash is often dumped in municipal landfills, where its toxic components can leach into groundwater. According to Environmental Defense Fund scientist Richard Denison, many facilities routinely combine fly ash with the less-toxic bottom ash to avoid exceeding established hazard levels. But even the combined ash is failing many tests, Denison reports.

"If the incinerators had to dispose of their ash as hazardous waste," says Cynthia Pollack of the Worldwatch Institute, "it would make the plants ten times more expensive [to operate]." In 1985, according to the 1986-87 *Resource Recovery Yearbook*, disposal fees for non-hazardous ash averaged \$13 per ton, while those for hazardous ash ran as much as \$200 a ton.

The dearth of federal regulations of the plants' smokestack emissions is another concern. Depending on the sophistication of pollution-control devices used, an incinerator may emit gases that contribute to acid rain, as well as up to 27 heavy metals and extremely toxic dioxin and furan compounds.

Like ash, airborne pollutants (other than solid-particle emissions) are subject



This Dade County, Fla., incinerator removes many recyclables before burning waste, but it does not employ scrubbers to reduce smokestack emissions.

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to precious little federal regulation: of the 27 toxic metals that incinerators may produce, only three (lead, mercury, and beryllium) are controlled. Increasingly, states are requiring burn-plant builders to install scrubbers that must curtail up to 95 percent of these acid-rain-causing emissions.

Despite their known toxicity, dioxin and furan are not regulated by the federal government. "These are two of the most toxic substances made by man," says Dr. Paul Connett, a chemist at St. Lawrence University in Canton, N.Y. "They can damage the lymphatic system, cause birth defects, and promote cancer." When burned, chlorine compounds in waste products such as plastic, bleached paper, and table salt regroup and form these toxic molecules.

In general, burn-plant emissions do not bode well for air quality. Poor air is already strangling many parts of the country, and the rush to build waste-to-energy plants is likely to exacerbate the problem. "Burn plants can add as much lead to the atmosphere as has been removed by de-leading gasoline," says Sierra Club lobbyist Blake Early. "Communities with high lead levels have no business considering mass burn." Lead's fine particles lodge easily in the lungs, then find their way into the bloodstream and accumulate in bone marrow.

Beyond the debate over incinerator ash and emissions, activists feel that incinerators will do nothing to conserve resources and will gut the recycling programs that have taken years to establish. Recycling advocates point to successful European and Japanese operations, where as much as 65 percent of municipal wastes are recycled, greatly reducing the amount of garbage to be buried or burned. Japan, for example, recycles 95 percent of its beer bottles and two-liter sake bottles. Tossed in incinerators, these noncombustibles simply increase the volume of contaminated ash that must be buried.

Recycling is also cheaper than either dumping or burning, advocates add. The one-ton bales of rotting paper on St. Pierre's barge, for example, might have fetched up to \$20 a ton from recyclers but would have cost at least \$40 a ton to dump—if a landfill had been willing to accept them. Cities should burn

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trash only as a last resort to their garbage crisis, activists say—and only after less-damaging waste reduction, recycling, and source-separation programs have been implemented.

"Should incinerators be built before a recycling program is in place, reducing the volume of garbage could be disastrous for plant operators and create conflicts with recycling proponents," wrote Allen Hershkowitz, director of solid-waste research for the New York environmental-research group INFORM, in a recent edition of *Technology Review*. Hershkowitz added that when burn-plant operators are forced to share their garbage with local recyclers after a plant has been designed, they usually seek permission to truck in garbage from other cities—an option most communities fight.

In the meantime, environmental groups, including the Sierra Club, are working to strengthen federal regulation of these plants. Because of a settlement reached with the Natural Resources Defense Council, in July the EPA announced regulations that would require new incinerators to employ the "best available technology" (BAT). That would mean the installation of scrubbers to reduce emissions. Operators would be required to ensure that the largest possible amount of waste and pollutants is destroyed in the burning process. The EPA plans to propose guidelines for reducing emissions from existing incinerators by late 1989.

Environmentalists and legislators are angry, though, that the EPA did not set specific limits on the amount of pollution incinerators may discharge. "The EPA's own data say that these incinerators are sources of numerous carcinogens," said Rep. Henry Waxman (D-Calif.), chair of the House Subcommittee on Health and the Environment, in a *New York Times* interview. "It is an outrage to say they should not be regulated as hazardous air pollutants."


A bill sponsored by Rep. James Florio (D-N.J.), H.R. 2787, is currently struggling through congressional committees. Besides requiring BAT standards for new burn plants, the legislation would set monitoring, operating, and maintenance requirements to ensure that burn-plant operators comply with

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the Clean Air Act. Florio has also introduced a companion bill, H.R. 2517, to regulate incinerator ash.

Meanwhile, a number of states either have passed or are considering mandatory recycling programs. Rhode Island, New Jersey, and Oregon all recently adopted recycling legislation, and New York has a solid-waste-management plan in the works that aims at recycling 50 percent of its waste within ten years.

But at presstime, 3,186 tons of New

York's garbage sits anchored off Coney Island. The load, largely composed of once-recyclable corrugated paper now ruined by sea water, waits to be burned in a scrubberless incinerator built 26 years ago. While incinerating the trash may rid America of a national embarrassment, many environmentalists feel that the real issue has simply been swept under the rug.

CAROLYN MANN is Sierra's copy editor.

CLEAN WATER

No Safe Harbor for Marine Life

The chemical TBT keeps boats free of barnacles and algae but poisons mussels and oysters—and it's climbing the food chain.

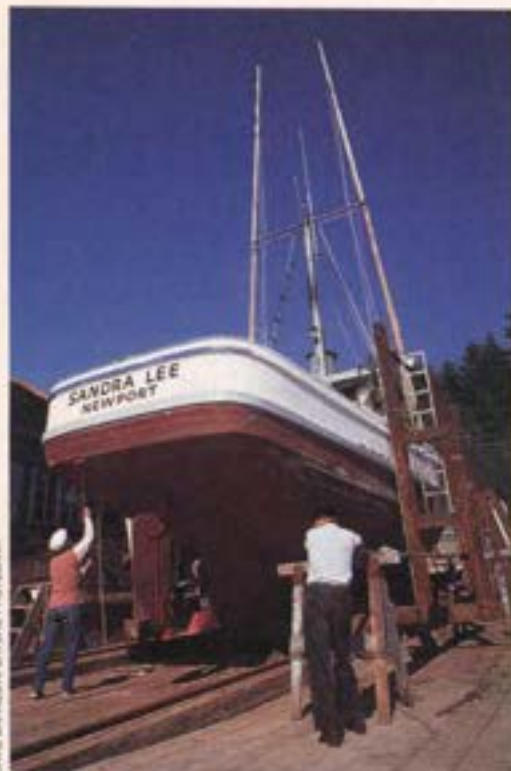
Arthur J. Mitteldorf and Judith S. Weis

BURIED IN THE Ponderous *Federal Register* of June 21, 1985, was a seemingly innocuous report announcing the Navy's plans to save American taxpayers hundreds of millions of dollars each year by painting its fleet with a paint containing the powerful biocide tributyltin (TBT). Barnacles, mussels, and other marine

hitchhikers that cling to a ship's hull dramatically increase drag, adding up to 20 percent to the fuel bill of a seagoing vessel. Unlike the copper-based paints the Navy has been using, which are weaker and degrade quicker, TBT-laced paints actually remain potent without maintenance. And besides being more effective, TBT paints are longer lasting. They require application only once every five to seven years, while copper-based paints must be applied once every two or three years and scrubbed clean every year.

According to the Navy's report, the use of TBT paints would be phased in over ten years, and any side effects would be carefully monitored. The Navy concluded, therefore, that its plan would pose no risk to the environment.

Despite such reassurances, the announcement sent warning flags flying among marine biologists and environmentalists. They claim that TBT poisons marine life at almost immeasurably weak concentrations—10 to 20 parts per trillion (ppt). And the chemical is moderately long-lived: Weeks after it has worn or flaked off a boat's hull, TBT may kill and disfigure "nontargeted" crustaceans and mollusks, including commercially valuable



Some states ban TBT paints on boats this size (under 82 feet) unless they have aluminum hulls.

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crabs, clams, and oysters. Organisms in their breeding or larval stages are TBT's most susceptible victims.

"TBT is probably the most toxic substance that we've deliberately put into the [marine] environment," says Dr. John E. Portman of the British Ministry of Agriculture, Fisheries, and Food.

Chemist Edward Goldberg of the Scripps Institution of Oceanography in La Jolla, Calif., says that the EPA, which controls TBT's use in marine paints, should treat the chemical the same way it treated DDT: ban its use immediately and permanently to protect animal ecosystems. "We have enough information now to take action," Goldberg says. "TBT should be banned for use in commercially available marine paints."

The Navy's proposal to use TBT paints on government vessels is only part of a larger problem. Various TBT-based paints coat the hulls of more than 70 percent of all commercial and recreational boats in the world. At least one third of the more than 700,000 pounds of TBT produced each year in the U.S. winds up on the hulls of boats. The remainder is used in fungicides, bactericides, and wood, textile, and paper preservatives.

The chemical's threat to nontargeted organisms has already raised the ire of commercial fishermen. In October the Pacific Coast Federation of Fishermen's Associations—the West Coast's largest commercial-fishing organization—endorsed a total ban on TBT. "We're willing to suffer the inconvenience of using other bottom paints and hauling out more often to prevent this substance from entering the water and killing fish and shellfish," says Nat Bingham, the Federation's president and a commercial fisherman himself.

The substance hits hardest in marinas and harbors with many boats and little tidal flushing. Releases are particularly high when a freshly painted boat is put into the water and when old TBT-laden paint is scraped into the water before boats are repainted. At concentrations of 100 ppt, the chemical can wipe out mollusk populations, yet concentrations of 200 ppt are common in harbors on both coasts. These figures often skyrocket to more than 900 ppt in the months of May and June, when most



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boats are repaired. The chemical enters the marine environment primarily through leaching (dissolving into surrounding water).

There is also growing evidence that TBT, if left uncontrolled, affects higher organisms. Jeffrey Short and Frank Thrower of the National Marine Fisheries Institute's Auke Bay Laboratory in Alaska raised fingerling salmon in pens coated with TBT. They found alarmingly high mortality rates and concentrations of TBT in the fingerlings' body tissues. When the researchers analyzed "fish farm" salmon bought in Seattle and Portland fish markets, they found TBT levels as high as 200 ppt. The California Department of Fish and Game recently found the first conclusive evidence of TBT accumulation in mammals: concentrations as high as 1,000 ppt in federally protected sea otters.

While TBT testing on humans has not yet been performed, most scientists believe that 200 ppt is not high enough to affect us. However, organic tin compounds similar to TBT are proven neurotoxins, substances that damage the human nervous system. Goldberg worries that the threat to humans will rise as TBT use continues, especially if barnacles become resistant to it.

Chemical manufacturers counter that proponents of a TBT ban rely too heavily on laboratory tests. Their own experience with tributyltin in the ocean, they say, shows that many factors help degrade TBT quickly into safe, inorganic tin. In April, Arthur Sheldon, director of safety and environmental affairs for New Jersey-based M&T Chemicals, told the Senate Subcommittee on Environmental Protection that commonly available copolymer paint (in which TBT is chemically bonded to paint molecules) releases the chemical so slowly that it is safer than both free-association paints (in which TBT is simply mixed in) and traditional copper-based paint. (The cumulative effects on marine life of copper, which is an element and therefore not degradable, have not yet been fully studied.)

But some countries dependent on the health of local fisheries aren't taking any chances with TBT. In 1982, France prohibited the use of these paints on any pleasure craft less than 25 meters (ap-

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proximately 82 feet) long, after evidence showed that 95 percent of the oysters near recreational-boat marinas were deformed and breeding poorly. (It is assumed that commercial ships spend more time in the well-flushed open ocean than do pleasure boats.) England has banned the sale of free-association paints and restricted the percentage of TBT in copolymer paints to 7.5 percent. West Germany, Switzerland, and Japan have also restricted the sale and use of marine paints containing TBT.

Last year Congress withheld funds for the Navy's TBT program, pending an exhaustive EPA study to decide whether TBT is safe. That report could take one to three years to complete, and few legislators will accept a wait-and-see attitude while the study is prepared. Early this year Sen. Paul Trible (R-Va.) introduced S.B. 428, which would ban the use of TBT in marine paint if the paint leaches more than 0.5 micrograms per square centimeter per day.

Coastal states have gone even further. Virginia, Maryland, New York, Oregon, and Alaska have passed laws modeled after those in France, prohibiting the use of TBT paint on most boats less than 25 meters long (under 4,000 gross tons in Alaska's case). Aluminum-hulled vessels and large boats are allowed to use low-release TBT paint. North Carolina mandates a maximum TBT level of 2 ppt in salt water and 8 ppt in fresh water, while Washington has banned all TBT paint—the strictest law in the country. Other TBT bills are threading their way through legislatures in California and New Jersey.

Proponents of TBT legislation cite extensive English and French studies as incontrovertible evidence that the chemical devastates valuable mollusk fisheries. Many are also concerned that the more we learn about TBT, the more onerous and wide-ranging a toxin it will prove to be. While it pales in comparison to DDT's persistent, far-reaching toxicity, TBT poses a similar, serious threat to an ocean full of nontargeted organisms. ■

ARTHUR J. MITTELDORF is cochair of the conservation committee of the Sierra Club's Ventana Chapter in Carmel, Calif. JUDITH S. WEISS is a marine biology professor at Rutgers University's Newark, N.J., campus.

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
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IN DEPTH

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Airborne toxics drift unregulated through America's skies, causing cancer, birth defects, and moral outrage. As with many of the nation's pollution laws, it's time to reassess.

Once More, With Compliance

Carl Pope

IN NATCHITOCHEs, LA., Neill Cameron sits down to write his column for the local *Times*. His target is air pollution. "In Louisiana in 1984," he writes, "14 people were killed and about 345 were injured by the accidental release into the air of almost 12,000 pounds of carcinogenic or mutagenic materials. . . . In the Geismar-St. Gabriel area of South Louisiana, 18 plants emitted 196,649,274 pounds of chemicals into the air the first nine months of 1986. Nine months, just the length of a pregnancy."

In Sacramento, Calif., state Assemblyman Lloyd Connelly (D) introduces the Air Toxics Hot Spots Information and Assessment Act. He distributes a fact sheet to the media and his colleagues. It reads in part: "Almost every manufacturer and user of toxic chemicals that has been examined routinely releases significant levels of substances proven or suspected of causing human health hazards, including cancer and birth defects."

About 70 miles from Sacramento, workers at a commercial complex near an electronics firm in Marin County routinely go home sick from exposure to xylene spewing from the plant. The afterburner approved by pollution control officials to incinerate the xylene fumes doesn't work—but the plant continues to operate.

In the Midwest, activists working with the Sierra Club's Great Lakes Toxics Project discover that the pollutants most devastating to fisheries in the area are airborne carcinogens and mutagens.

And in Washington, D.C., the senior staff of the Environmental Protection Agency concludes that as few as 45 of

the known toxic air pollutants are responsible for at least 1,700 cases of cancer annually in the U.S.

From all around the country comes the message: "There oughta be a law!"

As a matter of fact, there *is* a law—one that's been on the books for 17 years. Section 112 of the Clean Air Act, first passed in 1970 and strengthened in 1977, is entitled "National Emission Standards for Hazardous Air Pollutants." The 1970 version of the section was simplicity itself: It instructed the EPA to identify toxic air pollutants and to regulate them by setting and enforcing standards that provide "an ample margin of safety to protect the public health from such hazardous air pollutants."

Seven years later, when Congress revised the Clean Air Act, lawmakers were appalled to discover that the EPA had established standards for only five toxic air pollutants, although by that time several hundred had been identified. In the face of this clear disregard for the law, Congress selected 38 of the worst pollutants and gave the agency three years to regulate them.

The EPA slowed its pace even further. To date the agency has added only three pollutants to the list of those it regulates. Standards were set for one of these, radionuclides, only after the Sierra Club won three successive judgments against the EPA. The third time, the judge was so outraged by the agency's failure to comply with his previous orders that he threatened to throw then-EPA Administrator William Ruckelshaus in jail for contempt of court. Over the years the agency has made clear its intention to leave regulation of most of the 38 chemicals listed by Congress up to the states.

The regulatory approach that Con-

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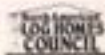
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gress and environmental groups took in 1970 has failed. Airborne toxic pollution, by volume the largest source of human exposure to toxic chemicals and therefore one of the most serious public-health hazards we face, has gone virtually uncontrolled for 17 years. The EPA, even when it has wanted to act, has

classes of pollutants as opposed to individual chemicals. These classes would include such groupings as volatile organic compounds, toxic metals, and products of incomplete combustion. Instead of thousands of regulations, the EPA would set a few hundred. With a smaller number of decisions required,

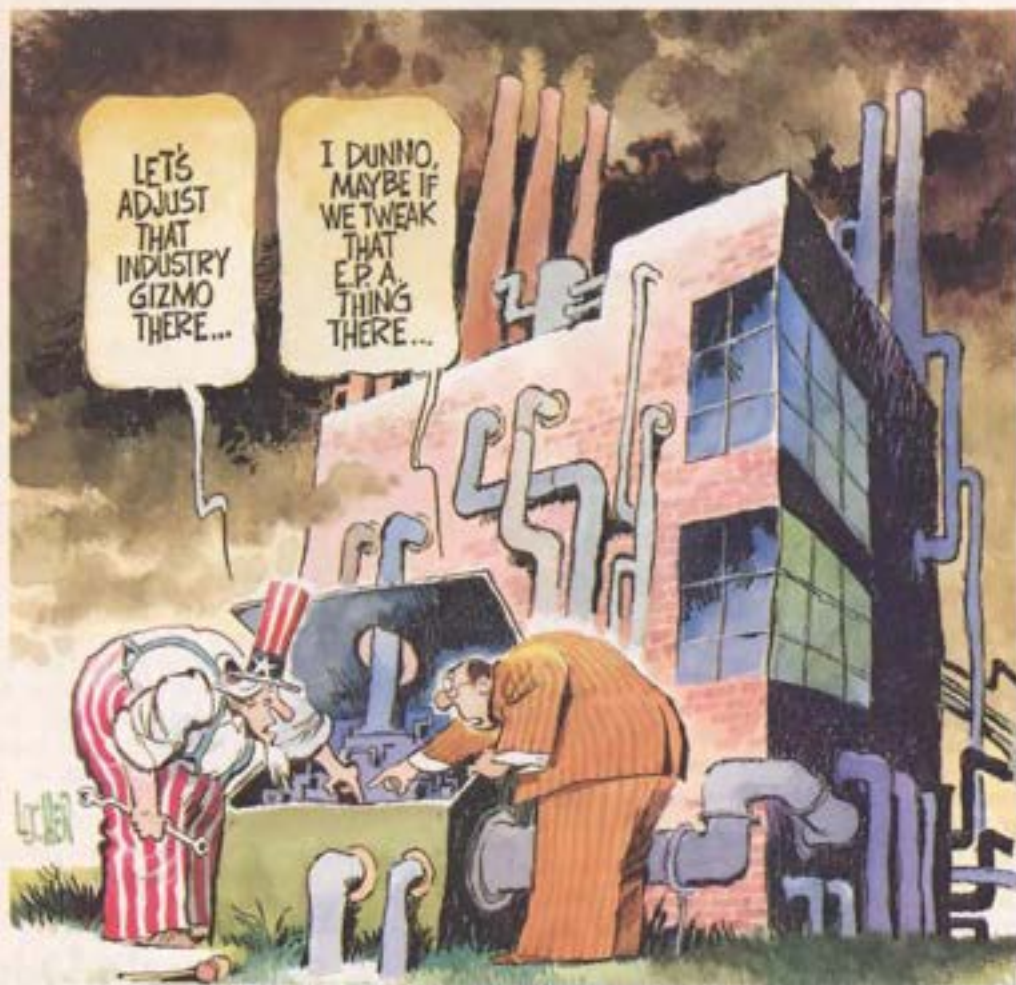
pollution-control approaches that will reduce production of toxic pollutants, or contain them fully within the process, rather than to "end of the pipe" pollution controls. It is much better to modify a manufacturing process to make it intrinsically safer, reducing the opportunities for toxic substances to es-

cape, than to rely on control measures that, like the xylene afterburner in Marin County, often don't work.

