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Cover: Symbol of rural America, many-bladed windmills were used to pump water throughout the semiarid West. They began to replace the older European models, with their four large sails, about a century ago. Today, a new generation of windmills, many radically different from what we are used to, is being developed to generate electricity. For more on "The Windmill Renaissance," see page 41. *Photographer, Gary Withey.*

The Mackenzie Valley Pipeline

HUGH McCULLUM

Photos by R. Fumoleau

Fort Good Hope on the Mackenzie River, about twenty miles south of the Arctic Circle.

The hearings droned on in the plush Explorer Hotel as they had off and on for sixteen months. The pipeline people were telling the royal commissioner what a great thing it would be for the Native people of Canada's last frontier if a huge natural-gas pipeline were built down the 2,800 miles of the Mackenzie Valley—career opportunities, a chance to get off welfare and into the wage economy, a chance to participate in the "development" of Canada's North.

Outside, in the rocky city of Yellowknife (population 9,000), situated on the north shore of Great Slave Lake in Canada's vast Northwest Territories, the ambulances started to scream. A mile away from the gleaming white hotel and the carefully muted and very polite hearings, down in the part of town where the middle-class white bureaucrats don't live, an eighty-four-year-old Indian, his two grandchildren and a young Native girl lay dying from gunshot wounds. A young white man from southern Canada was subsequently charged with their murders.

To some it was just another outburst of insensate violence, perhaps associated with booze or the frustrations that so often mar life in the North. To connect it with the largest industrial development project to date in Canada's history was emotional nonsense, proponents of the pipeline would argue. But a couple of days later, before going to bury his slain parishioners, a French Roman Catholic priest who has spent more than twenty years of his life with the Native people of the Northwest Territories, stood before the commissioner, Mr. Justice Thomas Rodney Berger of the Supreme Court of British Columbia, and dedicated his testimony to the victims:

> They were not shot by a killer; they were the victims of the so-called development that has taken place in the North for the last thirty or forty years, which created miserable and unjust conditions for the poor people of this district.

Hugh McCullum is a Canadian journalist based in Toronto.

Mr. Justice Berger has been accustomed to such unusual testimony during his tenure as the sole commissioner of the Mackenzie Valley Pipeline Inquiry, a "royal commission" set up by the Canadian government to determine the terms and conditions that should be attached to the construction of a natural-gas pipeline through Canada's enormous, thinly populated and fragile sub-Arctic. The royal commission is an institution unique to the British parliamentary system. Designed to investigate and make recommendations to Parliament and the government on specific issues, royal commissions are independent, investigative bodies with the power to recommend action, but without the power to enforce their recommendations. They have quasi-judicial powers, such as the right to hear evidence under oath and to subpoena witnesses. They can have one or more commissioners and are given sufficient funds to employ staff, travel and hold enough hearings to complete the work assigned to them under the terms set down for them by the government. The Mackenzie Valley Pipeline Inquiry has but one commissioner—Mr. Justice Berger. It cannot decide whether a pipeline should be built; nor is the government bound to accept its recommendations. But the process of the inquiry, rather than the final recommendations—important as they will be—is the key to the commission's importance. By allowing a broad spectrum of opinion to express itself, including that of industry, environmentalists and Native peoples, it has opened up the issues of Canada's northern development and Native claims in a way no other forum could have done.

The 17,000 Indians and Metis (people of mixed ancestry), 3,000 Inuit (Eskimos) and 9,000 whites who are scattered along the proposed route for the Mackenzie Valley pipeline present a social situation unique in North America, for nowhere else on the continent are Native peoples in the majority. The proposed pipeline has become a source of considerable tension between the Natives, almost all of whom oppose the project, and the whites, who are among its most ardent supporters. The whites see it as yet one more chance to open up and develop the frontier. The Natives see it as the end of their cultures. As they have told Berger over and over: "Our land is our life, our mother; if you destroy that, you destroy us."

The project is immense by any standards. Even the pipeline companies, who sometimes compare it to "a thread across a football field" ("More like a slash across the Mona Lisa," one ecologist scoffed), boast that it is

A Dogrib Indian girl from the village of Dettah.

the largest project ever undertaken by private enterprise anywhere in the world. Of course, more than just a gas pipeline is being considered. Berger's inquiry, for example, is charged with considering possible development of a mighty transportation corridor that could include railroads, highways and power lines within the next decade or so.

Canadian Arctic Gas Pipeline Ltd., a consortium of major oil, gas and utility corporations in the U.S. and Canada (The number of participating corporations fluctuates dramatically. Originally there were about twenty-seven, but the number has dropped as low as twelve and is currently thought to be about fifteen), wishes to build a forty-eight-inch, 2,600-mile pipeline to carry natural gas across the Alaska North Slope and the Mackenzie Delta to markets in Canada and the southern United States. The original cost of the Arctic Gas Line has been estimated at $8.3 billion; undoubtedly inflation has increased this forecast to more than $10 billion. The pipeline would have a capacity of 4.5 billion cubic feet of gas a day, enough to heat 45,000 homes for an entire year. The line would originate at Prudhoe Bay in Alaska, head east across the North Slope and Arctic National Wildlife Range, and cross the extreme northern Yukon to the Mackenzie River Delta on the shore of the Arctic Ocean. Here, it would pick up Canadian gas and continue south along the river, crossing finally into Alberta, where delivery lines would transport gas to markets in Canada and the U.S.

A second consortium, Foothills Pipe Lines Ltd., a largely Canadian group, wishes to build a "Maple Leaf" line to bring Mackenzie Delta gas to Canadian markets via a smaller forty-two-inch line costing, they estimate, some $4.5 billion, but after inflation, probably closer to $5 billion.

Both lines would be buried and carry chilled gas. Both lines would be constructed during winter months only over a three-year period. Each line is currently the object of intense scrutiny in Canada by the National Energy Board, a federal regulatory agency that will decide if there is current need for and sufficient supply of the gas and will finally recommend to the Trudeau government if, and to whom, a certificate of public convenience and necessity should be granted. Its hearings, already the subject of legal actions and contradictory testimony as to supplies and demands, are not expected to conclude before March 1977, even though Arctic Gas had hoped for a decision last year.

To understand the impact of the Mackenzie Valley natural-gas pipeline on the environment, two phases of the inquiry were set aside to examine the physical and living impacts. Arctic Gas spent almost $40 million on environmental studies that have been severely criticized by the Canadian Arctic Resources Committee (CARC) and the Northern Assessment Group, the two major environmental interveners in the inquiry. Among the unanswered questions was the effect of the pipeline on animal migration patterns, how noise would affect bird migration and how the more than 300 river crossings would affect the fish and other marine life. Gravel scooped from streams for construction purposes is expected to have a serious effect on

spawning grounds. The effects of possible blowouts and ruptures on the permafrost and tundra are still unknown.

Arctic Gas experts have been forced repeatedly to admit they lack complete environmental data and that there will indeed be some environmental impact. But they assure everyone that the impact "would be minimized" and that they will know more about the potential problems by the time the pipeline is started.

CARC remains highly skeptical:

> Those concerned for the environment and for the people of the North will receive cold comfort from the realization that the Canadian Arctic Pipeline Ltd. consultants did the best they could to develop appropriate methods within the constraints of economics and in the face of an unprecedented task. Nor can they receive solace from the assurance that the bugs will be solved by the time of the final design.

The environmental impact of the project is enormous. A summary of the potential impacts is frightening. An outline of the impacts prepared by the autonomous Environmental Protection Board indicates the following potential damage, unless stringent conditions are placed on the applicants by the findings of the Berger inquiry—conditions which, of course, would have to be imposed ultimately by the federal cabinet:

- North of the sixtieth parallel, the project will scar the land with its right-of-way 120 feet wide and 1,350 miles long. It will bring to previously undisturbed areas the noise and activity of 6,000 workers and 3,000 pieces of major equipment. Roads and access bases will make the land more accessible, and less and less land will remain in its natural state.
- Enormous impact can be expected on bird populations through aircraft, construction activities, human presence, pollution, habitation destruction and hunting. Swans, geese and ducks face the most serious disruption and, of course, the effect of possible gas leaks is still unknown.
- Caribou, marine mammal and sheep populations could be seriously depleted by excessive noise, hunting and harassment by construction crews, as well as by possible changes in migratory patterns.
- Fish numbers could be reduced through excess fishing, introduction of toxic materials into the water, destruction of spawning beds, and generally easier access to lakes and streams.

The board, whose report is deliberately low key, also lists a score of other dangers ranging from removal of archaeological sites to rather minimal effects of the project on air and water. According to the board, the effects could be minimized if time and money were spent by the applicants to build the pipeline with environmental safeguards and if the Canadian government were prepared to strengthen its regulation and enforcement mechanisms. The board expressed little hope that either of these eventualities might occur.

The main thrust of its report is the almost total lack of adequate environmental technology to protect the fragile ecology of the North and the lack of experience or precedent in building such a project through Arctic and sub-Arctic terrain.

The El Paso Gas Company of Houston, Texas, presented yet another plan to the United States Federal Power Commission in 1974, whereby Prudhoe Bay gas would be piped south to Valdez along the same route as the Alaskan oil pipeline. There it would be liquefied and loaded into specially built tankers, and shipped to ports on the West Coast. El Paso claimed that the proposed line would deviate no more than a mile from the oil line and that the same environmental factors would apply. Arctic Gas disputed this, claiming that many mountain passes enroute were too narrow to accommodate more than one pipeline. The company said that El Paso Gas would have to reroute more than a hundred miles, thereby requiring additional studies and delays, which would in turn increase the cost of the project. Environmentalists tended to prefer the El Paso route because it would avoid the Arctic National Wildlife Range and utilize an existing corridor, but at the same time they foresaw problems with the construction of additional facilities at Gravina Point near Valdez and new ones in California, where the gas would be shipped.

Then, in May 1976, at the eleventh hour and as debate continued over the first two routes, another consortium

Dogrib Indians ice fishing on Great Slave Lake, source of the Mackenzie River.

A woman of the Hare tribe tans a moose hide near Fort Good Hope.

formally applied to Canada's National Energy Board and the U.S. Federal Power Commission for a third route, one that environmentalists had been advocating for some time. A U.S. company—Northwest Pipeline—and three Canadian companies—Westcoast Transmission, Alberta Gas Trunk, and Foothills Pipelines—proposed to build a gas pipeline utilizing the existing oil corridor south to Fairbanks, then following the Alaska Highway through the Yukon to Fort Nelson, British Columbia, and Zama Lake, Alberta. Here the gas would enter existing Canadian transmission facilities and flow directly to markets in the American Midwest. For Canada, this proposal would postpone the unwelcome decision whether, when, how and by whom a Mackenzie pipeline should be built. It would also avoid most of the environmental and social problems associated with the Arctic Gas proposal. Finally, initial capital cost would be $5-6 billion, about half the cost of the Mackenzie Valley route. Both the government of B.C. and the territorial government of the Yukon enthusiastically endorsed the Alaska Highway proposal, but the Council for Yukon Indians, in its final statement to the Berger inquiry in November 1976, said it wanted no pipeline in the southern Yukon until native land claims were settled and implemented.

Scheduled to report early this year, Berger's commission is the most ambitious public inquiry ever conducted in Canada. For sixteen months now, and 40,000 pages of transcripts later, the man everyone in the North knows simply as "the Judge," has heard testimony on the impact this pipeline will have on the people and the environment of the Mackenzie Valley, an area of some 450,000 square miles stretching from the Beaufort Sea in the north to the sixtieth parallel in the south.

A precise man, Tom Berger conducted the inquiry into the pipeline's engineering, environmental and social problems with strict rules of procedure, often getting tough with the high-priced legal talent and costly consultants who flew in and out of Yellowknife for a daily fee plus expenses. But even the most objective observer could not fail to notice the difference between the formal and the community hearings. To many of the Native people scattered through the vastness of bush and streams, lakes and tundra, Judge Berger had become a kind of folk hero. To the young people, who stood around a little defiantly, waiting, and the old people, who had never seen so many strangers before, the Judge had something the people of the North recognize—integrity. They saw him as honest, decent and fair, and above all he listened. Even when, in the countless, drafty community halls and schools the hearings went on until 2 a.m., and the visiting press groaned and yawned as yet another witness shuffled forward—even then he sat and listened intently. He has used

Continued on page 29

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Leopold's Land Ethic:

Wishful Thinking or Workable Dream?

Robert McCabe, courtesy of the Wilderness Society

Aldo Leopold

Edward Schriver

During his lifetime Aldo Leopold expended his energies on the land and its creatures. In 1933 he published his book, *Game Management,* and in the same year took up the chair of game management in the Department of Agricultural Economics at the University of Wisconsin. Two years later, moved by the forces within him, he joined Robert Marshall and others to establish the Wilderness Society.

The period from 1933 until 1948, when Leopold died of a heart attack while helping neighbors fight a grass fire that threatened his Sand County farm, was full of excitement. Besides his university post, he was appointed to a six-year term on the Wisconsin Conservation Commission. The reaction to his commission appointment and to his relations with some of the more vocal citizens of the state over deer policy were stormy. The Trego Rod and Gun Club of Washburn County detested Leopold and used current events to inspire their attack on him:

> The Wolf is the Nazi of the forest. He takes the deer and some small fry. The Fox is the sly Jap who takes the choice morsels of game and the songbirds. Can Professor Leopold justify their existence because deer meant for human consumption should be fed to the Nazi because we must have protection for the trees? Can he justify the Jap or Nazi because he eats a rabbit or a grouse which are meant for human food, or the songbird on its nest, which was meant by the Lord for our pleasure, because this hungry Jap must live to eat the rabbit to save the tree?

Despite this attack on Leopold during the heat of the Second World War, he endeared himself to many other Americans for *A Sand County Almanac,* published shortly after his death. The way of thinking left by Aldo Leopold in this remarkable book is partially incorporated in two small excerpts from it:

> We reached the old wolf in time to watch a fierce green fire dying in her eyes. I realized then, and have known ever since, that there was something new to me in those eyes—something known only to her and to the mountain. I was young then, and full of trigger-itch; I thought that because fewer wolves meant more deer, that no wolves would mean hunters' paradise. But after seeing the green fire die, I sensed neither the wolf nor the mountain agreed with such a view.
>
> When we see land as a community to which we belong, we may begin to use it with love and respect. There is no other way for land to survive the impact of mechanized man, nor for us to reap from it that esthetic harvest it is capable, under science, of contributing to culture. That land is a community is the basic concept of ecology, but that land is to be loved and respected is an extension of ethics. That land yields a cultural harvest is a fact long known but latterly often forgotten.

Leopold challenged the human community to recognize that they are members, not lords, of the living land community; to treat the land with love and respect, not simply as the surface upon which they work out their proj-

Edward Schriver is associate professor of history at the University of Maine.

ects; to encourage a balance between strictly human needs and those of whole natural systems; and to persist in reminding themselves that the difference between being master and member of the land community is very great.

Upon a cursory examination of human practices, does Professor Leopold hold up a realizable dream? Among the obstacles are numerous habits and beliefs. And as we look at the past we find many people who have worked in the opposite direction from Leopold's dream. For example, John Passmore, an Australian philosopher, has concluded that if it is essential to the idea of community that its members have common interests and recognize mutual obligations, then people, plants, animals and soil do not form a community. "Bacteria and men do not recognize mutual obligations nor do they have common interests." Among other arguments against Leopold's view of land as community, those given by Douglas C. North, Robert Paul Thomas, and Alden T. Vaughan have been representative. North and Thomas indicate that during the High Middle Ages ". . . these wastes were being *tamed* [emphasis added], weeds and pastures were shrinking back from villages, and fields were spreading in ever expanding circles around the original settlements . . . ." Vaughan, writing of the New England frontier in the seventeenth century, says that the Puritans were " . . . too busy with the *struggle against nature* [emphasis added] to devote much time to diplomacy."

Two isolated examples do not prove a point, of course, and in the pages of history evidence can be adduced both for human cooperation with nature and the necessity to fight the wilderness to carve out a place for civilization. The main contention, however, should not be lost in the evidence: the human experience through the ages mainly has been that of opposition to nature, of attempting to tame, conquer, exploit or subdue it rather than to live in harmony with it. The basic model has been, and still is, mastery.

Some philosophers will assert that the process of mastery has been aided by the manner in which science has developed. Science has contributed to the domination and the conquest of nature by human beings. Science, they insist, has evolved in such a way as to separate the nature studied by scientists from the nature experienced by ordinary human beings. We exist in two worlds: the subjective-relative world of everyday experience and the objective-scientific world of specialized study. Often these two worlds do not coincide. Projects that appear to have sound scientific grounding may well cause adverse reactions in the everyday world—our attempts to apply nuclear energy to peaceful uses, for example. The difficulty arises because nature as known to many scientists is not the same nature that other people recognize.

Trade-offs

Other obstacles to realizing Professor Leopold's dream include our routine political and economic practices. Trade-offs, for example, appear on the surface to be acceptable means of accommodating competing demands. If one group wants something, they know they may well have to give up something in return to a competing interest. This is fine; the practice has its merits. Trade-off works to prevent paralysis. But when applied in cases where natural systems are a part of the trade-off, how does it operate? Are natural systems by their very structure good partners for trade-off?

Certainly, one might conclude that there are inherent difficulties in the simple statement, for instance, that we may have to trade off air quality for jobs and economic stability. The current hassle over interpreting, implementing and amending the Clean Air Act of 1970 stands as a vivid example of the problems involved. What shall be sacrificed? Air quality, human health, the environment? Economy of fuel for the automobile? The selling price of the vehicle? While some trade-offs of the above elements are no doubt necessary while our present circumstances prevail, it is obvious that environmental and human-health factors appear less than compelling to many decision makers in industry and in government.

No one would deny the difficulty of making a wise trade-off, but this is not ultimately at issue. Since it is very hard to put a monetary value on clean air, pure water, and such a phenomenon as a sunset, these factors do not fare very well in the trade-off process.

Trade-off is a useful device that is probably permanently fixed in our system. However, if it continues to be used as it has been in the past, the price we pay now in health and environment will most surely continue to be paid, perhaps in larger measure.

Related to the practice of trade-offs is the principle that problems are best approached by doing business-as-usual albeit with a bit more caution. Bolstering this notion is the further assumption that projects affecting the environment should be considered "innocent until proven guilty." The opposite suggestion—that projects involving large environmental risks should be considered as "guilty until proven innocent"—is still struggling for acceptance, though significant headway has been made in this country.

There are many vigorous and able advocates of doing business-as-usual. Among the most vocal are John Maddox, a former editor of the prestigious English scientific journal, *Nature,* and Wilfred Beckerman, professor of political economy at University College, London. Maddox and Beckerman insist that many of our environmental problems, if not most of them, can be treated only by the "business as usual but with more caution" approach, which they claim would allow the world economy to follow the time-tested goals of economic and industrial growth, while at the same time being able to deal with pollution and related problems. Maddox and Beckerman apparently conclude that the environment is basically a passive surface upon which human beings work out their plans. To Beckerman, the idea that the land is a living community of which human beings are but a part seems an absurdity. He views the problem merely as one of allocation—the allocation of resources over a span of time or at any given time between the environment and other uses, or among different groups in society. He makes no allowance for human beings as integral parts of natural systems of nature, nor does he admit that humanity and nature interact with each other. But Wilfred Beckerman should not be set apart; his views are not unique.

Another obstacle to the ecological approach is the manner in which we customarily address problems. Major projects, on too many occasions, are initiated with the attitude that if unforeseen problems occur, acceptable solutions will invariably follow. This attitude is reinforced by a fair measure of past successes, but may be entirely inappropriate when applied to natural processes that, at least with the human time frame, may be irreversible.

In the first weeks of 1975—to select one of many possible instances—three major oil spills were recorded around the world. The response of the world community was muted at best. The fact that the occurrence of large tanker spills, both routine and spectacular, is part of the world's everyday experience has taken much of the sting out of them. They are thought to be merely another of those problems that will eventually be solved or perhaps, must ultimately be accepted as the price we must pay for our way of life.

Richard J. Chorley, an eminent English geographer at Cambridge University, presents another difficulty for those who advocate the ecological approach. He advises his fellow geographers to be wary of viewing their discipline as human ecology. Chorley, without hesitation, concludes that "Man's relation to nature is increasingly one of dominance and control, however lovers of nature may deplore it." Geographers, he writes, should pay more attention to socio-economic approaches since the natural environment has become more and more a subsidiary part of their total concerns. Through population increase, the proliferation of competitive demands, and increasing complexity of organization, he insists, humanity is being set apart more and more from the physical and biological environment. "Competition to exploit, control and consume all manner of terrestrial resources, including [sic] space, is impelling man to continually extend his environmental dominance." According to Chorley, "social man is, for better or worse, seizing control of his terrestrial environment and any geographical methodology which does not acknowledge this fact is doomed to inbuilt obsolescence." Chorley's is one of the strongest assertions that there are overwhelming obstacles facing the acceptance of the ecological view of Aldo Leopold.

The second strongest, perhaps, is to be found in the separation operating between the science of ecology and the science of economics. Ecology, unfortunately, is popularly and wrongly viewed not as the study of natural systems, but as a social movement. Economics, on the other hand, is regarded as the necessary but gloomy science that, despite its generally somber practitioners, serves as the major guide to making decisions on allocation of scarce resources. Rarely are economics and ecology joined together, as they should be, in the minds of either experts or the general public. Although ecologists tend to stress limits, while economists traditionally favor growth and development, there are, nevertheless, workable and necessary connections between the two sciences. The premise that, in the long run, good ecology is good economics is valid. This idea is made eminently plain by Dasmann, Milton and Freeman in *Ecological Principles for Economic Growth:*

> But just as it has long been obvious that development efforts which ignore economics and engineering are likely to founder, so it should by now be equally obvious that development efforts that take no account of the ecological "rules of the game" are also bound to suffer adverse consequences.

The view is well stated; but currently it is little more than a fond hope for future application on a large scale.

Standing in the way is the belief that bigger is inherently better. Who doubts it? In the excitement about the politics involved with the SST, for example, only a few asked the genuine question—why? Why still more mammoth undertakings which might further degrade our life-support systems? What about noise levels and human health factors? In the United States some of these questions were heard, and for the moment the SST was shelved; but England and France went ahead with the project.

Supertankers are another excursion into bigness. Is it better, or worse, to have these large ships plying the world's oceans, to choose in effect to suffer fewer large oil spills instead of more smaller ones? What has been the benefit to us of these larger tankers? Have they brought down the costs of oil and oil products to consumers? Or, have they adversely affected the environment? What will be the long term ecological damage in such places as Bantry Bay, Ireland, or in the oceans of the world?

