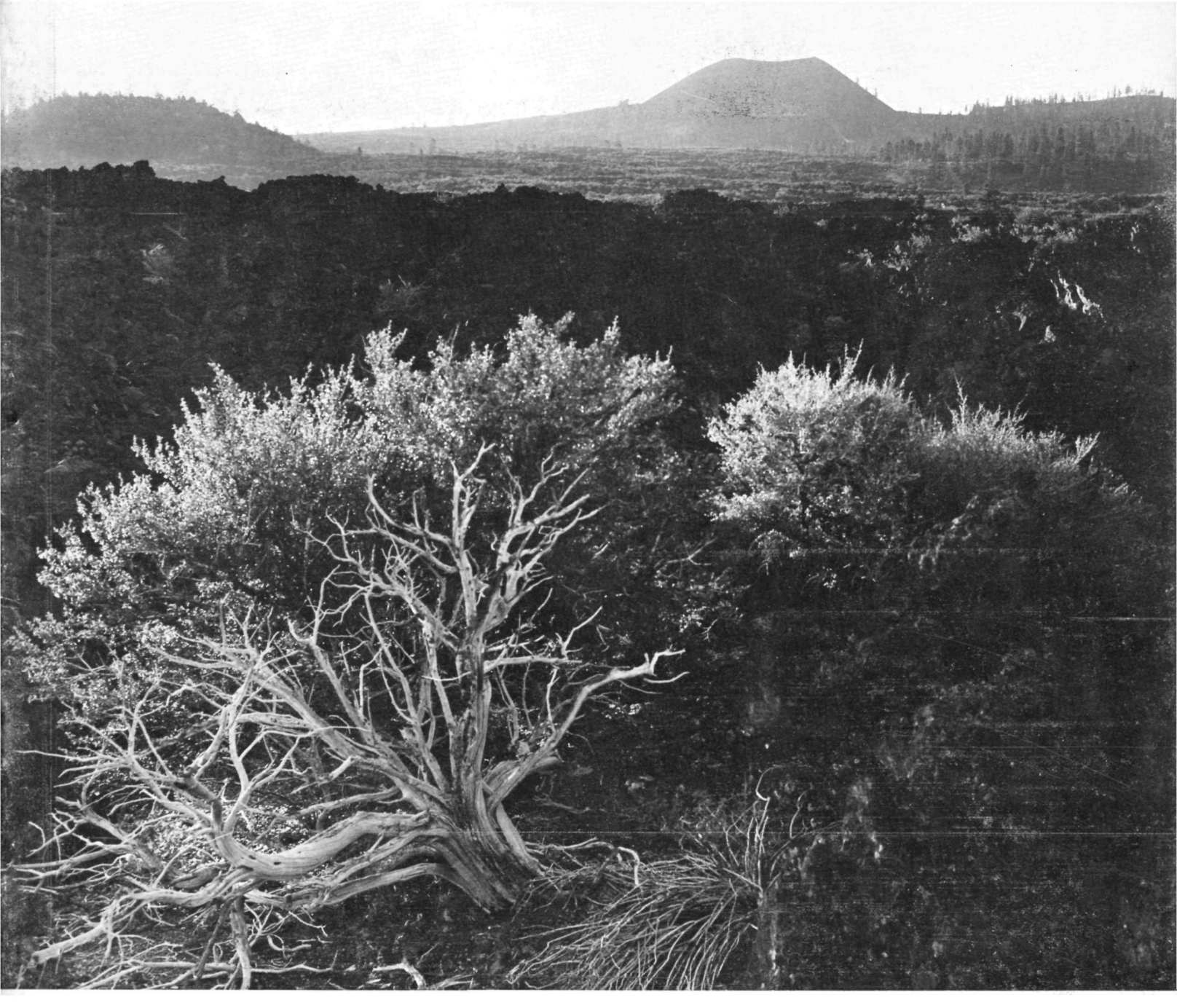
DECEMBER 1969

NATIONAL PARKS *Magazine*



STATECRAFT and the SST

THE impending technical success of the supersonic transport imposes an obligation on the nation to assume leadership in world affairs in precisely the opposite sense from that urged by the SST supporters: namely, a chance to place a deliberate brake on a dangerous and extravagant innovation in transportation.

Measured against any rational scale of human values, the SST is not desirable, but highly objectionable. The basic value judgments, the telic presuppositions, on which the SST project is based, like too many of the moral postulates of industrial society, East and West, are false and may lead to catastrophic results.

Moving forward with SST presupposes *speed* as a value. The true values in transportation would be comfort, safety, convenience, and the leisurely enjoyment of the journey. Air travel at moderate speeds and altitudes, with the magnificent views of the world it affords, can be an inspiring experience; high-speed, high-altitude flights eradicate this experience.

SST presupposes *proximity* as a value; Tokyo, Buenos Aires, and London are to be brought as close as possible to New York. Judging by the weekend exodus, most Americans think their big cities are hells from which to escape. We doubt that many Japanese and Argentinians are anxious to hurry into Manhattan. Most nonhuman animals have better sense than present-day humans; the birds space themselves out; *distance*, not *proximity*, will be a guiding value in building the hoped-for world community in the generations ahead.

Noise will be an intolerable accompaniment of SST. Sonic booms 50 miles wide will trail their destruction across continents and oceans, shattering the peace of the city, countryside, and wilderness. The ear of industrial man is being deafened physically by the surrounding noise; his organism as a whole, physical and psychic, may seem to be acquiring tolerance, but profound injury is more probable. The values of *silence* and *quietude* must be reestablished in place of *noise* and *tolerance* for noise.

The destruction of the *life-environment* that will be wrought by the SST will not be limited to sonic booms. Vast supersonic jetports will be needed, leveling farmland, forest, wilderness, and human habitations. The recently proposed south Florida jetport is but one horrible example.

More gravely, the SST project is based on *competition* as a value, whereas all the forces of history move us imperatively toward *cooperation* instead. We should be collaborating internationally with other nations having air transport facilities in developing a rational worldwide transportation system, not competing ruthlessly in the waste of resources and the ruination of the earth.

Finally, there is a basic presupposition of *impotence*, of national powerlessness, in our handling of this matter. It is said that we must join in the competition, lest others capture the leadership or bankrupt the nation by draining away foreign exchange. But what is needed is *competence*, not *impotence*—the ability to shape historical events to humane purposes.