While the major industrial sources emit the highest concentrations of toxic air pollutants, smaller sources are dangerous as well because of their proximity to people. The EPA estimates that the emissions from smaller sources and facilities are responsible for up to 75 percent of the cancer cases resulting from airborne toxics. Congress needs to require the EPA to set new national emission standards for such sources, standards that are sufficiently stringent to reduce their total emissions by 90 percent within five years. Again, the EPA should regulate categories of sources and classes of pollutants.

In some cases very small facilities, such as individual gasoline stations and dry cleaners, collectively emit large quantities of toxic

pollutants. The companies that supply the toxic chemicals to such small retail users need to take responsibility for compliance with emission standards. An individual gas-station owner may not have the technical and financial resources to install necessary pollution controls or to audit a compliance program, but the oil company that provides the fuel for the tanks does. If air cleanup programs are to be effective, compliance must become part of the cost of doing business for companies that supply toxic chemicals.



become paralyzed in bureaucratic, legal, and scientific processes. Attempts to regulate pollution chemical by chemical and source by source have yielded little protection but a significant administrative burden. In some cases the goal of providing "an ample margin of safety to protect the public health" is impossible.

There is a better approach, one being advocated this year by the Sierra Club and the National Clean Air Coalition as Congress reviews the Clean Air Act. Simply put, this new approach would require the EPA to set standards for

each one protecting the public against a much larger portion of the total problem, the control of air toxics could finally, and efficiently, begin.

Large chemical manufacturing and handling facilities, power plants, and other combustion plants are the sources of the highest concentrations of toxic air pollutants. Therefore, the most important step in this new approach is to require up-to-date pollution controls for these major stationary sources of toxic pollutants. In setting emission standards, the EPA needs to give priority to

The emissions of some classes of pollutants need to be completely eliminated. One such class is solvents, which are carcinogenic, neurotoxic, and potential sources of birth defects—and which are emitted by the millions of tons each year. Wherever safe substitutes for such toxic solvents are already available, the EPA should be required to mandate product substitution within one year.

Many responsible companies already do substitute: IBM, for example, has shifted to using banana oil in place of toxic solvents for cleaning and servicing typewriters. Where alternatives are not available, the EPA needs to establish a schedule for reducing and then eliminating production of the solvent. This will provide the time, incentive, and markets for the development of safe substitutes.

Such a departure from our present handling of toxic air pollutants will be bitterly resisted by polluting industries and the Reagan administration. In fact, this resistance has already begun.

On June 25, EPA Administrator Lee Thomas wrote to the Senate Environment Committee, opposing legislation introduced by Sen. David Durenberger (R-Minn.) that would adopt some of these requirements. Thomas contends that new legislation regarding toxic air pollutants is not needed; the Superfund legislation that Congress passed last year already requires the largest industrial facilities to provide communities with information about local toxic emissions. Thomas' letter ignores the fact that nothing in Superfund requires measures to prevent such releases, however, or to minimize the risks of accidents such as those that occurred in 1984 in Bhopal, India, and a year later in Institute, W. Va. Durenberger's legislation would set up programs to address those issues.

In testimony before the Senate Subcommittee on Environmental Pollution, Darryl Malek-Wiley, chair of the Sierra Club's Delta Chapter, spoke in favor of Durenberger's air toxics bill. Malek-Wiley told the senators how, in October 1986, the Delta Chapter researched and documented for the first

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time the air emissions from the 18 chemical plants in the Geismar-St. Gabriel area. It found that 24 percent of the pollutants, more than 82 million pounds, were carcinogens and mutagens.

"One might ask why Louisiana has not enacted its own air toxics laws," Malek-Wiley testified. "The answer quite frankly is that Louisiana is unwilling to place its industry at a competitive disadvantage by regulating air toxics beyond what is specified in Section 112 of the Clean Air Act."

In his letter of opposition to Durenberger's bill, Thomas also reiterated the administration's desire to set toxic-air-pollution standards based on economic rather than health considerations. The latest euphemism for this proposition is "risk management," a philosophy that many within the EPA itself know is unacceptable to the American public. A recent EPA publication designed to help the chemical industry communicate more effectively with the public about toxics advised, for example: "Over the past several decades our society has reached near-consensus that pollution is morally wrong—not just harmful or dangerous, not just worth preventing where practical, but wrong. To many it now sounds callous, if not immoral, to assert that cleaning up a river or catching a midnight dumper isn't worth the expense, that there are cheaper ways to save lives. The police do not always catch child molesters, but they know not to argue that an occasional molested child is an acceptable risk."

Polluting industries are resisting an unavoidable transition: They clearly want to maintain their long-standing monopoly on deciding how to manage and use chemicals. But as the American people focus on the moral element involved in toxic air pollution, they are increasingly unwilling to let industry or EPA experts decide whether it is "efficient" to protect them and their families.

This, not abstruse matters of regulatory philosophy, is at the heart of the conflict that faces Congress this year. ■

CARL POPE is the Deputy Conservation Director of the Sierra Club.

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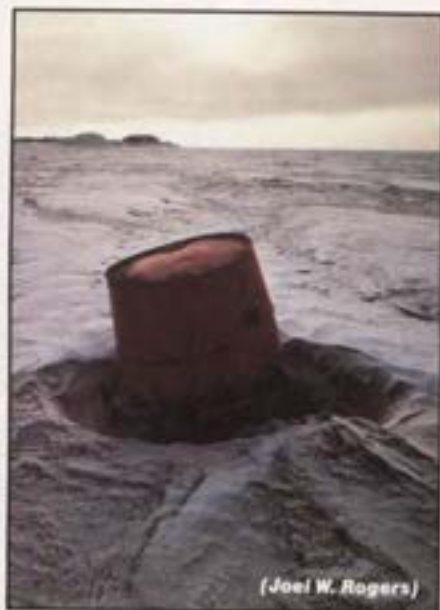


MUSK-OXEN
(Steven C. Kaufman Wildlife Photobank)



It's oil development versus wilderness in the Arctic National Wildlife Refuge. No one knows how much oil is there, but drilling for it would surely spoil one of the wildest places left in America.

JAMES R. UDALL



(Joel W. Rogers)

“What’s that?” someone asks as we finish unloading the rafts. A mile away, a tawny shape with the approximate bulk of Refrigerator Perry meanders across the tundra. We race for binoculars, eager to confirm that this is . . . yes, *Ursus arctos horribilis*, an Alaskan brown bear, a barren-lands griz.

The bear topples over on his back and rolls from side to side like a ship in heavy seas, paws held high. He (no cubs, probably a boar) rolls up, sniffs the air, then ambles our way. His blond coat burnished by golden twilight, the animal exudes a sense of dominion. Some of these grizzlies range over 150 square miles while roving the tundra in search of their next meal. Between May and September they may gain 80 pounds, feasting on tubers, ground squirrels, caribou calves, and bear cubs.

The bear’s path brings him ever closer to our camp.

With mounting excitement and apprehension, we watch him disappear in the willows 200 yards downstream. Just before he vanishes, someone spots another bear 800 yards upstream. We tentatively begin pitching our tents, and from time to time I glance over my shoulder, hoping that these opportunistic predators have been inoculated with the fear of man.

Five days earlier, having flown 3,000 miles on aircraft of decreasing size and increasing vintage, 11 of us landed on a gravel bar near the headwaters of the Hulahula River in the Arctic National Wildlife Refuge.

The Hulahula (named a century ago by homesick Hawaiian whalers) is fed by glaciers capping the 9,000-foot summits of the Brooks Range. The river runs due north and is choked with rocks. As we bumped our way downstream, the boatmen punctuated their commands with *sotto voce* epithets: “FORWARD! HOLD! BACKPADDLE! Damn!” After paddling 40 miles, we were nearing the so-called 1002

The Arctic refuge was established “to conserve fish and wildlife populations and habitats.” Congress will soon decide if there’s also room for oil development.

SNOWY OWL
(Art Wolfe Wildlife Photobank)





The Prudhoe Bay industrial complex, headwaters of the Trans-Alaska Pipeline. While few geologists expect that the Arctic National Wildlife Refuge will yield as much oil as Prudhoe Bay has, the refuge could suffer just as much from side effects such as air pollution, disruption of wildlife, and frequent oil spills.

("ten-o-two") area—a thin slice of coastal plain, 30 miles wide and 100 miles long, wedged between looming, snow-clad mountains and the permanent pack ice of the Beaufort Sea.

Although the 1002 area comprises just one twelfth of the refuge, biologists consider it the most critical portion because it is a breeding ground for so many birds and mammals. During July this is the scene of one of the most spectacular wildlife displays on the continent: the post-calving meeting of the 200,000-member Porcupine caribou herd. But this tundra is also notable for something quite discordant with the tussocks, lichens, and wildflowers that carpet the treeless expanse. This is the area that Interior Secretary Donald Hodel is urging Congress to lease for oil exploration on the exceedingly slim chance—one in one hundred—that somewhere beneath it, miles below the permafrost, there might be 9 billion barrels of recoverable oil.

THE COLLISION of interests in the 1002 area is destined to be monumental. "The oil industry has mounted a lobbying campaign the likes of which we have not seen since the Alaska-lands fight in the late 1970s," says Sierra Club Washington lobbyist Tim Mahoney. In response, conservation groups have revived the Alaska Coalition, at ease since its triumphant passage of the Alaska National Interest Lands Conservation Act (ANILCA) in 1980. "The oil companies have money and momentum," says Mahoney, "but we are recruiting a force of extraordinarily talented volunteers to save this refuge." Whatever Congress eventually decides—unless and until it acts, no development will be permitted—the 1002 vote will be one of the most important land-use decisions this country will make for decades.



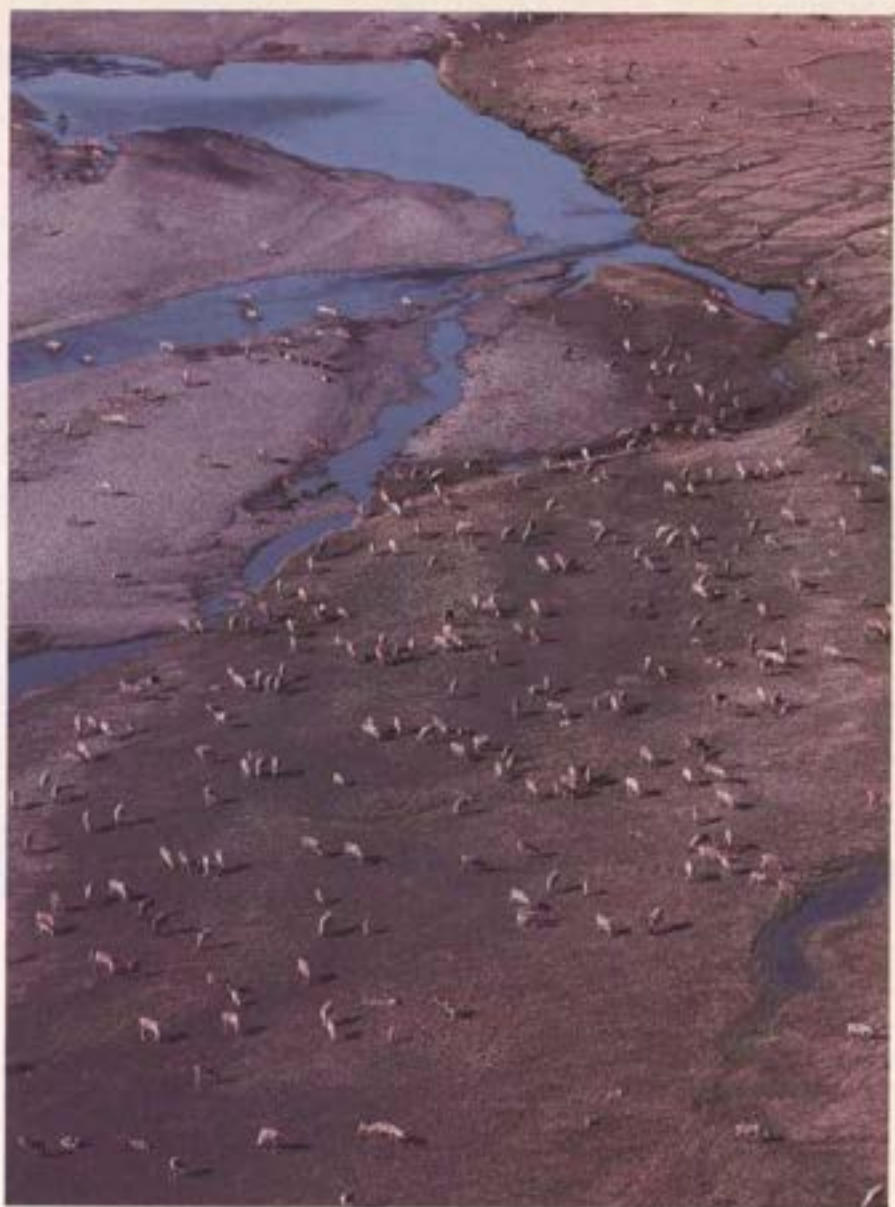
In shorthand, the conflict boils down to oil versus wilderness, an equation with only one unknown. Since we know roughly what oil is worth, the fate of the Coastal Plain must hinge on our answer to the question: What is this singular wilderness worth?

In a way, it is fitting that the Arctic National Wildlife Refuge should be the focus of such inquiries—for if there is wilderness left anywhere in North America, this is it.

ACCORDING TO THE Interior Department, the Arctic National Wildlife Refuge (referred to as ANWR and pronounced "Anwar" by the department and the oil companies) is "the only conservation-system unit that protects, in an undisturbed condition, a complete spectrum of the various arctic ecosystems in North America." Covering 18.9 million acres in northeastern Alaska, it is our most northern and second-largest wildlife refuge. Remote and virtually roadless, it is that ultimate rarity in the late 20th century—a vibrant landscape with all its wildlife, mystery, and magic intact. It's been called the "last great American wilderness," and it owes its existence to a vision five decades old.

In December 1960, in one of those moments of boldness to which lame-duck bureaucrats are occasionally prone, outgoing Interior Secretary Fred Seaton signed an order establishing the Arctic National Wildlife Range in northeastern Alaska. Seaton was a somewhat unlikely convert to an idea that had been nurtured by a long list of environmental luminaries since 1938. In that year, wilderness proponent and indefatigable Alaskan explorer Bob Marshall returned aflame from one of his treks through the Brooks Range. (Marshall would later write, "No comfort, no security, no invention . . . could provide half the elation of the days spent in the little-explored, uninhabited world of the arctic wilderness.") Hoping to protect the Brooks Range, Marshall advanced the astounding notion that all of Alaska north of the Yukon River be preserved as wilderness.

After Marshall's death in 1939 the idea of an arctic wilderness languished. In the early 1950s it was revived by a group that included biologist Olaus Murie and his wife, author Mardy Murie; George Collins and Lowell Sumner of the National Park Service; scientists A. Starker Leopold and F. Fraser Darling; and Supreme Court Justice William O. Douglas. With slide shows and letters, the



Porcupine caribou take to the seashore in search of relief from insects. This year most of the herd gathered farther west than usual, as if to stake its claim to the entire Coastal Plain.

group prepped Seaton for the day he would effect one of the most farsighted achievements in the history of American conservation.

In 1980, Congress passed ANILCA, doubling the size of the refuge and designating most of the original portion as wilderness. But Section 1002 of that bill left the future of the Coastal Plain hanging, pending a study of its oil and wildlife resources.

LIFE ON THE Coastal Plain is yoked to the cyclical transits of the sun. At 70 degrees north latitude, the sun rises on May 15, not to set for ten weeks. As the sun circles endlessly over-

head, the Coastal Plain becomes a haven for migratory birds and mammals. At the center of the pageant is a brown river of life, the Porcupine caribou herd.

The pregnant cows arrive in late May after a grueling 400-mile trek from their Canadian wintering grounds. Since survival often depends on timing in the Arctic, the cows' estrous cycles are exquisitely synchronized: 75 percent give birth within a four-day period in early June. The gangly, 14-pound calves walk within minutes; within a week they can outdistance a grizzly.

During the summer an astounding avian deluge descends on the wing—135 species have been sighted, including



TOM WALKER

The Coastal Plain offers visitors beauty, isolation, and an unparalleled wildlife show.

merlins, gyrfalcons, snowy owls, golden plovers, snow buntings, tundra swans, and threatened arctic peregrine falcons. In June, 2 million shorebirds nest on the Coastal Plain. In late August, as many as 300,000 snow geese arrive to gorge themselves prior to their long flight south.

Autumn in the Arctic is fleeting, and on winter's cue the geese depart. As the crushing cold settles, the Coastal Plain becomes hushed. The last straggling birds leave or die (only six species winter here), and mammals take to their dens.

In midwinter the sun does not rise for two months. With the wind-chill factor, temperatures in February average minus 80 degrees Fahrenheit. Lashed by blizzards, scoured by spindrift, the vast rolling tundra is empty save for a few wolves and scattered bands of stolid musk-oxen, their long fur "skirts" drooping to the ground. Survivors of the Ice Age, musk-oxen have fur that is eight times warmer than wool. Minus 30°F is to a musk-ox as room temperature is to us.

It takes forever, but finally the cold relents. By April the returning sun has vanquished the dead of winter. As the snow melts, the pulse of life quickens, and the cycle begins anew.

Summer solstice falls in the middle of our visit to the refuge, and we are fortunate to observe a bounty of wildlife. En route to the put-in, we flew over small herds of caribou. Tracing our way up the

Hulahula, we spotted scores of Dall sheep on the precipitous flanks of peaks towering 6,000 feet above the river.

On our first morning we found grizzly scat and wolf tracks a hundred yards from the cook tent, arctic loons on a nearby lake, ground squirrels in the cutbanks, golden eagles soaring in the sky above. Regrettably, we missed the post-calving aggregation when, for three weeks at the peak of the mosquito season, groups of 80,000 caribou sweep across the Coastal Plain. Zoologists believe this is adaptive behavior—a "mob the mosquitoes" ploy by which each caribou minimizes its torment.

On the fifth day we floated out of the foothills and entered the 1002 area. There is, of course, no sign of a boundary. This is not some separate entity that can be neatly sliced off for oil development; it is an integral part of the whole.

THE 1002 STUDY mandated by ANILCA took six years to complete. On April 21, 1987, Interior Secretary Hodel submitted the report and his summary to Congress. There is plenty of wilderness already in Alaska, Hodel said, and although drilling would cause "widespread, long-term changes in the wilderness character of the region," oil development "ultimately will be in the best interest of preserving the environmental values of the Coastal Plain." Though oil companies applauded Hodel, conservationists



A porcupine browses along the Hulahula, and a polar bear strolls the Coastal Plain, a rare Arctic onshore denning area.