Domination of the earth by humans has, of course, many other facets, excess population being only one of them. Will (or should) we limit the world's numbers? Extremes occupy the headlines of this controversy. Paul Ehrlich, for one, insists that we must act to curtail numbers; John Maddox, on the other side, is equally certain that in the long run the exact size of the world's population is unimportant.

United Nations activity illustrates even more clearly how difficult it is to reverse old behavior patterns. As the forum for the debate of nations, the U.N. has been the site of much discussion about population policy. One hears the charge that the industrialized nations are now asking, in effect, that the developing countries commit cultural and racial suicide. There appears at this time to be no end to the opportunities for more haggling and delaying of action in the U.N. The population bomb is fitted with a complex mechanism. No one is really sure how or when it will finally operate.

Deluding ourselves

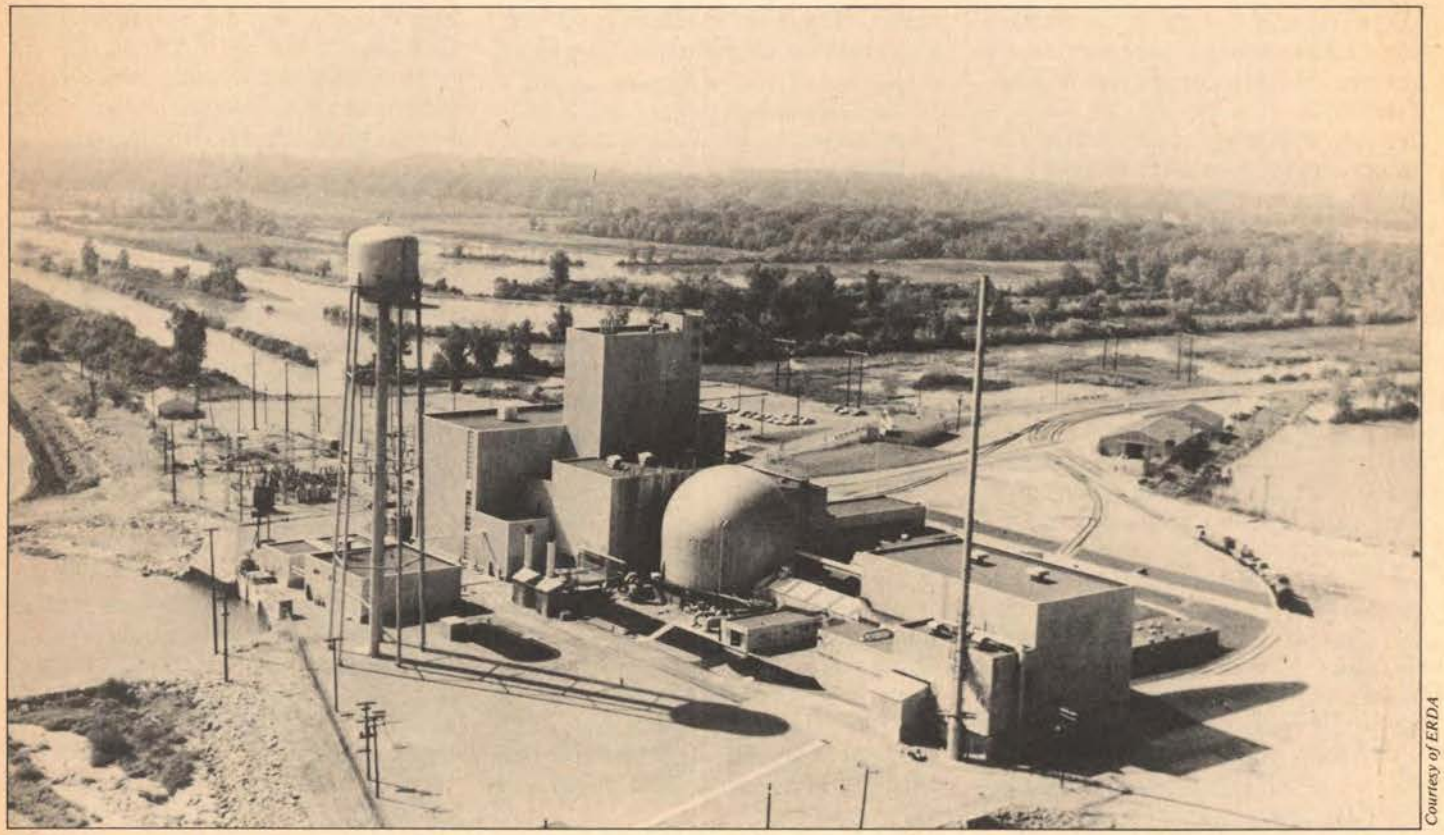
The greatest source of potential danger for the future is our infinite capacity for self-delusion. The Annual Reports of the Council on Environmental Quality—there have been six to date—reflect the tendency to assume that we are doing better than we really are. The Presidential introductions to the reports characteristically offer optimism. In the *Fifth Annual Report* (1974) we find these words: "Had our commitment to the environment not been ingrained, we might have reacted to the situation by discarding our environmental goals." One cannot minimize the progress made thus far in cleaning up our environment, but it is sheer delusion to believe that the old ways of doing things have been rejected. It is out and out fantasy to assert that we have made our peace with the land.

In fact, those who, as Leopold did in his day, question contemporary wisdom may have special scorn heaped upon them. There is an ample company of Americans who not only blame our inability to cope with serious economic problems upon environmentalists, but who also accuse them of sapping our will to approach such difficulties.

The militancy, and perhaps the effectiveness, of conservationists has increased in recent years, but their overall record in the last 100 years has not been impressive. Our ingrained concern for the environment has had some strange twists in our 200-year history as a nation. For instance, in reading the congressional debates concerning the creation of Yellowstone National Park in 1872, we find that the land for the park was approved largely because in the view of many congress-

Continued on page 16

Breeder Reactors, the Biggest Nuclear Gamble



Courtesy of ERDA

The Enrico Fermi Plant, near Detroit, is no longer in operation.

Steve McClary and Joel Primack

Like a gambler continually raising the stakes in an attempt to regain his losses, the federal government is betting on a new and dangerous nuclear-reactor system to supply U.S. electricity for the coming decades. Billions of public dollars were spent developing today's commercial nuclear-electricity industry. Now the Energy Research and Development Administration (ERDA) says that uranium is in short supply and that we must raise the stakes again by investing billions more in the rapid development of the Liquid Metal Fast Breeder Reactor (LMFBR). Since such reactors would be fueled with plutonium—one of the most lethal substances imaginable—the stakes involved in the LMFBR program are more than just financial.

The apostles of a fission future threaten us with brownouts and economic stagnation if we fail to build hundreds of reactors, including breeders, in the next decades.[1] But the case for rushing ahead with the breeder program is weak, since it depends on two questionable assumptions: (1) electricity-consumption growth rates which seem improbably high; and (2) insufficient uranium supplies to meet the demands of a burgeoning nuclear-power system. (See "How Much?" box.) In fact, the nation appears to be safe in postponing the breeder for some time, and if solar or other alternative technologies become available at acceptable cost in the next couple of decades, we may be able to bypass the breeder entirely—in view of its disadvantages, probably the best solution.[2,3]

The LMFBR differs from ordinary reactors in producing more fuel than it consumes. It does so by transmuting the most common isotope of uranium —U-238, which is useless as reactor fuel—into the fissionable man-made element, plutonium. Therein lies the breeder's unique advantage—and its most serious disadvantage. For plutonium is devilish stuff, one of the most carcinogenic substances known and the basic ingredient of atomic bombs. The 24,000-year half-life of its most common isotope, Pu-239, means that a

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"... plutonium is devilish stuff, one of the most carcinogenic substances known and the basic ingredient of atomic bombs."

substantial fraction of the plutonium produced today will still be part of the environment a hundred thousand years from now.

Ordinary reactors also produce plutonium—about a quarter-ton per year—but it remains in the used-up fuel rods. Today, this "spent" fuel is simply allowed to accumulate in cooling pools, where it poses relatively little immediate danger. But if reprocessing plants are built to separate reusable uranium from spent fuel, as nuclear-energy advocates have proposed, then the plutonium itself would be available for recycling—and for mischief. The Nuclear Regulatory Commission (NRC) is currently considering whether to allow plutonium recycling; the Sierra Club is among the environmental groups opposing it. Even the relatively small amount of plutonium in the wastes from such reprocessing plants is a serious cause for concern.[4]

With the breeder, the plutonium problem is even more serious:

- Since plutonium is the *only* possible fuel for the LMFBR, the breeder *requires* plutonium recycling; ordinary reactors do not.
- More than *six times* more plutonium would circulate in the LMFBR fuel cycle than in the ordinary reactor fuel cycle—even with plutonium recycling.[5]

A typical LMFBR would be fueled with about four tons of plutonium and would discharge about two tons each year. With hundreds or thousands of these reactors operating, the total quantity of plutonium in circulation would be staggering, especially when compared to:

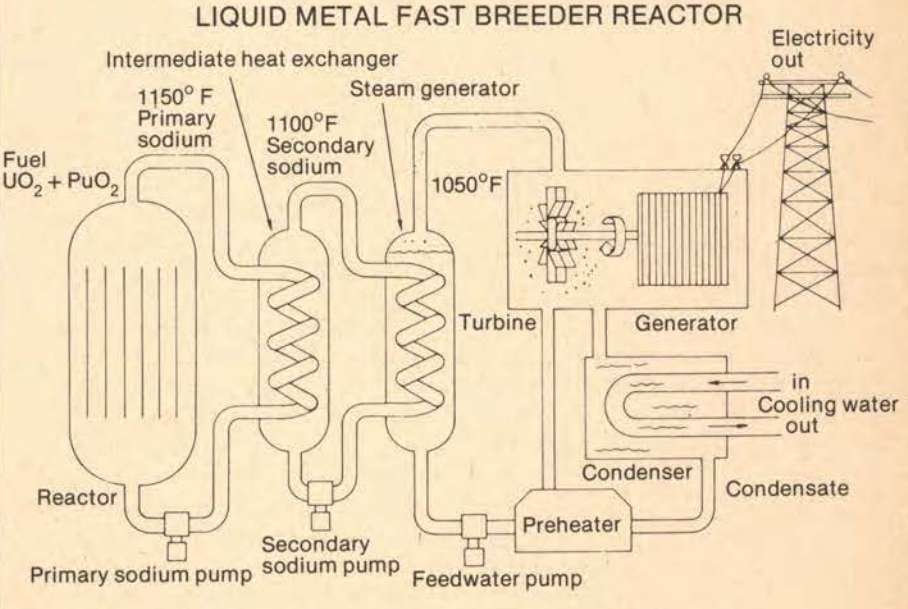
- 10 kilograms (1/100 ton), the amount of plutonium required to build a crude atomic bomb;[6] and
- 10 micrograms (1/one hundred billion ton), almost surely greater than the minimum amount required to cause lung cancer if inhaled and lodged in the lung.[7]

Extreme measures will obviously be necessary to prevent plutonium from being stolen or released into the environment. It is doubtful that our institutions will be capable of the vigilance required, and the consequences of failure are frightening. For instance, a respected former CIA official has speculated that once a group of terrorists obtains some plutonium and issues a credible nuclear-bomb threat, the government may feel justified in ignoring civil liberties and other laws in trying to stop them.[8] And if a terrorist bomb ever does explode, it would certainly be, in the words of Director Fred Iklé of the U.S. Arms Control and Disarmament Agency, "an event that would change the world."[9]

Even apart from terrorists, a U.S. commitment to plutonium-based electrical generating systems would lead to a large-scale international trade in plutonium—and from there it is a small step to a nuclear-armed world. At present, only France—which plans to build ten commercial LMFBRs by 1990—has gone very far toward a plutonium economy. If the U.S. decides to postpone such a pursuit for now, other nations may be encouraged to show similar caution. Perhaps even France is not irrevocably committed; in any case, the tighter the quarantine on plutonium, the smaller the number of nations that use it, the safer the world will be. The effects of just one nuclear weapon—let alone a nuclear war—could wipe out all the benefits of nuclear electric power.

Besides the drawbacks of a plutonium economy, the LMFBR is also likely to have a considerably higher capital cost than ordinary reactors. It may also be more accident-prone. Both of these problems stem partly from the liquid-metal coolant used in the LMFBR.

The liquid-sodium coolant helps to make reasonably efficient breeding possible, but it also has the undesirable property of burning explosively if it comes in contact with air or water. This causes serious problems in the design of the steam generator, where leaks between the sodium and water sides of the plumbing must be prevented. Significantly, both Britain and the Soviet



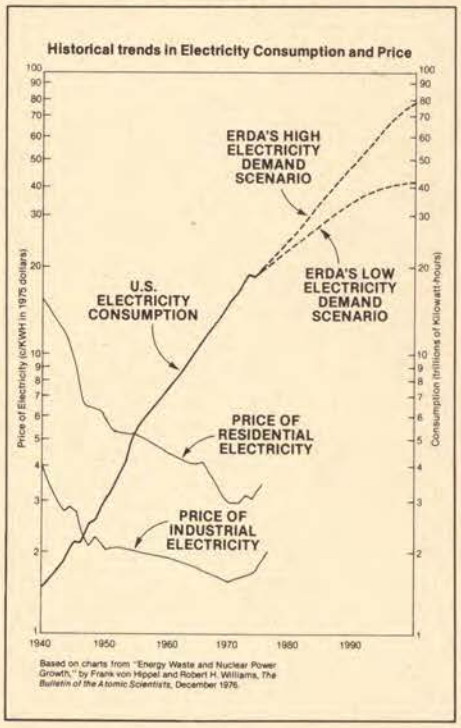
Source: Gerard M. Crawley, *Energy* (New York: Macmillan, 1975), p. 130.

"By postponing the breeder, we can preserve our choices for the next century."

Union have had serious problems with the steam generators in their LMFBR projects. The sodium coolant also complicates maintenance and refueling of the reactor. Thus both construction and operating expenses are likely to be higher for LMFBRs than for ordinary reactors.

In one respect, the LMFBR is actually safer than ordinary U.S. reactors. Since the sodium coolant is not under high pressure, the breeder is not subject to a catastrophic loss-of-coolant accident.[10] On the other hand, there are several kinds of potentially very dangerous accidents unique to the LMFBR. Because of the high power density and high concentration of fissionable materials in the core of the LMFBR, an accident involving core meltdown may be more likely than with ordinary reactors, and such an accident could lead to an uncontrolled chain reaction. Enough energy might be released to breach the reactor containment and allow the tremendous radioactivity in the core to escape into the human environment. The first U.S. prototype LMFBR, the Fermi reactor near Detroit, suffered a partial core meltdown as it was being tested—a warning, perhaps, for the future.[11]

In view of the LMFBR's disadvantages, it would seem logical that energy research be concentrated on finding alternatives to it. Instead, the government's breeder program is aimed at the earliest possible commercial introduction of this reactor and the plutonium economy that goes with it. Due in part to this "rush" attitude, the history of the LMFBR program has been one of massive cost overruns and, ironically, continual construction delays. Present ERDA estimates are that the program will cost at least $11 billion.[12]



Based on charts from "Energy Waste and Nuclear Power Growth," by Frank von Hippel and Robert H. Williams, *The Bulletin of the Atomic Scientists*, December 1976.

One casualty of ERDA's approach is fuel-reprocessing research. Because of its intense radioactivity and its high plutonium content, used LMFBR fuel will be extremely difficult and dangerous to reprocess.[13] There has been no experience with this technology on the huge scale that would be necessary for a widespread system of breeders. Yet ERDA does not intend to finish building even a pilot reprocessing plant until *after* the first large breeders are in operation.[14]

Another overlooked consequence of the proposed early introduction of the breeder would be the necessity for government subsidies for the first commercial breeders. If ERDA has its way,

How Much?

How urgent is the breeder? According to ERDA, the consumption of electricity in the year 2000 will be somewhere between 2.5 and four times what it is today, and some 450 to 800 nuclear plants will be needed then.[A1] But economic common sense argues against this.

Until the early 1970s, the cost of electricity declined steadily, encouraging rapid growth rates. (See graph.) Since then, electricity costs have started to rise along with all other energy costs, a situation that provides economic incentives for conserving electricity rather than using more. In contrast, ERDA's high-electricity-demand scenario postulates increased *in*efficiency in the use of electricity. Indeed, in this scenario, the equivalent of 350 nuclear plants is used to generate industrial-process heat by electric resistive heating.[A2,A3] By merely avoiding such wasteful new uses of electricity, we could assure that the number of nuclear plants would not exceed even ERDA's *low* projection. If, in addition, we undertake an economically practical program to increase the efficiency of energy production and use, we would be able to get by with no more than 250 reactors in the year 2000 according to a recent analysis.[A3] This scenario is actually more consistent with historical trends in capital expenditures than those with higher electricity growth rates.

The effect of this lowered projection on uranium requirements is dramatic. A reactor of the type now in use will need about 5,000 tons of uranium in the course of its thirty-year lifetime. Thus 250 reactors would require a commitment of about 1.3 million tons of uranium. If ERDA's lower projection of 450 reactors in the year 2000 is right—and this is the highest estimate we consider credible—then the lifetime uranium requirements for all these reactors would be about 2.3 million tons. How much do we have?

According to the most recent official estimates, the U.S. has a total of perhaps 3.7 million tons of uranium easily accessible, of which about half is in "reserve" and "probable" resource categories, and half is classified as "possible" or "speculative."[A4] These estimates are considered by some authorities to be too low, since they are based on exploration of only a small fraction of the regions that are geologically likely locations in which to find high-grade uranium ore.[A5] Even using the official estimates, there is adequate uranium to take us well into the next century.

The only rationale for rushing into a commercial breeder-reactor system in the near future appears to be the simultaneous assumption of unrealistically high electricity-demand projections *and* unrealistically pessimistic uranium-resource estimates. And even then, the breeder may not be the best solution. (See "What If. . ." box.)

the electric utility companies will start building large numbers of LMFBRs in the 1990s. But capital costs would be high and the technology unfamiliar. The only way to induce the utilities to invest in breeders would be for the government to take on all the extra costs and possibly also most of the risk. This could require billions of public dollars —an expense virtually ignored in ERDA's cost estimates.

This crash program is pointless, since uranium supplies are probably sufficient to take us into the next century. In our opinion, the best course would be to treat the LMFBR as an option for the future, not a near-term necessity. This would entail some fundamental changes in the goals of the U.S. breeder program, but most of the elements of the present program would probably still be retained—except for the Clinch River demonstration breeder plant, which appears to be pointless in its present form (see box).

Aside from Clinch River, ERDA's breeder program consists mostly of testing and research to provide the basis for building a practical breeder. For example, the Fast Flux Test Facility (FFTF) presently nearing completion in Richland, Washington, will be a test reactor for developing fuel assemblies to be used in future breeder-reactor cores. Other parts of the program involve testing and design of sodium-related LMFBR components, and some (but not enough) safety research.

Such research is vital to make a truly viable breeder available. In fact, by taking the time to gain more experience with reactor fuels and sodium components, ERDA could surely design a better breeder than would result from the present headlong approach.

Many of the problems of the U.S. LMFBR program stem from its commitment to early introduction of the breeder. In effect, ERDA has already decided that the LMFBR will be the major new energy source of the future.

This decision need not, and should not, be made today. By postponing the breeder, we can preserve our choices for the next century. The time to reorient the breeder program is now, before more time and money are wasted.

A good way to begin would be to conduct an independent technical review of the current LMFBR program. Surprisingly, no such outside review has ever been done, in spite of frequent cost overruns, design changes and construction delays. The beginning of a new presidential administration provides a natural opportunity to take a fresh look.

What If. . .?

What if the situation turns out to be even worse than ERDA would have us believe? If the demand for electricity goes back to the old pre-oil-embargo growth rates? If uranium resources are more limited than we think?

In this "worst-case" scenario, the best fission technology may not be the LMFBR, but a Canadian reactor system called CANDU,[B1] or perhaps the HTGR system being developed in the United States and West Germany.[B2] These systems have two advantages over the LMFBR: they are already in commercial operation, and they do not require plutonium recycling.

Unlike conventional reactors, which burn the rare uranium isotope U-235, or the LMFBR, which must be fueled with plutonium, the HTGR and CANDU reactors breed a third fuel, the uranium isotope U-233, from the element thorium. Since thorium is hundreds of times more abundant than U-235, a reactor system based on thorium could sustain itself almost indefinitely without exhausting resources.

Unfortunately, there is a hitch—the isotope U-233 is essentially as good a bomb material as plutonium. For this and other reasons, widespread adoption of either the CANDU or HTGR systems would entail serious diversion and proliferation problems.

The conclusion appears to be inescapable: the more energy and other resources we choose to consume, the greater the risk we thereby assume.

Clinch River

The present focus of the U.S. LMFBR development program is a small breeder reactor now in very early stages of construction on the Clinch River in Tennessee. Although the price tag for this project will be at least $2 billion, some *ten times* the cost of any nonfission research facility in the nation's energy program, the purpose of the Clinch River reactor remains obscure.[C1]

The reactor itself will teach us little new about LMFBRs, since it is a relatively early design—basically the same as the Fast Flux Test Facility (FFTF), though a little larger and able to generate electricity and breed relatively small amounts of plutonium. Perhaps the most useful thing Clinch River will do is test current models of sodium-water steam generators, which have been the source of many problems in foreign LMFBRs. But ERDA's planned plant-component test facilities will serve as better laboratories than the Clinch River plant in which to study the sodium-related problems of LMFBRs.

ERDA claims that Clinch River will let potential investors see how well an LMFBR works in a realistic utility setting (it will be part of the Tennessee Valley Authority). But since Clinch River is a one-of-a-kind reactor, this experience is likely to be largely irrelevant to more advanced breeders. One thing Clinch River will *not* prove is that breeders will be economic. Even excluding research and development costs, the plant itself will cost about *six times* as much as a conventional reactor, per unit of electrical generating capacity.

Another reason ERDA has given for going ahead with Clinch River is that it will give experience with LMFBR licensing problems. This is indeed true: ERDA has already had considerable trouble getting Clinch River licensed by the NRC. But licensing hinges on safety and other questions that vary greatly between different designs, and the uniqueness of the Clinch River reactor undercuts its usefulness even here.