The world's industrial cities, not only in America, fester in disorder; to save them will require vast economic outlays. Schools and communities all over America are overcrowded and understaffed; illiteracy in America exceeds that of a number of advanced countries. The degradation of our environment from the pollution of air, water, and land threatens the quality of our life and even our physical survival. The worldwide population explosion confronts millions with death by starvation; great resources in men and equipment must be poured into research and education to fight archaically high birth rates. Yet invaluable public money is to be thrown away on the SST in a compulsive pursuit of motion and speed.

Instead of being dragged meekly into another destructive international competition, we should propose a treaty among the SST powers (Russia, Britain, France, and America) to refrain from the development and deployment of SST. The burden of building and maintaining this extravagant and useless transportation facility will fall heavily on the shoulders of the Russian, British, and French people. No doubt the United States, with its greater industrial power, can win the competition eventually—but at what cost?

An SST nondeployment and nonproliferation treaty is needed, with deployment and proliferation halted before the major powers themselves become further entangled in their own technological stupidity.

Short of a multinational agreement to refrain from an SST debauch, unilateral action by the United States in self-defense is clearly available. International airports in the United States can be closed to the unwelcome invader. Flights of SST planes across our lands and waters can be prohibited. Without landing permission in the United States, operations by other nations, even within their own territories, are unlikely; if they occur, then let the damage be done in the land of their origins.

As a principal public-service defender of the National Park System, we in this Association are not without a special concern in our criticism of SST. Several units of the System have been damaged severely by sonic booms; if the SST corridors are moved away from the cities, where they are certain to be unwelcome, wilderness, its quietude and tranquility, will be seriously endangered.

As a private, nonprofit organization concerned also, in the public interest, with green and open spaces in the cities and the quality of urban life, we are convinced that the noise and violence of SST are intolerable in urban-industrial society.

At great price the nations may be moving to create a few of the international arrangements necessary for survival: the nuclear test ban treaty, the nuclear nonproliferation treaty, the strategic arms limitation talks. Part of the problem is to get a measure of cooperative control established over the forces of violence that technology has turned loose on the planet. The SST is a prime example of destructive technology; it needs to be taken firmly in hand by cooperative international action.

The demands of true statecraft, of genuine leadership in global affairs, and our immediate national interests, also, impel us toward a vigorous initiative in the world arena to bring the SST extravaganza to heel with the utmost dispatch.

—A.W.S.

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NATIONAL PARKS *Magazine*

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COVER *Cover photograph by Philip Hyde*

The tortured landscape of Lava Beds National Monument in north-central California is mute testimony to the Earth's geologically recent agony. Where fires of inner Earth once flared to the surface, now are cinder cones, sharp-edged black lava rocks, fissures, subterranean labyrinths, and caves—including ice caves. In this rugged setting about a century ago was enacted a tragic human drama—the Modoc Indian War—described in this issue (pages 18–21).

National Parks Association, established in 1919 by Stephen Mather, the first Director of the National Park Service, is an independent, private, nonprofit, public-service organization, educational and scientific in character. Its responsibilities relate primarily to protecting the national parks and monuments of America, in which it endeavors to cooperate with the National Park Service while functioning as a constructive critic, and secondarily to protecting and restoring the whole environment. Membership dues, which include subscription to National Parks Magazine, are annually: $8 associate, $12 contributing, $40 supporting, $80 sustaining, and $500 life with no further dues. School and library subscriptions $6.50 per year. Single copies 75¢. Contributions and bequests are needed to carry on our work. Dues in excess of $8 and contributions are deductible from federal taxable income, and gifts and bequests are deductible for federal gift and estate tax purposes. Mail membership dues, correspondence concerning subscriptions or changes of address, and postmaster notices or undeliverable copies to Association headquarters in Washington. When changing address, please allow six weeks' advance notice and include old address (send address label from latest issue) along with new address.

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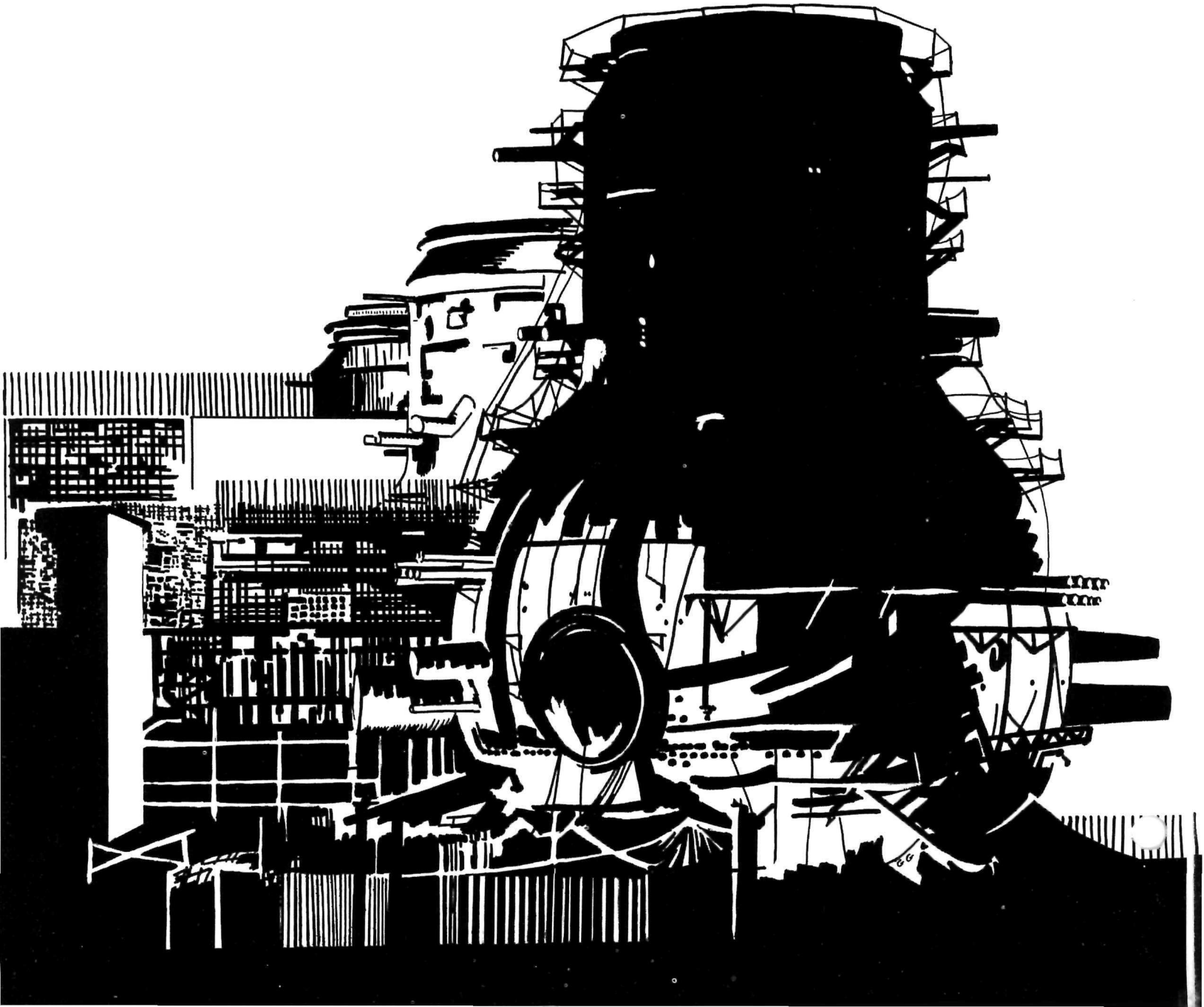
heat pollution