JOHNNY JOHNSON/WILDLIFE PHOTOGRAPHY

had some difficulty plumbing his logic.

But Hodel's decision came as no surprise. "The deck was stacked from the very beginning," says Bob Adler, executive director of Trustees for Alaska, a public-interest law firm. "For six years the department's actions have been characterized by extreme secrecy, rank bias, and outrageous attempts to prevent public participation."

In denouncing Hodel's decision, Sierra Club Chairman Michael McCloskey said, "The Arctic National Wildlife Refuge is our last chance to preserve intact an arctic ecosystem unique in its natural wonder. Every other portion of our arctic coastline, 1,100 miles long, off-



DEBBIE AND GERRIS MILLER

everything is rosy," Webber says. "We've seen a lot of changes we are unhappy with—in fact, habitat deterioration seems to be accelerating. I worry that if we keep adding all these oil fields together, we risk a cumulative collapse of major systems."

While acknowledging that oil development would destroy the Coastal Plain's wilderness character, industry officials contend that it wouldn't significantly harm wildlife. As evidence they cite the tripling of the Central Arctic caribou herd since Prudhoe development began. But biologist David Klein of the University of Alaska attributes much of this increase to the killing of wolves in the Prudhoe area. "Although the Central Arctic herd has increased, it has largely discontinued calving in the Prudhoe area," says Klein. "And, in any case, you can't extrapolate figures from the Central Arctic herd to another ten times its size."

shore and onshore, is open to the energy industry. It's time to draw the line."

The state of Alaska supported Hodel, although it cautioned him not to lease the caribou's core calving area before studying the impact on the herd. Convinced that oil development would harm polar bears and caribou, Canadian officials urged that the Coastal Plain be protected as wilderness. Cash-strapped Inuit residents of Kaktovik (a village just offshore from the Coastal Plain) approved limited leasing with regulations designed to protect their subsistence lifestyle. Indian residents of Arctic Village and Venetie, however, who are more dependent on the Porcupine herd, sent Hodel plaintive protest letters: "Don't do to the caribou what your ancestors did to the buffalo," wrote Joseph Tritt. "ANWR stands for Arctic National Wildlife Refuge, doesn't it? Doesn't the name speak for itself? What is a wildlife refuge if you destroy the wildlife's main calving grounds?"

What would "oil development" entail? If the 1002 area is leased and oil is found, a work force of 6,000 would build two large and two small airfields, a

hundred miles of pipeline, two desalinization plants, seven large production facilities, 50 to 60 drilling pads, 10 to 15 borrow sites (gravel pits), a power plant, and a seaport or two. By the time they finished, the Coastal Plain would be crisscrossed by 300 miles of roads. The sight, smell, and din of oil derricks, bulldozers, and airplanes would pervade not only the 1002 area but also adjacent wilderness portions of the refuge and Canada's Northern Yukon National Park to the east.

If Prudhoe Bay is any example (and there's no reason to think it isn't), the oil field's effects would hardly be benign. Since 1972 there have been 17,000 oil spills on Alaska's North Slope, most of them at Prudhoe. Air pollution at the industrial complex is significant, as are other environmental hazards. In one case, thousands of gallons of toxic chemicals were spilled by a fly-by-night operator later convicted of illegally storing 10,000 barrels of hazardous wastes.

Plant ecologist Pat Webber of the University of Colorado has studied habitat change in the Prudhoe area. "I do not agree with the oil companies that

herd to another ten times its size."

The draft 1002 report projected a population decline or distribution change for 20 to 40 percent of the Porcupine herd—up to 80,000 caribou. But the Interior Department excised this "editorial error" along with all mention of "unique and irreplaceable core calving grounds" from the final report. In Fairbanks, U.S. Fish and Wildlife Service employees were forbidden to use the term "irreplaceable." Such politically inspired word games have so tainted the agency's scientific objectivity that the report is now the laughingstock of biologists unaffiliated with the Service. (One dismayed employee is keeping a "seam" file to monitor all of the things that don't match up. "The report is so full of b.s. from Washington, you need hip boots to browse through it.")

"Obviously, there would be some disruption," says Alaska Game and Fish biologist Ken Whitten, "but we don't know how that would affect the herd. What we do know is that the cows with newborn calves are extremely skittish and easily disturbed. We also know that because of natural causes and Native



From the banks of the Hulahula, the midsummer midnight panorama extends to the glaciated peaks of the Brooks Range. The plain along the lower river is usually snow-free by June, when the caribou arrive to give birth to their young.



Travelers on the Hulahula bisect the 1002 area as they bounce north to the Beaufort Sea.

hunting, 10 percent of adults and 40 percent of all calves die each year. Thus, even if the effects of disturbance are small, they can still have profound impacts. In my view, current data are inadequate to make a responsible decision."

Professor Klein agrees: "The complexity of any living system is many magnitudes greater than the most complex engineering projects that may affect

them. The only responsible recommendation is to exclude from leasing those areas of known importance to caribou—that is, essentially all of the 1002 area."

Caribou, of course, are not the only animals that would be affected. The 1002 report predicts population declines for polar bears, grizzlies, wolves, golden eagles, wolverines, and arctic foxes. It also predicts a loss of up to 32,000

snow geese and 250 musk-oxen.

Overhunting eliminated musk-oxen from the 1002 area in the last century. In 1969, 51 animals were reintroduced to the refuge. The herd has thrived and now numbers more than 400. "This is one of the most outstanding success stories in the history of wildlife conservation," says Klein, "but it could be for naught if development proceeds." Unlike caribou, musk-oxen live year-round on the Coastal Plain, and the river valleys they frequent are the best sources of the immense quantities of water and gravel that drilling would require.

ALASKA SEN. TED STEVENS (R) delights in calling the 1002 area the "Saudi Arabia of North America." But this is hype. The 1002 report predicts only a 19-percent chance—one in five—that any economically recoverable oil lies beneath the Coastal Plain. If oil is found, the report predicts a 95-percent chance of at least 600 million barrels, a 5-percent chance of 9 billion. The mean estimate is 3.2 billion barrels—six months' supply at current U.S. rates of consumption. In no event could the refuge ever supply more than 4 percent of the nation's daily needs.

Bill Witherspoon, a petroleum geologist who worked on the Coastal Plain

for four years, believes Interior's estimates are overly optimistic. "Judged by the classic criteria for an oil province, the report offers discouraging news," he says. "It would be a shame for Congress to sacrifice this wilderness under the illusion that it represents another Prudhoe Bay. The area is already in service to the public. Let it remain as the last pristine arctic coastline."

The oil companies had hoped that an oil-rich layer of rocks—the "pebble shale"—found at Prudhoe extended into the 1002 area. Geochemical studies, however, show that 1002-area pebble shale would generate only gas, not oil. At Prudhoe a porous sandstone layer provides a reservoir for billions of barrels of oil. But the report suggests that a similar layer may be absent in the 1002 area. Finally, underlying rocks at Prudhoe have been gently deformed so that impermeable shale can prevent oil migration out of the sandstone reservoir below. But seismic data show that the underlayer of rocks in all except the northwest corner of the 1002 area is complexly deformed. Any reservoir that did exist would be exceedingly small.

Witherspoon is not the only one who believes that the report's estimates should be lowered: The Alaska Department of Natural Resources estimates that there is a 95-percent chance that the Coastal Plain holds 80 million barrels of oil, a five-day supply not worth the expense of exploring and drilling.

At the moment the world is awash in oil, gas is cheaper in real terms than it was in the '70s, and oil wells are being capped in proven fields. If Witherspoon is right, and the Coastal Plain is a wildcat province rather than a sure thing, why have the oil companies launched such a lobbying blitz? What are they really after?

Randy Rogers, executive director of the Northern Alaska Environmental Center, says: "With the exception of Prudhoe, the North Slope has been a disappointment. Companies that have lost a lot of money—Exxon has drilled 33 consecutive dry holes—hope to recoup their losses in the 1002 area. If enough oil is discovered to justify building a spur pipeline from Prudhoe, other marginal prospects along the coast be-

CONGRESS CONSIDERS THE ARCTIC COASTAL PLAIN

Is the pristine Arctic National Wildlife Refuge destined to remain pristine? That will depend on how U.S. representatives and senators vote. Those votes, in turn, will depend on how well wilderness advocates convey their wishes to Congress. Legislators are already surrounded by oil industry lobbyists and Alaska development boosters. An absence of letters and personal visits from conservationists could have a devastating impact on the wildlife-rich Coastal Plain of the refuge.

Working to protect this area is Rep. Morris Udall (D-Ariz.), the architect of the 1980 Alaska National Interest Lands Conservation Act (ANILCA). Udall, who chairs the House Interior and Insular Affairs Committee, introduced a bill in January that would declare the area wilderness, a designation that would prevent oil and gas leasing.

In a confident mood, Udall labeled his bill H.R. 39, the same number that was attached to ANILCA. That bill established more than 100 million acres of new parks and wildlife refuges, including a greatly expanded Arctic National Wildlife Refuge. Passage of this new H.R. 39 would reaffirm that the refuge is a national treasure, best left undisturbed.

In the House, Don Young (R-Alaska) has introduced an opposing bill, H.R. 1082, which states that "exploration, development, production, and transportation of the oil and gas resources of the Coastal Plain . . . should proceed with dispatch." Young's legislation gives lip service to the "reasonable protection" of the arctic environment, but in fact the bill would exempt oil and gas leasing on the plain from the requirements of the National Environmental Policy Act. As a result, the bill would give less protection to the refuge's sensitive lands than is routinely afforded other land leased for oil and gas development in the United States.

Young has skillfully gained support for his bill. By mid-July he had 149 cosponsors, while Udall had only 85. As the top Republican member of the House Interior Committee and a senior member of the Merchant Marine and Fisheries Committee, Young is well situated to promote his bill: Both these committees must pass the arctic legislation before the rest of the House can vote on it.

In the Senate, Alaska Republicans Ted Stevens and Frank Murkowski have introduced S.B. 1217—a pro-development measure almost identical to Young's bill. More bills may appear later, as legislators try to find some middle ground in the controversy. Legislation may be introduced that would allow only exploratory drilling or that would open up only parts of the Arctic Coastal Plain for oil development.

But conservationists firmly oppose any compromise on the refuge. "Even limited development would destroy the area's wilderness character," says Edgar Wayburn, the Sierra Club's Vice-President for National Parks and Protected Areas. "And it could lead to threats on other protected lands."

Industry spokesmen, sidestepping the wilderness issue, insist that the debate is simply one of oil versus caribou. "But it's not," Wayburn says. "It's *wasting* oil versus preserving the last wilderness of its kind in America."

Letters of support for H.R. 39 are vitally important. If you'd like to help, write your representative (House Office Building, Washington, DC 20515) and senators (Senate Office Building, Washington, D.C. 20510), urging them to support Udall's legislation and to oppose any bills that weaken or compromise protection of the area. If your legislators have cosponsored H.R. 1082 or S.B. 1217, urge them to withdraw their support.

The Sierra Club's stand is clear and simple: The Arctic National Wildlife Refuge is the *last* place we should look for oil. —Mark J. Palmer

come more viable—and valuable. Even if no oil is found, infrastructure development will still benefit them as they mount exploratory efforts offshore.

Mike Matz, Sierra Club Associate Alaska Representative, concludes: "The oil companies want to consummate one last sweetheart deal before Reagan leaves office. The clock is ticking—the time to rob the future is now."

ALTHOUGH THE OIL GLUT has obscured it, the U.S. does have an energy problem. Domestic oil production is falling, consumption is rising, and 7 of our 13 largest oil fields are 80-percent depleted. Oil imports now supply one third of U.S. demand; by 1995 it could be one half.

Our nation is behaving "like a person on an addictive drug," says Secretary Hodel, "in this instance, temporarily cheap oil. . . . We may be putting ourselves at the mercy of a supplier who eventually will exact a very high price for a substance we must have to survive." But Hodel's "drain-America-first" policy strikes some observers as pandering to an addiction we should be trying to break.

Amory Lovins, director of the Rocky Mountain Institute, believes the 1002 debate should be focused on "petropigs," not caribou. "It is important to recognize," Lovins says, "that our future need for oil is not fate but choice." In a scathing critique of the "mendacious" 1002 report, Lovins elaborates: "Since 1979 the U.S. has gotten more than 50 times as much new energy from more efficient use as from all net increases of energy combined. . . . Yet the report assumes that only more oil itself—not more efficient use of the oil we already have—can meet national needs."

Lovins argues that there are two immense untapped "oil fields" in America, "each bigger than the biggest in Saudi Arabia, and each capable of sustainably producing . . . over five million barrels of oil per day." One of these oil fields—the sievelike attics of buildings—could be tapped with insulation and caulking guns; the other, by replacing petropigs with fuel-efficient cars. "Either oil field could eliminate oil imports," says Lovins, "before a 1002-area oil field could deliver any energy whatever."

Christopher Flavin of the World-watch Institute notes that increases in oil imports are inevitable given our current policies, but adds, "Trying to stem this tide with Arctic Refuge oil is like trying to stop a major fire with a teacup. There is something pathetic about a great nation desperately sucking oil out of a national treasure in order to maintain wasteful practices that our industrial competitors are quickly abandoning."

Like Lovins, Flavin advocates more-efficient cars. The U.S. has one of the world's least-efficient automotive fleets, and a ten-mile-per-gallon improvement (from the current average of 18 mpg) could reduce oil use by 3.5 million barrels per day—four times the projected contribution from the Arctic Refuge.

Both Lovins and Flavin believe that leasing the Coastal Plain cannot be justified in the absence of a national energy policy. "Focusing political energy on such diversionary projects does real damage to the effort to develop workable solutions to our energy problems," says Flavin. "It is high time an effective national energy strategy is devised."

That could be a long time coming. At the same time it cries wolf about future energy shortages and touts the pressing need ("for national security") to lease the Coastal Plain, the Reagan administration promotes policies that squander billions of barrels of oil. Since Reagan took office he has slashed the budgets for conservation and renewable-energy programs by nearly 90 percent, vetoed a landmark appliance-efficiency bill (he later signed it when Congress passed it a second time), and rolled back new-car mileage standards (this alone will annually waste more oil than the refuge could supply). The upshot is this: Fifteen years after the first oil shock, Ford is again putting V-8 engines in Mustangs. The cars get 14 mpg in city driving.

AS IT NEARS the Beaufort Sea the Hulahula's flow is siphoned into braided channels, some too shallow to float our rafts. During our last day on the river we encounter what we jokingly refer to as "rough sledging." Finally, though, after hours of scraping along, we reach our take-out.

The next day, on my way home, I stop in Fairbanks to talk with Ave

Thayer, who managed the refuge from 1969 to 1980. During his tenure, Thayer often patrolled the area in a Super Cub, and he is as familiar with its charms and glories as any man alive.

Thayer, 62, is still drawn to the Arctic. Next summer, he confides, he wants to paddle his sea kayak along the coast from Kaktovik to Hershel Island, a distance of more than a hundred miles. A shy, precisely spoken man, Thayer guards his love for the refuge, perhaps because the depth of it embarrasses him.

I ask him how he feels about oil development on the Coastal Plain. "The refuge was established for a purpose—to protect the wildlife," he says. "The law says that any development must be compatible with that purpose. It also says that anyone proposing a change in the way the refuge is managed must provide some justification. What I keep coming back to is this: What is the justification for oil development there? What could be more incompatible with the purpose of the refuge than that?"

His words take me back to the night before, when I took one last walk on the refuge to savor the midnight light, the space, the views, the solitude. The land shimmered with heat, and in the distance I spied a caribou cow and calf moving in the wind like a mirage.

From that vantage point there seemed to be only one problem with the Arctic National Wildlife Refuge: Except for the animals, it has no constituency. It is the edge of the continent, the top of the world, and few people have been there. In that, the refuge reminds me of Glen Canyon, the place no one knew, another glorious site lost more through ignorance than malice.

As I splashed back through the tussocks toward camp, I contemplated the future. According to demographers, 50 years from now there may be 10 billion people on the planet. Oil, no doubt, will be in short supply. But in that crowded world, wilderness of this quality, this scale, will be an even rarer and more precious resource. If, of course, it still exists. ■

JAMES R. UDALL lives in Carbondale, Colo. He wrote "Just Add Water Marketing" for *Sierra's* March/April 1987 issue and has also contributed articles to *Outside*, *Audubon*, and *National Wildlife*.

COVER

NATURAL SPLENDORS

Sierra's Annual Photo Contest Winners

SECOND PLACE

Abstracts in Nature/Black & White

KURT W. JUNG

Birmingham, Michigan

Dracaena fragrans, Oakland County, Michigan



FIRST PLACE

The Meeting of Land & Water/Color

BILL LANE

Hanover, Virginia

Sunrise at Swan Cove, Chincoteague, Virginia



FIRST PLACE

Abstracts in Nature/Black & White

ROBERT LANDAU

Los Angeles, California

Tree Patterns, St. Louis, Missouri

For the past eight years, our September/October issue has showcased the winners of *Sierra's* annual photo contest.

In a magazine packed with facts, these pages offer readers a chance to stop and enjoy nature for its own sake—to savor its colors, forms, and infinite variety.

Our judges—Carolyn Robertson of Yolla Bolly Press, Steve Fukuda, a San Francisco freelance photographer, and Kim Komenich, a Pulitzer Prize-winning *San Francisco Examiner* photographer—made the final selections from a record-breaking field of 1,486 entries.

We owe thanks to Questers, Nikon, and Buck Knives for providing the contest prizes. Thanks, too, to the photographers who submitted their work. Images such as these both calm and inspire us—and renew our commitment to the world's natural splendors.