Much of the effort in the LMFBR program is directed toward developing industrial capability in LMFBR technology, and this is perhaps ERDA's main reason for proceeding with Clinch River. But industrial capability will not be maintained without orders, and new orders will not be forthcoming unless we rush into building additional plants without waiting to gain operating experience from Clinch River.

In short, the Clinch River plant, as currently conceived, has no place in an orderly LMFBR development program. ERDA perseveres, though, despite continual cost overruns (the estimated total cost has increased by a factor of three in four years), steadily slipping schedules and decreasing interest from utilities and reactor manufacturers.

Only a fanatic redoubles his effort when he is unsure of his goal. Even if we assume that ERDA would eventually be justified in spending $2 billion on an intermediate-sized breeder of advanced design, there seems to be little reason to continue with the Clinch River reactor.

Notes

1. See, for example, *Review of National Breeder Reactor Program* (U.S. Congress, Joint Committee on Atomic Energy, January 1976). A classic: H.A. Bethe, "The Necessity of Fission Power," *Scientific American,* January 1976, pp. 3-13.

2. The case against the breeder is presented in Thomas B. Cochran, *The Liquid Metal Fast Breeder Reactor: An Environmental and Economic Critique* (Baltimore: Resources for the Future/Johns Hopkins University Press, 1974), and more briefly in Thomas B. Cochran, J. Gustave Speth, and Arthur R. Tamplin, "A Poor Buy," *Environment,* June 1975, pp. 12-20. See also Brian G. Chow, *The Liquid Metal Fast Breeder Reactor: An Economic Analysis* (Washington, D.C.: American Enterprise Institute for Public Policy Research, 1975).

3. For an excellent, even-handed overview of the LMFBR program and its problems, see Frank von Hippel, *Issues Bearing on the Need For and the Timing of the U.S. Liquid Metal Fast Breeder Reactor,* Report to the Energy and Environment Subcommittee (U.S. Congress, House Interior and Insular Affairs Committee, April 1976).

4. According to T.H. Pigford and K.P. Ang, "The Plutonium Fuel Cycles," *Health Physics,* Vol. 29, pp. 451-468 (1975), roughly 0.5 percent of the plutonium that passes through reprocessing plants will end up in the high-level waste, and roughly 0.5 percent in the low-level waste (with additional losses in the rest of the fuel cycle). We note that the low-level waste, because of its much greater volume, may pose the greater environmental hazard.

5. See, for example, *LMFBR Program Proposed Final Environmental Statement* (AEC Report WASH-1535, December 1974; reissued as ERDA-1535, December 1975) Vol. IV, pp. 74-84. This source gives 1,680, 210, and 280 kilograms of average annual plutonium output in the fuel cycles of LMFBR and ordinary reactors without and with plutonium recycle, respectively. Recent breeder designs have even higher plutonium outputs, and the plutonium bred in the breeder "blanket" is especially suitable for making bombs.

6. Mason Willrich and Theodore B. Taylor, *Nuclear Theft: Risks and Safeguards* (Cambridge, Mass.: Ballinger Publishing Co., 1974). Sophisticated bombs require less plutonium.

7. See John T. Edsall, "Toxicity of plutonium and some other actinides," *Bulletin of the Atomic Scientists,* September 1976, pp. 27-37.

8. Herbert G. Scoville, in *Oversight Hearings on Nuclear Energy—International Proliferation of Nuclear Technology* (U.S. Congress, House Committee on Interior and Insular Affairs, July 1975), p. 97.

9. Quoted in Ref. 8, p. 1.

10. For an overview of the problem of loss-of-coolant accidents in ordinary reactors, see *Oversight Hearings on Nuclear Energy—Nuclear Reactor Safety* (U.S. Congress, House Committee on Interior and Insular Affairs, June 1976), especially the testimony of W.K.H. Panofsky and Frank von Hippel. See also articles by Joel Primack, *et al.,* in *Bulletin of the Atomic Scientists,* September 1975.

11. For a popular account, see John G. Fuller, *We Almost Lost Detroit* (Reader's Digest Press/Crowell, 1975).

12. See Ref. 3, Chapter VI, and General Accounting Office, *The LMFBR Program—Past, Present, and Future* (GAO Report No. RED-75-352, April 1975); reprinted in *Fast Breeder Reactor Program* (U.S. Congress, Joint Economic Committee, April 1975). The cost of the Fast Flux Test Facility, for example, has gone from $87.5 million to $622 million; the completion date has slipped five years.

13. Plutonium in solution has a very low critical mass. The draft *Generic Environmental Statement Mixed Oxide Fuel* (AEC Report No. WASH-1327, August 1974), Vol. II, Appendix II(A), describes a number of hair-raising accidents which have already occurred in chemical processing of fissile material.

14. ERDA, *LMFBR Program: Overall Plan* (ERDA-67, December 1975); reprinted in *ERDA Authorizing Legislation Fiscal Year 1977* (U.S. Congress, Joint Committee on Atomic Energy, February 1976), pp. 2106-2122.

A1. ERDA, *A National Plan for Energy Research, Development, and Demonstration: Creating Energy Choices for the Future* (ERDA 76-1, 1976), p. 47. The 1975 edition (ERDA-48) contains details of the scenarios.

A2. Most industrial-process heat is used to produce steam; today this heat is provided by fossil fuel-fired boilers at industrial sites.

A3. F. von Hippel and R.H. Williams, "Energy Waste and Nuclear Power Growth," *Bulletin of the Atomic Scientists,* December 1976.

A4. The latest figures are in ERDA News Release No. 76-94, April 2, 1976. See also testimony of Robert Nininger, ERDA Assistant Director for Raw Materials, in *Oversight Hearings on Nuclear Energy—Nuclear Breeder Development Program* (U.S. Congress, House Committee on Interior and Insular Affairs, June 1975), pp. 383-403.

A5. M.F. Searl, *Uranium Resources to Meet Long Term Uranium Requirements* (EPRI, September 1974); reprinted in Ref. A4, pp. 405-520. Searl estimates a fifty percent probability that total U.S. resources exceed 13.2 million tons.

B1. "CANDU" stands for *Can*adian *D*euterium-*U*ranium reactor; deuterium is the heavy isotope of hydrogen, which combines with oxygen to make "heavy water." See Hugh C. McIntyre, Natural-Uranium Heavy-Water Reactors," *Scientific American,* October 1975, pp. 17-27.

B2. "HTGR" stands for *H*igh-*T*emperature *G*as-cooled *R*eactor. Although a sizable reactor of this type is presently operating near Denver, General Atomic, which developed the HTGR, has lost so much money on the project that it is unwilling to undertake additional reactors without government subsidy.

C1. *Report of the Liquid Metal Fast Breeder Reactor Program Review Group* (ERDA-1, January 1975). For a rebuttal see testimony of Thomas B. Cochran in *Oversight Hearings on Nuclear Energy—Nuclear Breeder Development Program* (U.S. Congress, House Committee on Interior and Insular Affairs, June 1975).

Aldo Leopold *Continued from page 11*

men it had no apparent commercial value.

Is Aldo Leopold's dream of a land ethic at best improbable? The honest reply would be yes it is. But some Americans have been doers as well as dreamers. Just perhaps this improbable dream is worth the struggle to bring it to fruition. There is a stout company of people, and not only Americans, who today believe in the viability of such a dream.

Years ago Aldo Leopold recognized the difficulties implicit in the dream:

> This land is too complex for its inhabitants to understand; maybe too complex for any competitive economic system to develop successfully. For the white man to live in real harmony with it seems to require a degree of public regulation he will not tolerate, or a degree of private enlightenment he does not possess. But of course we must continue to live with it according to our lights.

Leopold saw two possibilities for improving these lights. One was to apply science to land use. The other was to cultivate a love of country based upon respect for the living earth.

René Dubos writes in sympathy with the Leopold vision. Dubos believes that humankind will be successful only if its interventions into nature are compatible with ecological laws. He tells us that by projecting our dreams into ecological determinism we may be able to enrich ourselves and the earth. The raw material of nature must be manipulated into environments that are "ecologically sound, esthetically rewarding and favorable to the growth of the human spirit."

An improbable dream, Professor Leopold? In the final analysis what we must learn is stated bluntly by Raymond F. Dasmann:

> One cannot see a very bright future, however, regardless of institutional controls, unless there is a change in attitude toward land. So long as it is regarded as a mere commodity whose value is to be judged only in the marketplace, we will continue to destroy the earth on which we depend. When land is regarded as the home for people and other living things, as the sole base for humanity's future—then there will be hope.

Aldo Leopold spent his life as a witness to this hope. **SCB**

Nuclear Exports: The Perilous Enterprise

Courtesy of the Bulletin of the Atomic Scientists

Proliferation of nuclear power also provides the means for nations to fashion nuclear weapons.

Greg Thomas

When the atomic bomb made its grim debut in August, 1945, at Hiroshima and Nagasaki, the United States alone possessed the secret. Almost immediately, President Truman committed the nation to a position unheard of in the annals of technology. Recognizing that the destructive powers of the atom were inseparable from beneficial uses, he offered to place nuclear energy under international control. The Russians, themselves on the brink of the discovery, rejected the plan. Soon after, there were two nuclear powers.

Today, there are six. The prestige and tactical advantage of nuclear weapons continue to provide an incentive to other nations to join the nuclear club. The worldwide proliferation of nuclear power technology provides the means. Unchecked, the current drift toward increased access to nuclear explosives threatens to put at the disposal of governments and, ultimately, individuals, the ability to inflict at will enormous damage on one another and on the natural world. It is improbable that the power, once possessed, will not ultimately be used.

The difficulty in insuring that nations do not misuse atomic power is that in the process of generating heat for electricity, nuclear reactors transform much of their uranium fuel into other radioactive substances, including plutonium, which accumulate in the fuel rods. As the element is solely the product of man's recent ingenuity, natural systems have evolved no tolerance for plutonium. But in addition to its extraordinary toxicity, plutonium is also the material of choice for fabricating nuclear explosives. With as little as ten pounds of plutonium, equipment and materials that can be readily purchased, and technical information freely available, an atomic bomb can be fashioned in a matter of days even by a person who is not a scientist.

Recent events indicate that little exists to deter the diversion of the peaceful atom to weapons production if the will to do so exists. In 1974, India shook a complacent world by such an exercise of will and thereby joined the ranks of the United States, the Soviet Union, Great Britain, France and China as a nuclear weapons state. But unlike the other members, India's credentials were forged of materials produced in a reactor designed to furnish electricity. India simply diverted plutonium from a power reactor, which it had imported from Canada under an agreement

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that contemplated only "peaceful" uses. A new era in the course of nuclear proliferation had dawned.

If politically troubled India had the bomb to use, or indeed to sell, where in a starving unstable world might it next appear? France and West Germany, both determined nuclear exporters, provided a ready answer. Agreements to sell both power reactors and the technology to separate plutonium from the spent fuel were signed with Pakistan (recently at war with neighboring India), South Korea (ready for war with neighboring North Korea), Brazil (suffering strained relations with neighboring Argentina) and Iran (maintaining traditional hostility toward neighboring Iraq). At the same time, the Nixon administration initiated simultaneous deals to provide both Egypt and Israel (the latter reputed to have atomic bombs in its possession already) with power reactors (without plutonium-separation equipment) and fuel guarantees. The dust from the latest armed encounter between them had barely settled.

It should not be assumed that this nuclear hardware, or even the plutonium-separation technology, was purchased to make bombs. Indeed, the separation of plutonium for reprocessing as a supplemental nuclear fuel had always been a potential development in the use of nuclear energy. It is inescapable, however, that recycled plutonium can find its way into an arsenal if the political will to do so exists, as it did in India. Given the precarious relationships of these importers with their neighbors, a certain skepticism is irresistible. Even under the most benign circumstances, possession of separated plutonium puts the possessing nation within days of a nuclear device. The threshold into the domain of the superpower becomes easily surmountable. Predictably, a relatively trivial motive force could at any time tip the balance.

But the full dimension of the problem is far greater. Mad rulers, internal revolutions and desperate military responses within national governments are all too common in history. The current era has been plagued by terrorists, who have grown increasingly sophisticated in their tactics and manipulation of available resources. The allure of nuclear capability may be irresistible to them; it surely opens terrifying new horizons for everyone else. The existence of separated plutonium, however well guarded, may put such groups a giant step closer to such capability than does the existence of plutonium within spent fuel rods.

As the number of fingers on the nuclear trigger increases, so do both the incentive and the means to join the club. Contemplating this spiral, David Lilienthal, the first chairman of the U.S. Atomic Energy Commission, reflected during the course

of recent Senate hearings: "If a great number of countries have arsenals of nuclear weapons, I am glad I am not a young man, and I am sorry for my grandchildren. That would produce a terrifying prospect for the young men and women who are looking forward to a future."

In searching for a solution, the most compelling fact is that the options are becoming fewer.

President Eisenhower launched the U.S. Atoms for Peace programs in 1954. As civilian nuclear programs began to unfold in the world at large, the nuclear-weapons states struck a bargain with the nonweapons states. Under this Treaty on the Non-Proliferation of Nuclear Weapons (NPT), the nuclear powers agreed to share civilian nuclear technology with the have-nots in exchange for their promise to forswear the development or acquisition of nuclear weapons and to place their civilian nuclear facilities under safeguards established by the International Atomic Energy Agency (IAEA), which was set up to promote the peaceful uses of nuclear energy around the world.

Rewards for not agreeing

Unfortunately, this arrangement created more proliferation problems than it settled. On the one hand, it preserved the *status quo* for the existing nuclear states, allowing them to continue stockpiling nuclear arms. On the other, it provided the framework for proliferation of nuclear hardware and materials, eventually turning some importers—Germany, for example—into exporters in their own right. As an additional irony, it rewarded nonsignator states by permitting them to "go nuclear" with less stringent safeguards than those restraining countries that subscribed to the treaty. Nonparties not only retain the option to develop nuclear weapons, but they are also uncommitted to IAEA safeguards for civilian technology, except those that obtain materials from NPT sources. Even technology replicated from NPT-party imports is not automatically covered.

Understandably, many nations have not ratified the NPT, including India, Pakistan, Brazil, Egypt, Israel and France. Unfortunately, many of these are the very countries where the risks associated with proliferation have proved to be greatest.

Even where the IAEA safeguards apply, their adequacy to prevent diversion of sensitive material is questionable in the case of nuclear reactors, and negligible in the case of plutonium reprocessing or storage facilities. At best, the IAEA is merely a monitoring and bookkeeping operation. It can detect statistically significant diversions of sensitive materials within relatively broad time spans, but even then its reports are secret and its power to recover stolen material nonexistent. It is completely ineffectual against the thief who would steal amounts too small to detect, or the paramilitary operation that might easily overwhelm a nuclear facility. It is essentially worthless in the case of a nation willing to risk international reprisal by overtly producing illicit bombs.

The abundance of nuclear suppliers today (including the United States, U.S.S.R., Canada, France, West Germany and soon, Sweden, Japan and Italy), and the broad latitude in the prevailing safeguards requirements have created a vigorously competitive and increasingly unhealthy market. The clear trend is toward achieving competitive advantage by "sweetening" reactor deals with relaxed safeguard conditions or, in the case of the French-Pakistan and German-Brazilian agreements, with dangerous fuel-cycle components not available from more wary suppliers. There is scant prospect that this trend will be arrested until all the exporting nations commit themselves to a saner course.

Notwithstanding that the discovery of atomic power was inevitable, the nation that first unleashed it retains a unique responsibility to contain it. The United States has both that moral obligation and, perhaps, the exclusive means to accomplish it, but only if it acts boldly and soon. It remains the dominant supplier of nuclear fuel, without which a reactor cannot operate. Under current policies, the United States offers assurances of fuel supply to secure reactor sales, regardless of whether its customers have ratified NPT or trade in hazardous nuclear technology. The rationale, simply stated, is that if the United States refuses to supply the demand, some other exporter will fill the gap, thereby reducing our international leverage to control proliferation. This lever, however, is preserved only so long as it is not applied. Since other exporters subscribe to similar philosophies, the lowest common denominator among them tends to define the export criteria for the entire world.

The Ford administration initiated negotiations with other suppliers to secure an international agreement on export controls. These efforts have met with only modest success. Notably, discussions have apparently not slackened the enthusiasm of several countries for development of the next generation of power reactor, the breeder, which will make large-scale reprocessing of plutonium a necessary corollary to nuclear power. France, particularly, exhibits every intention of capturing the world market for this technology.

While the United States temporizes in a quest for voluntary accords, the best means of securing international restraints is evaporating. Several other nations are rapidly developing the technology to enrich uranium for reactor fuel. When this market becomes as diversified as the reactor market has become, clearly the opportunity to apply the lever will have passed.

Rewards for agreeing

It is imperative that the United States act now at least to establish a selective and discriminating export policy that rewards those countries that agree to stringent limitations on their nuclear activities. Fuel services and all other nuclear assistance should be immediately confined to countries that:

- Forswear additional nuclear explosives for all purposes;
- Place all nuclear facilities under effective safeguards and physical security;
- Forego the development, acquisition or export of fuel reprocessing or enrichment facilities;
- Require the same set of conditions of those countries to whom they might in turn sell nuclear materials and technology.

The reprocessing moratorium is certain to be the most controversial. It is also the most important. Nothing short of leaving plutonium in the spent-fuel rods will be sufficient, over the long run, to keep it away from those who aspire to the bomb. Even then, the spent fuel must be assiduously protected.

Particularly, the concept of permitting the separation of plutonium and its fabrication into fuel under international auspices does not qualify as a reasonable "middle ground." It is widely recognized that plutonium, usable for weapons, would be readily available from the fresh reactor fuel. The unavoidable transportation of these fuel elements to reactors would provide a link which invites an eventual mishap.

The reprocessing moratorium, then, must be absolute. To be effective, it must also be universal. Whether it can be achieved depends upon several factors, both economic and political.

The economic case for using plutonium fuels is unproven at best. That question, and many others relating to the advisability of plutonium recycling, have been placed in issue in the proceedings before the U.S. Nuclear Regulatory Commission, in which the Sierra Club is an active participant.

The political component is, admittedly, somewhat imponderable. It seems most likely that in the face of the considerable moral persuasion of the United States, coupled with a selective export policy, supplier nations would find it very difficult to pursue the heedless course of the past. A framework and incentive would be established for meaningful negotiations. If success cannot be guaranteed, at least a break will have been made with current trends that, in sum, amount to a prescription for disaster. **SCB**

Radioactive Wastes:
An Aspirin Tablet per Person?

John P. Holdren

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It is not uncommon to hear from the public-relations arm of the nuclear industry that the radioactive wastes from nuclear power are equivalent in size to no more than an aspirin tablet per year for every person whose electricity is provided by nuclear plants (General Electric, "Nuclear Power: The Best Alternative," GEZ-6301.4A, 1975). Probably the most misleading aspect of this analogy is that toxicity, not volume, is the important characteristic of the wastes. If a "tablet" were an apt comparison, it would have to be a cyanide tablet, and even this does not do justice to the magnitude of toxicity of the fission products.

It turns out, moreover, that a tablet per person is far from correct, even in respect to volume. If the high-level radioactive wastes from the reprocessing plant are solidified in their most concentrated form—the process to which the aspirin-tablet view presumably refers—the resulting volume per 1000-MWe LWR per year is 2.5 to 3.0 cubic meters. Since such a plant, running at a generous average of seventy-five percent of full capacity, could meet the full electricity demand of 750,000 Americans in 1975 (this includes not only their residences but the associated commerce and industry), the volume of high-level solid waste per person served is 3.3 to 4 cubic centimeters. The volume of an aspirin tablet is about 0.4 cm^3, so the solidified high-level wastes are about the size of ten aspirin tablets per person.

This figure, however, is only the tip of the iceberg. Most of the high-level wastes have not been solidified yet and federal law requires only that solidification take place within ten years of the creation of the wastes. The volume of the liquid form before solidification is ten times greater than that of the solid (100 aspirin tablets per person). Additionally, there are the highly radioactive remains of the fuel cladding (2 cubic meters per reactor year, or five aspirin tablets/person).

Unfortunately, even this is only the beginning. The reprocessing plant also produces annually for every 1,000-MWe reactor about twenty-five cubic meters of "intermediate-level" liquid wastes (contaminated to between 10,000 and 1,000,000 times the MPC) and 1200 cubic meters of "low-level" liquid wastes (10 to 10,000 times the MPC). These amount to sixty and 3,000 additional aspirin tablets per person, respectively. "Low-level" solid wastes from the reprocessing plant and from the reactor itself add up to between eighty and 160 cubic meters per year (200 to 400 more aspirin tablets per person). These wastes contain alpha-emitting radioisotopes of very long half-life.

All this adds up to a volume equal to that of 3,300 to 3,600 aspirin tablets per year per person served. If the Nuclear Regulatory Commission (NRC) approves the routine recycling of plutonium in LWRs, an additional 340 cubic meters of plutonium-contaminated wastes per reactor per year will appear at the fuel-fabrication plants—another 850 aspirin tablets per person served. The total is still not an overwhelming volume—around 1,500 cm^3 of waste per person per year—but remember, the toxicity of this material is what is really important. It is disquieting, in any case, to find the nuclear industry—so quick to complain about "irresponsible" statements from environmentalists—glibly dispensing information that is both qualitatively misleading and quantitatively in error by a factor of thousands.

Data cited in this article are from: United States Atomic Energy Commission, Safety of Light Water Reactors and Related Factors *(WASH-1250), 1973, pp. 4-89, and T.H. Pigford, "Annual Review of Nuclear Science," Vol. 23, pp. 515-559.*

John P. Holdren is an Associate Professor of Energy and Resources at University of California, Berkeley.

Editorial

Taking the Lead on Land Use

William Futrell

The Sierra Club needs to take the leadership in a new great debate on land use in the United States. As Aldo Leopold said, land is not merely soil, it is a fountain of energy flowing through a circuit of soils, plants, and animals. It is the basic resource. Land abuse has been the unaddressed, unresolved environmental issue of the 1970s. After much legislation and initial successes in the fight to control pollution, concern has mounted over threats to the land base. Senator Jackson and Congressman Udall led a prolonged campaign for a federal land-use bill that was rejected by six successive Congresses. At the beginning of a new administration and a new Congress, it appears that the drive and leadership to push a national land-use bill is gone. The time has come for a grass-roots movement led by a new and expanded Sierra Club National Land Use Committee for land stewardship.