john r. clark



Scientists consider heat as the primary environmental control of life on earth; yet when this great power is misused, it assumes the role of pollutant. Heat in the form of hot water discharges has much in common with pollutants more widely known to the public: it is produced in vast amounts by basic industry; it is dumped like sewage into public bodies of water; and, once dumped, it can generate massive ecological disturbance.

Thermal discharge and power plants go hand in hand. Electrical energy is generated in one of two basic ways: by steam or by falling water. A generator is driven by a turbine in either method. In a water-power plant the potential energy of river or reservoir water is realized by allowing it to plunge down a sharp drop and over the blades of the turbine. In a steam plant the energy of burning fossil fuels—coal, oil, or gas—or nuclear fuel is used to produce steam at high pressure. The steam turns the turbine, which powers the generator. However, once it has gone through the turbine, the spent steam must be recondensed into water, which is done by cooling it in a condenser with water taken from a lake, river, estuary, bay, or ocean.

A nuclear power plant represents no great conceptual departure from the more familiar coal-fired plant. Both are thermal plants, but heat is obtained in the so-called "nuke" plant by fission reaction in an atomic pile. Nuclear plants obviate need for transporting huge quantities of fossil fuels, thus widening the choice of plant location. Moreover, they do not pollute the air with smoke. The price of these advantages is the threat of radiation hazards (both short and long term) from such plants, the full extent of which is unknown; and the additional thermal pollution they create.

Ideally all heat produced should be turned into electricity. In practice much is wasted; the amount of waste is the index of plant efficiency. Nuclear plants waste 50 to 60 percent more heat than fossil fuel plants, and this heat is discharged as additional thermal refuse in the outflow from the condensers.

Of the 60,000 billion gallons of water per year now used by American industry for cooling, about three-quarters is used in power plant steam condensers. As of now, thermal pollution has erupted as a problem only in some limited areas. However, power development apparently is not going to wait for technology to provide easy answers to pollution problems. Relatively few nuclear plants are in operation at the moment, most of them government-subsidized installations designed to develop techniques for economical nuclear power generation. But a new generation of fully commercial plants is under construction, and many more are being planned. It is estimated that within the next decade there will be nearly three-quarters as much electrical energy generated in such plants as in all other thermal plants combined. Because of ever-increasing demands of an exploding population, by the end of the century the power industry will be generating an estimated 2 million megawatts of electricity, by far the largest portion of it in nuclear power plants. This level of energy production will yield, every day, enough waste heat to warm *107 cubic miles* of water by 20°F., a level of thermal addition that could produce catastrophic effects if inflicted on many of our waters. An amount equal to one-third of the daily freshwater runoff of the United States would be needed for plant condensers. Already it has been estimated that half again as much water as occurs in the summertime daily freshwater runoff passes through the cooling systems of thermal electric power plants along certain of the heavily industrialized and populated watercourses of the northeastern United States, which obviously requires the reuse of at least part of the available flow. (Summer is generally the low-flow period.) Moreover, much of this water occurs where it is inaccessible to the plants, so it is apparent that accessible water is used many times over, often being recycled before it has had a chance to cool down to normal temperature again. (Cooling systems of thermal plants commonly raise the temperature of water used by 10° to 30°F.)

To some people it may seem strange that a temperature rise of "only" 10° or 20°F. in the vicinity of a power plant could be ecologically devastating. That it can indeed be devastating is testimony to the delicacy and complexity of the communities of aquatic life, especially where heat is involved.

In many ways water provides the kindest environment for living organisms. The aquatic environment is stable; it supports the bodies of inhabitants without the necessity for massive skeletons, so allows the development of biologically efficient body forms; and it constitutes a virtually endless supply of the aqueous basis of life's vital fluids. There is a host of advantages in addition to these for the water-living organism. By contrast, land organisms must conserve water, support themselves against gravity, and evolve ingenious schemes for breeding. They must adapt to wide fluctuations in temperature and climate, storm and fire, landslide and flood, and exposure to relatively harsh radiation. Through a bit of an oversimplification, it might be said that land organisms have evolved to be tough and adaptable, whereas marine organisms have been softened by luxury and now depend for existence on a more stable medium.

A characteristic of most natural bodies of water is that temperatures change slowly; in addition, the fluctuation usually is confined between about 28°F. and perhaps 100°F. Because of this thermal stability, aquatic animals are cold blooded and therefore at the mercy of ambient temperatures. The heat of their surroundings determines their internal temperature and thus the biochemical pace of their lives. Generally speaking, in cold water fish slow down; as the temperature rises, they become more active. Heartbeat and respiration rates go up, and all the fishes' biochemical reactions are accelerated. This acceleration is desirable as it occurs naturally in the spring, when winter torpor gives way to full activity again, but beyond a certain level it can cause trouble.

The difficulty stems from the fact that there is a limit to how much an organism's metabolism can be wound up

by rising temperature. The biochemical processes run faster and faster until the delicate mechanisms that keep all running smoothly together are overtaxed and begin to operate abnormally; then the animal ceases to reproduce properly and suffers internal disorders that lead to ill health or even death.