SECOND PLACE
People in Nature/Color
BOB WOODALL
Wilson, Wyoming
Lightning Storm,
Last Park, Colorado



SECOND PLACE

The Meeting of Land & Water

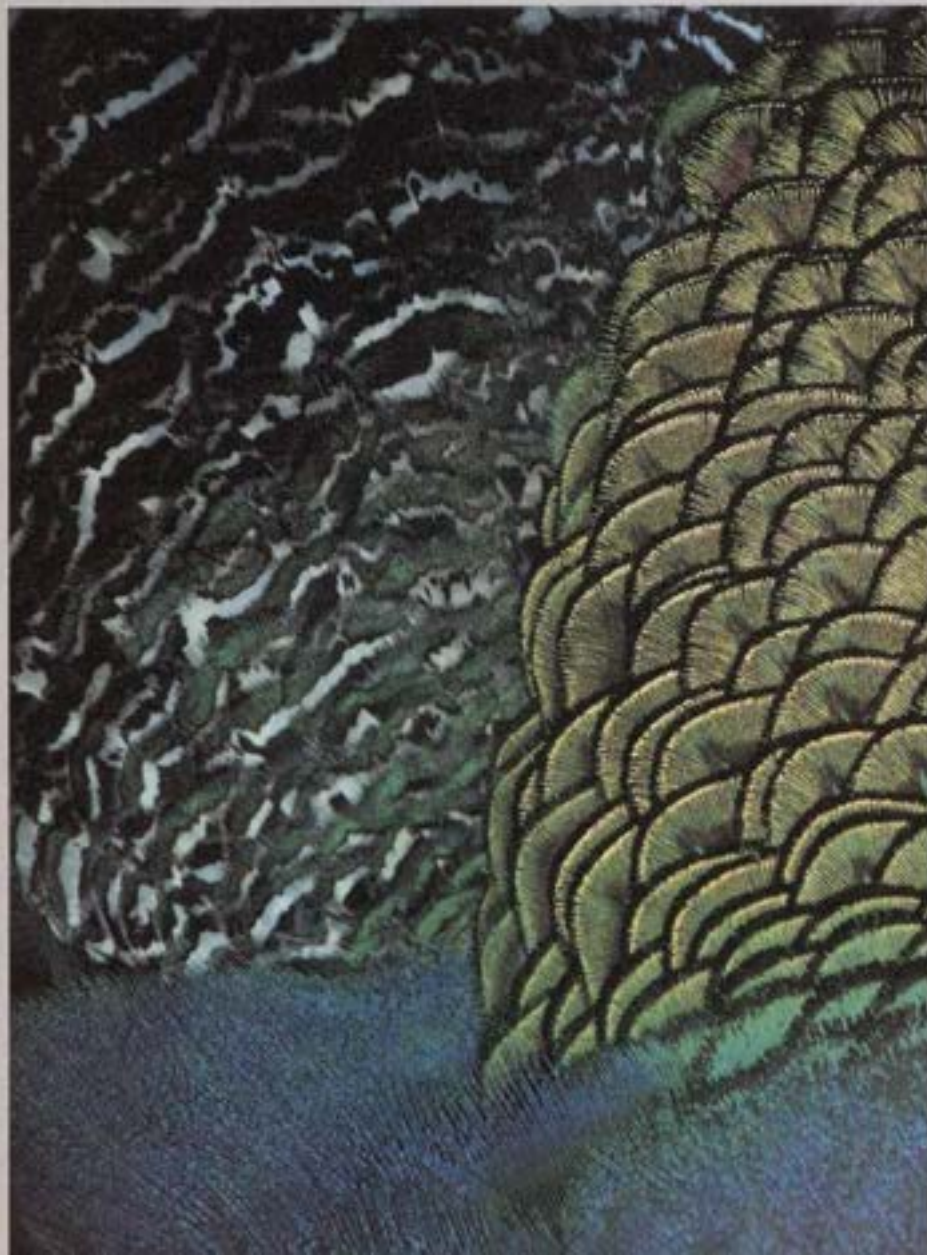
Black & White

ROBERT P. SOUTHER

North Quincy, Massachusetts

Squam Rock Park,

Squampton, Massachusetts



SECOND PLACE

Abstracts in Nature/Color

WILLIAM HOLLISTER

San Jose, California

"A Magic Castle"



FIRST PLACE

People in Nature/Color

BRUCE HANDS

Seattle, Washington

Fly Fishing at Dawn,

Yellowstone National Park, Wyoming



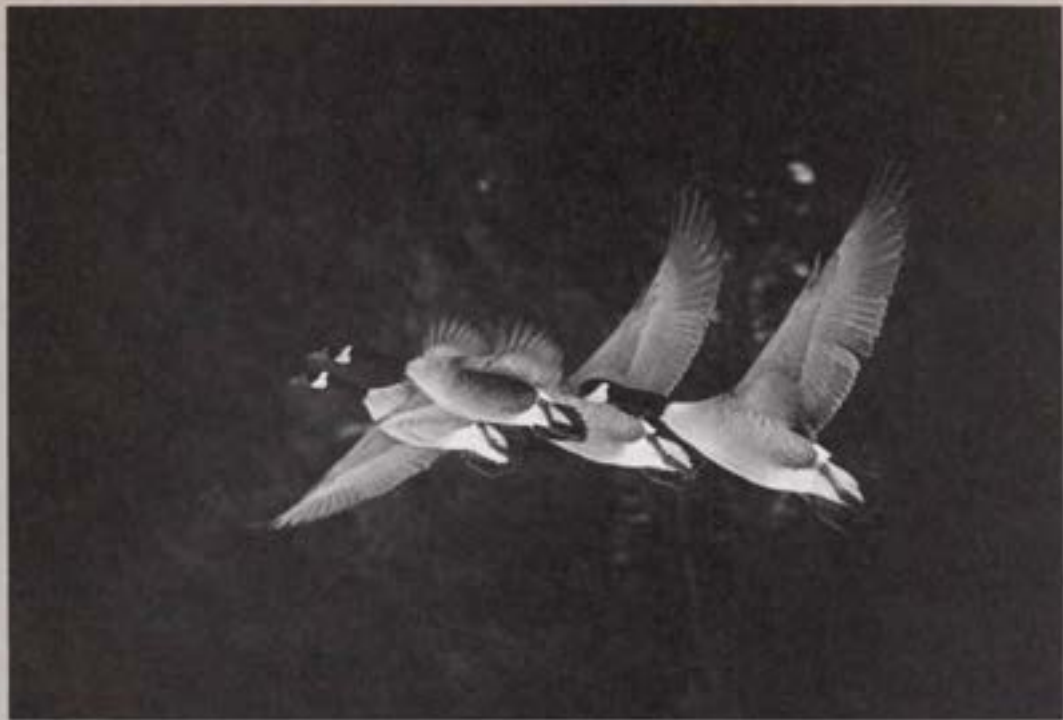
FIRST PLACE

People in Nature/Black & White

SHEILA WHINCUP

Sooke, British Columbia

Feet in Creek, Vancouver Island, British Columbia



FIRST PLACE

Wildlife/Black & White

DAVID W. COULTER

Delaware Water Gap, Pennsylvania

Geese Flying Over McIlhenny,

Pocono Mountains, Pennsylvania

FIRST PLACE

Abstracts in Nature/Color

INES E. ROBERTS

Santa Barbara, California

Peeling Bark of Eucalyptus Tree





SECOND PLACE

The Meeting of Land & Water/Color

ANDREW OSBORNE

Kremling, Colorado

*Water Droplets on Aspen Leaves,
Fairplay, Colorado*



FIRST PLACE

The Meeting of Land & Water/Black & White

KENT M. SIMMONS

Atlanta, Georgia

*Sunset on the Red Trail,
Okefenokee Swamp, Georgia*



SECOND PLACE

Wildlife/Color

IAN C. TAIT

Bakersfield, California

*Giant Green Anemone,
Half Moon Bay, California*

SECOND PLACE

Wildlife/Black & White

ANDY YOUNG

Croton-on-Hudson, New York

*Grey Snappers,
John Pennycamp State Park, Florida*





SECOND PLACE

People in Nature/Black & White

STANLEY E. McCLEAVE

Maryville, Tennessee

Susan/Little Duck, Hawk Ridge, Great Smoky Mountains National Park



FIRST PLACE

Wildlife/Color

LILLI ZAENKER

Lauderdale Lakes, Florida

Grasshoppers Mating, Loxahatchee National Wildlife Refuge, Florida





RICHARD RAWLES

In 1983 President Reagan called upon the scientific community to develop a defensive system that would render nuclear weapons "impotent & obsolete." But close examination by concerned physicists has revealed a very different purpose behind Star Wars—one more in keeping with its cinematic namesake.

THE DARK SIDE OF THE FORCE

Gerald Yonas is not amused. It's not his fault the slide projector won't work. The chief scientist for the Strategic Defense Initiative Organization is used to technology of a higher caliber, and the irony of a simple equipment failure is not lost on his audience, which has packed

Illustration by Jeffery Newbury

San Francisco's Palace of Fine Arts auditorium to hear him defend President Reagan's Star Wars package. Yonas' speech depicts the complex obstacles to missile defenses in space as ultimately surmountable, and his patience with the technician operating the projector is stretched to the limit. The crowd is distinctly unsympathetic, and Yonas' grim expression seems to indicate he feels the equipment is rigged.

Yonas is obviously uncomfortable in his public-relations role. His speech is highly technical, laced with the argot of the Strategic Defense Initiative. He speaks of "lethality research." His concerns are for the "survivability of pre-deployed assets" and the ability of tracking sensors to withstand the "radiation environment" of nuclear war. According to Yonas, the mission of Star Wars is not so much to create an impenetrable shield against incoming warheads as it is to "introduce uncertainty into the mind of the attacker."

This rationale—which has become a familiar refrain in the debate over the Strategic Defense Initiative—is a fall-back position from Reagan's original avowed purpose of making nuclear weapons "impotent and obsolete," a goal that even those designing Star Wars concede is not realistic.

The new "uncertainty" rationale springs from the paradox contained in the doctrine of deterrence: While their power as a deterrent derives from the resolve to use them, nuclear weapons must never be used. The more uncertain the outcome of a nuclear war, the argument runs, the more a potential enemy is discouraged from initiating an attack. Star Wars, its proponents claim, would reinforce Soviet uncertainty of their ability to survive a nuclear war.

But there are those who feel our deterrent doesn't need enhancing. Robert Bowman, former head of the Air Force's Star Wars research program, is one. "A Soviet planner contemplating a first strike on the United States would have absolute certainty that he would fail," Bowman says.

Why? Because the United States possesses 6,000 to 7,000 survivable warheads on its submarines. "I think that's deterrence enough," he adds. "But that's not what's important. The important thing is, the *Russians* think that's deterrence enough."

Throughout the debate, critics are consistent on a key point: SDI does not transform mutually assured destruction into mutually assured survival. On the contrary, they say, SDI would make initiating a nuclear war a more attractive alternative than it is under the present strategic stalemate. To understand why, one must first examine some of the technical difficulties Star Wars poses as a defensive system.

Strategic defenses aim to intercept warheads in three "phases" of flight: the boost phase, before the missile can launch its warheads and accompanying decoys (the "threat cloud") at U.S. targets; the midcourse phase, the 20-odd minutes during which the threat cloud coasts through space; and the terminal phase, when the warheads reenter the atmosphere.

Most experts agree that boost-phase interception is critical to a successful strategic defense because the boosters themselves are easily visible, relatively large targets, and each carries up to 20 warheads. According to Bowman, boost-phase interception would have to knock out 96 percent of the missiles to give the rest of our defenses a chance of eliminating the remaining warheads.

Intercepting single warheads during the midcourse phase is especially problematic because they are more numerous, harder to detect, and very difficult to distinguish from decoys. Terminal-phase interception is the only defense currently feasible, but this tactic can be easily overwhelmed by additional offensive weapons.

The impetus for the Strategic Defense Initiative came originally from proposals for new and exotic directed-energy weapons such as particle-beam accelerators and chemical, free-electron, and X-ray lasers. Scientists

were quick to point out the enormous logistical problems of launching and maintaining chemical lasers in space. Ground-based free-electron lasers would depend on space mirrors to deflect beams at missiles. Richard Garwin, a nuclear weapons expert and former science advisor to President Nixon, likens such a scheme to a kind of "space billiards," with 50,000-mile three-mirror shots requiring an accuracy of six inches.

The plan for a relatively light, nuclear-pumped X-ray laser, fueled by a hydrogen bomb, neatly circumvented the enormous energy requirements of other defenses. But this plan has been criticized by many within the weapons community who doubt that the Soviets would acquiesce in allowing nuclear bombs to circle overhead with only our word that they would not be used offensively.

Most damaging to the hopes for beam weapons was a recent report by the prestigious American Physical Society, which concluded that at least ten years of intensive research are needed to determine whether directed-energy weapons are feasible. Tests have indicated that such weapons have only one percent, or less, the power output and beam quality required before any decision could be made to deploy them. "In addition," the authors of the report state, "the important issues of overall system integration and effectiveness depend critically upon information that, to our knowledge, does not yet exist."

With directed-energy weapons in abeyance, strategic defense proponents are concentrating on developing "kinetic" energy weapons, sometimes called smart rocks. These are small, heat-seeking missiles that destroy missiles or warheads on impact or by exploding a fragmentation bomb at close range. Although hundreds of battle stations would have to be lifted into space to provide adequate coverage, only a fraction would be over Soviet missile fields at any given time. All, however, would be "circling around like ducks in a shoot-

ing gallery," according to Sidney Drell, deputy director of the Stanford Linear Accelerator and codirector of the Stanford Center for International Security and Arms Control.

Garwin believes that vulnerability is the fundamental problem with space-based defenses, which include the various tracking and surveillance satellites that select the targets and aim the weapons. All would be vulnerable to space mines and other countermeasures that even SDI proponents agree are serious enough to warrant counter-countermeasures and ever more elaborate deployment schemes.

Given the vulnerability of satellites, "pop-up" weapons (lasers launched from submarines or allied territory on warning of an attack) look like a reasonable alternative. But, Garwin says, "We have recently discovered a problem, and that is that the Earth is round." For a pop-up weapon to get high enough fast enough to strike a missile in boost-phase on the other side of Earth, its own booster has to weigh something on the order of 450 tons. "Very serious problem," says Garwin.

Such concerns have prompted a number of physicists to question the wisdom of the Strategic Defense Initiative as national policy. Not only have they found the multibillion-dollar-a-year program lacking in foresight, they see it as an outgrowth—some would say the capstone—of a deliberate U.S. drive toward military supremacy.

"The only believable use for Star Wars against ballistic missiles would be in the hands of an aggressor," Bowman asserts, "to protect him from retaliation from the few missiles he'd missed in his first strike." He adds that nuclear weapons are already impotent and obsolete: "The real purpose of Star Wars is to make nuclear weapons useful again. Without SDI, we would probably never have the guts to use our nuclear weapons first."

Emotions on the issue run deep, and the Star Wars debate has taken on an almost religious cast. One also gets a sense of the historical moment while listening to Bowman speak of lasers blasting satellites. When asked what prompted his conversion from head of Star Wars research to the program's harshest critic, Bowman, a 22-year veteran of the Air Force, refers to the military buildup of the Reagan administration. "It's not so much that I saw the light," he says, "as a pall of darkness fall over the nation."



Sometimes referred to as the first-use option, the threat to initiate the use of nuclear weapons in defense of Western Europe has been the mainstay of American foreign policy for 40 years. "We have continued to look for ways to gain enough nuclear superiority on some level to make it credible that we would use nuclear weapons to counter a Warsaw Pact conventional attack," says John Holdren, a physicist from the University of California at Berkeley and past president of the Federation of American Scientists.

Even the notion of a U.S. strategic first strike at Soviet missiles, as distinct from the tactical first-use option on a European battlefield, is not without precedent. In *To Win a Nuclear War* (South End Press, 1987), physicists Michio Kaku and Daniel Axelrod state, based on recently declassified documents, that President Eisenhower contemplated a first strike on the Soviet Union in 1953.

His hand was stayed, however, because the United States possessed no effective shield against retaliation. Even taking into account the advantage that comes with the element of surprise, 75 percent of Soviet long-range bombers might be expected to get through the United States' air defenses, a possibility Eisenhower

judged to be an unacceptable risk.

Other presidents have contemplated less catastrophic nuclear measures. President Nixon, by his own admission, planned in September 1969 to end the Vietnam War with his November Ultimatum to Hanoi, a secret threat to use battlefield nuclear weapons. He later wrote in his autobiography that he was kept from carrying out the threat only by the massive demonstrations against the war that October.

These two concepts—that we possess no shield against retaliation, and that public opinion would not support the first use of nuclear weapons—make a premeditated first strike untenable. It is nonetheless the role of the military to make contingency plans, and one available option is a preemptive first strike. The idea of preemption is to limit the damage an adversary can inflict, in the belief that an attack is imminent. Daniel Bell, in fact, argues in *The Button* (Simon & Schuster, 1985) that the entire command-and-control apparatus of U.S. strategic forces is geared to such a strategy.

"The purpose of nuclear weapons is not to actually end the world," says physicist Kaku. "The purpose of nuclear weapons is to dominate the world." Star Wars is an attempt, he says, to return to the halcyon days of U.S. nuclear supremacy that existed during the 1950s. Bowman agrees: "Star Wars is a blatant attempt to regain absolute military superiority through the development of new offensive weapons disguised as a defense."

"It's really a race to see who can reach the hearts and minds of the American people," maintains Kaku. "Whether scientists can convince the American people that SDI cannot work defensively, and therefore its only application is offensive, or the Pentagon can convince them that it is a defensive system and nothing evil can possibly come of it."

According to Stanford's Drell, this mix of offense and defense "increases

the temptation or the lure of the nuclear madmen, because it makes them think there might be an advantage to blackmail or to going first."

Even President Reagan recognized the more sinister aspects of SDI when, in his March 23, 1983, speech calling for a Star Wars program, he cautioned: "I clearly recognize that defensive weapons have limitations and raise certain problems and ambiguities. If paired with offensive systems, they can be viewed as fostering an aggressive policy."

If it weren't for the dangers inherent in a defense policy that seriously entertains a first strike, the debate might boil down to one's view of Soviet intentions. "Anybody who sees a first-strike war-fighting plan in the U.S. might equally interpret the massive Soviet buildup of ICBMs in the same way," says Drell. Similarly, regardless of U.S. intentions, it is Soviet *perception* of U.S. policy that determines their reactions, which in the case of weapons deployment in space could back them into a launch-on-warning posture. In other words, they wouldn't wait around for the warheads to fall on their silos before retaliating. With strategic defenses, says Holdren, "the activation of your defensive system in time of crisis is not distinguishable by the other side from what you would be doing if you planned to strike them first." And because responses to perceived threats have to be immediate, Star Wars greatly increases reliance on computers, creating a destabilizing condition—and with it the possibility of unintentional nuclear war.

If both the United States and the Soviet Union were to deploy strategic defenses in space, a situation would exist where each side, in time of crisis, would place a premium on preempting the other by shooting first. "Since the best defense is a good offense," explains David Redell, a computer scientist with Digital Equipment Corporation, "satellites would be on a hair trigger to respond to perceived

attacks by shooting back to destroy other satellites before they themselves were destroyed." And if more advanced directed-energy weapons were involved, it would be imperative to fire before fired upon. With weapons like the X-ray laser, there is no time to get out of the way as there would be with the slower kinetic weapons. According to Hans Bethe, a Nobel laureate in physics, "When you see it, you are dead."

B

ecause the element of surprise is the key to minimizing losses in any first-strike equation, some see SDI as an effort to seize the "high ground"—take military control of outer space—and make a first strike credible by threatening Soviet early-warning and communications satellites. Such military superiority in space could translate into political leverage during the Third World conflicts that arise between the superpowers.

Even hard-line SDI officials concede that such SDI components as the X-ray laser may be much more useful in an offensive role as an antisatellite (ASAT) weapon. Other SDI weapons' candidates would become useful as antisatellite weapons long before they could be made effective against ballistic missiles.

Bethe considers the ASAT potential "one of the great dangers of the SDI concept." He adds that it is very destabilizing and bad for the peace of the world. "I find it deplorable that we have not concluded a treaty banning antisatellite weapons," Bethe says, "because satellites are much more important for us than for the Soviets."

Without a separate ASAT treaty, however, SDI weapons could be tested under the guise of ASATs. Most significantly, for the present, SDI provides a bulwark against arms control, as was so aptly illustrated at the Reykjavik Summit. It is clear from the So-


viets' response to SDI that they see it as an offensive system. "The Strategic Defense Initiative may not be able to defend against anything else, but it can defend against arms control," says Holdren.

Drell stresses the need for an educated public to form an arms-control constituency that will influence weapons policy. The only times that there have been successes in limiting the development of nuclear weapons—the ban on atmospheric nuclear testing and the anti-ballistic missile treaty—were when an informed constituency existed. This finally occurred when people felt personally threatened from fallout or from the prospect of having nuclear-tipped ABM interceptors deployed near American cities. "The personal threat right now," says Drell, "is that these nuclear weapons may be used."

One curious development perhaps best encapsulates the Star Wars story and reinforces the American Physical Society's conclusion that the system depends on knowledge that doesn't exist. In the absence of feasible strategic defenses, computer scientists are working to fill the void with generic battle-management software flexible enough to adapt to any combination of weapons and sensors and capable of dealing with any nuclear threat dreamed up by war planners. Because strategic defenses cannot be tested under actual wartime conditions, these programs are to be tested entirely by simulations and then retrofitted to whatever hardware is on hand.