At a recent series of briefings for Club leaders in Washington, D.C., congressional staff members and land-use lawyers reiterated the message that Jackson and Udall were exhausted from their six-year push on a federal bill, which had come tantalizingly close to passage three times, and would not push on land use unless President Carter made it one of his early and major goals. Club leaders who have followed the progress of the Jackson/Udall bills now have mixed feelings about them. Compromises removing all sanctions and most federal controls over the use of federal funds suggest that passage might be a hollow victory, an environmental equivalent of some of the massive federal funding programs in the human resources field that have turned sour in a bureaucratic maze.

Yet it would be tragic to lose the momentum of the Jackson/Udall bills. In many states, knowledgeable citizens believe nothing will happen without federal incentives. Many states do not even have a data base, an inventory of resources to serve as the basis of environmental planning. What is needed now is a grass-roots movement to shape a new popular consensus on land-use issues, and to determine whether to push for a comprehensive planning law, as we have done for the last three years (and failed), or to push, piecemeal, for a series of standard-setting laws, with teeth, to protect specific resources such as prime farmlands and coastal areas. It may well be that a back-door approach in which we take our enemies on one by one is the best strategy.

William Futrell is vice president of the Sierra Club.

The Sierra Club needs volunteers to put together a series of campaigns on the pressing land-use issues.

(1) *Prime Farmlands.* We need a subcommittee of the National Land Use Committee to advise the Club on how best to protect these critical areas.

(2) *Coastal Zone Management.* The coastal areas face their greatest danger as pressure mounts for offshore oil drilling in virgin areas.

(3) *The Urban Frontier.* At its last meeting, the Sierra Club Board of Directors identified a public-works program (creating environmental jobs) to make American cities livable as one of its major legislative goals. Other subcommittees are needed on what we call Back Door Land Use Planning, the score of federal programs under pollution laws that require a permit for an activity that impacts land use.

Failure to act carries inevitable consequences. Even in earlier days when the results of land abuse had not been scientifically documented, its human consequences were recognized by the morally alert. William Faulkner wrote of the insight of an old hunter who had watched the destruction of the forests he had known as a youth:

> In the old days we came in wagons: the guns, the bedding, the dogs, the food, the whiskey; the young men. . . . There had been bear then. A man shot a doe or a fawn as quickly as he did a buck. . . . But that time is gone now. Now we go in cars, driving faster and faster each year because the roads are better and the distance greater, the Big Woods where game still runs drawing yearly inward as my life is doing.
>
> . . . God created man and he created the world for him to live in. . . . The woods and fields he ravages and the game he devastates will be the consequence and signature of his crime and guilt, and his punishment.
>
> . . . No wonder the ruined woods I used to know don't cry for retribution. The very people who destroyed them will accomplish their revenge.

The bottleneck on a federal planning bill should not discourage Sierra Club members. Just as Antaeus drew his strength from the earth, we gain new vitality from grass-roots land-use concerns. It is time to go back to doing what the Sierra Club does best: a grass-roots campaign for land stewardship. We need the help of members who have expertise and experience on land-use matters to expand the National Land Use Committee. Please send your ideas and nominations to: Bill Futrell, Chairman, National Land Use Committee, The Sierra Club, 530 Bush St., San Francisco, California 94108.

Indiana: Bloomington's Toxic Waters

Don Jordan

A Westinghouse Electric Corporation electrical power capacitor manufacturing plant in Bloomington, Indiana, has been identified as the primary source of the polychlorinated biphenyls (PCBs) that have contaminated water, land, agricultural produce, sewage facilities and people in and around the southern Indiana city of 65,000. Westinghouse's plant has been in operation since 1959, and the Indiana State Board of Health has known of the corporation's use and discharge of PCBs since 1968. Westinghouse itself even found the toxic, pesticide-like chemicals in fish quietly collected from area streams during a 1971 monitoring program. But the presence of PCBs was unknown to Bloomington authorities until November, 1975, when the U.S. Environmental Protection Agency (EPA) listed the city as among thirty-seven sites across the country hosting an industrial discharger of PCBs. (See table.)

After an EPA national conference in Chicago, accusations of negligence and cover-up were aimed at the Indiana State Board of Health. Several monitoring programs were initiated, and by March, 1976, Westinghouse discharges had been traced to storm-water drainage from outdoor handling and storage areas for the oily fluids; to airborne emissions; to wastewater discharges to the city sewer system; and to leachate from several landfills used as corporate PCB dumps until 1972.

Sewer discharges have caused the most concern, for dried sewage sludge has been found to contain between 200 and 400 parts per million (ppm) of PCBs. Since effluent from the city sewage-treatment plant is passing the pollutants to a local stream, Bloomington's utilities department is technically the "discharger" to the local environment. Westinghouse, however, is the ultimate source.

The nutrient-rich sludge has been given to local farmers as a fertilizer for years, which means that sludge users have unknowingly poisoned their own fields. Fish living in waters downstream from the sewage plant have accumulated up to 334 ppm—many times the U.S. Food & Drug Administration's so-called "action" or tolerance level of five ppm in fish for human consumption. Nearly forty miles of stream, and portions of the east fork of White River have been posted with signs warning that fish therein are "unfit for human consumption." The east fork of the White River is a tributary of the Wabash River which in turn flows into the Ohio River, where high levels of PCBs have been found in catfish. One farmer who treated a pasture with sludge found his family cow producing milk contaminated with five ppm of PCB—twice the FDA tolerance level for adult humans. His wife's adipose tissue was tested and found to contain over four ppm of PCB.

Bloomington's drinking water has been pronounced as "safe," but conflicting data on PCBs in fish from the supply reservoir and lack of data on Westinghouse air emissions cause a nagging worry in the area. Bedford, a small limestone-mining town twenty miles downstream from Bloomington, pumps its drinking water from contaminated streams. This water has also been pronounced "safe to drink" by state health authorities. Bedford's problem is complicated, however, by a General Motors foundry that used and dumped PCBs in that area until 1973.

Although no fish sampling has been initiated in streams accepting drainage from old PCB dumping sites, a soil sample from atop one dump was found to contain 1,000 ppm of PCB.

Testing by the National Institute for Occupational Safety and Health found PCBs in fat tissues from all eight workers at the city sewage plant, ranging from 10.4 to 5.8 ppm. Only five percent of 637 people tested in a national monitoring program had accumulated more than two ppm of PCB.

As the home of Indiana University and a hotbed of environmental activity, Bloomington erupted in public controversy as news of food-chain contamination was revealed. State health authorities refused

Transformer and Capacitor Plants Using PCBs in the U.S.

COMPANY (Capacitors)	PLANT LOCATION
General Electric	Hudson Falls and Ft. Edwards, N.Y.
Aerovox	New Bedford, Mass.
Universal Manufacturing Corp.	Bridgeport, Conn. and Totowa, N.J.
Westinghouse Electric	Bloomington, Ind.
Cornell Bubilier	New Bedford, Mass.
P.R. Mallory & Co., Inc.	Waynesboro, Tenn.
Sangamo Electric	Pickens, S.C.
Sprague Electric Co.	North Adams, Mass.
Electric Utility Co.	LaSalle, Ill.
Capacitor Specialists Inc.	Escondido, Calif.
JARD Corp.	Bennington, Vt.
York Electronics	Brooklyn, N.Y.
McGraw-Edison	Greenwood, S.C.
RF Interonics	Bayshore, L.I., N.Y.
Axel Electronics, Inc.	Jamaica, N.Y.
Tobe Deutschmann Labs	Canton, Mass.
Cine-Chrome Lab, Inc.	Palo Alto, Calif.

COMPANY (Transformers)	PLANT LOCATION
Westinghouse	South Boston, Va., and Sharon, Pa.
General Electric	Rome, Ga. and Pittsfield, Mass.
Research-Cottrell	Finderne, N.J.
Niagara Transformer Corp.	Buffalo, N.Y.
Standard Transformer Co.	Warren, Ohio, and Medford, Oregon
Helena Corp.	Helena, Ala.
Hevi-Duty Electric	Goldsboro, N.C.
Kuhlman Electric Co.	Crystal Springs, Mass.
Electro Engineering Works	San Leandro, Calif.
R.E. Uptegraff Mfg. Co.	Scottsdale, Pa.
H.K. Porter	Belmont, Calif., and Lynchburg, Va.
Van Tran Electric Co.	Vandalia, Ill., and Waco, Texas
Esco Manufacturing Co.	Greenville, Texas

Source: "National Conference on Polychlorinated Biphenyls"; U.S. EPA Office of Toxic Substances (EPA 560/6-75-004).

Don Jordan is a freelance writer based in Bloomington.

to advise individuals affected by contamination and denied any knowledge of adverse health effects due to PCB poisoning. A similar tack was followed by medical authorities in Bloomington.

Dr. Thomas Middleton, a pediatrician and chairman of the local health board, contradicted present knowledge of the infamous Japanese Yusho incident of 1968, where over 1,200 people were poisoned by PCBs. Middleton called PCBs merely a "food adulterant" similar to Vitamin E.

State interest in the dispute was boosted during gubernatorial campaigns and with the formation of a citizen-action group led by Bloomington Sierra Club members.

A local prosecuting attorney and a health department official stimulated legal action by "reserving the right" to file a pollution suit against Westinghouse. The move forced public hearing of the problem.

These hearings began September 30, in Bloomington, with Joseph Karen, a state board of health attorney, appointed as hearing officer. Local Sierra Club president Dennis Falck has called the state's handling of the matter a "scandal" and formally objected to the naming of Karen as hearing officer for reasons of conflicting interest.

Falck has also accused Westinghouse of employing "environmental blackmail" by threatening to lay off 300 workers if the city's zero-discharge ordinance were enforced. The city backed down.

With passage of the Toxic Substances Act, production of PCBs in the United States is to be banned entirely by 1979. Monsanto, the sole U.S. producer, has announced it will stop production of PCBs by late 1977. Westinghouse will use up its existing stocks and has announced plans to switch to a new capacitor fluid made by Sun Oil. Westinghouse calls the fluid WEMCOL and describes it as isopropylbiphenyl. Corporate research claims environmental and health safety for this fluid, but an independent assessment has yet to be made.

Contaminated sewage sludge has been piling up in Bloomington at the rate of seventeen tons a month for over fourteen months, and no disposal solution has been found. PCB residues in seven miles of sewer main still bring a pound of PCBs a day to the treatment plant. Line replacement is estimated to cost $3-4 million. Several landfills are to be reworked at unknown cost, and removing PCBs from contaminated stream sediments is considered infeasible by the State Board of Health.

Westinghouse has made it clear that a sharing of the staggering cleanup bill is expected. After threatening to drag legal matters out "for two or three years," corporate defenders said during the state hearings that since the public has shared in the fire-protection benefits afforded by PCBs, the public must also share responsibility for environmental damage and cleanup. Westinghouse claims the city, not their capacitor plant, is the discharger to the "waters of Indiana."

Although state health officials predicted the Westinghouse hearings would be completed in one week, mid-February saw the state still presenting its case. Westinghouse has bombarded the hearing officer with objections and tedious cross examination of state witnesses. One state chemist was virtually badgered from the stand by company attorneys, who claimed that testimony from a standard chemical reference book was "hearsay" because the chemist did not write the book. A civil suit filed against Westinghouse and Monsanto by a group of individuals claiming personal damages has been venued to another county, and yet another public hearing is planned. Westinghouse has applied for a National Pollution Discharge Elimination System permit for storm-water runoff discharges from its buildings and grounds. Contaminated groundwater supplies connected with this discharge are expected to constitute the main issue of the permit hearing.

Interest is expected to increase in the future as a U.S. Public Health Service study is scheduled for 1977. Dr. Renate Kimbrough of the service's Atlanta Center for Disease Control has already visited Bloomington to lay the groundwork for an epidemiological survey on PCB health effects in the area. **SCB**

Alaska: Native Peoples and the National Interest Lands

Jack Hession

In 1971, when Congress extinguished the aboriginal land claims of Alaska Natives with a grant of 43.7 million acres and nearly a billion dollars, it also—at the Natives' urging—directed the Secretary of the Interior to classify the remaining public lands in such a way as to protect subsistence resources. Native villagers throughout the state use more than 44 million acres to gather the fish, game, berries, wood and other products of the land.

Two years later, then-Secretary Rogers C.B. Morton submitted a bill to Congress that recommended that about 64 million acres of unreserved public lands be added to the national wildlife refuge, park, and wild-and-scenic-rivers systems pursuant to a Congressional directive in the same act that settled Native land claims. He also suggested 19 million acres for the national forest system, in response to the desire of the Forest Service and Earl Butz, then would-be natural resources "czar", even though Morton's original study withdrawals were lands picked by Interior agencies for their nationally significant wildlife and natural values.

Despite this major flaw, Morton's bill was an important step toward realizing Congress' desire to safeguard subsistence resources of the public lands, simply because the rivers, refuge and park systems afford the highest degree of protection for the wildlife habitats and populations dependent upon subsistence practices. But far superior in this regard was the conservationists' bill, which called for setting aside 106 million acres in the three national conservation systems. Now, as the Ninety-fifth Congress takes up the National Interest Lands legislation, the Alaska Coalition of conservationists has proposed a revised bill that would set aside 115 million acres in the three systems. Morton's bill has also been reintroduced, and additional proposals are expected from the new Carter administration, the state of Alaska, and others.

So far, the various Native groups have yet to take a position before Congress on the National Interest Lands issue, preoccupied as they have been with making their land selections. But positions can be expected, since there is at least one national land-system proposal in every one of the twelve Native regions, and in most cases the proposals are adjacent to Native-owned land. Attitudes among the Natives toward economic development and the degree to which they depend on subsistence resources vary from region to region. Native responses to the "d-2" lands (as they are called after Sec. 17 (d)(2) of the settlement act) will probably range from outright hostility to support based on the recognition that these lands can serve as a repository of the national resources that subsistence depends on.

Philip Hyde

Alaska Range near Camp Denali

H.R. 39, the Alaska National Interest Lands Conservation Act of 1977, introduced by Representative Morris Udall and (at this writing) seventy-four of his colleagues, would establish six wilderness areas in the two existing national forests. One of these areas would consist of Admiralty Island, which has been the center of intense controversy over the past several years. Now, Interior Department withdrawals on the island for land selections by the urban Native corporations of Juneau and Sitka threaten the spectacular system of bays and inlets that help make Admiralty of such national importance. The two corporations, based far from the island, plan to log its dense forests—habitat that sustains the fish and wildlife resources on which the villagers of Angoon depend. As a result, Angoon has sued Interior, as have the urban groups, who feel the department did not go far enough in setting aside central Admiralty lands for them. A suit has also been filed by the Sierra Club because the Alaska Native Claims Settlement Act does not authorize withdrawals for the two urban groups on Admiralty Island. Angoon villagers may also support H.R. 39's Admiralty proposal, or put in a bill of their own in a continuing effort to save their homeland and current livelihood from devastation by clear-cutters. (See the September 1976 *Bulletin* for a view of the area in contention.)

An overall d-2 bill is being prepared by the statewide Alaska Federation of Natives (AFN). A creature of the regional corporations, the AFN may be attracted to the state's proposed "fifth system" of essentially "multiple-use" management of most of the d-2 lands. If this happens, Natives at the village level will have to make a special effort to get their message directly to the Interior Committees during the field hearings this summer, a time when subsistence activities are at a peak.

All the regional corporations established by Congress to administer the lands and funds of the land-claims settlement are very development-minded. They are exploring their lands for oil, gas, and hard-rock minerals, often in partnership with large U.S. corporations based outside Alaska. Large-scale logging operations are planned by the Tlingit-Haida Indians of southeast Alaska, for example. At the same time, there is a strong undercurrent of concern at the village level that subsistence values be preserved. Experience in Alaska has shown the villagers that where such uses as mining, road-building, excessive hunting, and clear-cut logging have occurred, fish and wildlife populations have suffered and subsistence opportunities have declined, in some areas perhaps permanently. It will be interesting to observe how the Natives will handle the conflict between resource exploitation and subsistence values on the millions of acres of habitat they own.

To date, only two Native organizations have indicated publicly their desire to see public lands adjacent to their own holdings given the protection of the park and wildlife-refuge systems. In 1974, the Arctic Slope Regional Corporation introduced a Nunamiut National Park Bill which compared very favorably with the Alaska Coalition's proposed Gates of the Arctic National Park. But the Nunamiut proposal wasn't reintroduced in the last Congress because the corporation was at odds with the Interior Department (which has its own proposal) over land-selection procedures. Since that time, the western Arctic caribou herd has "crashed" drastically, and its future is in doubt. Inasmuch as a Gates of the Arctic National Park would afford the highest degree of security for a significantly large portion of the herd's range, the North Slope Eskimos, especially the inland Eskimos of Anaktuvuk Pass in the central Brooks Range, may put the park bill back in.

In western Alaska's Yukon-Kuskokwim Delta, a Native conservation organization called Nunam Kitlutsisti favors national wildlife refuge status for d-2 lands adjacent to the existing Clarence Rhode National Wildlife Refuge. Member villages of Nunam Kitlutsisti have selected several hundred thousand acres from the existing range and are parties to a cooperative management agreement with the U.S. Fish and Wildlife Service. **SCB**

Jack Hession is the Sierra Club's Alaska representative.

Northwest: A Perfect Opportunity for Energy Conservation

Doug Scott

As most of the nation shudders through the cold days of winter, the Northwest continues to "enjoy" an unusually balmy season, with very little rain (and almost no snow). This could be the prelude to a serious energy shortage in the coming year. In a region where ninety percent of the electric energy is derived from hydroelectric dams, lack of both winter rains and snowpack in the mountains translates directly into low reservoirs, which may be incapable of maintaining electric-energy generation through the next fall.

This all happened last in 1973-74, when the region responded with a major energy-conservation effort. Oregon's then-Governor Tom McCall ordered all outdoor-advertising lights shut off, and consumers across the region cut back effectively on their energy use.

The sad fact, however, is that the region's energy policy-makers did not extend that excellent public initiative into a long-term, continuing conservation effort. The region's key energy supplier, the Bonneville Power Administration (BPA), is the federal agency that markets and distributes the power generated at federal hydroelectric dams on the Columbia River system. BPA's long-outdated statutory mandate emphasizes maximizing supply, but makes no reference to conservation. (BPA opposed efforts simply to add the word "conservation" to its legislative mandate in 1974.)

Meanwhile, the region has been coming to an inevitable turning point. There are no more big dams to be built, so new increments of power must come from one of two sources: either new thermal generation (nuclear plants or coal-fired plants burning Montana strip-mined coal) or a serious regional program of long-term energy conservation investments. Kilowatts are indifferent: a kilowatt saved is every bit as useful as a new kilowatt generated at one of those expensive thermal plants.

BPA, working in familiar combination with public utilities, private utilities, and the energy-intensive aluminum industry, has neglected serious efforts toward conservation-investment programs (other than the public-relations sort). Instead, the regional "power structure" is hard at work on plans to develop more and more thermal plants—and to have Uncle Sam underwrite them. A key feature of the plans would sustain the subsidization of a handful of aluminum smelters that located in the Northwest years ago only because of "cheap" power. These smelters now use forty percent of BPA's power.

To the rest of a nation shivering through winter paying higher power bills than does the Northwest, this whole scheme may raise questions. The plan BPA and the utilities are after is premised on merely stretching out the old way of doing business: increasing energy supply and limiting conservation efforts to speeches and temporary "band-aid" programs.

Who pays the bill? Who holds the bag? We all do, for under the BPA/utility/aluminum-industry plans, this federal agency would be authorized, for the first time, to purchase shares of new thermal plants *in advance,* thus providing up-front financing for such plants. The effect of the federal guarantees will be to reduce the interest rates on revenue bonds. Then, these expensive new increments of thermal power would be "blended" in with the low-cost hydro-power generated by the federal dams that taxpayers paid for. The thermal power would cost ten times the current cost of the new increments of energy, stretch out the subsidy to the aluminum industry (by increasing rates to all users), and blunt incentives to energy conservation.

Under the BPA plan, the aluminum plants' contracts with BPA would be extended for decades. They would pay far less than the real cost of the energy they receive, and thereby stretch out their subsidy.

There are questions to be asked about all this. The stakes are very high: million-dollar investments, and impacts on the land, the air, and the people of the region. For the first time, an effective coalition of environmental and consumer groups is ready to ask those questions, loudly and long.

Should the rate-paying domestic and rural consumers pay higher electric bills to maintain the subsidized rate for the aluminum plants?

If jobs are the issue, what kind of industry should be encouraged through our energy-pricing policies—energy-intensive industry, or job-intensive low-energy industry? (Each job in the Northwest's aluminum industry costs two million kilowatt hours (KWH) per year, compared to each job in the timber/forest-products industry, which costs 28,000 KWH/year.)

The Sierra Club and others in the environmentalist-consumer coalition feel that energy "development" ought to proceed along the most cost-effective lines, taking into account all the real costs (including environmental impacts and social costs). And so we ask: ought the taxpayers lend their good faith and credit to underwrite Northwest thermal plants, when serious long-term conservation investments, saving kilowatts instead of generating more, would cost them less? Studies in the region show that investment programs in insulation, energy-efficient electric equipment, and industrial-process improvements could eliminate the need for new generation facilities, at least through the end of the century.

The challenge is not how to finance more new plants, but how to implement region-wide investment programs that save kilowatts (and reduce the need for more nuclear plants and more strip mining in Montana and Wyoming).

Who will make these decisions? In the past, the whole show has been controlled by BPA, the utility leaders and the aluminum-industry lobby, along with a handful of Northwest legislators. There have been real choices to be made, but the people of the region have not had a direct voice in making them. Nor have the nation's taxpayers, who have been left holding the bag.

Fortunately, BPA does not yet have authority to purchase shares of new thermal plants, so it must obtain authority to do so from Congress, if the plan is to proceed. Thus, we have a forum to raise the issues of conservation, environmental and social impacts, energy-intensive versus job-intensive industry, and cost-effectiveness.

If the low-water year does come in 1977-78, the region will again have to show what it can do in short-term conservation. It would be far better, though, if Congress were to resist the old familiar call to subsidize more plants and instead initiate serious programs to bring energy-conservation investments "on line."

Opportunities for the Sierra Club to help shape the legislative response to this challenge will arise in this Congress. Already, the Club has been instrumental in derailing a bill in the last session that would have codified the *status quo,* giving the illusion of a remedy without the substance.

Prospects under the Carter Administration should be more promising. President Carter has committed himself publicly against the spread of nuclear weaponry. An evaluation of the problems and solutions by the administration should be completed by the end of February, 1977. A bill may be introduced in the Congress shortly thereafter.