Such consequences may result from a rise of only a few degrees when temperatures are naturally high. The limits of tolerance are sharply defined for each species. Normally the fishes in a particular body of water adapt to extremes in temperature of that water so far as possible by natural selection; those unable to adapt die or seek other waters. However, when a river whose summertime temperature in a particular stretch almost never exceeded 90°F. suddenly has an average summer temperature of 93°F., the apparently small rise over the previous limit can be disruptive to much of the river life of the area. In a river, excessive temperatures could form a "thermal block" preventing migrating adult fish from going upstream to spawn and young fish from returning to estuary or ocean. In many organisms, spawning and migration are triggered by temperature, usually as an automatic reaction. Rising spring temperatures induce development of gonads and the deposition of eggs by the female; in estuarine shellfish, spawning takes place only hours after the critical temperature is reached. Forcing spawning to occur with artificial heat at a time of year when conditions are not right for survival of the young will reduce a population of animals as surely as killing them directly. Lake trout can tolerate water temperatures of up to 77°F. However, satisfactory growth of their young cannot take place in waters over 68° F., and spawning will not occur at temperatures above 48°F. A population of lake trout that can never reach water below 50°F. will die out like the shellfish, from reproductive failure.

Even if adult organisms can manage to lay eggs, thermal pollution still may bring death to their offspring. Higher temperatures result in faster development and hatching of eggs; but beyond a certain point, as with adults, the biochemistry goes awry and the eggs develop abnormally or not at all. The Oregon Fish Commission says that if the temperature of the Columbia River is increased by only 5.4°F., hatchability of Chinook salmon eggs will decline disastrously. Carp eggs exposed to temperatures between 68° and 75°F. will not undergo cell division.

Thermal pollution can have other directly deleterious effects on aquatic life that deeply concern biologists as proposals are advanced for the proliferation of nuclear and other thermal power generating plants. But biologists are not worrying most about direct effects of heat at the present time. More important than the absolute limit of tolerance of a given organism, or even the ability of a population of one species to survive, is the ability of the ecosystem to work smoothly.

As the effects of man's misuse of his planet are realized, the word "ecosystem" is becoming familiar. An ecosystem, roughly speaking, is a biological community considered as a whole in the context of its physical environment. An ecosystem can be as small as a drop of water swarming with one-celled animals or as large as a mountain range; the life of each member of the ecosystem is intertwined with the lives of all other members and with its physical setting.

For the purposes of his work, the ecologist does not consider that desert lizards are in the same ecosystem as mountain sheep. It is less cumbersome to consider each system as completely closed. But actually small systems make up bigger systems, until the whole earth may be considered as one great ecosystem. Over the millions of years that life has existed it has evolved such intimacy with its physical surroundings that little can happen on the surface of the planet that does not somehow affect life. The effect may be infinitesimal, but what is felt by life in one place has consequences for life in another. The lesson that man is learning all too slowly is that he, too, is part of the ecosystem; what shakes the system, shakes him, sooner or later.

Thus it is with pollution, thermal and otherwise. It is impossible to assess the full impact that man's activities can have on aquatic ecosystems or the full consequences to himself. Aquatic organisms from bacteria to whales are important to man for their economic or esthetic value, or because they support other organisms with such value. For example, oceanic algae provide 70 percent of the oxygen renewal for the air we breathe. Few ecosystems are as tightly woven as aquatic ecosystems, and generally speaking the smaller or shallower a body of water, the tighter and more vulnerable is the system it supports. Volcanoes can explode beneath the deep sea, yet life there soon closes over the scene of the cataclysm. On the other hand, a puddle teeming with tadpoles and their prey can be destroyed by a human bootfall.

Shallow lakes, rivers, and estuaries are among the tighter and more heat-sensitive ecosystems. They do not contain a huge amount of water to dilute heated effluents; furthermore, in many lakes and estuaries water currents are sluggish and inefficient at mixing hot water with cool. And these bodies of water, particularly the estuaries, are the ocean's nurseries. They are placid compared to the churning sea, and many forms of marine life depend on their protected waters as sanctuaries for their young. Their marshes, lagoons, bayous, creeks, and sloughs provide shelter from predators for the tiny larvae and vulnerable fry; and the water is a rich source of minerals and microscopic animals, plants, and bits of organic detritus that comprise the larvae's food.

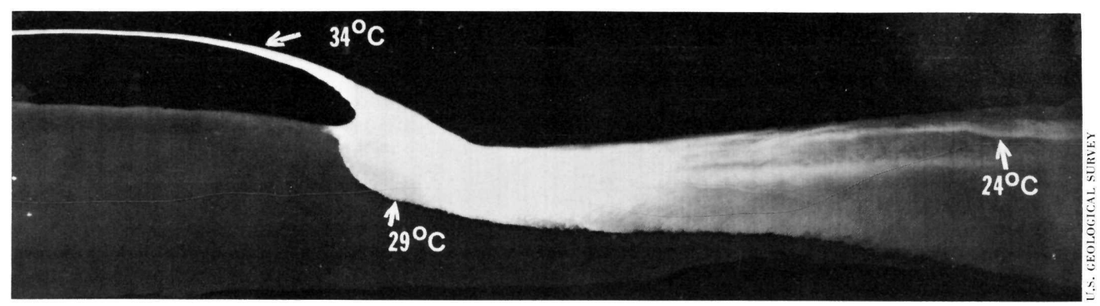
We have seen how the temperature range in which a creature can spawn, and in which its young will thrive, is much narrower than the range in which it can maintain a toehold on life. Furthermore, ecological relationships of microscopic life such as algae and larvae are extremely complex and subtle. This level of life is even more dependent than adult fish on a stable environment; minute physical changes can reverberate powerfully through such a tightly interdependent level of the ecosystem.

The advent of thermal pollution in some of the most valuable estuarine nurseries could be disastrous. The effect of heat on spawning and egg development already has been mentioned. As another example, three groups of algae commonly found in water form the diet of many small animals and larvae—diatoms, green algae, and blue-green algae. According to one study, although all three forms may be found where temperatures range between 68° and 104°F., the relative abundance of the species of each varies with temperature. At 68° diatoms comprise by far the largest portion of the total number of species of the three forms. At about 83° green algae species have increased and diatoms have declined until both are in equal abundance, and blue-green species have begun to become more numerous. At 95° greens have peaked and are declining, blue-greens have increased to a population two-thirds that of the greens, and diatoms are insignificant. Beyond this temperature blue-green species take over.