This approach typifies the strange mixture of political fantasy and science fiction that has gone into the creation of Star Wars. By making nuclear war more likely and arms control agreements more difficult, strategic defense inspires nothing more than a false sense of security, and all nuclear-use theories become the stuff of nightmares. ■

RICHARD RAWLES is a writer living in Oakland, Calif., who often reports on defense issues. He is also an editor for PCW Communications.



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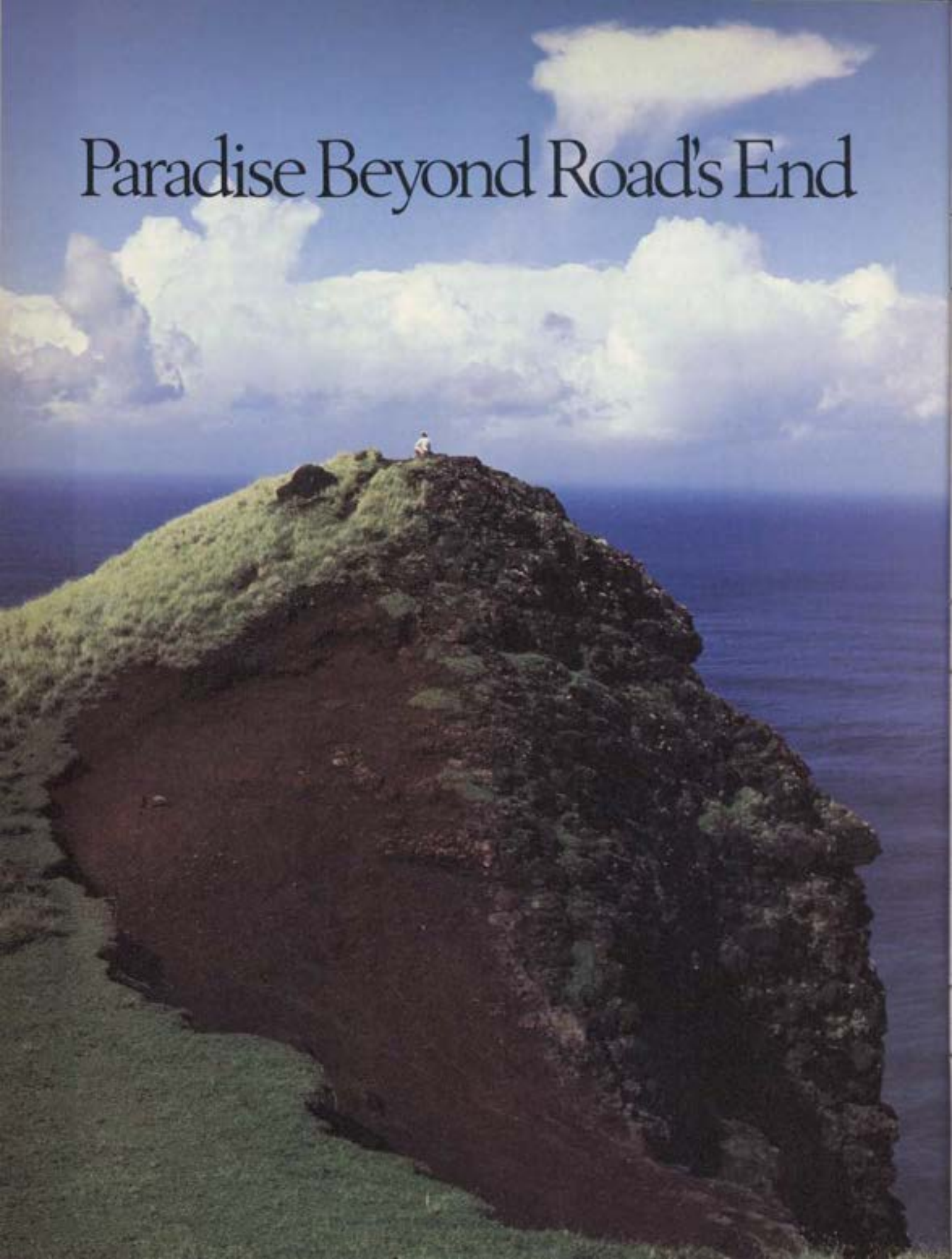
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Paradise Beyond Road's End



Follow an ancient trail along the windswept cliffs and into the dense rainforests of Kauai's Na Pali Coast.

The ideal trail begins where pavement can go no farther. It's not merely an alternative route to a destination but the only overland route available. Such a trail leaves the last beach parking lot on the rainy northwest side of Kauai and follows the soaring volcanic cliffs and flower-choked gorges of the Na Pali Coast to Kalalau Beach, 11 miles away.

I start walking on the Kalalau Trail late in the afternoon after saying goodbye to friends. Then and there my shoulders begin negotiating a truce with my pack, which holds all the necessities I need for my four-day trip—namely, blanket, tarp, food, tobacco, and books. When I meet other hikers laden with tents, stoves, and all manner of gear, including stockpiles of insect repellent, I start to appreciate my light load.

My first ascent of one of Na Pali's rugged seaside cliffs sets the standard for the ascents to come. The trail winds sharply up eroded palisades toward windswept promontories, then zigzags down the other side into verdant gorges cut by mountain streams rushing to the beach below.

I should mention that this is beautiful country, but the trail is narrow and cluttered with tree roots, shale fragments, and slippery *kukui* nuts. It's only atop the cliffs, halfway between one ravine and another, that I can stop, look, and admire. On the way up or down, the trail itself commands my attention.

Despite my caution, occasional distractions of startling quickness or rare brilliance force me to a halt. A bird I don't recognize darts out of a tree whose name I also don't



GENE ANDREWS

Hala tree at Hanakapiai Beach.



EL HAMILTON SIMON



RON WARTS/POST LIGHT



know. A shaft of sunlight catches a huge round spider's web just below the trail's edge. It's worth the off-trail scramble to meet the web's maker, a rotund red-and-black arachnid with bright yellow spikes rising from its backplate like a crown of tiny rhinoceros horns. This, it turns out, is a *Gasteracantha*, a spiny spider. I think of that spider as I climb the next precipice, where the deep foliage reduces to shrub size and then gives way to open sky.

As I reach the summit, the clifftops divide light and dark, wet warmth and dry heat. Here, the sun rises and sets a hundred times each day from behind tropical clouds, its light pouring along the paths carved by streams between steep cliffs. In the valley's shade, the smell of overripe fruit and flowers predominates. But out in the sun, it is the smell of earth that rises, a dry perfume of red soil and bugs.

Separated from the herd and balanced halfway down a bluff, a young goat cries. As I approach, the older goats turn to me, assuming a wait-and-see stance, ignoring their offspring entirely. The kid tenses its muscles and moves, not slowly and carefully as I would, but in leaps and twists. An elder merely sneezes as the kid rejoins the group, and they move away. I continue over the hump of that cliff and down into the next valley.

I spend the first night a mere two miles in at Hanakapiai Beach, where I find a collection of people as varied as the animals I encountered along the way.

Goats, introduced to Hawaii in the late 1700s, have led to deforestation, erosion, and extinction of many native plants and birds (above); Hanakapiai Falls (right); an Ohia lehua tree overlooking the two-mile-wide Kalalau Valley (below).



Two Japanese Hawaiians come back to camp carrying archery equipment but no goats. A biochemist soon to return home to Switzerland shares a buffet with me on the rocks by the beach. A middle-aged couple guards a fully furnished campsite, she in charge of stoves and fire, he busily alternating between a flashlight search for freshwater prawns in a six-inch-deep pool and a relentless

high-tech attack on insect invaders. It rains on us that night, but my plastic lean-to holds up fine. I wake up fitfully during the night—it's as if my mind is trying to come to grips with the significant differences between my old world and this new one.

About a dozen more cliff ascents and drops into rainforest gorges make up the remaining nine miles to the trail's end. I

become familiar with the valleys, their wildflowers, bugs, and carpets of rotting guavas, mangoes, and passion fruits. I come to relish each new vista as the trail emerges at each cliff's end, around peaks sculpted from volcanic rock. The unfolding views make me feel lighter, despite my pack's insistence to the contrary.

After I edge past one last palisade, a huge bare hill of red soil rises in front of me, its skin peeled off eons ago and carried away by wind erosion. In a severe rain the hill would turn to slippery, precarious mud. But here it doesn't rain. The trail has passed the invisible line that divides Kauai's wet and dry sides. (Mt. Waialeale, located in the center of the island, is considered the wettest spot on Earth.) The contours have changed from sharp to rounded, and the trail is no longer a series of switchbacks but meanders over hills and bluffs. On the smooth ridge below me I spot a *heiau*, an arrangement of large stones marking a Hawaiian holy spot—a place of sacrifices—overlooking the sea. From here I wander slowly down into the broad Kalalau Valley, breathing deeply, sweating freely.

A river cuts its way around rocks and under fallen trees like a scene from the Lost World. The gnarled roots of six-foot-tall white ginger plants spread into every available crevice above and below the water level. The plants' huge flowers fill the air with a sharp and languid scent.

I step out of my clothes and into a freshwater pool, only to find an additional gift. Where my foot enters the water, a yellow object I thought was a leaf turns out to be a mango that has been washed downstream and delivered directly to me.

One last mile leads to Kalalau Beach. The trail is lined with passion fruits and wild tomatoes the size of berries. The path ends on a vast blond beach bordered by black cliffs rising hundreds of feet. A delicate waterfall at one end of the cliff completes the scene, providing drinking water and a natural bath for Kalalau's visitors. From the escarpment above, wild goats send down periodic showers of volcanic rock, creating a ten-foot no-man's-land in front of the cliffs. Even so, humans and frigate birds alike

risk the intermittent onslaughts to reach the cliff base's shallow caves.

Only 40 years ago, native Hawaiians lived in this paradise, terracing every inch of the valley for taro farms. This was also the home of the mythical Menehune, a people who accomplished prodigious building feats but who came out only at night. Today this tropical coastline—even without roads—is no longer a pristine paradise. Helicopters regularly roar over the beaches and waterfalls, while motorized rafts, loaded with tourists eager to catch a glimpse of Hawaii's

"untouched" coast, buzz the shore.

In the late-afternoon sun I do my best to ignore the interruptions. I spread myself out on the wide beach and spend the last part of the day listening to waves breaking like muffled cannons on the sand. In a few hours the evening's entertainment will begin: a roseate sunset that will fill the horizon, only to be upstaged by the night sky. I lie there, reading and listening. The truth is, I couldn't walk another step if I tried. ■

MARK FREEMAN is a freelance writer in San Francisco.



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The Natural Magic of Olaus Murie

James and Regina Glover

ON THANKSGIVING DAY, 1949, a young wildlife biologist named Bob Krear pulled his car into the gravel driveway at the log cabin home of Olaus and Margaret Murie in Moose, Wyo. The Tetons loomed white and jagged just a few miles away, but he had little time to enjoy the scenery. As Krear stepped from his car, a coyote sprang off the porch and bounded toward him. The animal leaped up, smacked Krear on the chest, and licked his face exuberantly.

A couple of hours later, Krear sat down with about 30 other people for turkey dinner. "Somebody let the door open and in came the coyote," Krear remembers. "She bounded right up on top of the table and started gulping up the turkey. I guess it was Joanne, the Muries' daughter, who finally grabbed her and took her outside again. Things like that were always happening there."

Murie lore is rich with stories of moose, martens, squirrels, toads, and various other critters sharing close quarters with the family. The stories illustrate why Olaus Murie became one of the most important naturalists and environmentalists of this century: He had an unparalleled curiosity about and a love and tolerance for wild creatures, and he dedicated himself to saving as much of their habitat as he could.

Murie was a premier naturalist in the tradition of Alexander von Humboldt, John James Audubon, and William

Bartram. As a field biologist, he roamed widely over North America—including extensive journeys in Canada and Alaska by dogsled and canoe and on foot—making detailed natural-history surveys. He was one of the first Americans to appreciate fully the concept of ecology and to integrate it into his personal philosophy. As early as 1931 he argued for a more enlightened approach to the management of predator species. Murie was instrumental in the preservation of two major wildland areas: Grand Teton National Park and the Arctic National Wildlife Refuge. He made an enormous impact on hundreds of grassroots conservationists after World War II by traveling about, slides and projector tucked

under his arm, speaking on the need to save a few pieces of wild America.

Olaus Johan Murie was of average height, slender because he often didn't bother to eat, slope-shouldered, and wiry. His face was long and weathered, his eyes deep blue. He cultivated humility as one of the highest virtues, and his widow, whom friends call Mardy, says he was "a man totally without guile."

Murie was born in Moorhead, Minn., in 1889 to poor Norwegian immigrants. He was greatly influenced by the writer and illustrator Ernest Thompson Seton, whose books at the Moorhead School library Murie nearly wore out from avid use. As a youth he



"I am fond of all our native mammals, amounting almost to a passion. . . . from the standpoint of a scientist, a naturalist, an artist."

FRANK S. BALCH/DOUGLAS HORN PHOTOGRAPHY



The Teton flatlands: In 1950, Murie convinced Congress to protect them within the bounds of Teton National Park.

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learned to draw and paint wildlife, to build homemade canoes, and to identify every plant and animal on sight.

After graduating from Pacific University in Oregon in 1912, Murie worked on two of the Carnegie Museum's ornithological expeditions—one to Hudson Bay, the other across Labrador. He was a balloon observer for the Army Air Force during World War I.

Then, in 1920, the U.S. Biological Survey hired Murie to conduct a thorough study of a caribou herd that roams from Alaska to the Yukon Territory. While in the Northwest he met a young Fairbanks woman, Margaret E. Thomas, who liked the outdoors almost as much as he did. One evening they went for a walk and heard a great horned owl hooting in the woods.

"Olaus answered him," Mardy later recalled. "Again the owl spoke, a bit closer this time. Olaus hooted again, and so it went, until suddenly out of nowhere the dark, soft shape floated into a treetop right above us on the riverbank and sat silhouetted against the golden sky. What kind of magic did this man have?"

Their romance had begun. Three years later, Mardy, her mother, and friends were laughing about the unconventional preparations Mardy had made for her upcoming wedding. "Her trousseau is going to be a fur parka and fur boots and flannel pajamas and wool shirts and hiking boots!" exclaimed Mardy's friend Elizabeth Romig.

On August 19, 1924, the Muries were married in a log mission church beside the Yukon River. For their honeymoon they explored the Brooks Range by dogsled, Olaus collecting specimens and Mardy cooking ptarmigan over a Yukon stove. "So far as I knew," Mardy wrote in her account of their experiences, *Two in the Far North*, "our life was to be one long field trip."

Murie finished his caribou study in 1926. Man, he concluded, had disrupted a natural system that had evolved over thousands of years. At the time, people thought that wolves were depleting the caribou, with man's overhunting possibly a contributing factor. But Murie found that competition from domestic reindeer—a growing industry then—was actually the main problem. "The

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caribou's greatest menace," he wrote, "is . . . man's economic developments." Murie's next assignment was to study the elk herd in Jackson Hole, Wyo., once renowned but by then mysteriously declining. While researching the elk, however, Murie became alarmed at the systematic extermination of predators being carried out by the Biological Survey. The Survey's policy was to classify animals as either harmful or beneficial, depending on whether they killed game and livestock. The Survey not only conducted an aggressive campaign of poisoning and trapping "varmints," it

piece in physical fitness. The big cats are infinitely beautiful. The wolf is a noble animal, with admirable cunning and strength. I would not exterminate even these. I would utilize every opportunity to let them live in limited numbers wherever conditions permit it."

But few of Murie's colleagues in the Biological Survey (later to become the Fish and Wildlife Service) agreed. His superiors prohibited him from publishing or speaking about his study of coyotes in Jackson Hole because it put the coyote in a more favorable light than official Survey policy did. And several of his reports criticizing various aspects of Survey policy were conveniently lost and received no attention whatsoever.

As the years passed, the Murie family (they had three children) became increasingly involved in the still-small community of Jackson. Murie served on various boards, Mardy helped establish a town library, and they were regulars at the American Legion dances during the long Jackson Hole winters.

The friendly community was ripped apart by a bitter controversy on March 15, 1943, however, when President Franklin D. Roosevelt proclaimed the Jackson Hole National Monument. To be administered by the National Park Service, the monument included 221,610 acres of national forest as well as state and private land in the flat sage country east of Grand Teton National Park.

Screams of protest from Jackson Hole were heard all over the country. Opponents staged a highly publicized cattle drive, complete with Hollywood movie star Wallace Beery, across the monument. Local newspapers compared the monument proclamation to Hitler's annexation of Austria. Proponents of the monument were literally frightened into silence, at least for several months, so frenzied were the protests.

Even most conservation groups opposed the monument at first. Their primary objection was to Jackson Lake, a large and beautiful (but artificially enlarged) body of water at the heart of the new monument. The National Parks and Conservation Association and The Wilderness Society had already gone on record as opposing the inclusion of the lake in a national-park unit. The two



COURTESY MARGARET MURIE

Olaus Murie and his favorite dog, Jack.

also spread posters and literature designed to incite hatred toward them. To Murie, this was unwise and unethical.

In a letter he wrote in 1931 to a friend in the American Society of Mammalogists, Murie said: "I am very fond of all our native mammals, amounting almost to a passion. I am interested in them from the standpoint of a scientist, a naturalist, an artist. I dislike no animal because he eats. If an animal eats to the extent of harming me unduly, I will retaliate, but only to the extent of relieving the situation and without hatred."

The recipient of this letter, A. B. Howell, represented the more enlightened thinking of the time. But even Howell had conceded that wolves and mountain lions were despicable killers. To that Murie responded: "Personally, I believe the cougar is Nature's master-



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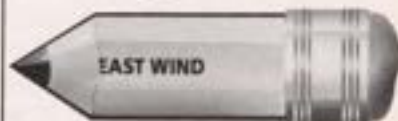
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organizations feared that Jackson Lake would later be used to justify dams and artificiality in other national parks.

Murie, however, favored the monument, including Jackson Lake. He felt national-park or monument status was the only sure way to save the valley from uncontrolled development. He knew that much of the local opposition was stirred up by entrepreneurs with visions of hotels, restaurants, souvenir shops, and summer homes dancing in their heads. And since Jackson Lake had been enlarged before its inclusion in the monu-

ment, it presented, to Murie, a less dangerous precedent than others supposed.

Through vigorous correspondence, articles, and speeches at conservation meetings, Murie managed to change the minds of four different environmental groups. His article "The Spirit of Jackson Hole," published in the Winter 1943 edition of *National Parks* magazine, helped win over The Wilderness Society and the National Parks and Conservation Association. His arguments also convinced the Izaak Walton League and the Federation of Western Outdoor

Clubs. At a gathering of the latter group in Utah, a club official who thought the monument would destroy elk hunting in the region tried to prevent Murie from speaking. A motion overruling the official had to be passed. Murie—by then known as "Mr. Elk"—explained that there would be plenty of hunting in the nearby national forests and that the elk migration routes would be protected by the monument.

Murie was able to change the minds of these organizations because he had become to the Jackson Hole region what John Muir was to the High Sierra. Nobody knew more about the area's natural history than Murie. And Murie's motives were beyond reproach: People knew that he only wanted what was best for the land and its wildlife. He had no hidden agenda.