Building upon constructive proposals of the past, the Sierra Club can remain vigilant to assure that legislative reforms embody the following elements:

- The criteria governing U.S. nuclear

Doug Scott is the Sierra Club's Northwest representative.

exports should guarantee that such material and hardware are not used directly or indirectly for producing reprocessed plutonium;

• The U.S. should put the world on notice and create a productive climate for negotiating international accords by restricting its nuclear exports to nations that forswear reprocessing and adopt adequate safeguards with respect to all indigenous nuclear activities;

• If any mechanism for postponing application of any such criteria by the president is necessary to achieve agreement with other nations, the authority should be narrowly circumscribed and made subject to review by the Congress. It must be borne in mind that any process for exemption from criteria which the United States reserves to itself cannot easily be denied to other nations, where the potential for abuse may be great;

• The United States must provide prudent and positive incentives to other nations to subscribe to rigorous international export limitations, including particularly a moratorium on reprocessing. It may be useful for the United States, in cooperation with other nations, to take steps to indemnify those nations against any financial disadvantage entailed in such a moratorium. In order to induce less developed countries to select non-nuclear power options for the future, the United States and other developed nations should establish a vigorous technology development and transfer program with such countries, concentrating upon small-scale, decentralized and inexpensive energy sources. In view of the flagging enthusiasm in such countries for the nuclear option and the necessity for broad-scale capital-intensive electrification which it entails, this initiative may provide a singularly attractive palliative against nuclear proliferation.

The Sierra Club has not written off the nuclear option as an eventual source of power if and when the myriad of environmental threats now associated with its use are adequately resolved. Unlike nuclear proponents, the Sierra Club does not indulge in the presumption of boundless human ingenuity, which holds that the risks of nuclear power can be incurred now and resolved later, by some unknown but inevitable "technical fix."

The folly of technological optimism is magnified in the international setting where technological controls, even if available, cannot be mandated. Moreover, it is far from clear that the peculiarly human component of the plutonium-diversion risk could be adequately restrained by hardware or gadgetry, however sophisticated. One investigator has calculated that the permutations of credible diversion scenarios would be of the order of 10^{70}, a number so large that it could not be counted by all the high-speed computers in the world in a time as long as the age of the solar system. Designing a safeguards framework that would pacify plutonium is not, therefore, a hopeful enterprise.

Perhaps it is too early to close the door on the recovery of the fuel value of spent reactor rods. Perhaps, indeed, unforeseen future technology will make it an acceptably safe process. It would be foolhardy in the extreme, however, to allow the best and perhaps the last opportunity to forestall the plutonium risk slip away under that faith. Fate does not always deal kindly with the unwary faithful. **SCB**

California: Last Chance for Mineral King?

Hal Thomas and John Modin

On almost any cool summer or autumn morning, while resting near Sawtooth Pass high above the Mineral King Valley, one can see far into and beyond Sequoia National Park—east across the deep gorge of the Kern River to the jagged Sierra crest; west beyond the mountains to the vast San Joaquin Valley, now usually concealed beneath a layer of opaque brown smog. By early afternoon, the smog will have risen several thousand feet, borne by mountain breezes, so that by evening, both the Mineral King Valley and the great peaks around it may be obscured by a dirty haze. But more than the view is suffering from air pollution in this region. Injury from oxidant is occurring to trees in both the yellow-pine and mixed-conifer belts from Mineral King north to Kings Canyon, affecting not only ponderosa and Jeffrey pines, the usual victims of ozone damage, but also white fir, sugar pine and black oak.

And far below, in the San Joaquin Valley, where agriculture is by far the largest and most important industry, crop damage from pollution is reported by the California Air Resources Board (ARB). Last October, the ARB released a report on the problem in which it was estimated that economic losses from oxidant injury to such crops as cereals, alfalfa, cotton, grapes, fruits, nuts and vegetables, amounted in 1975 to more than $18.7 million in Fresno County alone. The report stated that at least eighty percent of the total receipts from production of crops susceptible to pollution damage in California are from those grown in the San Joaquin Valley. To contain crop losses at current levels, the report said, would require "improvement of existing air quality and prevention of further increases in emissions."

The same report cites the Forest Service's own prognosis for continued injury to forest vegetation and decline of commercial timber stands at current levels of air pollution. Forest Service research teams have disclosed that tens of thousands of acres of prime timberland, including that within Sequoia and Kings Canyon national parks, are now affected by air pollution, and that even a moderate increase of pollutants could cause a rapid stand decline. Nevertheless, the Forest Service has persistently supported the Disney Corporation's proposal to build a grandiose, year-round resort in Mineral King Valley, one that would bring an additional 200,000 smog-bearing vehicles annually into the San Joaquin air basin. The final environmental impact statement for the project envisions eighteen ski lifts into high mountain passes and glacial cirques, three villages, two mountaintop restaurants, swimming pools, ice rinks, shops and malls, and an awesome 2.8 million visitor-days per year. All this would be crammed into an area of only 16,000 acres, producing a visitor impact of 170 to 180 visitor-days per acre per year, as compared to 8.7 visitor days per acre in Yosemite National Park.

Despite these negative impacts, however, and the Forest Service's own figures on smog damage to conifers in the region, the agency has recently issued a document, prepared under contract by Meteorological Research, Inc. (MRI), that minimizes current levels of air pollution and plays down the effects that an "anticipated 786,000" additional visitors to the area, as a result of the Disney development, would have on these levels. The MRI report concludes that increases in pollution would be less than one percent. Even so, the ARB has warned that "*any* ozone addition will be harmful, with each successive increment inducing a greater increment of damage."

A recently released report ("The Potential for Ozone Injury to Forest Trees in and near the Proposed Mineral King Project") prepared by the Forest Service's own Insect and Disease Management staff confirms ozone injury to ponderosa pines in Sequoia National Park near Crystal Cave and on Milk Ranch Peak bordering the park. "The ponderosa pine stands on Milk Ranch Peak," the report states, "are more greatly affected than any yet discovered in the Sierra Nevada." Milk Ranch peak is located just less than two miles north of the road leading into the Mineral King Valley.

Dr. Wayne T. Williams, forest pathologist and until recently an air-pollution specialist with the Forest Service, directed a survey by the agency of trees damaged by air pollution in the Mineral King Area. Dr. Williams reports:

> The Mineral King [Disney] prospectus is a prime example of individuals within the USFS [Forest Service] who are not managing the forest for the good of the peo-

Bruce Bernbaum

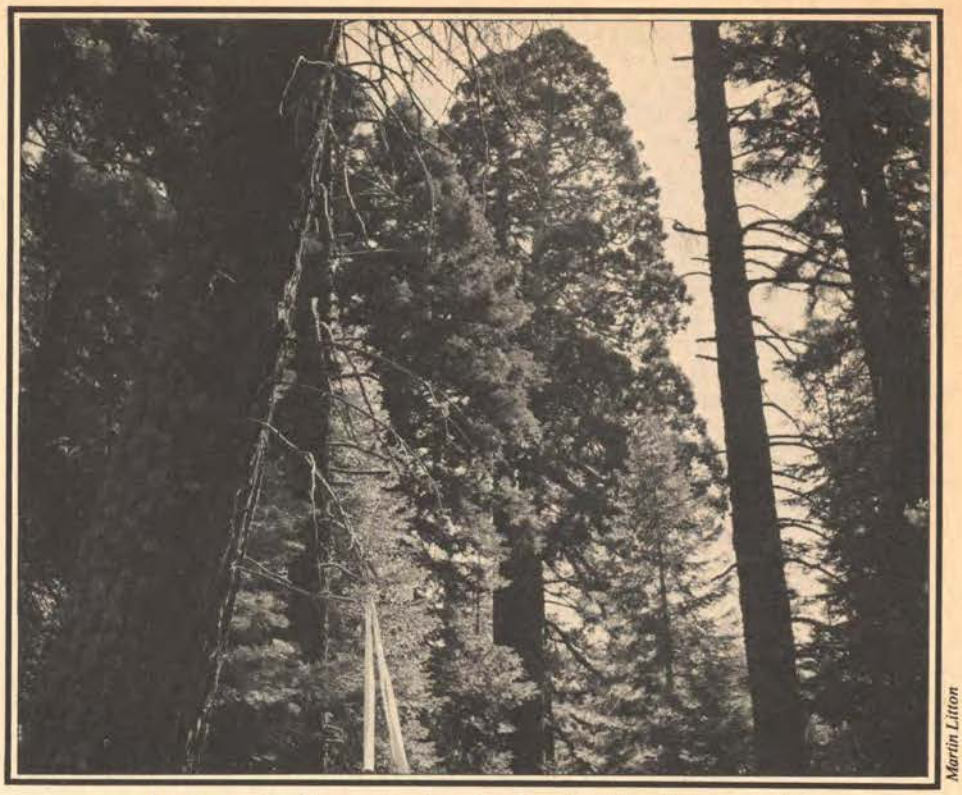
Sunset at Mineral King, near the Upper Eagle Lake Trail

Hal Thomas chairs the Sierra Club's National Committee on Forest Practices, and is an author. His latest book, Coyotes: Last Animals On Earth?

John Modin co-chairs the NCRCC/SCRCC Bi-Regional Task Force on Mineral King, and is a Fish Pathologist with the California Department of Fish and Game.

ple, but who are proposing such a land rape for the furtherance of their own careers. The USFS has blatantly ignored data generated by its own staff and recommendations thereof, since the Mineral King project was originally prejudged as "good" without a consensus of the people or an analysis of the data and recommendations by either USFS staff or outsiders. The USFS staff was threatened with immediate job termination should the people be informed about detrimental environmental implications of the Mineral King development.

In 1965, the Sierra Club's board of directors formally opposed development of the valley and its environs. Then, in 1969, after all efforts failed to persuade the Forest Service not to permit the proposed Disney ski resort, the Club filed its now-famous Mineral King Suit in the U.S. District Court, seeking both preliminary and permanent injunctions against the government's issuing the permits necessary for construction to begin. The court granted a preliminary injunction, but the Circuit Court of Appeals dismissed the action, ruling that the Club did not have standing to sue. In 1972, the Supreme Court upheld the circuit-court decision, but invited the Club to file another suit based on different premises than the earlier one. Reactivation of the suit awaits Forest Service action on the final environmental impact statement on the Disney proposal.



Martin Litton

Survey marker clings to tree branches. Despite claims highway would not disturb sequoias, the route is right through groves.

Senator Alan Cranston and Representative John Krebs of California each introduced bills late in the last session of Congress to transfer Mineral King to the National Park System by adding it to Sequoia National Park. Hearings were not held on these bills because of the unanticipated press of other legislative matters, and so they died as the session ended. However, new bills have been introduced (H.R. 1771 and S. 88) and will receive much greater attention in the new Congress. The bills have already been referred to the interior committees of both houses of Congress and to the Merchant Marine and Fisheries Committee of the House. Representative Krebs is determined to obtain prompt hearings and action on his bill in the House. "This legislation," he said, "is designed to protect a uniquely beautiful alpine valley. I will do whatever I can to see to it that the House acts favorably on the bill in the 95th Congress."

There is no question that the political climate has never been more favorable for adding Mineral King to Sequoia National Park. In introducing his bill, Senator Cranston said:

> . . .I introduce for appropriate reference a bill to add the area known as Mineral King to Sequoia National Park. Serious questions have been raised about the compatibility of the Forest Service proposal with Mineral King's natural values and its Game Refuge status. . .
>
> . . .Mineral King is not being properly managed to meet public needs and protect the area. There is inadequate parking in the valley. The vegetation is being damaged and the river is being polluted. This deterioration of the Mineral King area must cease.
>
> . . .the bill I am introducing today takes Mineral King out of the Forest Service's jurisdiction and places it under the Interior Department as part of Sequoia National Park. I believe that as part of the National Park System the wildlife habitat and scenic and natural values of Mineral King can best be protected and preserved.

Changes in the House Interior Committee and the National Parks and Recreation Subcommittee, as well as indications of environmental concern on the part of the new administration, portend well for the Mineral King bills. Still, the opposition is already intense, well financed and publicized. It is essential that opponents of development and proponents of park status for Mineral King convince their senators and representatives to cosponsor and urge hearings for the Cranston/Krebs legislation. Write to your senators at: Senate Office Bldg., Washington, D.C. 20515; and to your representatives at: House Office Bldg., Washington, D.C. 20510. For more information, or to volunteer help in your area, write Mineral King Task Force, P.O. Box 5396, Fresno, CA 93755.

HELP GET MINERAL KING INTO THE NATIONAL PARK SYSTEM!

Mineral King Task Force
P.O. Box 5396
Fresno, California 93755

White T-Shirts with 3-color view of Sawtooth Peak & words, "Save Mineral King"

Adult at $4.50

Size	No.	Amt.
S	(34-36)	
M	(38-40)	
L	(42-44)	
XL	(46-48)	

Children's at $3.50

Size	No.	Amt.
S	(10)	
M	(12-14)	
L	(16-18)	

Pack or Shoulder Patch; 3-color view of Sawtooth, words "Mineral King," at $1.50 _____

Bumper Stickers: at 2/$1.00

"Mineral King-Nat'l. Park" _____

"Keep Mineral King Natural" _____

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Mackenzie Valley Pipeline

Continued from page 7

freighter canoes, float planes, ancient DC-3s and helicopters to conduct hearings in twenty-eight Arctic settlements, almost all of which, except Yellowknife, have Native majorities. He has listened with awesome patience and politeness to endless hours of testimony in English, Slavey, Dogrib, Loucheux, Hare, Chippeweyan and Inukitut, the language of the Eskimo.

The testimony of the experts over the last several months has elicited serious questions about the pipeline construction from the engineering as well as environmental and sociological points of view. Conflicting testimony has left undetermined the possibility that in sensitive permafrost zones, the pipeline may buckle and damage the environment. Both applicants for the Mackenzie line want to bring in 6,000 construction workers with enormous machines, equipment and staging areas to lay the pipeline. Environmental witnesses, drawing on the experience of the Alyeska oil pipeline crossing similar terrain in Alaska, have raised serious questions that construction companies, trying to meet completion deadlines, would shatter the delicate ecological balance. A number of other technical experts have questioned the safety and proposed size and composition of the pipeline.

Overshadowing the battery of technological evidence, however, has been the complex question of Native land claims, an issue entangled with an incredibly insensitive and archaic bureaucracy in Ottawa designed to administer the lives of Canada's Natives. Simply put, the Natives of the North want their land claims settled before one spadeful of earth is moved, and they do not want them settled by selling off their rights for cash. They want some form of self-determination, development of renewable resources, protection of the environment, their own economic involvement with Northern development and, above all, control of the land they have occupied "since time immemorial."

And so, the Native people have tried to organize themselves and have claimed all 450,000 miles of the Mackenzie Valley as theirs. They are saying that the real question for Canadians to decide is whether Canadian justice can accommodate them. Can they survive as the first people of this country with special rights, or must they be assimilated and forever cease to exist as a cultural entity? For Native people know, clearly and unequivocably, that in order for them to be themselves, the land and the animals and the birds and the fish must continue to be part of their lives.

If white people come with bulldozers, seismic lines, helicopters, and pipes, then lakes will be blasted and fish and animals most certainly killed. People and machinery will scare away the caribou and the fox. Traditional rutting, nesting and calving areas will be disrupted. If the land is threatened, then so are the Native cultures.

In testimony last April during the socio-economic phase of the Berger inquiry the Natives painstakingly laid out evidence that was a shocking indictment of past injustices in the North by paternalistic federal and territorial governments. They presented an overview of the colonial patterns of resource development and a blueprint for an Indian-controlled future that they claim is constitutional, practical and essential to their very survival. At the center of their struggle is the Dene Declaration, a proclamation that states that the Indian peoples have the right to self-determination within Canada and to a measure of control over their own lives. (*Dene* is an Indian word meaning "people" and common to the Mackenzie.)

Reaction of white northerners

Spurred on by the former Minister of Indian Affairs and Northern Development, Judd Buchanan, who described the document as "gobbledygook" that could have been written by a tenth-grade student, many of the white northern population reacted by leveling accusations of "creeping socialism" and "insurrection" against the Dene, branding them separatists or worse. (Warren Allmand, the new minister, has not committed himself about the pipeline and says he will place a great deal of weight on the Berger Commission report.) Other white northerners, although sensitive to the Natives' claims to the land, feared that if a pipeline were not built they would lose a once-in-a-lifetime chance for better jobs and a healthier economy. And if the Natives were given control over the land, they asked, what would happen to whites? Would they be pushed aside?

The Indian and Metis people themselves did not escape the tremendous pressure exerted upon their lives and communities by the proponents of the Mackenzie Valley pipeline. A small group of Native people, predominantly Metis, who had until recently supported the Dene Declaration and were working in unison to develop a joint land claim, broke away, claiming a separate identity and a desire to develop their own land-claims proposal. A pipeline, they say, is closely linked to their economic future.

Impasse continues

The impasse shows little sign of moderating. In an atmosphere of division and suspicion on the part of Native groups and hostility and confrontation by whites, the government could exert pressure on the Native people to settle their land claims quickly, issue a license to build the pipeline, and start the construction whenever it wished. The result of such an action would be politically explosive. Some Natives have promised quite calmly to lay down their lives for the land. Opposition to the pipeline from southern supporters of Native rights, such as the churches, environmentalists and other public-interest groups, would be enormous. The National Energy Board is already hearing evidence that a pipeline with a life expectancy of twenty years at best, and more likely ten, is only postponing the inevitable day when alternative energy sources and far stricter conservation measures must be taken.

During its southern hearings, the Berger inquiry heard hundreds of citizen-produced briefs supporting the idea of stopping the pipeline altogether or delaying it until further examination of the issues could be undertaken. A church-supported idea for a suggested ten-year moratorium rapidly caught the imagination of Canadians wherever Berger went. In essence, the moratorium would do four things: settle land claims justly for the Native peoples; develop environmental technology and experience in the North so that questions of ecological safety could be guaranteed; allow Native peoples to develop their own economic development programs using renewable rather than nonrenewable resources and to engage in public development of energy policies in Canada based on conservation rather than consumption.

Industry and government quickly

moved to quell support for the proposed moratorium by claiming it to be unrealistic, and by threatening southern Canadians and Americans with "freezing to death in the dark" because of acute energy shortages. Indeed, serious pressures from American consumers in the Midwest have put the issues of environmental protection and Native rights in Canada in the position of being dealt with hastily, inadequately and as secondary to the economic needs of the U.S. But even considering the shortages of natural gas that have plagued the American Midwest and East during this, the coldest of recorded winters, a Mackenzie pipeline is not the only, or even the best, solution. The recently proposed Alaska Highway route would deliver gas to the same region more cheaply and without the attendant social and economic disruption.

The Arctic Gas proposal, one senior Ottawa energy official admitted, is primarily to bring U.S. gas from Alaska across Canada to American markets; any "piggybacking" is window-dressing, for the reserves of gas in Canada are insufficient at this time to warrant a pipeline. Nor are Canadians desperately short of gas. Reserves from conventional fields in the south could probably meet Canadian needs for the next thirty years if deliverability and conservation regulations were improved.

Increasingly nationalistic, many Canadians are sensitive to any further American involvement (already more than seventy-five percent) in their economy. There is fear that the decisions for the Arctic Gas pipeline are to be made in Washington, rather than Ottawa, because of the enormous political persuasion of the giant multinational oil companies, which control most major Canadian producers. Ottawa seems to lack the will to resist. Prime Minister Trudeau went on record two years ago as favoring the Arctic Gas proposal and may think the pipeline is a foregone conclusion.

Berger's decision

Government officials have attempted to undermine Berger's inquiry by saying it is too long (almost two years before completion) or too expensive (an estimated $3 million). He gets a little testy with that: "If I'm going to conduct this inquiry, I'm going to do it right. It takes time, but if Canada can't take time to make an informed decision about what is going to happen to our last wilderness and its people in the northland, then what has Canada got time for?"

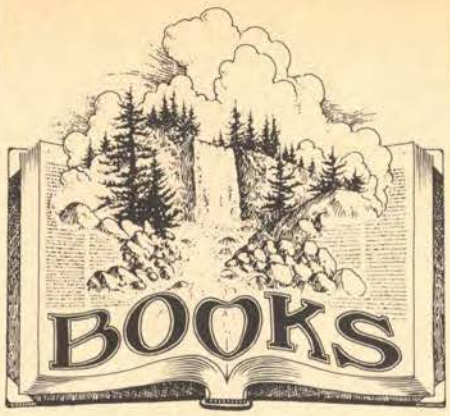
What Berger will recommend is still a matter for speculation. Many think he will call for a halt until land claims are settled. It seems clear he will require stringent conditions to assure environmental protection. Some people hope for a full moratorium. What the government will do with his report is anyone's guess. Undoubtedly Berger's high profile will make it difficult to ignore his recommendations. But regardless of reports, conditions, high-level international politics, energy shortages or national feelings, the people of the Mackenzie and their land remain inseparable. The question for them is clear and it is repeated over and over. It is a question of survival.

Chief Frank T'Selie of Fort Good Hope told Judge Berger and the presidents of Arctic Gas and Foothills how he saw it:

> There is a life-and-death struggle going on between us, between you and me. Somehow in your carpeted boardrooms you are plotting to take away from me the very center of my existence. You are stealing my soul. By scheming to torture my land, you are torturing me. By plotting to invade my land, you are invading me. If you ever dig this trench through my land you are cutting through me.
>
> You are the twentieth-century General Custers. You have come to destroy the Dene nation. You are coming with your troops to slaughter us and to steal land that is rightfully ours.
>
> You are coming to destroy a people who have a history of 30,000 years. Why? For twenty years of gas? Are you really that insane?
>
> Our Dene nation is like this great river. It has been flowing before any of us can remember. We take our strength and our wisdom and our ways from the flow and direction that has been established by ancestors we never knew. We will live out our lives as we must and we will die in peace because we will know that our people and this river will flow on after us.
>
> We know that our grandchildren will look after this land and protect it and that 500 years from now someone with skin my color and moccasins on his feet will climb up these ramparts and rest and look out at the river and feel that he too has a place in this universe, and he will thank the same spirits that I thank, that his ancestors have looked after his land well and he will be proud to be a Dene.
>
> It is for this unborn child, Mr. Berger, that my nation will stop this pipeline, it is so that this unborn child can know the freedom of this land that I am willing to lay down my life.

SCB

The Poverty of Power: Energy and the Economic Crisis, by Barry Commoner; Alfred E. Knopf, New York, 1976. Cloth, $10.00.