Now, many of the tiny organisms naturally present in an estuary depend on diatoms rather than green algae for food, because diatoms normally are more abundant. A change in the abundance of the kinds of algae decreases organisms that depend on diatoms and increases organisms that can best utilize green algae. At the upper end, the blue-green algae are indigestible to many organisms that graze on algae, and consequently the total number of grazing organisms in the estuary drops. This decrease results in the loss of larger animals that had been feeding on the smaller animals, then the loss of even larger predatory animals, and so on up the food chain, inevitably all the way to the producer of the thermal pollution—man.

Of course, any adverse shift in algal populations would reduce the proper food for the larval form of many open-ocean fish species, spoiling the otherwise suitable nursery for those species. If, as is often the case, nowadays, a widespread and important oceanic species has relatively few unpolluted nurseries left, the loss of only one could have serious consequences for the species. Again, man, attempting to harvest the species, will suffer the boomerang effect of his own actions.

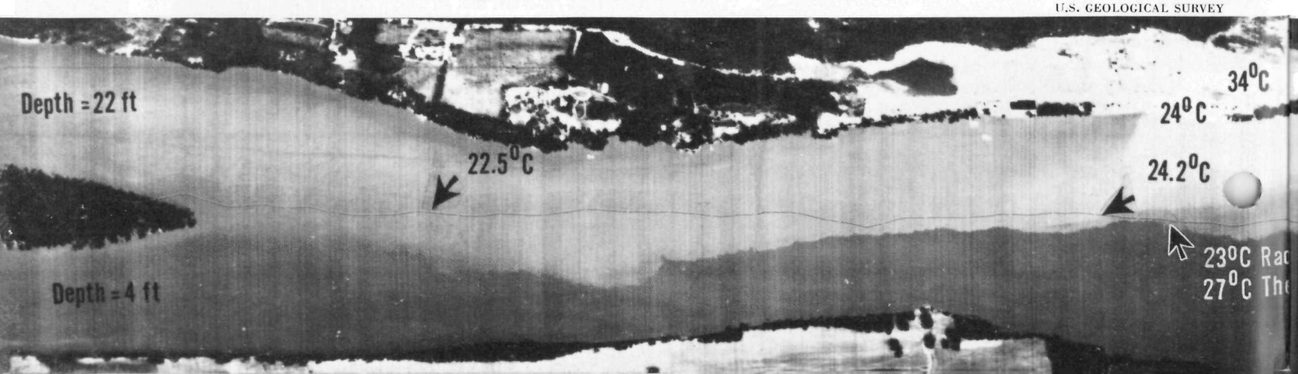
Finally, ecological imbalance often results in a population explosion of undesirable algae. At night algae, like all plants, use oxygen instead of producing it. If the algal population reaches a high enough level, there will not be enough oxygen in the water to sustain the plants through the night and many will die. The oxygen-consuming bacterial decay of these algae will further reduce oxygen levels, and more algae will die, even in the daytime. This process is the familiar phenomenon of algal bloom followed by die-off that produces a malodorous slime and water that may

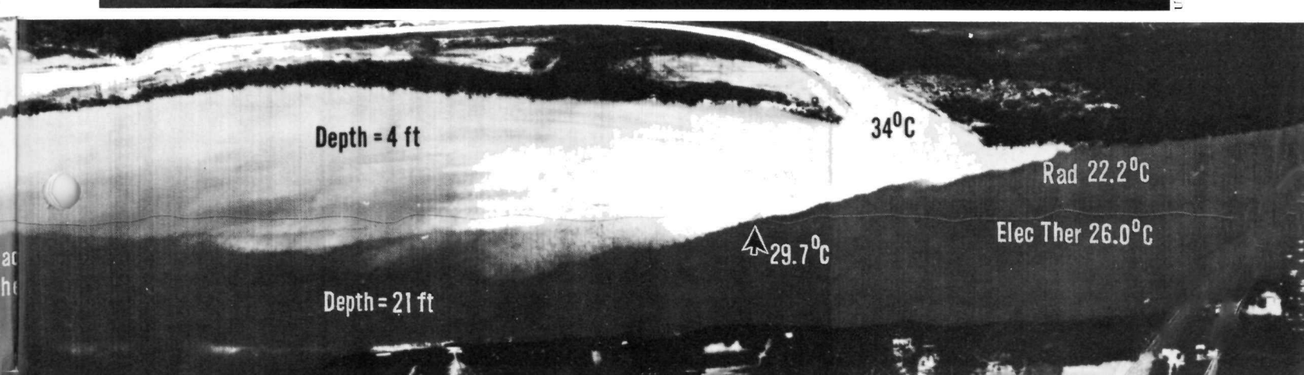


U.S. GEOLOGICAL SURVEY

Infrared photographs of the Connecticut River at the Yankee nuke plant at Haddam show how surface plume of warm condenser water spreads across the river on outgoing tide (right) and incoming tide (below). At slack tide the water tends to gather in a blob. This plume has been accused of forming a thermal barrier to the passage of shad and salmon on their spawning runs; they may encounter the plume and turn back without spawning normally.

U.S. GEOLOGICAL SURVEY





be unlivable for all but anaerobic bacteria. Needless to say, higher organisms lose out early in the competition with bacteria for oxygen. This phenomenon is especially likely to occur if water is thermally polluted that already contains overloads of sewage effluents and agricultural fertilizer runoff. Both of the latter contain nutrients for algae that hasten their growth.

Thermal discharges do not have to heat an entire body of water in order to cause concern. Some ecologists are worried about the invaluable Chesapeake Bay ecosystem because of nuclear power plants such as that being constructed at Calvert Cliffs in Maryland by the Baltimore Gas and Electric Company. The company has commissioned baseline studies of the bay in the vicinity of the plant site. Armed with results of such a study, scientists will be able to determine what effect the plant's operation will have on the bay ecosystem. The company says that it will avoid serious consequences for the bay at any cost but claims that inasmuch as it is warming only 35 acres of surface water by 3°F., on the average, no harm will be done. Some scientists studying the bay are not so sure. Their concern is not just that 35 acres of the 2.1-million-acre bay might be ruined. Rather, they fear that the 35-acre thermal "plume" might be spread across the 6-mile-wide waist of the bay near the site, forming a thermal barrier to the passage of surface organisms to spawning grounds in the upper bay. Others fear that even a small rise of 3°F. in mean temperature can have consequences as yet unknown.