It was much more difficult for Murie to convince the general public, the courts, and the Congress, however, than it was to convince his friends in conservation. The state of Wyoming brought suit against the federal government, arguing, among other things, that the monument lands had no special beauty or interest. In the ensuing case, Murie was a star witness for the Park Service. He listed the animal species—including elk, moose, and trumpeter swan—that would benefit from preservation of the valley. He emphasized the ecological relationship between the mountain range and the adjacent plain. "Thus," he concluded, "it becomes important to preserve an ecological entity, to have an area of sufficient size . . . that can be kept free from undue alterations or interference with natural processes."

The court decided in favor of the monument. Immediately, bills were introduced in Congress to abolish it. Murie traveled to Washington, D.C., to testify. He recruited the support of "outside" organizations, including the Sierra Club, which at that time was primarily a regional group. He wrote scores of letters to politicians, fellow environmentalists, and opponents, urging them to view the Teton Range and the adjacent valley as one ecological unit. His efforts (and, of course, those of several others) were rewarded in 1950, when Congress added a large portion of the monument to Grand Teton National Park.

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Meanwhile, Murie had finished his elk study. He found that the herd size exceeded its winter range and that the elks were dying from a form of calf diphtheria. Murie recommended a combination of herd reduction and range restoration to solve the problem, and both were subsequently carried out. But Murie had grown weary of government service. In 1945 he resigned from the Fish and Wildlife Service and accepted a half-time position as director of The Wilderness Society.

During the next 18 years Murie wrote dozens of articles and made scores of presentations all over the country, putting into clear and concise terms the reasons why wilderness ought to be saved. He became the great populist of conservation, and everywhere he went, grassroots environmentalists turned out to hear his wisdom.

"It was really something," remembers Bob Kranenberg, a close friend who, with his wife, Mickey, often traveled with Olaus and Mardy. "They'd

George Collins and Lowell Sumner made a preliminary study of the region, hoping to have it designated as a national park. The politics weren't right for that, but in 1956, Murie organized a natural-history expedition to strengthen the case for preservation.

The expedition became something of an event. A documentary film was made and widely distributed. Supreme Court Justice William O. Douglas dropped in for a week and wrote about it in one of his popular wilderness-travel books.

When the research was done, Olaus and Mardy promoted the refuge idea through magazine articles, another film, and various testimonies. The following summer they went back to Alaska to drum up local support. Murie gave talks and convinced several sportsmen's groups to support the refuge concept. "He was masterful in getting the ear of the shooter type of conservationist," says Collins.

On December 7, 1960, Interior Secretary Fred Seaton announced the establishment of the Arctic National Wildlife Range. It was only 9 million acres and did not provide all the protection Murie had hoped for, but it was an important first step. When he heard the news, Murie took Mardy in his arms and wept openly for one of the few times in his life.

Murie died of cancer on October 21, 1963. He was 74. He left a legacy of dedication, wisdom, and humility worthy of emulation by any environmentalist. A few months before Murie died, the Sierra Club honored him with the John Muir Award, its highest accolade, for his outstanding achievements on behalf of conservation.

But Murie's story is best summarized in a single sentence he once wrote: "A poetic appreciation of life, combined with a knowledge of nature, creates humility, which in turn becomes the greatness of man." ■

JAMES GLOVER is working on a biography of Olaus Murie to be published by The Mountaineers. REGINA GLOVER is an assistant professor in the Department of Recreation at Southern Illinois University.



Murie and a young colleague, Brina Kessel, collect field specimens in what is now the Arctic Wildlife Refuge.

have these meetings, and first this group would corner him and then another group would corner him. He could hardly get to the original meeting because everyone always wanted his opinions on different situations. It could be on any area in the United States. He kept right up on all of them."

Murie's crowning achievement was protection of the Arctic National Wildlife Range, known today as the Arctic National Wildlife Refuge. A 19-million-acre wilderness in northeast Alaska composed of mountains, spruce forest, and open tundra, it is critical habitat for the Porcupine caribou herd. (See "Polar Opposites," page 40.)

In the early 1950s, conservationists

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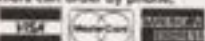
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The demise of Rancho Seco would be good news for Sacramento-area ratepayers and residents. The facility is ranked among the ten worst-run nuclear power plants in the nation.

Headed for the Last Shutdown

SACRAMENTO, CALIF.

SACRAMENTO-AREA VOTERS may soon decide whether to shut down the 913-megawatt Rancho Seco nuclear power plant.

"Given the safety and economic history of this plant, we think the people ought to have a voice in determining its future," says Michael Remy, an attorney and spokesman for Sacramentans for Safe Energy (SAFE). The group recently led the successful petition drive that will put the issue on the ballot.

The plant, just 25 miles from California's capital, has had trouble from the start. On dedication day in October 1974, valve problems in the steam turbine forced a shutdown for repairs. The plant was closed for 13 of its first 18 months in operation due to malfunctioning equipment. In fact, the plant has been closed for about 60 percent of its 13-year life.

Today, the plant is shut down again, this time as a result of its third serious cooling accident. In the fall of 1985 the reactor cooled itself too rapidly, putting severe stress on its containment vessel. The Nuclear Regulatory Commission ordered the plant closed in December 1985, until numerous plant repairs and modifications could be made, and until the utility could demonstrate its ability to operate the plant safely.



Five postponed restarts and nearly two years later, the plant is scheduled to open again in January. Meanwhile, repair costs have mounted—and so have customers' electrical bills. Between 1975 and 1986, average rates in the district increased by 184 percent. This year brought another 20-percent increase, and district officials say additional hikes are ahead.

Because the plant is run by a publicly owned utility, SAFE was able to use California's initiative and referendum

TALLO D'AGOSTIN

process to put the issue on the ballot. The group's 600 volunteers worked for six months to gather more than 50,000 signatures on petitions, ensuring that they would have the 25,000 valid signatures required.

Members of SAFE wanted to hold the election this fall. "We should vote before the utility restarts, spends more money, and risks people's health," SAFE member Nini Redway told *Sierra*. The utility, on the other hand, wanted until November 1988 to prove it could run the plant safely and efficiently.

In July a Superior Court judge chose a compromise deadline: June 1988. The date coincides with California's primary election.

While voter initiatives aimed at shutting down nuclear plants have been tried in other states, none have succeeded. If SAFE wins this election (and recent polls indicate that it might), the news would likely travel far beyond the Sacramento area.

"If politicians see that people feel this strongly about nuclear plants," Redway says, "perhaps they will reconsider the use of nuclear power." —Hal Rubin

A Million Stars Caught in the Sea

VIEQUES, PUERTO RICO

The U.S. Navy owns two thirds of the Puerto Rican island of Vieques. While it uses some of the 33,000-acre island for maneuvers, firing practice, and ammunition storage, most of the land is left alone, save for occasional beachgoers and grazing cattle.

As a result of this benign neglect, thousands of acres of land and many miles of coastline have been preserved. Brown pelicans, hummingbirds, brown boobies, and smooth-billed anis breed on the island. Rare orchids bloom on the mountainsides.

But the island may soon lose its greatest treasure—Puerto Mosquito, one of the last phosphorescent bays in the world.

Though no one can explain why, microscopic organisms called dinoflagellates glow at night wherever the water in

the bay is disturbed—be it by a school of fish or a manatee. Human visitors can watch tiny sparks fall from their wet fingers and see the illuminated wake of their boat. "It is as though a million stars were caught in the sea," says island historian Elizabeth Langhorne.

Nearly all the other phosphorescent bays of the Caribbean have been destroyed by shoreline development that has altered the quality, quantity, or nutrient supply of their waters. According to a Navy report, only about 14 phosphorescent bays remain worldwide.

Now a large, privately owned herb and vegetable farm—complete with fertilizers, herbicides, and insecticides—has been built on government land just north of Puerto Mosquito. A local conservation group is working to ensure that this new development does not harm the bay's unusual marine life.

The Vieques Conservation and Historical Trust (P.O. Box 1472, Vieques, PR 00765) has requested a transfer of the land directly adjacent to the bay, now managed by the Puerto Rican Industrial Development Corporation, to the com-

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monwealth's Division of Natural Resources—or to "any department that would try to preserve the bay in a natural state," says Trust President and Executive Director Myrna Pagan.

The group has suggested that this land could be leased to the Trust, which would monitor the bay's waters and establish a conservation area on its shores.

The farm's manager appears to be taking "every possible precaution to prevent damage to the bay," Pagan says. "But until we get a monitoring system

set up, we don't know if these measures are enough. And there are other serious threats, including grazing, garbage dumping, and tourism."

Extreme caution is necessary around Puerto Mosquito, the Trust believes, because of its fragility, rarity, and beauty. To dive into the bay on a moonless night "is to share universal fires," Langhorne writes at the end of her book, *Vieques: History of a Small Island*. "Is it not a gift of the Gods, a madness to throw away?" —William C. Rice



Where the Roads Ought to Stop

TEMAGAMI, ONTARIO

The good news came in 1983, when the provincial government set up the Lady Evelyn–Smoothwater Wilderness Park in northeastern Ontario. The bad news came two years later: The preserve was not to be strictly protected as a refuge from civilization. The province planned to leave open and extend a timber road that bisected the park. A new

nine-mile section of road would link the park to a busy highway and allow logging of the wildlands outside the park's southern boundary.

Conservationists and tourism interests were outraged. "Our members have traditionally been concerned about the wilderness," said Bruce Hodgins, director of the Wanapitei Wilderness Centre. "This road is a fundamental attack on that tradition."

In response to a groundswell of such criticism, the newly elected Liberal government ordered a halt to construction and an environmental assessment of the road project—the first ever on a forest access road in Ontario.

But the battle was far from won. The draft assessment document, released in September 1986, "was so blatantly pro-timber that we were shocked out of our innocence and into organizing," says Claire Muller, a property owner in the area who became cochair of the group that resulted, the Temagami Wilderness Society (204 Wedgewood Dr., Willowdale, Ontario M2M 2H9). The group is devoted to the defense of the 178,900-acre Lady Evelyn–Smoothwater Wilderness Park and to hundreds of thousands of acres of unprotected wildlands that surround it. Taken as a whole, the 864,000-acre area is known as the Temagami Wilderness.

For a while provincial officials figured they had merely a local fight on their hands. Then the International Union for Conservation of Nature and Natural Resources, the world's largest international alliance of conservation organiza-

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One of Canada's most popular canoeing areas, the Lady Evelyn-Smoothwater Wilderness Park offers majestic scenery, unusual flora and fauna, and ancient Indian trails.

tions, included the park in its 1986 Threatened Areas Register. The listing instantly made the Lady Evelyn-Smoothwater controversy an international issue.

Despite this publicity, the Ministry of Natural Resources appears to be standing firm. In a final environmental assessment now being reviewed by senior provincial officials, the agency has again recommended construction of the road. The Temagami Wilderness Society plans to request a public hearing before the province's Environmental Assessment Board.

Meanwhile, the Society has been doing its homework. The group has



learned that the Temagami wildlands contain one of the densest concentrations of archaeological sites on the Canadian Shield. These lands also nurture the aurora trout, a nearly extinct fish species that exists nowhere else, and virgin stands of red and white pine more than 350 years old—some of the oldest in Canada. Here, too, is the world's only known complete system of *nastawgan*—traditional Indian trails.

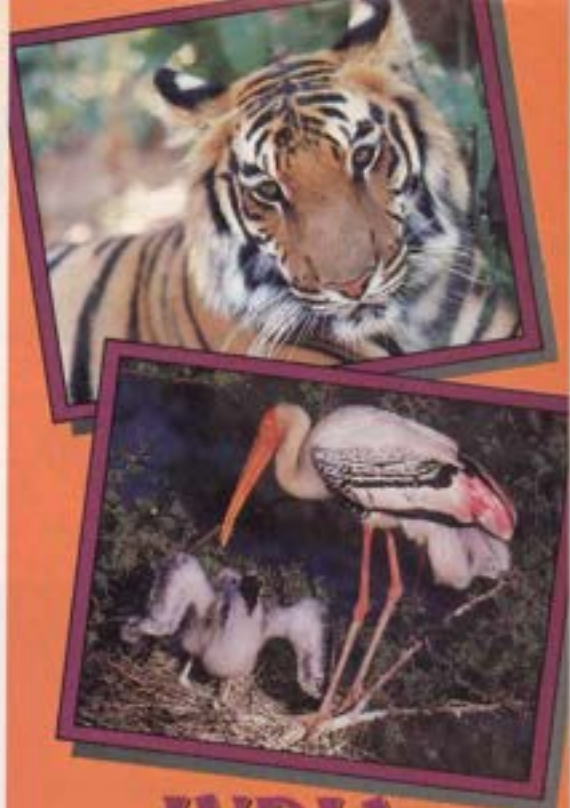
"We've barely scratched the surface, and look what we've discovered," says Muller. "I think we have something here more valuable than any of us could have ever imagined when we started out to save it." —**Brian Back**

From Old Rails to New Trails

THE MISSOURI RIVER

In 1804, Meriwether Lewis and William Clark began their historic exploration of the newly acquired Louisiana Territory. Now conservationists, outdoor enthusiasts, and history buffs are celebrating the beginnings of a hiking and bicycling trail that will follow the explorers' route halfway across the state of Missouri. Most of the 200-mile-long recreational trail will run along the north bank of the Missouri River, beneath the towering dolomite bluffs that line the floodplain.

The opportunity to establish a Missouri River Trail arose in 1986, when the Missouri-Kansas-Texas Railroad (called KATY locally) announced that it intended to abandon rail lines running between the Missouri towns of Machens and Sedalia. That's when local trail supporters went to work. First, they drew local officials' attention to a 1983 federal law allowing the Interstate Commerce Commission (ICC) to approve trails on abandoned rights-of-way being held for possible future use. With the support of Gov. John Ashcroft (R), the Missouri Department of Natural Resources se-



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cured ICC approval for the Missouri River Trail in March.

Meanwhile, trail supporters, including the Ozark Chapter of the Sierra Club, defended the trail concept in two other arenas: in federal court, against landowners who called the conversion a land-grab, and in the state legislature, where funding was being discussed.

"Environmental groups, recreational groups, chambers of commerce, city governments, and others worked to encourage grassroots support for the trail," says Darwin Hindman, a Sierra

Club member who organized the KATY Missouri River Trail Coalition (1264 Sunset Lane, Columbia, MO 65203). The trail will meet a need for recreation and open up an important historic and natural area, Hindman says. For declining small towns along the route, it also offers the hope of an economic turnaround.

While the idea of the trail excites many Missourians, it is not without opposition. Some adjacent landowners are worried about trespassing and van-

dalism, and some claim that the trail represents an unfair taking of private lands by government.

Some concern has been laid to rest by the positive record of trail users at 95 other rail-to-trail conversions in 23 states. But landowners have taken the land-grab dispute to the U.S. District Court in St. Louis, arguing that the right-of-way should return to the landowners that granted railroad easements about a hundred years ago. More than a dozen organizations, including the Sierra Club, have intervened in this suit on behalf of the state, the railroad, and the trail. They argue that the plan does not take the land from private interests but merely allows trail use while the federal government holds onto the easements granted, in case the corridor is needed for public purposes in the future. At press time the judge had not ruled on the case.

Despite the wrangling, trail plans



The Missouri River Trail: a linear park for hikers, bikers, and anyone who ever dreamed of traveling with Lewis and Clark.

have moved forward. The Missouri General Assembly has approved \$229,000 for staff and equipment. A private donor has paid the \$200,000 the state owed the railroad. More money is needed to pay for trail construction, but state officials hope to have at least a few miles of trail ready for hikers by spring.

"Once complete, it will be the longest rail-to-trail conversion in the country," Hindman says. "It will serve as an example of what can be done and what should be done with abandoned rail corridors all over the country."

—R. Roger Pryor

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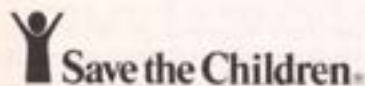
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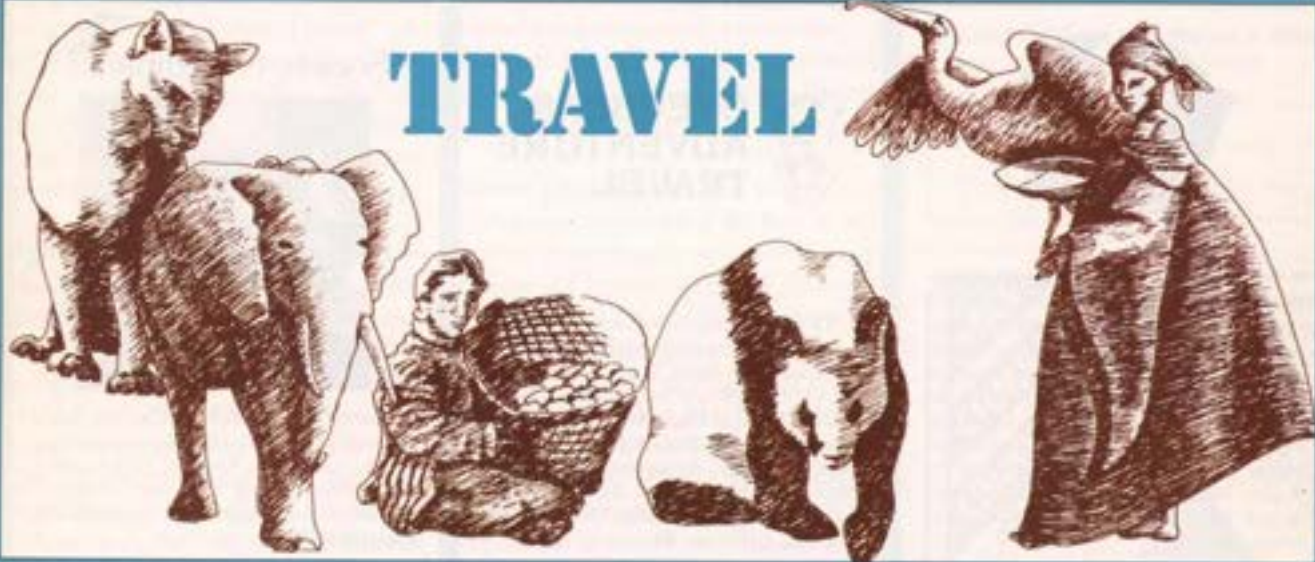


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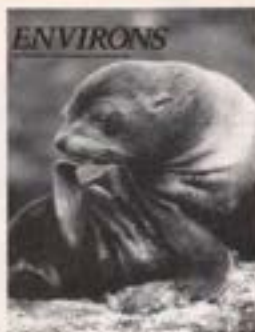
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SIERRA NOTES

Sierra Club Executive Director Michael Fischer delivered an address to the Commonwealth Club of San Francisco in June. His speech centered on the myths underlying the Reagan administration's insistence on oil and gas development along the coast of California and the Coastal Plain of the Arctic National Wildlife Refuge. (See "Polar Opposites," p. 40.)

Fischer, named the Club's Executive Director in April, served as director of the California Coastal Commission from 1978 to 1985. More recently he was a senior associate with Sedway Cooke Associates, a national urban and environmental planning firm.

Copies of his speech, "Drain America Dry First Is Poor Public Policy," are available from the Public Affairs Department of the Sierra Club, 730 Polk Street, San Francisco, CA 94109. Please include a self-addressed, stamped envelope with your request.