Is Socialism the Answer?

Richard Tybout

Barry Commoner suggests that we commemorate this 200th anniversary of our republic with a debate on the merits of socialism:

> ...it may be time to view the faults of the U.S. capitalist economic system from the vantage point of a socialist alternative—to debate the relative merits of capitalism and socialism. Such a debate is now the central issue of political life in Europe, and it is perhaps time for the people of the United States to enter into it as well. (p. 262)

He comes to this position after a review of a variety of problems in energy production and use in the American economy, culminating in a more general discussion of "the capital crisis," to use his term.

Commoner's general thesis is that there are interrelations among several basic flaws in the American economy. He asserts in the beginning of the book that "the threat of environmental survival," "the apparent shortage of energy" and the "unexpected decline of the economy" are all somehow linked.

> Thus, what confronts us is not a series of separate crises, but a single basic defect—a fault that lies deep in the design of modern society. This book is an effort to unearth that fault, to trace its relation to the separate crises and to consider what must be done to correct it at its root. (p. 3)

Problems of environmental survival are not much discussed, though this is not necessary in view of the author's other well-known works on the subject. His chapter on nuclear power is well done, as one would expect. His objections to the administration's "synfuels" proposals and problems of using coal are useful, and most environmentalists would agree that we have slighted solar energy.

Most of the book is on energy and economics, as the title suggests. Here, the work has its own basic flaw: the author gives no evidence of understanding economic efficiency but writes as though it should be superseded by thermodynamic efficiency. He begins with a chapter on thermodynamic efficiency, which he uses as a criterion of economic performance throughout the book. It is one thing to present arguments as to why thermodynamic efficiency should supersede economic efficiency, which Commoner does not do. It is another altogether to assume that thermodynamic efficiency is the proper criterion and then to spend one's time finding examples of economic decision-making that are not controlled by it, which Commoner does do.

Economic efficiency implies the minimization of all costs, labor, capital, energy, and other resources, for a given output or a given level of consumer satisfaction. Thus, if energy has a low cost and labor a high cost, and if energy can be substituted for labor, then to achieve economic efficiency energy will be used extensively and labor sparingly. Conversely stated, achieving physically possible thermodynamic efficiency could be wasteful of labor and hence in conflict with economic efficiency. In a condition of maximum economic efficiency, no person can be made better off without making someone else worse off. The concept of economic efficiency is extended across time through the rate of time discount and to some aspects of environmental protection by valuing the damages from environmental abuse.

In order to avoid greater reliance on nuclear power and coal, Commoner favors petroleum. He sees oil and gas as transitional fuels to renewable sources. The transition might take half a century and should be based on domestic reserves (pp. 57, 58). His discussion is of petroleum costs in 1985 and thereabouts. He bases his figures on: (1) a 1972 National Petroleum Council report that is both outdated and falls short of the state-of-the-art in energy forecasting; and (2) a task-force report for Project Independence. Why he did not use the *Project Independence Report* (PIR) itself is not clear. Although the latter has since been superseded by the Federal Energy Administration's *National Energy Outlook* (1975), which is more accurate and less optimistic, PIR itself shows that domestic independence would be expensive in 1985, even with a very considerable expansion of nuclear power, which Commoner presumably opposes (as does this reviewer). We don't know what the cost would be for domestic independence if maintained until renewable energy resources take over. Some scholars, whose works are not mentioned by Commoner, have investigated the possibility of combining national security with low-priced foreign oil via oil-storage programs and other strategems.

But Commoner wants to emphasize another point in his chapter on oil:

> ...the oil companies are not a reliable vehicle for the production of U.S. oil, for they seem to be less interested in producing oil than in producing profit. (pp. 62, 63)

He takes two pages (pp. 55, 56, with quotes from oil company executives) to show that U.S. oil companies in pursuit of profits developed low-cost foreign sources in the fifties and sixties instead of providing more (high cost) domestic capacity, and several more pages (pp. 61-63) to note that even if oil companies invest domestically, it will not be in oil production unless this is the profit-maximizing alternative.

This is like berating a fish for swimming. Business firms are organized for the purpose of making profits. There is no need to go to great lengths to show that this is what they are trying to do. The need, instead, is to show that profit-making in the oil industry is not in the public interest. This Commoner does not do, though there are legitimate arguments that can be made for this view—interference with foreign policy and excessive control of other domestic energy industries, for example. These are not mentioned.

Commoner considers three energy-using industries: agriculture, transportation and petrochemicals. The agricultural study is interesting, but his remarks on transportation are inconclusive. Unfortunately, one cannot reach conclusions on transportation policy without taking account of the special problems created by regulation. At least as good a case can be made (on energy-conservation as well as economic-efficiency grounds) for phasing out regulation (protectionism) as for phasing in public ownership of railroads, trucking and air transportation.

The author's presentation of information on a conspiracy by General Motors and others to replace electric trolleys by buses (pp. 189,190) reminds us of the hazards of unrestrained corporate behavior.

His most sweeping recommendations apply to the petrochemical industry:

> It is regrettable but true that there is no way to improve the low social value of the petrochemical industry short of reducing its level of activity. By its very design, the industry is *inherently* inefficient in its uses of energy and capital; it cannot be reformed, it can only be diminished. (p. 208.)

Commoner uses thermodynamics to reach his conclusion of inefficiency in the use of energy. Whether he also thinks it is inefficient to make commodities from petroleum, instead of burning it, is not clear. He seems to think that capital-intensive activi-

Richard Tybout chairs the Sierra Club Economics Committee.

ties are inherently inefficient in the use of capital. This is not true as a general proposition. (If it were, solar house-heating would be in bad shape.) He finds the petrochemical industry of low social value because of more traditional environmental concerns: pollution, cancer-creating substances, nonbiodegradability. Commoner would not completely eliminate the industry because of a few plastic products for which he believes there are not adequate substitutes.

Who is to say which items are good substitutes? If the price mechanism were used (which Commoner does not propose), consumers would make the choice. But if the intention is to reduce environmental and health damages from plastics, then these goals should be dealt with directly—either taxing or banning the offending activity. Taxes would cause prices to be higher; revenues would go to the U.S. Treasury; and consumers would be in a position to make their own choice of which products are preferable in the light of the higher prices of plastics.

Commoner culminates his analysis of the U.S. economy with "the capital crisis," or the current problems of getting capital. This, of course, is more serious for industries that are capital intensive, as the energy-producing and heavy energy-using industries are. I think the following best represents the gist of his argument:

> . . . the tendency toward diminished capital productivity that is inherent in modern production technology has not been effectively overcome by opposing economic forces. (p. 230)
>
> As progressively larger amounts of capital are invested the output of the production system increases but the amount of labor that is used does not keep pace with the rising output. (p. 244)

Commoner then quotes Marx:

> ". . . capital is not merely reproduced; it is continually increased and multiplied. . . . However, owing to the progress of machinery . . . fewer and fewer workers are necessary in order to produce the same quantity of products. . . . They form the industrial reserve [which] is irregularly employed, or comes under the care of Poor Law institutions." (p. 252)

At several points, Commoner alludes to unemployment in the context of increasing capital intensity. Finally, he states:

> . . . the U.S. economic system has in fact experienced a falling rate of profit. . . which seems to be closely related to displacement of labor by capital. . . . These are precisely the diagnostic faults that Marx attributed to capitalism. . . . Although economists can, of course, provide alternative explanations for these phenomena, their general similarity to the faults which are the substance of the socialist critique of capitalism suggests that there are grounds to at least consider the possibility that the pervasive and seemingly insoluble faults now exhibited by the United States' economic system can best be remedied by reorganizing it along socialist lines. (p. 259)

It is always in order to raise questions about the proper role of government in our mixed economy, but it would seem at least as much in the public interest to note what the "alternative explanations" by economists are, if one is interested in an enlightened discussion. I do not propose to remedy Commoner's omission in the limited compass of this book review, but a few factual notes are in order:

1. The capital shortage that we have experienced has come during a time when inflation has produced very low, sometimes negative, real rates of return on loanable funds. In such circumstances, it is not surprising to find the demand for capital exceeding the supply.

2. The U.S. economy has not had a long-run general increase in capital intensity in the twentieth century. The ratio of national wealth to GNP (in constant dollars) went from 5:1 in 1900 to 3:5 in 1948 to 3:0 in 1966. Business wealth (consisting of business structures, producers' durables, inventories and business land) went from 38.7 percent of total wealth in 1900 to 35.3 percent in 1948 to 35.1 percent in 1966. (Figures are from V.G. Lippitt, *The National Economic Environment,* McGraw-Hill, 1975. Tables 2-2 and 2-3.)

3. Bosworth *et al.*, whom Commoner cites, gives a balanced discussion of the various alternative future capital needs expected in the decade of the seventies. This is a scholarly study which suggests that some small increase in the rate of savings may be called for in the coming few years, but does not support the kind of alarm voiced by business representatives and Secretary of the Treasury William Simon, as quoted by Commoner.

4. There was, indeed, a drop in profits from 1966 to 1973, as Commoner reports economist Nordhaus' finding. But he does not report Nordhaus' conclusion. According to Nordhaus: "In sum, there seems little reason to think that profits are badly out of line with historic experience. Since 1958, price has averaged 5.0 percent above average total cost. . . . In 1973 price was 4.3 percent above average total cost." (W.D. Nordhaus, "The Falling Share of Profits," *Brookings Papers on Economic Activity,* Vol. 1, 1974, pp. 207, 8.) In other words, the 1966 profit level was out of line, not the 1973 level.

Thus, the factual basis for Commoner's observations is subject to significant question. But one need not know the above facts to raise questions about the validity of the Marxian diagnosis. The Marxian logic of capital intensity does not explain why Russia in 1917, China more recently,

Brief Reports

Nuclear Energy

The Accident Hazards of Nuclear Power Plants by Richard E. Webb. 230 pp. University of Massachusetts Press: Amherst, 1975. $6.95 paperback.

A thorough and, at times, technical analysis of the safety and reliability of nuclear reactors by a nuclear engineer formerly associated with the Atomic Energy Commission. He concludes that there is no scientific basis for claiming nuclear power plants to be safe and recommends that a thorough investigation be conducted on reactor-safety standards and technology.

The Electric War, by Sheldon Novick. 376 pp. Sierra Club Books: San Francisco, 1976. $12.50 cloth.

A thorough and very readable survey of nuclear power, policy and politics in the United States. The book explains nuclear technology, examines the problems and dangers associated with it, and presents all sides of the debate through interviews with scientists, environmentalists, federal officials and industry representatives. This book is intended for the general reader who wants to know more about nuclear energy. Novick is an editor of *Environment* magazine and author of *The Careless Atom.*

Nuclear Energy, The Unforgiving Technology, by Fred H. Knelman. 264 pp. Hurtig Publishers: Edmonton, Alberta, Canada, 1976. $4.95 paper.

Alarmed at the Trudeau government's enthusiastic commitment to the development of nuclear power, Knelman, a prominent Canadian scientist and environmentalist, has written this book to arm that country's citizens with facts to oppose its current nuclear policy. The book is outspokenly critical of both nuclear technology and government policy, for, as Knelman points out in his preface, "Values stand centre stage in the nuclear debate. . . ." Though intended especially for Canadians, the book is appropriate for Americans as well, since if a nuclear accident were to occur in either country, political boundaries could well be meaningless.

The Nuclear Impact, by Frank Kreith and Catherine B. Wrenn. 248 pp. Westview Press: Boulder, Colorado, 1976. $18.95 cloth.

An exhaustive case study of the now defunct Plowshare Program to stimulate natural-gas production by explosion of underground nuclear devices in western Colorado. This book is not so much about the hazards of the so-called peaceful uses of nuclear power as it is about the perfect willingness of the federal bureaucracy, in alliance with industry, to doggedly pursue its goals regardless of cost, need, public opinion, or the weight of reason, fact or morality.

Nuclear Power, by Walter C. Patterson. 304 pp. Penguin Books, Inc.: Baltimore, 1976. $3.50 paper.

A survey of the technology and social implications of nuclear power. Intended

and many underdeveloped countries since have opted for economies with dominant, or sole, economic direction by government, while the major developed, capital-intensive, Western countries are holdouts for private operation.

I wish I could report that some new insights had resulted from the foray of an eminent biologist into the field of economics, but such is not the case. The book is full of economic nonsense. This should be apparent from prior discussion herein. I might add that employment and unemployment are discussed as though independent of wage rates. No attention is given to the effect of consumer preference on the profitability of alternative industrial outputs. The argument sometimes turns on physical ability to produce cotton, wool or oil without reference to costs. There are still other difficulties.

The structure of the analysis is no better. I do not know whether Commoner thinks our collective management of capital, our pursuit of economic efficiency (rather than thermodynamic efficiency) or some combination of these, or some other phenomenon is the "single basic defect" to which he refers in his introduction. Economic problems there are a-plenty in the American economy. But one learns very little about them from this book. **SCB**

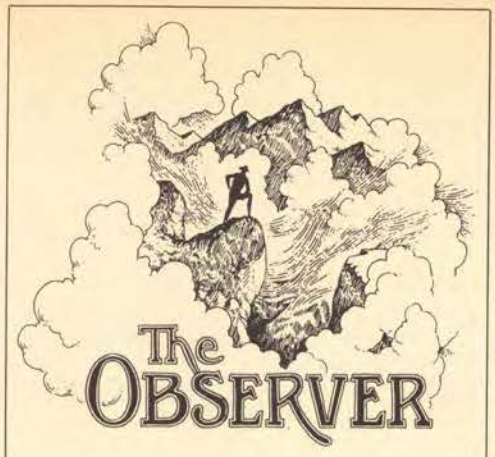
for the average reader who wants to be able to understand and participate intelligently in the nuclear debate. Patterson, a nuclear expert, works for Friends of the Earth in London. His account is cautionary, rather than loudly critical, but the book makes clear that nuclear energy may well create more problems than it solves.

Unacceptable Risk, by McKinley C. Olson. 312 pp. Bantam Books, Inc.: New York, 1976. $2.25 paper.

A survey of the nuclear debate now under way in the United States. Olson's account is objective, but his personal doubts about nuclear power are apparent. One of the more readable books on the subject thanks to Olson's controversial style and liberal use of anecdotes and personal interviews.

We Almost Lost Detroit, by John G. Fuller. 278 pp. Readers Digest Press: New York, 1975. $8.95 cloth.

A novelistic account of the near-meltdown that occurred on October 5, 1966, at the Enrico Fermi atomic plant near Detroit, and of the cover-up that began as soon as the danger was first noticed and ended only with the publication of this book a decade later. At the time, scientists and officials working at the Fermi plant were told not to inform the residents in the surrounding region that a nuclear accident was impending. Only after a month of hoping and tinkering with the faulty reactor did technicians finally rest easily that a disaster had been avoided. Frightening reading.



Robert A. Irwin

Outings for Rural Youth

What in the world is a Sierra Club inner-city outings (ICO) program doing in the wide-open, sun-bathed Coachella Valley of Southern California? Who needs it there, where the largest "metropolis" is Palm Springs (pop. 25,000) and the populations of most of its scattered towns are counted in the hundreds? Who needs it? The kids who live there, that's who. In the three years since the San Gorgonio Chapter's Tahquitz regional group adopted it, the ICO program there has taken root and thrived. It has given wilderness experiences to hundreds of young people, who, though they lived almost within touching distance of magnificent wild country, had never before had the chance to experience it.

The prime mover behind this ICO program for country kids was a young schoolteacher from San Diego, Pam Johnson. While in the San Diego Chapter, she had assisted in its program, which, like those in several other chapters, took kids from their big-city, brick-and-concrete environments into untrammeled wilderness. (See this column in the October, 1975 *Bulletin*.) All such programs now operate under uniform Sierra Club guidelines adopted by the board of directors in December, 1975. They coordinate their activities under an ICO subcommittee of the national outings committee.

It was the beauty of its deserts and mountains that lured Johnson to the Coachella Valley four years ago. Not long after she settled in the tiny hamlet of Oasis, she was amazed to find that not one organization in the valley had been doing anything to get young people into the surrounding wild areas—and to teach them to respect and enjoy the lands. In her spare time from teaching she immediately began to plan an ICO project, which she called "The Bighorns" (after the region's wild sheep). In January, 1974, with the backing of the Tahquitz Group, The Bighorns took off.

Johnson started out with little but her enthusiasm, an old VW bus and borrowed equipment. To save the time it would take to organize a special group, she said, the easiest way to get young people was through local agencies. She was able to convince them of the potential value of wilderness trips for their mostly "3-D" (disadvantaged, disturbed or delinquent) youngsters. Her first set of greenhorn backpackers was a bunch of youths on probation, accompanied by a couple of adults. Subsequent early recruits came from such organizations as Boys Clubs and Girls Clubs, teen centers, PSYCS (for disturbed youngsters), and Turn-Off (for teen-age addicts). She soon saw that no lasting effects could be achieved by only one wilderness experience. Instead, she planned a series of backpacking hikes, each a little more difficult and each demanding more responsibility than the preceding one. All this work during the school year 1975-76 had to be crowded into weekends, because both Johnson and her volunteer assistant had full-time jobs. They had to get as many kids into the mountains and deserts as they could, to prove that not only would the young people like to go, but also that the agencies would benefit from letting them go. The strategy worked.

For this school year (1976-77) the Coachella Valley Unified School District granted Johnson a leave of absence to enable her to carry on her project full time. With the aid of some private foundation funding, she has been able to broaden her program beyond the 3-D kids to the "3-As" (average, affluent Anglos), most of whom also are strangers to their own local wilderness. She is working with elementary, junior-high and high school teachers not only to take members of their classes hiking, but also to make the wilderness experience part of the educational process, using special classroom materials for study before and after the trips.

A new wilderness backpack program for a sixth-grade class in Coachella Junior High gets under way this month. Ten young people, their teacher and as many parents as wish to will go into areas of increasing difficulty over three successive weekends. A week before any series of hikes begins, a slide show and discussion on similar wilderness trips is presented to a class and the pupils' parents. Many of the kids become excited, of course, when they spot one of their friends on Johnson's slides. Each participant must get written parental approval.

In February, for the first time, Johnson led a group of nine Campfire Girls with two adult leaders on a two-night hike, the girls preparing all the meals. She also led three such trips in November, December, and January, but on those occasions

with boys on probation who were all members of an ecology class in the county's continuation high school (San Cayateno) in Thousand Palms. All, Johnson said, were "end of the line kids." If they didn't make it in this last-chance school, it was back to Juvenile Hall or jail. On their first backpack several of them tasted water from a natural source for the first time in their lives. One of them, Gabriel, was so delighted with the water, Johnson said, that he took home a canteenful so his parents could taste it too.

As the Bighorns-ICO program is expanded and more and more trips scheduled, Johnson is recruiting and training volunteer leaders to help and to give her more time for planning and making community contacts. For only by involving the parents and enlisting the support of the community and its leaders, she says, can such an ICO effort succeed. Because of her work in the valley, she was invited to the University of California at Davis to take part in a conference in February for federally funded outdoor educational programs for migrant workers and their children. Despite the profusion of luxurious estates for the very rich in the Palm Springs area, most of the population of the valley is at the opposite end of the scale: poor, mostly Chicano, field hands or migrant workers.

Pam Johnson naturally is excited about her project and the enthusiastic support she is getting from the San Gorgonio Chapter and the Tahquitz group. She has a monthly column, sort of a running progress report on the ICO program, in the chapter's newsletter, *Palm and Pine*. Her success should be contagious. She is proving that other groups and chapters without cities big enough to have "inner cities," also can conduct useful ICO programs for small-town and rural youths. Inner City Outings in any area can open the eyes of young people to nature's wild places and things. "We must reach the coming generation when they are still impressionable," says Johnson, "if our natural resources are to be saved."

You can help her in her work in an immediate, practical way. Many of her young hikers need boots. Even worn-out boots, she says, are better than the street shoes or tennis shoes too many of them have to hike in. Send them to: Pamela Johnson, P.O. Box 712, Thermal, California 92274. She would also like information on what is available, and where, in ecology educational material. Can you help? **SCB**

Get That Ballot In

It's Sierra Club election time again. If you have not cast—and mailed—your ballot for five members of the Club's board of directors, do so now. The deadline for the *receipt* of ballots is noon on Saturday, April 9, 1977. Last year only 29.7 percent of the Club's eligible voters cast ballots. Not too bad, of course, when compared with some chapter responses. The Kern-Kaweah Chapter, one of the Club's smallest, in its latest election, however, reported 171 ballots cast, or about thirty percent of its electorate. I can think of another chapter, which will remain unnamed, that had a voter response of just under three percent! If the Sierra Club is going to work in a democratic way, it needs the fullest member participation possible. The Club takes all reasonable effort to make it easy. Just punch five holes, lick a stamp, and mail.

The Sierra Club Comes Through

Some requests to the Sierra Club for help are unusual, indeed. The public sometimes seems to credit us with power to invoke divine intervention. One night Club Regional Vice President Carl Holcomb was working late in the Washington office, when the phone rang. Holcomb, who lives in neighboring Virginia, is also chairman of the Appalachian Regional Conservation Committee. The man on the line said that an apparently ailing blue heron had been perching in a tree in his orchard for several days and that he couldn't get any of the local authorities to do anything about it.

"What can the Sierra Club do?" he wanted to know.

Holcomb asked where he was calling from.

"Monterey," was the answer.

"Virginia?" Holcomb asked.

"No, California!"

"That's a long way from here," Holcomb told him, "but I'll see what I can do."

"Nothing, I suppose," the caller said, and hung up.

Holcomb, knowing how he himself doesn't like getting the runaround, being bounced from one person to another, called his friend, Hal Thomas, chairman of the forest practices committee of the regional conservation committee in Northern California, and told him the story.

Thomas then got on the phone and called a fellow member of the Tehipite Chapter, in the Fresno area, who also works for the California Fish and Game Department. Then he alerted the Fish and Game people over on the coast, who thereupon went to the Monterey orchard and removed the blue heron.

Holcomb is proud of his long-distance service, and only hopes that fellow in Monterey will now join the Club.