What can be done about the thermal pollution threat? Until population is stabilized, demand will continue to increase. Meanwhile, to avoid damage to aquatic life, plans for thermal plants should hinge on thorough ecological studies that map existing conditions and predict areas of special vulnerability. Even if more expensive, other heat disposal methods should be sought.

Many schemes have been advanced for using the waste heat of thermal plants to some advantage, but unfortunately most so far have proven impractical. One of the most promising of these ideas would use the waste heat to aid in evaporating seawater in desalination plants; another would use excess heat to make sewage treatment processes more efficient. Paradoxically, in view of the danger to natural aquatic life of waste heat, sea farming may eventually be a profitable consumer of the thermal energy that now is allowed to escape. In controlled use, such heat could extend the growing season by promoting more rapid growth of marine life during spring and fall because of its speeding up of body processes. Tests now under way in Scotland have shown that two saltwater fish species, plaice and Dover sole, may be grown to market size faster in nuclear plant seawater effluent than in the ocean.

At the moment, however, and for many years to come, most of the waste heat must be released into the environment. Anywhere it is released it will affect the ecosystem to some extent. In view of the impact on the aquatic environment, it would seem that water—even the water at the edge of the ocean—should be the last place chosen for heat disposal. However, if it must be dumped into water, several alternatives are available, choice of which should depend on the ecological nature of the receiving body of water. A discharge method producing least harm in one body of water might produce most harm in another.

The only alternative to water as a waste heat dump is the air. Three possibilities exist.

First, a large, fairly shallow impoundment may be constructed, into the shallowest end of which the heated effluent is pumped. The heat is dissipated from the reservoir into the air; and, once cooled, the water is withdrawn from the deepest end for use again in condensers.

Second, a cooling tower can be used. The heated water is sprayed into a cooling countercurrent of air in the tower. Cooling is partly evaporative. The disadvantage both of this type of tower and of cooling reservoirs is that much of the cooling water is lost by evaporation. More seriously, in cool climates wet towers can produce a large amount of fog and in winter could ice over a considerable area; the towers needed for a 1,000-megawatt plant would emit some 20,000 to 25,000 gallons of water per minute as vapor, the equivalent of an inch of rain a day on an area of 2 square miles.

The third method of dissipation is both most desirable from the environmental point of view and most expensive. (At that, the extra cost might be only about $1 a month for the "average" homeowner.) This is the so-called dry tower. In this kind of tower condenser water is pumped through coils of tubing across which air is drawn. The heat is dissipated as from the radiator of a car. Because the system is closed, there are no evaporation problems.

Power companies, in business for a profit, like to keep costs down. Therefore, they prefer to discharge heat into natural waters first, cooling reservoirs second, wet towers third, and dry towers fourth. The ecologist prefers the reverse order, with perhaps a few exceptions. Before long many natural waters will reach the limit of their heat-absorbing capacity. Then it may pass that energy consumers—homeowners and industries alike—will have to pay the full cost of the product they buy instead of letting the environment pay part of the bill—a bill that, added to all her other bills, may impoverish Mother Earth. ■

John R. Clark, assistant director of the Sandy Hook Marine Laboratory of the U.S. Bureau of Sport Fisheries and Wildlife, is chairman of the Advisory Council of the American Littoral Society, which he helped found in 1961. This article was prepared jointly with the editors. It expresses his personal views and is not an official statement of the Interior Department.

To Redwood Retreat

LOLA BEALL GRAHAM

First forest folk
to enter space—
With skyway view,
uplifted face
You bathe in
seaborne atmosphere
While scanning ages.
Pioneer
In youthful trim,
in stately form
You overcome—
fire, flood, and storm;
With healing grafts—
no minor gift
To set new goals
in tonnage lift.

Now I have come
to your retreat
To learn survival
at your feet;
How you have reached
to such a height
And show no aging,
wilt, or blight.
Perhaps your secret
of renown
Is wearing crosses
like a crown.

SEQUOIA

LOOKING TOWARD THE KING

PHILLIP L. NELSON & ROBERT C. ECKHARDT

We started up the road to Mineral King just curious, two students on a lazy western summer. We ended up wide awake, our eyes opened. They had to be. That was quite the road, then—20 miles of it, one lane. It was so narrow that it seemed hung over the Kaweah River by the very roots of the chaparral. It defied our car to stay on it. Like a finger trace over the hills it writhed in and out, up and over every hollow, every hummock in the land. We could feel the very movement of the hills in the road. The land came alive in it.

But not too alive, at first. At 4,000 feet in the brown California summer, dust settled over the brush and the scarlet monkeyflowers as a heavy quietness. We watched as the golden brown stretched on and up to where we thought green mountains should have begun. Live oak, tree-sized manzanita, and sunburned grass swept over the hillsides everywhere. The silence was washed away by an occasional trickle of water at shady corners in the road, only to settle again.

We had about lost hope of crawling up far enough to see the Big Trees. It seemed our road would never let us reach the end, until the first redwood told us we were finally getting

. . . a spike of red and blackened wood
standing watch across the valley

somewhere. Soon the Big Trees began to march by us regularly. They really seemed to march *around* us when the road twisted and turned about their feet, until neither we nor they seemed to be going anywhere except around each other. The road squeezed so carefully between the swollen trunks that we nearly touched. We did so in spirit from our dwarfed car, although luckily we left neither paint nor scarred bark behind us. Yet we had mixed feelings about seeing the big ones, for among them were the stumps. The name *Atwell Mill* should have warned us, but then we had not thought about Atwell Mill to start with! We were just beginning to awaken to the place.

We found out that the area had been logged after 1890 but that pulling big redwoods out of the mountains with oxen was not profitable. The mill, which had never paid anyway, really became a losing business when all the smaller trees had been cut and only the unwieldy redwoods remained. After cutting about 1 percent of the redwoods, the mill gave up, and the land was given to Sequoia National Park.