Edgar Wayburn, Sierra Club Vice-President for National Parks and Protected Areas, has received the National Parks and Conservation Association's prestigious Marjory Stoneman Douglas Award for Citizen Conservation. The award recognizes Dr. Wayburn's pioneering environmentalism over the past 40 years, particularly his role in implementing the 1980 Alaska National Interest Lands Conservation Act and in establishing Redwood National Park and the Golden Gate National Recreation Area in California. The Douglas Award takes its name from the woman whose efforts led to the establishment of Everglades National Park in 1946.

Singular efforts by Sierra Club volunteers were honored at the Second Sierra Club International Assembly in Vail, Colo., July 2-5. In addition to the John Muir Award (see "Afield," page 12), five other citations were made:

■ **Special Achievement Awards** (for efforts of singular importance to conservation) to Mary Wimmer for her work on the Monongahela Trail Recovery Project, and to Lebron Hardie for his

role in the establishment of the Franklin Mountains State Park and the Urban Wilderness Park in Texas.

■ **The Oliver Kehrlein Award** (honoring outstanding work in the Club's Outing program) to Louise and Calvin French for more than two decades of innovation and dedication to leader training.

■ **The Special Service Award** (for strong and consistent commitment to conservation over an extended period of time) to William Skelton for leadership in forest management nationwide, but most particularly in Tennessee.

■ **The Special International Achievement Award** (recognizing the role of an individual or organization in international environmental protection) to Norman Myers for focusing worldwide attention on the value of tropical forests and species diversity.

Sierra Club Books will continue its tradition of showcasing the best in wilderness photography with the release in October of *Portraits of Earth* by Freeman Patterson (\$35, cloth). Patterson's "earthscapes" explore the dynamic forces that shape geologic structures, river systems, and plant and animal communities. The work of another acclaimed photographer, Galen Rowell, is now available in paperback with the September re-release of *Mountain Light: In Search of the Dynamic Landscape*, (\$19.95).

Photojournalist Robert Wenkam presents a dramatic look at the violent forces of nature in his book *The Edge of Fire: Volcano and Earthquake Country in Western North America and Hawaii* (\$35, cloth).

Mountaineer and filmmaker Julie Tullis is the author of a posthumously published book, *Clouds from Both Sides* (\$17.95, cloth). Tullis, the second Briton ever to scale K2, recounts her childhood in London, her marriage to fellow rock climber Terry Tullis, and her career as a filmmaker. Tullis died from exposure on the descent from K2 in August 1986.

The Backyard Birder's Journal by Howard Blume (\$12.95, paper) is a

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- Have you considered whether a life income trust would be financially more desirable?

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These books may be ordered by mail from the Sierra Club Store, Dept. T-150, 730 Polk St., San Francisco, CA 94109. Include \$3 per order for shipping and handling. California and Arizona residents should also enclose applicable sales taxes. Members may subtract a special 10-percent discount from prices listed. Allow four weeks for delivery.

The Sierra Club re-elected incumbents Richard Cellarius, Sally Reid, and Robert Howard to the Board of Directors in July. Edgar Wayburn, a former Board member, and Ruth Frear, a former Regional Vice-President, were also elected. Each will serve a three-year term.

The ballot included two resolutions about the Club's effort to prevent nuclear war and to end the arms race. The first proposed that the effort should be made a "major priority conservation campaign" with funding of at least one percent of annual dues. This measure was rejected by 65 percent of the 48,022 members who responded. In response to a second resolution, 44 percent said the nuclear-war/arms-race issue should receive its current level of funding, while 22 percent said funding should be greater, and 30 percent said funding should be less than current levels.

A literature list of Sierra Club pamphlets, brochures, and booklets on public lands, population, outdoor activities, wildlife, pollution, education, and many other topics is available from the Public Affairs Department of the Sierra Club, 730 Polk St., San Francisco, CA 94109. ■

The Evolution of a Movement

Beauty, Health, and Permanence: Environmental Politics in the United States, 1955-1985

by Samuel P. Hays, in collaboration with Barbara D. Hays
Cambridge University Press, 1987.
\$29.95, cloth.

Larry Anderson

WHENEVER THE FISH in a favorite lake are decimated by the effects of acid rain, or toxic wastes pollute a community's water supply, or a loved one succumbs to an occupational disease like asbestosis, another corps of Americans join the environmentalist ranks. Citizens who have never before considered themselves political activists begin to sign petitions, speak up at public meetings, and write legislators and editors. According to historian Samuel P. Hays, it is this personal, local impetus, the natural human desire to protect and enhance the quality of daily life, that has shaped the recent period he labels the Environmental Era.

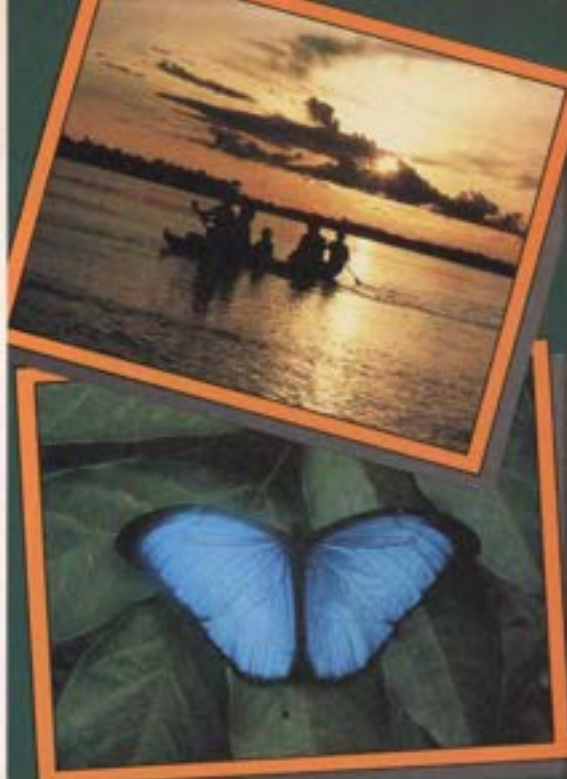
For Hays, environmental history serves as the standard by which the most fundamental of American social concerns and political decisions may be evaluated. In an earlier book, *Conservation and the Gospel of Efficiency* (1958), he argued that the conservation movement, which took shape earlier in this century, stressed the "efficient development and use of material resources." Such powerful patriarchs as Theodore Roosevelt and Gifford Pinchot, he wrote, were wary of both corporate interests and preservationists like John Muir, so they helped create powerful, centralized governmental institutions with expansive new controls over the nation's resources.

But "conservation gave way to environment after World War II," writes Hays in this sweeping study, "amid a rising interest in the quality of life beyond efficiency in production." By the

1950s, as more and more of the nation's citizens emerged from the pressures and constraints of economic depression and war, personal aspirations were increasingly debated in the public arena of politics. Indeed, the battle to effect improvements in the environment, Hays asserts, has been instrumental in transforming the fundamental processes of American politics.

In topical chapters rather than in a chronological narrative, Hays traces the evolution and dynamics of a prodigious range of environmental issues, ideas, and events. During the 1950s and 1960s, according to his reconstruction of the times, environmental politics focused on outdoor recreation and the preservation of wilderness and open space. A growing concern with pollution control and "ecology" climaxed with a spate of new legislation in the late 1960s and early 1970s. Most recently, environmental activism has revolved around such issues as toxic chemicals and human health, energy policy, and renewed questions of decentralized political control over resources.

Even before the onset of what Hays describes as the "Reagan anti-environmental revolution," the force of the environmental movement was being deflected—and not just by the traditional corporate villains. "Environmental politics shifted in the 1970s from legislation to administration," he writes, "from broader public debate to management." The scientists, economists, and planners who staffed government agencies had a mandate to protect resources. Yet they soon found themselves besieged not just by business lobbyists, who thought the government was being too restrictive and punitive, but also by environmentalists who insisted that the agencies weren't moving nearly fast enough. Gradually, these technocrats carved out their own political turf. "Institutional power was the stuff of political power," Hays writes. "Its continuous presence and potential for action



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forced others to reckon with it day in and day out. As a result it set the bounds, if not the agenda, for action."

At the highwater mark of the environmental movement, in the late 1960s and early 1970s, the media played a cheerleading role, with splashy cover articles and environmental horror stories that shaped and promoted the legislative agenda. In the years that followed, in Hays' view, much of the nation grew wary of the environmental movement, which took direct aim at the traditional American priorities of resource development and ever-increasing production. The new administrative requirements of environmental law, according to critics, were also symptomatic of a political process that was becoming gridlocked. The mood of "the political intelligentsia," as Hays describes it, was a feeling that "the system had become too open, and too many political forces had entered the fray."

One widely touted tactic of political neutralization has been "environmental mediation." Promoted as an even-handed means of avoiding protracted litigation and controversy, such negotiations, Hays skeptically observes, are based on an implicit criticism of the environmental movement's more combative tactics.

Among the many lessons Hays has gleaned from his study of environmental politics, two emerge most prominently: the role of science and the struggle for control of technical information. The conclusions of scientists, who are proud of their identity as neutral scholars and technicians sharing a common dedication to objective analysis, are often attacked as reflecting special ideological or economic interests. Again, unavoidably, politics rears its head, revealing the degree to which scientific institutions are, in fact, political institutions—and revealing also that science and technology do not by themselves contain the answers to all the world's environmental dilemmas. Choice, hence politics, is unavoidable.

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the Freedom of Information Act, right-to-know laws, litigation, legislatively mandated permits and hearings, and environmental impact statements, environmentalists are fighting for access to information that has previously been kept under wraps by businesses and government agencies.

Carefully and logically organized, exhaustively and imaginatively researched, restrained in tone, scholarly and a bit dry in style, sympathetic to the environmental cause yet evenhanded in its lucid exposition of controversial ideas and events, *Beauty, Health, and Permanence* possesses some of the strengths—and a few of the drawbacks—of a solid and comprehensive textbook. The reader may yearn at times for a telling anecdote in place of a broad generalization, for the personal voice of one of Hays' political protagonists instead of one of his clear but colorless summaries.

Hays, working on a broad historical canvas, is more interested in overarching themes and patterns than in individual personalities and events. (Which may explain, for example, why a controversial and significant figure like David Brower is not mentioned once in this 600-page book, while the Sierra Club figures often as a representative environmental organization.) And in his examination of the ideological underpinnings of contemporary environmental debate, Hays does not take up the role and significance of more militant organizations like Greenpeace, Earth First!, and some animal-rights groups, which may be broadening the ideological and tactical agenda for the next stage of environmental politics.

The pragmatic, grassroots source of environmental activism, Hays concludes, opened up new opportunities for "political participation despite a system in which involvement through voting by party [is] steadily declining." This fine book documents the progress and the successes of a movement that is now part of the political mainstream.

Hays' most important contribution, however, may be his sobering analysis of the political, institutional, and individual forces working to thwart and restrain environmental-protection initiatives. He focuses on the critical and troublesome question for which only



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time will provide the answer: Do we have the will, intelligence, and psychological capacity to comprehend and control the environmental consequences of our actions?

LARRY ANDERSON, who reviewed Tim Palmer's *Endangered Rivers* and the *Conservation Movement for our March/April 1987 issue*, is a frequent contributor to *Sierra*.

Riding the Rapids of Change

To Govern Evolution: Further Adventures of the Political Animal
by Walter Truett Anderson
Harcourt Brace Jovanovich, 1987.
\$22.95, cloth.

John Hart

ATENTION, wilderness preservers, Earth Firsters, opponents of gene-splicing, defenders of nature in pristine integrity: the game you may think you're playing is over. It ended centuries ago.

This is perhaps a secondary theme of a challenging new book by Walter Truett Anderson, environmentalist, political scientist, and writer of strikingly lucid prose. But it is one to which he keeps returning. Environmentalists, whom Anderson calls "the preeminent good guys of today's drama," are the audience he most wants to reach. "Good guys" or not, he suggests, we have some rapid growing up to do.

Anderson begins his argument by showing—reminding us, really—how thoroughly human beings have dominated nature, and for how long. Citing everything from aboriginal hunting to ozone depletion to genetic engineering, Anderson makes the case that there is no such thing as "nature" now—not in the old, easy sense. Nature is no longer a force beyond our control or a territory "untrammeled by man," in the words of the Wilderness Act. Because everything we do favors some forms of life at the expense of others, we are today "the driving force in evolution"—whether we like it or not.

Look at the extinction rate, with the loss of species dwarfing the Great Ex-

inction of some 65 million years ago. Look at our transportation of plants and animals, which has created a worldwide biological community—an evolutionary battleground that did not exist before—and the troubling standardization of food crops and livestock. Then there's the new genetic engineering. We hold the power to control our own evolution, chiefly through decisions about who is, and who is not, conceived and born.

Anderson runs rivers, likes river images, sees us as the crew of a raft. Our vessel has entered a series of unscouted

rapids. The first big drops are past; the waters ahead look rougher still. Some of the crew would like to turn the raft around and paddle upstream to a calmer stretch. This is the one thing that's impossible. We are committed to the river and must start learning—before it's too late—how to handle the oars.

Handling the oars means developing a new kind of politics—what Anderson calls biopolitics, a shift from environmentalism "to a larger frame of reference that includes such concerns as the general problem of extinction (not just

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the loss of certain species), genetic erosion, and regulation of the new biotechnologies."

Biopolitics, to Anderson, means debating what we are doing instead of just doing it. It means changing over from random meddling—drastic, uninformed, and often damaging—to what he calls evolutionary governance: doing things, if not by master plan (unrealistic), at least with greater understanding of the choices being made. It means developing new institutions. It means coming to terms with our power.

Issues that belong to this new biopolitics are already around us everywhere: in debates about snail darters and California condors, in pro- and anti-abortion arguments, in the animal-rights crusade, in battles over the field-testing of genetically altered bacteria. In the middle of the book Anderson surveys a long line of such issues, relating them to his theme. Generally, he is slow to choose sides. "Sometimes it is more instructive to take note of what people are arguing about than to try to figure out who is winning," he says.

His tolerance, though, is denied to two groups: those who simply applaud our power over nature, ignoring the dangers, and those among the environmentalists who simply oppose such dominance, ignoring its reality. He has no kind words for "deep ecology," Earth First!, or Jeremy Rifkin. He seems to see such viewpoints as fundamentally outside the needed politics, inimical to it. (Yet they are also inevitably part of it.)

Somewhere in here I would have welcomed a clearer acknowledgement that a decision *not* to act is also possible in biopolitics—running a river need not mean bouncing off every rock. And I would have welcomed a clearer endorsement of traditional preservation work. While it may be truly impossible to leave a piece of the world alone, there are times when the lightest possible management is the best. Anderson may feel these points too obvious to dwell on, but in a book as widely read as this one ought to be, they really could use some underlining.

Anderson asks us to see the swirling biopolitical issues as fragments of a half dozen continuing "projects"—evolutionary/political undertakings that have

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already begun but that need sharper definition and more conscious debate:

■ **Population control.** We are trying to control the world's population but can't agree on how to do it. (Just when the Third World begins to look with favor on the notion of birth control, U.S. authorities decide they're against it.)

■ **Eugenics research.** By accident and sometimes by design, we are reshaping our population: through birth control, genetic screening, medical advances in infant care, and even directed breeding programs (as with "genius" sperm banks). Anderson reopens discussion here on a topic that for decades has been too hot to handle.

■ **Genetic preservation.** In the face of the new Great Extinction, which may be likened to the burning of the ancient library at Alexandria, we are now trying to "maintain a store of genetic information" by saving endangered species and varieties, sometimes in whole ecosystems and sometimes only in zoos and tissue banks.

■ **Genetic engineering.** We are beginning to modify species for our own purposes more directly than ever before. Anderson sees nothing uniquely dangerous in this but calls attention to issues that have gotten little press: What useful products should be attempted first? For whose benefit? Should a living thing be subject to patent? Should plants be bred to toler-

ate pesticides ("hard path") or to resist pests directly ("soft path")? And so on.

■ **Animal rights.** At the same time, we are wrestling to recognize, or perhaps to promulgate into existence, "rights" for nonhuman living things—as species and as individuals.

■ **Earth restoration.** Along with the usual work to preserve ecosystems, a number of good efforts have been made around the world to rebuild the badly damaged ones.

This last area offers Anderson the opportunity to advance his one major specific proposal. He calls for a vastly expanded Earth restoration project. He'd prefer that it be an international effort but feels that the United States by itself "could easily set in motion an ecological Marshall Plan or several of them—one for Africa, for example, another for Central America." Such projects would incorporate the needs of local people, not ignore them or displace them. Here is work of "size and scale and beauty beyond anything we have yet attempted."

For the rest, Anderson's message is: Get thinking. Get working. Get arguing. Look to the oars; we just might make it yet.

Confronting the ideas in this book is an excellent way to start.

JOHN HART, a widely published environmental writer, lives in Fairfax, Calif.



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TAN SAHSA

The Quiet Tyranny of Time

**Time Wars: The Primary Conflict
in Human History**

by Jeremy Rifkin

Henry Holt and Company, 1987.

\$18.95, cloth.

Seth Zuckerman

"WHAT IS TIME?" Saint Augustine once mused. "If no one asks me, I know. If I want to explain it to a questioner, I do not know." In *Time Wars*, genetic-engineering critic Jeremy Rifkin attempts to do Saint Augustine one better: to explain how people's concept of time changes their view of themselves and the world around them. Rifkin, whose earlier works include *Entropy*,

Algeny, and *Declarations of a Heretic*, describes the tendency to subdivide time into smaller and smaller parts, and the effects of that accelerating tempo on every aspect of human culture, from our treatment of the environment to our burial practices.

Rifkin charts four successive philosophies of time that have held sway since before recorded history. The first was biotic time, in which events were determined by natural rhythms such as the setting of the sun and the ripening of berries. The next was calendar time, marking off the year into days, weeks, and months, with set periods to commemorate specific cycles and events. He marches on to clocks and schedules,

which divide time into hours, minutes and seconds, which in turn serve to synchronize people's actions. We stand poised on the brink of the era of computer time, he warns, in which silicon chips measure out our lives in nanoseconds (billionths of a second) and control the rhythms of our actions.