Energy and the Club

Ellen Winchester

In the following letter to Sierra Club President Brant Calkin, Ellen Winchester, who chairs the Club's National Energy Committee, outlines her views as to what the Club's energy priorities should be for the next two years. The Editor

Dear Brant:

Since President Carter has stated that the number-one priority of his energy advisor, James Schlesinger, will be energy conservation, how can the Club orchestrate its abundant resources of manpower, geographic spread and communication channels to promote energy conservation as a top-priority issue? Since no President can govern by fiat, it seems clear that this administration will depend on public-interest and environmental groups like ours to persuade the American public that a meaningful reduction in energy use is necessary and possible. Further, since Dr. Schlesinger's additional charge is to increase energy production, including coal, offshore oil drilling and nuclear power, with the latter planned to fill the gap between pared-down energy needs and nonnuclear energy supply, it also seems clear that this administration will place on us a considerable burden of proof concerning feasible alternatives when we oppose any of its energy supply choices. If our record in this field is weak, our credibility and strength in court and in Congress will be accordingly reduced.

The implications of American oil consumption reaching new highs—19.3 million barrels of oil per day in the four weeks ending December 17—are, of course, international in scope, affecting not only our balance of payments and our dependence on foreign suppliers, but also the attitude of other Western nations whose consumption is dramatically less than ours. They can naturally be expected to view our gluttonous use of a diminishing world resource with resentment and alarm. It is a situation that does not persuade de-

RETRACTION

We have been informed recently by the Kinney Shoe Corporation that it sells no shoes manufactured from whalehide. The corporation, indeed, sells a shoe it labels as "whaleskin," but the product is made from cowhide. Therefore, the information printed in our February 1977 Letters column was incorrect. We regret any inconvenience we have caused the Kinney Shoe Corporation. The Editor.

veloping nations to restrain adoption of nuclear technology, with its ominous military potential. Numerous legislative options are available to the government to reduce energy consumption.

Two pieces of legislation were passed in the last Congress that we can all work to implement. The Energy Policy and Conservation Act, in addition to promoting greater automobile and appliance efficiency, offers the states funds, materials and encouragement to cut energy use by five percent of projected 1980 usage. The Energy Conservation and Production Act authorizes billions for insulating commercial buildings and apartment houses and millions for low-income persons and others to weatherize their homes. (The April *Energy Report* and May 21 and December 3 *National News Report* contain detailed explanations of the opportunities provided for Club action by these acts.) Many states have set up citizen advisory groups to work with state energy offices in planning the implementation of the two acts. Most such citizens' groups seem to be confused, ill informed and frustrated. If implementation funds are appropriated by the next Congress, environmentalists have a role to play in making sure the money is spent usefully. In several ways, both acts seem more intended to table meaningful action through study than to promote it. Nevertheless, our chapters should be motivated and educated to make the most of the provisions of these bills.

Both to utilize the above legislation and to go beyond it, as is needed, chapter and group energy leaders need materials, slides, film strips, TV spot announcements, bibliographies of free literature, and as much Club-produced information, or Club-approved information, as can be made available. Much of this can be found already prepared by both governmental and public-interest groups, some of whom would welcome our help in distribution. The Environmental Law Institute, for example, has produced a body of model legislation concerning building codes, recycling oil, mass transit, and many other areas.

As of this moment, almost all our chapters and many of our groups have energy chairpeople who are looking for information and guidance. They also seek a sense of the Club's approval of their mission. The *Energy Report* is an effort to satisfy these needs. It is an inadequate effort in face of the widespread public apathy these Club leaders must address.

Chapters need help and encouragement to set up information centers that could, in turn, promote group action, and to lobby their state legislatures both to pass energy legislation and to fund research on renewable resources and low-energy job technology. (It is axiomatic that low-energy-intensive industry will employ more people than high-energy-intensive technology—but translating that fact into attractive job opportunities that will serve as alternatives for wasteful, unnecessary production is a challenge neither federal nor state governments are working on. Obviously, labor unions will not embrace a national policy of reducing energy growth if that reduction means fewer jobs.)

At this moment, a mass of ideas for solar heating and cooling, biomass conversion and use of wind energy, are being tried in various sections of the country. (Yet only seventy-five solar-energy houses were built in the whole country last year.) A very appropriate project for group action is sorting through these possibilities and selecting those that could be regionally useful, then promoting them. Encouraging energy audits of member energy use with a view toward cutbacks, and motivating county and city governments to sponsor such audits for their buildings, is another area crying for attention. Acting as "energy ombudsmen" is appropriate for Club members living both in cities and rural areas, where farmers need help in reducing dependence—now escalating rapidly—on high-energy-intensive agricultural technology that tends to "mine" our agricultural resources with long-run devastating effect.

Sierra Club members can help each other with insulation projects, or help low-income families; continue efforts to obtain bicycle paths; arrange for car-pooling centers; push for improved bus systems; establish recycling centers; provide speakers and programs for community organizations; fight utility expansion by proving that energy conservation can free the *needed* energy more cheaply; press state public-service commissions to change rates to encourage the use of industrial-process steam for electrical generation, an action experts say could reduce industrial consumption of electricity by forty percent; urge public utilities to test and rent solar equipment for industrial, commercial, and residential buildings; push model building codes encouraging energy efficiency and the use of wind and solar power, including passive solar energy utilized through proper siting, as has been done in Davis, California.

As motivation to produce the above kinds of action (and the list of possibilities is only skimmed here—for more see the April *Energy Report*), development is needed of materials showing the effects of energy misuse on wilderness, coasts, air and water quality and public health. The Council on Environmental Quality has stated, for example, that a twenty-five percent improvement in gasoline mileage last year could have saved 1.3 million barrels of oil per day, equal to twenty percent of imports and "more than double what optimistic estimates suggest the Gulf of Alaska's Outer Continental Shelf could produce in 1985." In short, the same kind of orchestration of all our capacity that has made us historically effective in securing wilderness protection can be used in the long term to reduce the exponential increase in energy consumption that threatens the planet with previously undreamt-of massive degradation. **SCB**

News

OCS bill reintroduced

Bills to update procedures for oil and gas leasing and development on the Outer Continental Shelf (OCS) were reintroduced in both houses of Congress. The bill contained in last year's conference report was reintroduced in the House as H.R. 1614 and in the Senate as S. 9. The House also voted to continue its ad hoc select committee on the Outer Continental Shelf. Last year's bill failed to pass in the final hours of Congress because of parliamentary maneuvers by opponents and the threat of a veto by President Ford. Given a more receptive administration and greater lead time, the bill can probably be considerably strengthened. In testimony given to the Senate Interior Committee at hearings on his confirmation as Secretary of the Interior, Cecil Andrus said that he would "place in a holding status" the department's offshore leasing until the legislation is passed. Meanwhile, the department has released a revised OCS leasing schedule covering 1977 to 1980. It proposes many new sales, including six in the Gulf of Mexico, three on the Pacific Coast, nine in Alaska, and seven on the Atlantic Coast.

Strip mining bill introduced

Legislation to apply federal leverage to the states to protect land from irretrievable damage by coal strip mining has also been introduced. In the House the legislative vehicle is H.R. 2, by Interior chairman Udall. In the Senate, the bill is S. 7. Both the House and Senate interior committees intend to make stripmining legislation their number one priority. The Carter administration also supports enactment of a bill.

Joint Committee on Atomic Energy stripped of legislative powers

The House of Representatives, following an earlier recommendation by the Democratic Caucus, voted 256 to 142 to dismantle the legislative functions of the Joint Committee on Atomic Energy (JCAE). The committee has been a strong nuclear-energy advocate ever since its creation in 1946. As such, it has been a major congressional obstacle to redirecting U.S. energy priorities. This paves the way for a more balanced approach to energy legislation by the new Congress.

More administration appointments—so far, so good

News of appointments to key administration environmental positions has continued to flow in since the inauguration. The first was that of former Representative Patsy Mink (D-Hawaii) to be Assistant Secretary of State for Oceans, International Environment and Scientific Affairs. While in Congress, Ms. Mink was consistently given high scores by the League of Conservation Voters, and while chairing the important Mines & Mining Subcommittee of the House Interior Committee, she worked hard in the effort to obtain passage of a stripmining bill.

The appointment of California Assemblyman Charles Warren as chairman of the Council on Environmental Quality made environmentalists jubilant. He had served as chairman of the California Assembly's Committee on Resources, Land Use and Energy. His accomplishments include: creating the state's Energy Resources Conservation and Development Commission; supporting nuclear safeguards legislation that became law; contributing significantly to state coastal legislation; and replacing the tax on standing timber with a yield tax on harvested lumber.

A third appointment, that of John F. O'Leary as head of the Federal Energy Administration, was greeted with somewhat less enthusiasm. O'Leary had most recently been head of the New Mexico Energy Resources Board. Although environmentalists in New Mexico characterized him as "intellectually honest" and "receptive," and credited him with taking some significant steps with regard to solar energy and energy conservation in that state, he was, at the same time, criticized for accepting high energy-demand projections supplied by industry and for supporting the $100-billion Rockefeller energy-subsidy plan.

Oil storage proposed

In December 1976, the Federal Energy Administration (FEA) issued a report on a proposed oil-storage scheme as a hedge against another oil embargo. While environmentalists have generally favored the idea of oil storage, the report has raised concern about the potential impact of the particular sites chosen for storage. As proposed, the system would place some 150 million barrels of oil in a number of salt domes in delicate and productive wetlands along the Gulf Coast. Environmentalists feel that this proposal is too hasty, that considerable environmental damage could result, and that better sites are available, including a northern band of Gulf Coast domes located in dry areas, as well as salt beds in New York, Illinois, Ohio, and Michigan.

Club members participate in bird rescue

Since the *Argo Merchant* ran aground off New England there have been at least seven significant tanker mishaps near U.S. shores. Of special concern to the Club was the *Olympic Games*, which ran aground in the Delaware River, spilling 134,000 gallons of oil. The oil could not be fully contained, and was washed up on the river banks. Doug Jeffers and Paulette Nenner of the Club's National Wildlife Committee led sixteen Club members to Wilmington, Delaware, to aid in saving waterfowl. The Club's Delaware Group rented and organized an emergency cleaning center where oil-soaked ruddy ducks, Canada geese, black ducks, mallards and scaup were washed in a nontoxic detergent, dried and fed.

News

Board of Directors sets priorities and adopts policies

Meeting in Washington, D.C., the Club's board of directors established legislative priorities for the next two years. These will focus the Club's lobbying efforts during the 95th Congress on really key issues. At the top of the list of major campaigns is the protection in Alaska of more than 100 million acres of National Interest Lands as parks, wildlife refuges, and wild and scenic rivers. Renewal of the Federal Water Pollution Control Act, amendments to the Clean Air Act, legislation to conserve energy (probably focusing on utility-rate reform), passage of the Endangered American Wilderness Act (an omnibus package of Forest Service *de facto* wilderness areas), renewed efforts to obtain a federal strip-mining control bill, and improvements in the Outer Continental Shelf Lands Act (which governs offshore oil and gas leasing) will also be major campaigns. In addition, the board took a significant new step by deciding to work toward ensuring that proposed urban public-works legislation is environmentally beneficial. Among regional, area-specific issues, those of highest priority for the Club were declared to be the following: Redwood National Park, Mineral King, Locks and Dam 26, the Boundary Waters Canoe Area, the proposed Tall Grass Prairie National Park, Great Smoky Mountains National Park wilderness, the Atchafalaya Swamp, and opposition to such environmentally harmful water projects as Russell Dam, Dickey-Lincoln Dam, Tocks Island Dam and the Tennessee-Tombigbee Canal. The board also adopted policy statements on energy subsidies and recombinant DNA research, and an interim policy on transportation. For copies of any of these statements, write to the Club's Conservation Department, 530 Bush St., San Francisco, CA 94108.

Ford keeps restrictions on predator poisoning

In a victory for both environmentalists and coyotes, former President Ford decided against rescinding former President Nixon's executive order restricting the use of predator poisons on federal lands. Lifting the ban would have resulted in the wholesale poisoning of not only coyotes, but numerous nontarget animals. The Club is not opposed to predator control per se. But rather than large-scale slaughter of many innocent animals, the Club supports limiting control efforts to areas where a species is causing significant damage and to elimination of only the harmful individuals. Use of live traps that contain animals without serious harm, so that nontarget species can be released, has proven an effective and economical predator control method in both Kansas and Missouri since the 1940s.

BWCA update: logging moratorium agreement reached

The Boundary Waters Canoe Area logging controversy has been resolved somewhat, and Minnesota environmentalists are pleased and relieved. A Club suit brought to prohibit timber cutting on lands under consideration for inclusion in the BWCA had been overturned and the injunction lifted by the eighth circuit court, leaving the area legally free to be logged. However, environmentalists and the timber industry were able to reach agreement on a six-month moratorium on logging in those areas of the Superior National Forest under consideration, and it is hoped this will be a long enough time for Congress to reconsider the BWCA bill.

Alaska lands bill introduced

On the first day of the 95th Congress, Representative Morris Udall (D-Arizona) introduced the conservationist-backed bill, H.R. 39, to add almost 115 million acres in Alaska to our national conservation systems. The lands proposed for inclusion are: National Parks and Monuments, sixty-four million acres; National Wild and Scenic Rivers, four million acres; and National Wildlife Refuges, forty-six million acres. In addition, another 4.5 million acres now reserved in the Tongass and Chugach national forests are proposed for classification as wilderness. The bill now has some seventy-five sponsors. Edgar Wayburn, Chairman of the Club's Alaska Task Force, commented: "This is the beginning of the last and greatest legislative opportunity of our lifetimes to dedicate for future generations vast and significant landscapes and natural ecosystems large enough to protect a wide spectrum of animal and plant life. We have less than two years to succeed, and we must succeed."

Ways to reduce oil spills recommended

In Washington, D.C., Eldon Greenberg, of the Center for Law & Social Policy, represented Club and other environmental groups in testifying before the Senate Commerce Committee, which has been considering the rash of recent oil spills. Greenberg said that in addition to needed and long-delayed action by the Coast Guard under the Coast and Waterways Safety Act, the law itself should be strengthened. He also recommended that the U.S. consider establishing a 200-mile-wide pollution-control zone to protect the marine resources now covered by the 200-mile fisheries jurisdiction established last year. He recommended that "in order to overcome the inbred and conservative nature of the Coast Guard bureaucracy inherent in its military structure," either the standard-setting authority over marine pollution should be given to the Environmental Protection Agency, or greater civilian control should be exercised over the Coast Guard.

Guest Opinion

From time to time in this space we present "Guest Opinions"—messages from prominent individuals who are not primarily involved on a daily basis with environmental concerns, but whose voices should be heard by those of us who are. Their viewpoints on various conservation issues, while inherently interesting and important to us, do not necessarily reflect or represent Sierra Club policy.
The Editor

Human Needs and Natural Constraints

UNEP and the World Environment

Mostafa K. Tolba

Mostafa K. Tolba is executive director of the United Nations Environment Programme, whose headquarters are in Nairobi, Kenya.

In an opening statement to the Governing Council of the United Nations Environment Programme (UNEP), meeting in Nairobi in March and April 1976, I outlined a number of principles by which UNEP would be guided in the future planning of its activities.

The first principle and the starting point of UNEP's work should be to satisfy basic human needs for food, shelter, clothing, medical care, education and creative, productive work without, at the same time, producing adverse impacts on resources and the environment. It is UNEP's job, therefore, in cooperation with other members of the UN, to promote in both rich and poor countries alternative life styles and patterns of development. These new life systems would seek to demonstrate that our objectives can be achieved without destroying our resource base or transgressing the limits of biological tolerance of the planet's life-supporting systems.

The human species is part of nature. The quality of life and the level of material well-being we can expect to enjoy depend on several factors related to this fact. Most important among them are: the resources nature has made available; the speed, manner and technology by which resources are exploited and used; the level of distribution of the benefits gained from such use; the existing population and its rate of growth; and the nature of the demands we make on resources.

We affect the environment through our social and economic behavior, and the process has been greatly increased during this century by breakthroughs in the physical, chemical and biological sciences. In recent years, we have become increasingly aware that there are, at least, physical limits to our actions, and, more important, that these actions in turn have beneficial or adverse impacts on the environment. Hence, *by environmental management, we mean management of the human actions that affect the environment.* To achieve this, to attain the social consensus and economic means necessary to guide our activities so they no longer destroy the environment, has become a fundamental necessity of our times.

One of the greatest challenges facing us today is to satisfy the basic needs of all people without simultaneously destroying the resource base from which those needs must be met. The question immediately arises whether we have enough resources. This requires research into complex questions such as what resources are available, how they are distributed and the ways in which they are being used. It also suggests the desirability of establishing alternative styles within the constraints of resource availability and the least possible environmental disruption.

This is where the interrelationship between environment and development comes in. In terms of satisfying human needs, the environment can be thought of as the stock of physical and social resources available at a given time. This stock changes over time, and the rates and kinds of change are important dimensions of the environmental-management process. The resources available for the satisfaction of human wants and needs comprise the physical environment. These resources include not only forests, minerals and the like, but also, for example, adequate and reliable rainfall, moderate temperature and other climatic factors that affect agricultural production and energy consumption.

Development, on the other hand, is a dynamic process aimed at improving human well-being through the use of the stock of physical and social resources available. It involves all nations. It is a process that does not yet have a recognized conclusion, nor a final goal of achievement. The more technologically advanced nations continue to seek new means of improving their use of natural resources and enhancing the welfare of their people. Developing nations are striving hard to improve the economic well-being of their people, often using as their target the standards of living now enjoyed by the developed countries. All nations are making efforts, and will continue to do so, toward more development, so the process is global and continuing.

It is true that industrial and agricultural development have created many environmental problems, from the pollution of water, land and air, and the consequent costs in human health and well-being, to the spread of the deserts, largely through mismanagement of natural ecosystems. These threats are not localized, and by themselves, or through their interactions with other factors, become matters of regional or global concern. An example is the possible impact on global climate of the continued combustion of fossil fuels to meet energy demands. Such cases constitute possible dangers to the "outer limits" people must respect for our long-term good and even for survival.

But it must also be realized that many environmental problems are caused by lack of adequate development. Today there are hundreds of millions of people whose basic needs for food, shelter, clothing and medical care are not being satisfied; hundreds of millions more lack access to even a rudimentary education or regular employment. This is not only an intolerable situation in human terms, it also has serious environmental consequences. For example, the relentless pressures that arise when basic needs are not met can erase the resource base from which man must inevitably gain his sustenance. The destruction of forests, the loss of arable soil, the loss of productivity through disease and malnutrition, and the increasing pressure on fragile ecosystems that so often result from poverty, are as significant as the pollution created by industry, technology and overconsumption by the affluent: both lead to the rapid depletion of natural resources.

New kinds of development must recognize the limitations as well as the opportun-

ities inherent in the natural resources upon which all human activities depend. It is now clear that past patterns of development in both industrial and developing countries have been characterized by such serious environmental damage that they are simply not sustainable over the long term.

It is clear that new kinds of development should avoid irrational and wasteful use of resources. The most blatant instance of such irrational use is the projection of profligate life styles as desirable ways of achieving human happiness. To take just one example: much extra energy is used at the manufacturing stage to produce tins of drink with pull-tab stoppers, so as to save the minuscule effort of punching the hole; and resources are deliberately designed to be lost when throw-away tins are produced rather than reusable glass bottles.

Taken to extremes, human actions can cause irreversible damage to natural resources. An example of totally irreparable destruction is soil that has been eroded by wind and water action and that now accumulates at the bottom of the sea. An example of near total destruction is the over-cutting of forests: when trees are cut down, seeds of regeneration destroyed, and soil previously held by the root system wasted away, the forests may be virtually impossible to replace. Less irreparable, but still costly, is forest destruction that results in the loss of seeds but not soil; the lands affected could be replanted, but it may take a century or more for them to support productive forests again.

If development is to be sustained, its environmental impact must be assessed and protective approaches adopted. Thus, the concept of continued environmental assessment is important, and at UNEP its global application is called Earthwatch. It embodies four functions: evaluation and review, research, monitoring and information exchange. Evaluation and review provide the analysis to identify gaps in knowledge and action. Research provides new information or new interpretations of old information, which may lead to a better understanding of environmental problems and thus provide guidance for the decision-making process. In a continuous and systematic fashion, monitoring gathers certain data on specific environmental variables and evaluates such data to determine and predict important short- and long-term environmental trends. Information exchange provides data to the scientific and technological communities and so ensures that decision-makers at all levels have the benefit of the best information available, at the appropriate time and in the most usable form.

Since its inception a few months after the 1972 Stockholm Conference, UNEP has begun to develop and apply this theoretical concept in practical terms, the most marked progress being in the field of monitoring and information exchange. A Global Environmental Monitoring System (GEMS), an International Referral System (IRS) and an International Register of Potentially Toxic Chemicals (IRPTC) have been established.

The purpose of GEMS, a global network of monitoring systems coordinated through the efforts of UNEP, but executed by a number of United Nations agencies and other bodies, is to establish the means of understanding rapidly and correctly the changes brought about in the global environment by mankind's actions. Seven goals have been set for GEMS: (1) to establish an expanded human-health warning system; (2) to assess global atmospheric pollution and its impact on climate; (3) to assess the extent and distribution of contaminants in biological systems, particularly food chains; (4) to assess critical environmental problems relating to agriculture and land and water use; (5) to assess the response of terrestrial ecosystems to the human pressures exerted on them; (6) to assess the state of marine pollution and its impact on marine ecosystems; and (7) to improve the monitoring of the factors necessary to understand and forecast natural disasters. Though it is an extensive system and an ambitious concept, which will take many years to realize completely, we have already made substantial progress in getting new monitoring operations under way and existing ones coordinated.

The IRS does not deal in information itself, but provides a switchboard to put the seeker of information in touch with its provider. When fully operational, and supported by a network of national focal points, the IRS will be a most valuable tool in providing governments, decision-makers, professionals, research workers, educators and others with ready access to sources of environmental information. IRPTC will provide the means to handle data and answer queries about environmentally significant chemical substances. It is expected that IRPTC, like IRS dependent upon the support of national centers for the supply and updating of data, will be operational within eighteen months or so.

The ultimate purpose of the assessment program must be to provide early warning of any regional or global threat to human welfare, even survival, resulting from unplanned activities that transgress the "outer limits." The information collected must be disseminated widely by the policy planners and decision-makers in an easily understandable format so that it can be used effectively in the development of environmental-management strategies. It may also require an appropriate legislative framework within which such actions can be controlled. This is why environmental law is being given increasing attention.

UNEP is currently initiating demonstration projects that will use the best possible scientific information available while ensuring its suitability to local conditions and

needs. A good example of this approach is an estuary in Colombia where UNEP has been working with local authorities to determine the feasibility of increasing oyster production. By focusing not on oyster production *per se*, but on the entire estuarine biomass, as well as the local fishery economy and technology, it is hoped to clarify for planners their range of options and consequences of action in terms that will lead to development of the estuary for the maximum long-term benefit of the local people. Several other demonstration projects, illustrating different aspects of environmental management, are being developed elsewhere.