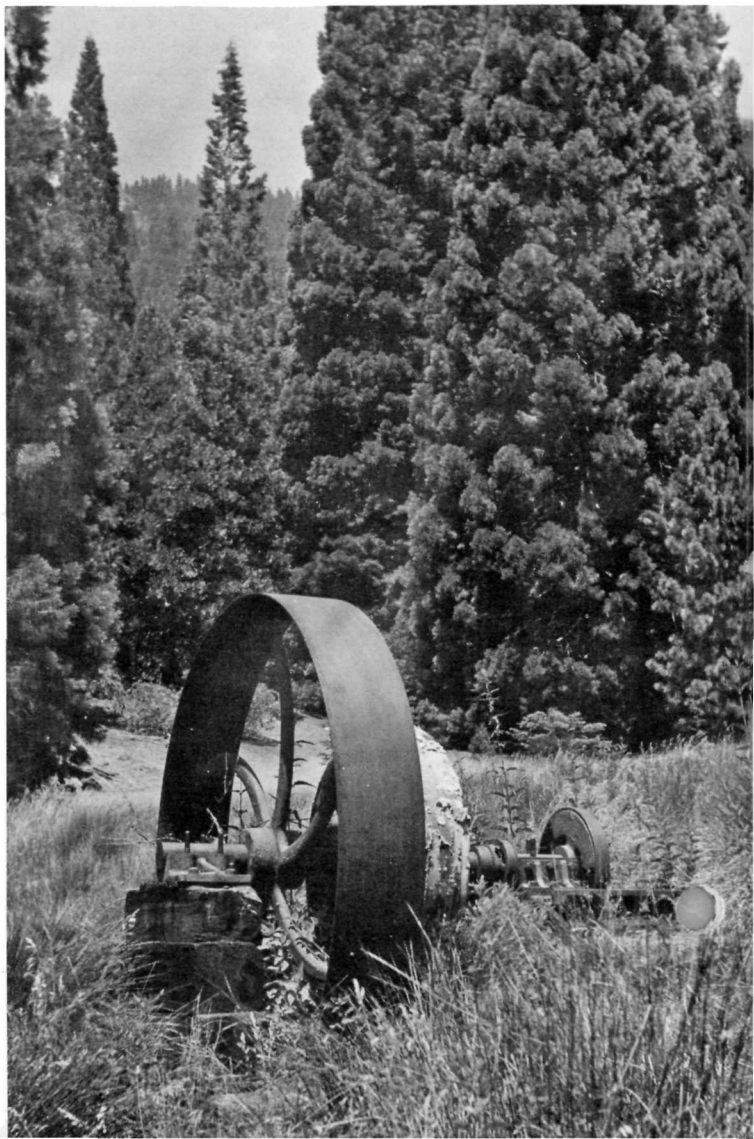
We found a new view of Atwell Mill, one place where the trees had won. The stumps became to us reminders of a fight and of a victory.

We reached our campground just past the Ranger Station as the shadows were finding the ridge top across the Kaweah. It was a small campground, nearly full when we arrived, but quiet. It fit well among the redwoods in the grove; it seemed right, not crammed in among the trees as so many other campgrounds seem. Our smoke smelled better, our coffee tasted better, our sleeping bags felt better there. We had come to see Mineral King and to hike into the Hockett Wilderness. But after spending several weeks in the high country to the east, we were finding a different country. We were finding a land of trees.

The valley of the Kaweah River, rising eastward into the mountains from the Central Valley of California, funnels warming winds up into the Sierras. Plants in the Kaweah River Valley are able to live higher than on other mountains. We could understand why the live oak forest seemed to rise so much higher than we had expected, and why we had to go so far to find the Big Trees. (One old codger 12 feet through is reported hale and hearty up at 8,500 feet!) We could see also that the warm winds would be dry during the summer and that they helped account for the brown of the land. Even many of the trees themselves were brown in the dryness.

. . . among them were the stumps

. . . Atwell Mill, one place where the trees had won



As we began to understand the country, we decided to stay long enough to see more. In the morning we took a trail from the old site of Atwell Mill down toward the river. Stopping at a river is so natural on a hike that one never need plan to do so, and should never plan not to. Out of its granite bed the river had scooped a stairway of deep basins that passed the water out of the mountains, along with the children who slid from one to the next. There were nearly a dozen people near the trail's crossing, swimming, fishing, or just looking. We turned upstream, and after a few steps had lost the people, had left everything except the river.

But we did not stop long, for we had seen something else. Before reaching the river we had been able to look across the valley to some of the great trees standing on the far side. A good view of a redwood in the thick forest was rare, a good view of several we could hardly believe. Since the redwoods grew in a band around the head of the river valley, sometimes scattered, sometimes in groves, we knew that if we climbed the opposite side of the valley we could reach part of the band.

Up we climbed, now and again glimpsing the red trunks thrusting up through the lesser trees. Yet we could not get a good look through so many branches until our trail crossed Deer Creek. This second granite stairway provided enough clear space for magnificent views of the trees along its banks. High on the mountainside we watched through their trunks as another twilight enshrouded Atwell Mill. We had done something we were to do again and again. We had found a tree.

This finding of trees became the meaning of the place for us. We tried finding trees farther down the river, climbing from the road through the scrub and heat to the Kaweah below, and then up the other side along Eden Creek. About a mile or so up through the brush and heat and rattlesnakes of the creek's canyon (but also a mile or so up through penstemons and monkeyflowers and the black and orange rock of the gorge) we found the lower edge of the Eden Creek Grove.

Marking the edge of the grove was one redwood, the lowest, the closest. It had no bark, no branches, and one would have said, no life. It was a spike of red and blackened wood, standing watch out across the valley. We wondered why it had held on so long, watching, waiting for something that would have to happen very soon for its wooden gaze to see.

And so we found what is commonly called a tall but dead stump.

This tree finding is hard to explain. It happened when we walked through a forest of believable trees, a forest of fir and cedar. It happened when we felt their fallen cones and watched a spider on mysterious business, when we discovered a ghostly flower in the shade or a rattler in the sun. We began to get a feeling for that forest, and then—suddenly—there would loom before us a big, red shape, its

We could not get a good look until our trail crossed Deer Creek

bulk curling out over the earth like no tree. Yet it was a tree—and more. It was the way one found it, standing alone, among the rest, standing and waiting. It is a waiting that can make a dead stump live on Eden Creek.

In that towering redwood lived a bit of every tree, flower, and dim, one-celled alga on the edge of life itself. The redwood on the Kaweah was a plant culmination, a life culmination. It was a symbol held forth by all green life. It was a boundary, an entrenchment. That this overwhelming triumph had to be sought back and away in valleys and coves was to us a tragic prophecy.

In the dusk, the sudden stance of a column so big that it resembled no tree spoke of prehistory. It transcended time. Of what it spoke, alpine lakes and granite monoliths say little. But in a monkeyflower's throat or in the eyes of a nightwandering spider one can sense that same haunting message of life.