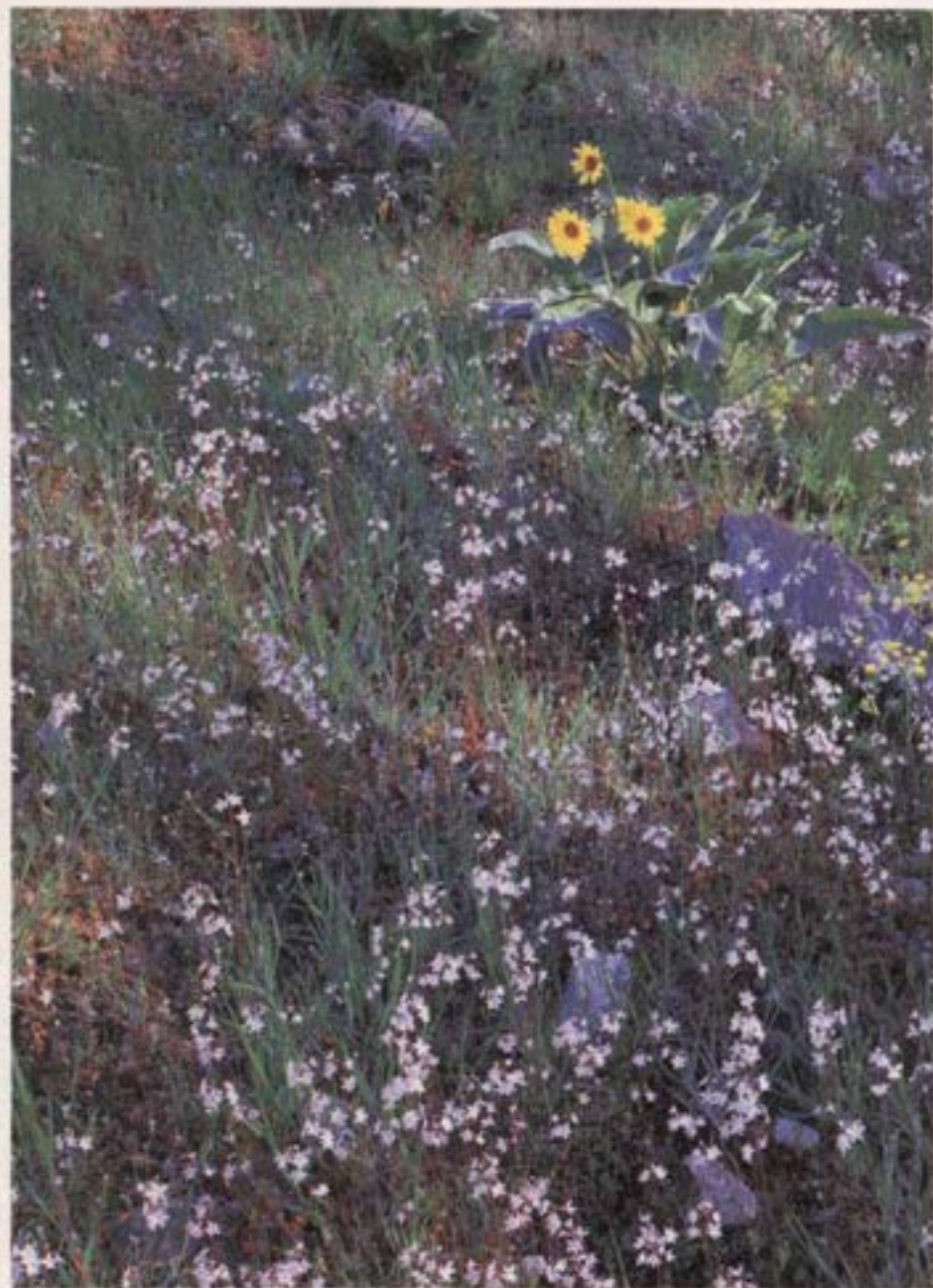
Some of Rifkin's most thought-provoking insights relate to our alienation from the natural environment that the subdivision of time has caused. Computer time and frantic clock time rush by so much faster than natural rhythms that people miss the imperceptibly slow workings of the environ-

ment. Hours and minutes are mere abstractions that are not rooted in natural phenomena. They are used to organize people's lives in ways that ignore the world around them. The obsession with these minute divisions of time has oriented the inhabitants of industrial society to the present, the immediate future, and the past—to the exclusion of careful, long-term stewardship of the land, water, and air.

But Rifkin goes astray in trying to blame all the evils of industrial society on the changing temporal orientation of Western culture. He falls into the trap of technological determinism: He makes it sound as though the invention of clocks and the acceleration of time changed people, enabling industrialists to make them come to work punctually. But these changing systems of calculating time were symptomatic of deeper social changes. Rifkin studiously ignores the deep-seated economic and political reasons (such as enclosure of the commons or the concentration of wealth) that gave the early industrialists the power to attract and discipline their work force, and that now enable employers to demand prodigious output from their clerical workers.

Rifkin's methodology leaves as much to be desired as his substance. He uses the technique of "footnote fake-out," by which he elaborately references a series of non-controversial statements and then makes an unsubstantiated leap of faith in the hope that the reader won't notice. For example, talking about the effect of computer games on children's hand-eye coordination, he quotes a series of statements on the difference between playing with blocks and using a kids' computer program. Neither the quotes nor the subject matter has

AT A GLANCE



Wildflowers of the American West
by Rose Houk
Designed by McQuiston & Daughter
Chronicle Books, 1987.
\$27.50, cloth; \$14.95, paper.

"Like the sun among the stars," writes Rose Houk of the large balsamroot flowers growing amid prairie stars and grass in this photograph by Pat O'Hara. Houk is a writer and editor specializing in natural history.

anything to do with time, but from here he leaps to the conclusion that children develop a conception of time through full-body movement.

Rifkin is at his shrillest when he warns of the consequences of "computer time," during which the control over the timing of events is in the hands of machines. He issues hand-waving warnings that make Chicken Little look like an optimist. He claims that with automated manufacturing, "the only human participation in the process is in the design of the program"—although, clearly, humans are responsible for the ongoing maintenance of the robots and the supply of energy and raw materials to the factory. He blames computers for the appearance of graceless nerds who prefer silicon to human company—but forgets that the caricature of the nerd with the slide rule strapped to his belt long predates Stanford's and MIT's computer hackers.

Throughout the book, the reader can only wonder what time frame Rifkin does endorse, since he in turn criticizes calendars, clocks, and computers. A modern-day Luddite, he longs for the imagined glories of an earlier age. When he describes medieval time as "leisurely," one wonders whether feudal serfs would agree. He finally does call for a society based on empathy, not domination, in which time would be "democratized." That is, everyone's time would be equally valuable, and people would not chop time up into little pieces in order to control each other's lives. Planning for the future and describing the past would be community undertakings. But Rifkin's brief vision of a utopian future doesn't justify spending one's own valuable time on the book's 263 pages. This topic is more suitable for a bull session at the local bar than for a book.

SETH ZUCKERMAN is a freelance writer living in San Francisco.

BRIEFLY NOTED

History enthusiasts will appreciate Joseph M. Petulla's *Environmental Protection in The United States* (\$22.50, cloth; \$14.50, paper, from the San Francisco Study Center, 1095 Market St., #602, San Francisco, CA 94103). The book takes a critical look at the successes

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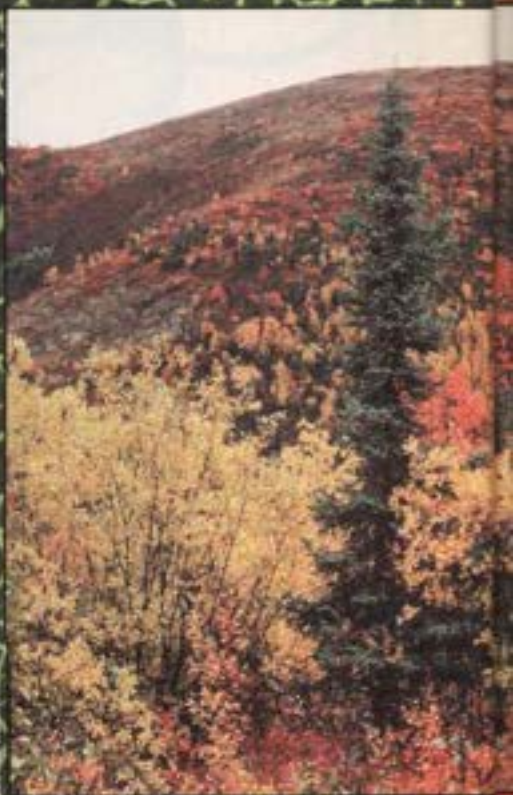
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Pigments remain in leaves for only a short time after leaves have fallen. All but the tannins, another pigment found in leaves, soon dissolve, leaving the forest floor a dull brown. Eventually the leaves decompose, providing nutrients for the soil and nearby aquatic ecosystems. In addition to leaves, autumn trees scatter a variety of seeds, nuts, and fruits that are quickly gathered by birds and mammals also preparing for winter.



Carotene and xanthophyll, the two pigments that turn leaves golden, are present in leaves all summer long. In fact, leaves contain more of the two pigments in midsummer than in fall. In summer, however, the continual supply of green chlorophyll hides them. Despite the brilliant colors they produce, the two pigments amount to less than one percent of the weight of the leaves they color.





The evergreens in this mixed stand survive winter without shutting down their internal plumbing. Their small, needlelike leaves are protected by a thick waxy coat that slows moisture loss. Like deciduous trees, evergreens lose leaves, but not all at once. Unlike deciduous trees, evergreens can photosynthesize as soon as spring conditions permit—they don't need to wait for a new set of leaves to form.

The broad leaves of deciduous trees provide large surface areas for photosynthesis, a tree's food-making process. Besides sunlight and nutrients, trees need water—lots of it—for photosynthesis. Evaporation through the broad leaves claims about 99 percent of all the water the tree roots absorb.

Autumn Leaves

*Why They Change Colors ~
Why They Fall*

AS IF TO CELEBRATE the end of each successful growing season, in autumn the leaves of many trees deck themselves in brilliant gold, red, orange, and purple before they die and drop to the ground.

The reasons leaves change color and fall are as fascinating as the spectacle itself. The fall pageant is part of a well-coordinated process that allows trees to survive harsh winters.

The woods of the eastern half of the United States and southeastern Canada are particularly impressive. They are part of what is called the world's Temperate Zone (although you wouldn't know it from the hot, humid summers and freezing winters), and most of their trees are called deciduous, from a Latin word meaning "to fall off."

Deciduous trees change as the climate changes. The barren branches of winter give way to lush spring blossoms, then to the full green leaves of summer, the vibrant colors of fall, and back to winter's sparseness. While deciduous forests exist on other continents, the fall display is most colorful in North America.

To endure, deciduous trees must adapt to the amount of water available to them. Water normally enters a tree through tiny hairlike roots covering the tips of its larger root system. Nutrients in the soil dissolve in the water, forming a liquid called sap. Sap is pulled up to the leaves through rows of cells that form hollow tubes called



JIMMY WATSON

Once the abscission layer has cut off the leaf's lifelines, only the walls of the leaf veins hold the leaf to the tree. With the help of wind or frost, the leaf breaks loose and falls to the forest floor.



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Anthocyanins bring brilliant scarlet and purple hues to autumn forests. The more acidic the tree's sap, the brighter the red coloring. (Alkaline sap produces blues and purples). Trees such as the purple beech contain so much anthocyanin that the pigment masks chlorophyll's green even at the height of summer. Anthocyanins are also responsible for the colors of red cabbage, cranberries, red apples, and grapes.

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xylem (pronounced zy-lem), located just inside the bark.

In spring and summer, when moisture is plentiful, nutrients and water move quickly from the soil to the leaves to help trees grow. A deciduous tree's broad leaves provide large surface areas for photosynthesis, a chemical reaction that changes water and carbon dioxide into sugar and oxygen. Sugar is the food that provides energy for all living things.

Photosynthesis cannot occur unless a substance called chlorophyll is present in the leaf. Chlorophyll, which gives leaves their green color, traps energy from sunlight and uses it to start the chemical reaction of carbon dioxide with water.

But broad leaves, so important to the tree's spring and summer growth, are ill-suited to winter conditions. Virtually all the water absorbed by the tree's roots evaporates into the air through the leaves. In winter, when very little water

is available in the frozen ground, a broad-leaved tree would be unable to replenish the moisture it loses through its leaves, and it would soon die of thirst.

To survive the winter, then, a deciduous tree simply shuts down the intricate circulation system that brings water to its leaves and food from the leaves back to the tree. By turning off its plumbing, the tree preserves critical supplies of moisture in its roots, trunk, and branches before the soil freezes and cuts off the tree's water source.

When a tree senses the shorter days, less intense sun, and cooler temperatures of autumn, it begins to form a layer of weak cells, called the abscission layer, at the base of the leaf stalk, where the leaf attaches to the twig. As the layer grows it constricts the leaf's circulatory system, and leaf metabolism slows. Less water reaches the leaf for photosynthesis, and less food is carried to the rest of the tree. Eventually, the abscission layer completely plugs the tubes that carry the leaf's water and mineral supply.

Fall colors are a product of the tree's winter cutbacks. As the leaf's chlorophyll supply declines and disappears, so does its green color. Other colors then reveal themselves—such as golds and yellows. These colors have been in the leaf all along as substances called carotenoids (some of which make carrots orange) and xanthophylls (which make egg yolks yellow), but until now they have been masked by the green color of the chlorophyll.

Other changes produce an even wider range of hues. Cooler air temperatures slow the removal of sugars from the leaf, boosting the production of pigments called anthocyanins. These give red, blue, and violet tints to many leaves. Anthocyanins, unlike the pigments that are always present in a leaf's cells, are carried in the sap.

Even while the tree builds its winter defenses, it is preparing for a quick start in the spring. Before its leaves drop, tiny buds that hold next spring's leaves tucked inside have already formed at the base of the leaf stalk—ready to burst out when longer days signify the beginning of a new growing season. ■

FAYLENE ROTH is a freelance writer living in Sonoma, Calif.

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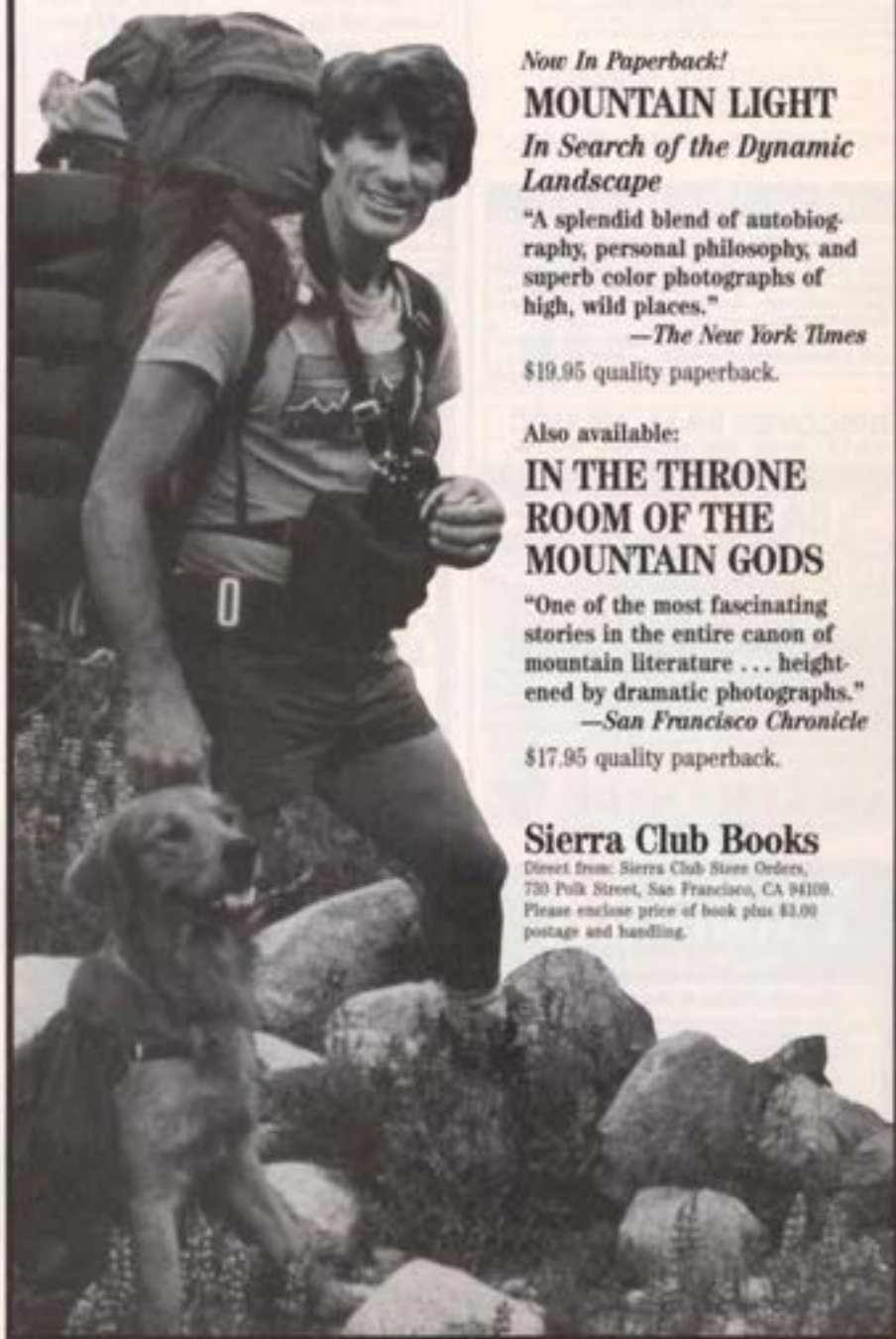
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Is it true that peregrine falcons are back in their native nesting grounds after almost becoming extinct due to DDT? (Dora Whitlinger, Claremore, Okla.)

Falco peregrinus is making a comeback, and not just in the wilderness. The raptor has become an urbanite, nesting atop skyscrapers in cities such as San Francisco, Salt Lake City, Baltimore, and New York, where it is safe from other predators and hunters and food is plentiful. (Pigeons are a favorite peregrine snack.)

The bird's successful recovery can be attributed largely to the work of the Peregrine Fund at Cornell University in Ithaca, N.Y. In 1970 the Fund launched the nation's first peregrine breeding and reintroduction program. Now two affiliated centers conduct similar programs: the Santa Cruz Predatory Bird Research Group at the University of California, and the World Center for Birds of Prey in Boise, Idaho.

Approximately a thousand peregrine pairs once inhabited the continental United States, but by the mid-1960s the species was nearly extinct. Now the count is up to between 300 and 400 pairs nationwide.

A swarm of bees has built a hive in a tree in our city yard. Someone told me that the bees could be a threat to our pets or to neighborhood children. Is this true? (Edna Ostrum, Turlock, Calif.)

Although the disposition of bee species varies greatly, a colony near one's home is generally no cause for



alarm. As long as the colony isn't too close to ground level and is protected from direct threats (such as rock-throwing children), chances are it is safe to leave the hive alone.

According to Dr. Eric Mussen, an apiculturist at the University of California at Davis, the existence of one hive in an urban yard or flower garden will not significantly increase one's chances of being stung, nor will it dramatically alter the local bee population.

However, if bees sense danger to themselves, the hive, or the queen, they may sting. If this causes concern for pets, small children, or adults who suffer severe allergic reactions to stings, it is possible to have the hive removed. The names and phone numbers of bee-

keepers who render such services are available through the SPCA, public health department, or apicultural groups in your area.

How many arches are in Arches National Park? (Betty Mott, New York, N.Y.)

Located near Moab, Utah, this 82,953-acre park exhibits some of the country's most unusual sandstone formations, and contains roughly 200 arches. This figure may increase, however, as explorers penetrate the less accessible areas of the park, and more arches are revealed.

It's been 25 years since the publication of Rachel Carson's *Silent Spring*. How much progress have we made in halting the chemical

abuses that she described in her book? (Sara Hermonson, Bend, Ore.)

Rachel Carson's landmark book got short-term results. The pesticide DDT was banned for use in the United States in 1972, and the chemical industry shifted away from most chlorinated hydrocarbons, the chemical family that includes DDT.

However, a new generation of pesticides has emerged—many of them water-soluble and designed to be used in smaller amounts. They are supposed to kill a targeted species fast and then break down into less-dangerous substances.

But these post-DDT pesticides have brought with them a multitude of unanticipated problems. While they do break down when exposed to air and sunlight, they can also be washed into groundwater supplies, where they degrade very slowly—if at all.

So while we've stopped killing nontargeted birds and other wildlife with DDT, we are now befouling our own drinking-water supplies. A 1987 EPA study revealed 20 types of pesticide residue in groundwater samples from 24 states.

Even the DDT ban was less than complete. The chemical is no longer used in this country, but U.S. companies continue to sell large quantities of DDT to developing countries.

Meanwhile, our chemical dependency has grown. Pesticide use has more than doubled since 1962—the year that *Silent Spring* hit the bookstore shelves.

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Photo: Bob Mackay

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