UNEP already has a substantial amount of information on the problems associated with environmental management in areas such as human settlements, public health and arid lands. This information and experience can be used by both developed and developing countries, depending on their needs and requirements, and we are giving high priority to improving the mechanisms for disseminating such technical information.

In the years ahead, we face the tasks of meeting the minimum human needs of mankind and avoiding environmental catastrophes. We do not believe that disaster is inevitable, but the urgency is extreme: there is very little time in which to set right our approach to environmental management and to meet the legitimate demands of the world's poor. What is necessary, rather than incremental *ad hoc* steps, is integrated environmental management based on the realization that the ultimate self-interest of all nations is inevitably bound in an inescapable web of interdependence. We shall need to act far more thoroughly and speedily than we have thus far to redress environmental and human grievances, and we shall need to harness the energies of all society in this effort. But the job is not insurmountable: given enough political will, adequate resources, and good environmental practices, the obstacles can be overcome.

As the Cocoyoc Declaration, adopted by the UNEP/UNCTAD Symposium on Patterns of Resource Use, Environment and Development Strategies, states:

> We have faith in the future of mankind on this planet. We believe that ways of life and social systems can be evolved that are more just, less arrogant in their material demands, more respectful of the whole planetary environment. The road forward does not lie through the despair of doom-watching nor through the easy optimism of successive technological fixes. It lies through a careful and dispassionate assessment of the "outer limits," through the cooperative search for ways to achieve the "inner limits" of fundamental human rights, and through all the patient work of devising techniques and styles of development which enhance and preserve our planetary inheritance. **SCB**

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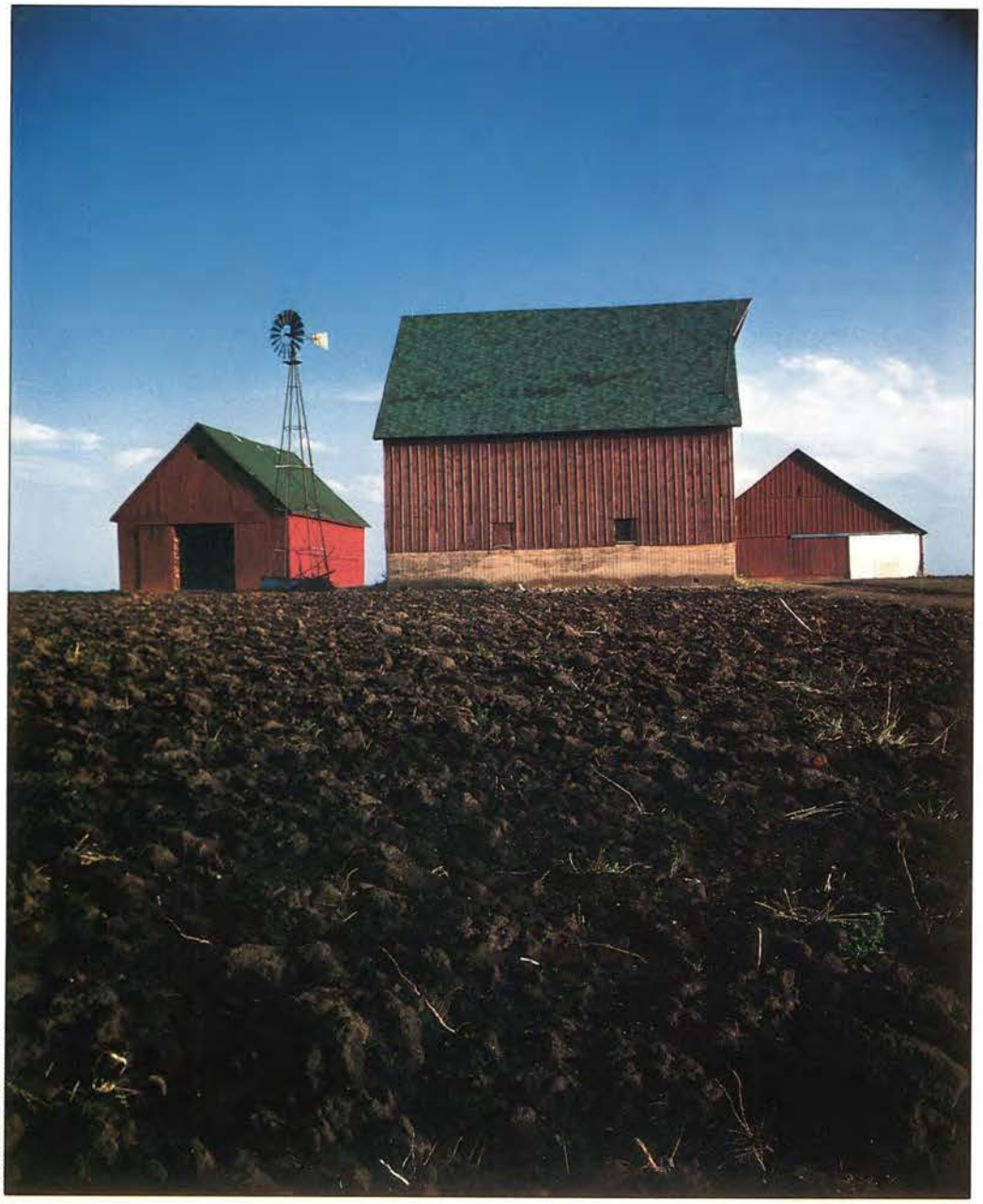
The Windmill Renaissance

VOLTA TORREY



Photos by Grant Heilman

The most nearly inexhaustible source of energy yet available to us is the sun. It bathes the earth with radiation, and the wind derives its strength directly from this energy. Windmills have often enhanced both the earth's productivity and its beauty, without ever polluting the air, water, or soil. But when nuclear power was first demonstrated at Alamagordo, New Mexico, thirty-two years ago this summer, further development of wind-energy conversion systems in the United States virtually ceased, and was not resumed until recently.

The Persians caught bits of the wind's energy more than ten centuries ago to irrigate gardens in their arid land. Their crude sails revolved horizontally, like carousels, and a few like them are still turning in Afghanistan. Five centuries ago, Northern Europeans caught more of the wind's energy with nearly vertical sails,

Volta Torrey is the author of Wind Catchers *(The Stephen Greene Press, 1976).*

which were copied here until about 100 years ago, when our inventors substituted small many-bladed fans for the long rectangular sails of the Dutch, English and other European peoples.

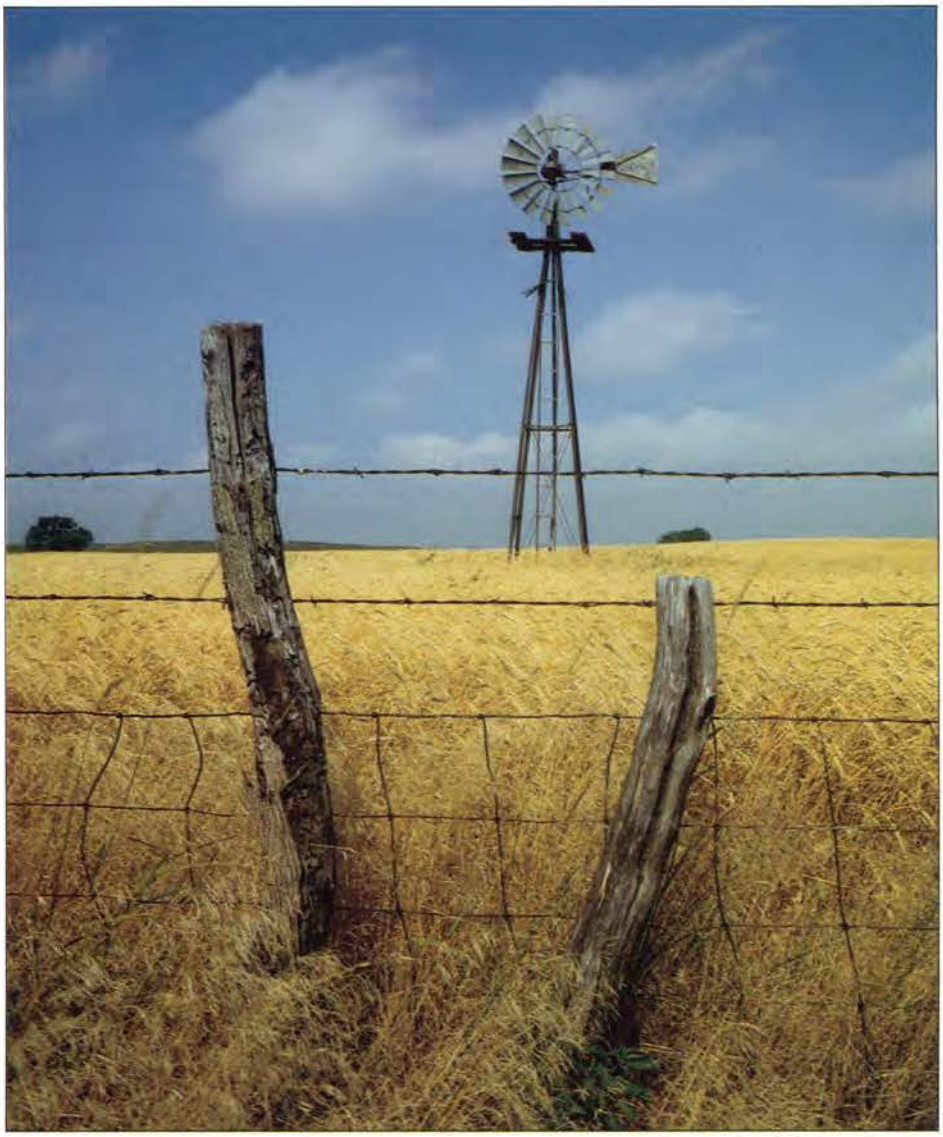
The American windmills cost less to construct, were easier to manage and yielded enough energy to lift water from deep wells. When we celebrated our first centennial year, dozens of new factories were beginning to produce millions of dollars worth of windmills. The plants were clustered near Chicago, and the wind-driven engines exhibited at the Columbian Exposition on that city's lake front were one of its most spectacular attractions. Sears, Roebuck & Co. and Montgomery Ward sold thousands by mail, and windmill manufacture provided work for men whose labor was no longer needed on farms because of the increasing mechanization of agriculture.

Role of early windmills

The windmills they produced helped homesteaders survive and eventually prosper on the semiarid Great Plains west of Omaha. They also filled trackside tanks with water for the locomotives that first crossed the continent. Volunteer firemen saved flimsy wooden buildings in frontier towns with water pumped by windmills, and many Americans soon had running water in their homes for the first time. Windmills became a significant factor in our country's exports, and the industry throve until rural electrification reduced the demand for its products.

The fans on the farmers' towers revolved too slowly to generate electricity. More speed was obtained by replacing them with two- or three-bladed "impellers," which resembled the propellers on airplanes. This rejuvenated the windmill business for a few years after World War I, but the little aerogenerators could only deliver direct current, which was expensive to store and incompatible with the alternating current the utility companies poured into transmission lines from their steam and hydroelectric plants.

This technical obstacle to the use of the wind was reduced during World War II. If nuclear energy had not seemed so promising to most of our engineers, legislators and investors when that war ended, the wind might be generating millions of kilowatts for our utility companies today.



Palmer Putnam, a Boston engineer living on Cape Cod in the 1930s, was impressed both by the wind's strength there and by his utility company's monthly bills. He thought the wind should be used to reduce the cost of electricity and, with Dr. Vannevar Bush's help, he interested dozens of eminent engineers and scientists in designing a gigantic wind-driven power plant. New England utility executives concerned about increasing demands on their hydroelectric plants found Putnam's ideas attractive, too. The S. Morgan Smith Company, a leading builder of water turbines, then undertook the construction of the most powerful wind turbine ever built. General Electric produced a synchronous generator for it, and the machine was erected during the war on a high knoll in Vermont called Grandpa's Knob.

It was able to feed enough current for a small town into New England companies' transmission lines. But the builders and operators were handicapped by other war-time demands, and one of the two big impeller blades in the rotor broke loose. That wind plant could have been repaired and modified, but it was built without government help; and the S. Morgan Smith Company could not afford to continue the work on it. So the company decided to tear it down for junk when the atomic bombs ended the war. No other such mighty turbine has since been built anywhere in the world.

Although you seldom see a stationary wheel drawing useful power from the wind in our cities or suburbs today, tens of thousands of fan wheels are still pumping water for cattle on Western ranches, on scattered farms and in the less developed countries. Three years ago, two American factories were still producing a few windmills

to run pumps, and a third company was still manufacturing small aerogenerators that often have proven especially valuable even though they yield only a few watts of electrical energy. Those bits have enabled radio operators to stay on the air in electrical blackouts to direct rescuers to victims of severe storms, earthquakes and similar emergencies. During the first winter that we were asked to save energy in the United States, those little "Windchargers" also kept a few Christmas trees lit for us.

The prices demanded by the Arabs for their petroleum account largely for our current interest in further development of a source of energy used in their part of the world long ago. Our big federal Energy Research and Development Administration (ERDA) categorizes wind as a subdivision of solar energy and has increased support for studying it, but thus far it has pushed development of nuclear and other sources of energy much more enthusiastically.

Grant Heilman

Windmills today

Our biggest wind-energy conversion system today is a 100-kilowatt machine designed by space engineers and erected on the Ohio Shore of Lake Erie near Sandusky. It is less than a tenth as powerful as the one on Grandpa's Knob, but similar to it in many respects. Beaumont Smith, former president of the S. Morgan Smith Company, and Carl Wilcox, one of its engineers, were honored guests at the dedication of the Ohio plant last fall. "After thirty-five years," Mr. Wilcox observed, "our ideas have been proven worthwhile." On this machine, ERDA expects to test new concepts and components for more powerful wind turbines, and several aerospace companies are competing for contracts to produce them.

Although the Ohio plant is the largest one now running, many other new types are generating smaller amounts of electricity elsewhere. Almost any home handyman can build a windmill that will pump water, but building an economical, efficient aerogenerator is still a complex technical challenge.

At Albuquerque, New Mexico, in the Sandia laboratories that ERDA inherited from the Atomic Energy Commission, a small team of aerodynamics specialists has built a modern rotor that revolves parallel to the ground, the way the world's first windmills did. Instead of catching the wind with simple sails, this one does it with scientifically designed bow-shaped airfoils. Engineers call this a "vertical axis wind turbine" because the axis of rotation is perpendicular both to the earth's surface and to the windstream that drives it. Several similar turbines are being tested in other states and Canada. The Sandia team believes this kind of machine will prove to be best for generating electricity, and ERDA has applied for a patent on its experimenters' innovations.

At Mukwonago, Wisconsin, a technological commune called "Windworks," sponsored by Buckminster Fuller, has been especially interested in small aerogenerators that anyone handy with tools might assemble. This group has devised new kinds of vertical rotors, towers and power converters. With one of the latter, the owner of a Windworks system might make his utility company's meter run backward whenever the wind produced more power for him than he was using. Representative Henry Reuss is testing a Windworks system at his summer home in Wisconsin. He has permitted his utility company to put a ratchet on his meter, however, to keep it from being reversed by energy from the wind.

At Stillwater, Oklahoma, a newly organized firm called American Wind Turbine, Inc., began manufacturing another new type of windmill last year. The rotor on it is built like a bicycle wheel, with a rim around it so that power can be drawn from it at either the hub or the rim. The wheel weighs less than the old type of fan and is easier to support at an appropriate height. This turbine can either run a pump mechanically or generate electricity.

Both on our big ranches and in many other places still remote from transmission lines, some machine of this sort may be the most economical type of power plant yet feasible. The wind that drives these and other new experimental machines costs nothing, and this accounts largely for the windmills' ability to survive competition from alternative energy sources.

A tradeoff of esthetics for function may be required when the newest prototypes are built; such a tradeoff is anticipated with windmills to be erected on San Francisco Bay area hills.

Windmills in art

Generations of artists and children have found windmills especially fascinating. Rembrandt was one of the first of many painters who left us pictures of their countries' windmills. Since Shakespeare's day, perceptive writers have also sprinkled poetry, plays, novels, and essays with allusions to windmills. And city youngsters still leap out of family cars at a "Children's Farm" maintained by the National Park Service near Washington, to run and watch an old gray farm windmill pump water spasmodically into a tank for barnyard animals.

Nostalgic senior Americans have spent millions of dollars to build replicas, import, restore, and reconstruct fine examples of windmills designed long ago in Europe. American windmills, too, are now attracting more attention; special bicentennial exhibits in the Smithsonian Institution last summer featured full-size models of two different types of windmills manufactured in the industry's heyday.

Few authorities expect a windmill ever to generate as many megawatts of energy economically as a big thermal or nuclear plant, but most experts agree that wind-driven engines can provide supplemental power during peak loads. The most desirable sizes and types of wind-energy conversion systems can soon be determined, and economic as well as environmental and sentimental motives all suggest that more attention should be given to solar energy, including the wind, in formulating policies to provide our country with adequate energy. **SCB**

The Year of the Mushroom

Polyporus versicolor

SUSAN LARIVIERE

Good nature photographs seem to be taken in bunches. Whether it be trees or waterfalls, each year ends with a bountiful crop of one particular subject, as though nature endowed these elements with exceptional beauty and placed them in unusual abundance in our path. It may be that photographers become highly sensitive to those elements, thereby discovering them more frequently, but whatever the reason, this year, for us, was the year of the mushroom.

Mushrooms are the fruiting bodies of fungi that grow in soil and wood. Lacking chlorophyll, they are incapable of photosynthesis and thus must rely for food on the tissues of other plants, either living or dead. These they decompose by means of powerful secreted enzymes which liberate the nutrients trapped in the tissues for use not only by the fungi, but other plants as well. Indeed, many species of trees would otherwise be unable to obtain nutrients from the soil.

Our interest in mushrooms helped us enjoy nature from a new perspective. As we walked, our eyes combed the ground, the trees, the places where we knew mushrooms could grow and some where we didn't think they would. And we found them. Small, large, spherical and even amorphous mushrooms, in reds, yellows, oranges, browns and whites. The more we looked, the more we found.

Finding good nature subjects to photograph partly depends on being in the right place at the right time, but mostly it depends on being sensitive to what is around you. This year was the year of the mushroom. What next year will turn out to be we don't know, but we look forward to the surprises ahead.

Susan Lariviere and Ted Schiffman are members of the photography and wildlife committees of the Atlantic Chapter.

Above, Coprinus disseminatus Below, Hygrophorus miniatu

All photos, except extreme right, by T.H. Schiffman

Calocera viscosa

Boletus (species uncertain)

Ganoderma tsugae

Susan Lariviere

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AUDUBON'S LAST WORK

The Quadrupeds of North America (1854)

Audubon's Last Masterpeice

The true artist can never rest on past accomplishments. John J. Audubon was surely of this breed.

Just as soon as his monumental *Birds of America* had been completed, Audubon's boundless love of living things led him to yet another wildlife project of grand scale... the magnificent *Quadrupeds of North America.*

From 1842 to late 1843, Audubon and his talented son roamed the length and breadth of America in order to capture the image of our native creatures in their natural habitats. A journey that proved to be this remarkable man's last; for he died at the conclusion of the *Quadruped* project. Leaving a legacy so rich and beautiful that it prompted the famed French naturalist Louis Agassiz to proclaim that the *Quadrupeds* were without equal in all the world.

The results deserved this praise, for they are truly spectacular. From the smallest meadowmouse to the stately elk, each animal bears the mark of Audubon's unique genius. The lumbering bears, the mischievious otter, the crafty fox and wolf, the sleek cougar, ferocious bobcat, and more. Each appear just as Audubon saw them in a wilderness yet unspoiled by man.

The *Quadrupeds of North America* are without question an American masterpiece that you should indeed feel proud and privileged to own. The last work of a giant. A most rare opportunity for you to grace your home with an authentic antique of unquestionable pedigree and beauty.

Very Rare Antique Lithographs *(Not Reproductions)*

Audubon completed the Octavo *Quadrupeds* in 1854, each image being hand-printed and hand-colored. Each an original first edition lithograph so exacting that the furs shine and the eyes glow as if the very print were alive.

After a long and thorough search, Volair's Archives Collection is now able to offer a limited number of these beautiful hand crafted lithographs to a discriminating public. Each print is an original antique 1854 Audubon Quadruped, *not a reproduction.*

Each print has been carefully mounted and framed in accordance with rigorous museum standards so that your beautiful investment may be preserved—an investment that can only increase with the passage of time.

Each and every print is of pristine quality and measures 14" x 16" framed.

Each original First Edition Audubon is **$110.** And the Volair Extended Payment Plan is available for your convenience.

The price includes, of course, all shipping, handling, framing and insurance. Everything.

Although Volair's Archive Collection is the largest of its kind in the United States, our quantities of these seldom-seen prints are quite low—it is important that you order now to assure satisfaction.

Our offer of Audubon's *Quadrupeds* is an opportunity for you to own a rare and highly desirable work of art—public trading of these lithographs is virtually coming to an end.

The Documentation and Guarantee

Each Audubon is accompanied by a Certificate of Authenticity bearing the Volair Seal, and each Certificate is issued in the name of the subscriber. Authenticity is fully guaranteed forever by Volair. *Remember these are not reporductions, but rather, original antique 1854 lithographs by J. J. Audubon.* The Volair 90-Day Unconditional Guarantee is available should you not be completely satisfied or if you wish to exchange your print for another—and that's a promise.

Please remember that the number of these exciting prints is very limited—to ensure your preference and to avoid disappointment, order now.

SUBSCRIPTION APPLICATION
Audubon's Quadrupeds of North America/$110. each framed.

I understand that each and every print is an original first edition Audubon from 1854, *not a reproduction,* and that my satisfaction is guaranteed.

Preferences (please indicate 2nd choice)
No Preference _____
Deer, Elk, Buffalo etc. _____
Bear or Cat _____
Foxes, Wolves, Dogs _____
Otter, Mink etc. _____
Rabbits, Squirrels, etc. _____

Name _____
Address _____
City _____ State _____ Zip _____
Method of Remittance ☐ Check ☐ Credit Card (MC/BAC/Am. Exp.)
Card No. _____ Exp. Date _____
☐ Payment in Full ☐ Volair Extended Payment Plan. Please enclose **$55.** We will bill you for the balance of **$55,** upon delivery.

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