That we must speak in reminiscence is sad. They plan to replace the road and our experience. The new highway might be easier to stay on, even while hordes of other cars compete for the same precious pavement. It will not undulate or twist between redwoods: one will not be disturbed by strange feelings of life under one's tires. The new road will feel natural, for one will be able to travel even in the alien mountains without leaving the reassurance of blacktop and the comforting society of other cars. Redwoods will no longer scrape paint, because they will not be left there to get in the way. Dust will be eliminated, not with water in shady corners, but with tar.

We are not a dried, conservative voice speaking out against glittering progress. In our university rooms, a year and a continent away from our western summer, we wish merely to suggest that the national trusts of public land and public future are being compromised. The problems of our existence—environmental awareness and adjustment—are being once again ignored. The future of a land is being thrown away for private and political gain.

We do not want to save a past, or a relic. We merely want our land to retain possibility, opportunity, and life. We do not want it to be killed and maimed with mistakes. We want not to conserve a past, but to save a future in our land.

Perhaps we are too late. Perhaps $23 million of highway, and 14 ski lifts, 1,900 rooms, 10 restaurants, 5,000 cars, and 14,999 other people every day in Mineral King are necessary before the modern person can cope with a tree, rock, or flower. Perhaps it is necessary to cut the trees with a road, blast the rocks and stitch them with ski lifts, and cover up the flowers with parking lots lest we stumble into our environment. Perhaps mountains uncrowned with bright restaurants bother people. Perhaps our old road and the wilderness it guarded are luxuries we can no longer afford.

Yet we cannot believe this, because trees and that road are not luxuries. They are two of the needs our society is ignoring. People have spoken, but too few and too seldom. The trees can only stand silent. We may have little time left to find them. ■

One of the hard-fought conservation battles of recent years has been to save the beautiful Mineral King valley in the High Sierras of southern California. Originally excluded from Sequoia National Park because of mining operations that later ceased in the valley, Mineral King is a national game refuge on land administered by the Forest Service of the U.S. Department of Agriculture. Several years ago the Forest Service began promoting development of a gigantic ski resort in Mineral King; Disney Enterprises responded to a bid invitation and received a concession for the project. The plan contemplates year-round access for 2½ million visitors annually via a new all-weather, heavy-use highway slicing across the national park, and extensive development in Mineral King that would destroy the area for wildlife protection, trail-type recreation, and wilderness enjoyment. National Parks Association advocates abandoning the project and including the area in Sequoia National Park, to be managed in keeping with park principles.

SPEAK OUT NOW. IT MAY NOT BE TOO LATE.

The Forest Service could abandon its project as not in keeping with sound recreational development in national forests—especially in national game refuges; the Department of the Interior could rescind permission for construction of an access highway across the national park and refuse permission for crowd access by *any* means across national parkland; the President could add Mineral King to Sequoia National Park by executive order—where it rightly belongs as a wildlife refuge and as an ecological unit of the park. Addresses: President Richard M. Nixon, The White House, 1600 Pennsylvania Avenue, NW, Washington, D.C. 20500; Secretary of the Interior Walter J. Hickel, Department of the Interior, Washington, D.C. 20240; Secretary of Agriculture Clifford M. Hardin, Department of Agriculture, Washington, D.C. 20250.

STEPHEN F. ARNO

INTERPRETING THE RATTLESNAKE

IMAGINE YOURSELF decked out in the dapper garb and Stetson that identifies you to visitors as a "forest ranger." Actually your job is National Park Service *naturalist;* but let us dismiss the technicalities. To the public you are an answer man or universal expert on the outdoors. However, you secretly aspire to be something more, namely an *interpreter* of the natural environment. Hopefully, through your friendly, personal contacts with visitors you will be able to do more than simply add to their fun of seeing the magnificent outdoors. You especially want to be able to instill some measure of true appreciation of the natural world in the minds and hearts of these visitors, who are part of our prolific, urbanized society.

There are so many stories to tell about the innumerable facets of this natural world that interpretation possibilities are endless. But a naturalist learns early that certain topics have a high priority with most visitors. Certainly *wild animals* rate near the top of the popularity list, probably because it is easier for visitors to appreciate certain wild creatures than it is to appreciate other aspects of this unfamiliar outdoor environment. So interpreting the lives of deer, chipmunks, and birds comes easy to a naturalist.

But how about interpreting "dangerous" wild animals? Fortunately there has been so much discussion, even in mass media, of the role of predators that the place of bears, coyotes, eagles, and even wolves and mountain lions is readily understood by most visitors. In a way it seems that in man's transition to the "soft" urban life, he has lost some of his irrational disdain for predators; and now his attitude toward them is more commonly fascination. Yet some wild creatures still seem to be truly despicable—the rattlesnake, for example. During the summer of 1965 I attempted to place the rattlesnake in a rational perspective for visitors at Kings Canyon National Park in California's Sierra Nevada.

Along with Steve Stocking and Garrett Rickman—high school biology teachers—I was a seasonal naturalist at Cedar Grove, deep in the Kings River Canyon. Here, in the sunny pine forests and broadleaf elfin woodland or chaparral, dwell bears, ground squirrels, deer, coyotes, hawks, and the Pacific rattlesnake (*Crotalus viridis* var. *oreganus*). There are also 400 tenting spots at Cedar Grove, and it is the hub of a system of popular hiking trails.

Park Service policy on rattlesnakes in Kings Canyon is that people should leave them alone or pitch them away from the trail using a long stick. Only when rattlers are found in areas where humans are concentrated, such as campgrounds and overlooks, are they to be killed. This snake protection seems absurd to many visitors unless it is explained by a ranger or naturalist.

He can tell visitors that their chances of meeting a rattler while hiking about the canyon are few and that the snakes are very rare in the campgrounds. If a person uses ordinary caution, the danger of his being bitten when he encounters a rattlesnake is slight; and with modern treatment the likelihood of permanent injury or fatality is minute indeed.

The visitor is told that when he hikes through this kind of country, away from settlements, a normal precaution is to watch where he walks. A rattlesnake will usually buzz his alarm if a person gets within a few yards. The reptile is probably as anxious to avoid our presence as we are to avoid his, and a Pacific rattler usually will strike only if he feels there is no alternative for his own protection. Hikers with boots 8 inches high and trousers hanging down over their boot-tops are well protected against a rattler's fangs. But a surprisingly common rattlesnake encounter is the case when a whole string of backpackers passes within a few feet of a rattler before the last man in line finally notices it.

People who fear snakes are almost invariably unaware of the facts. For instance, Laurence Klauber [1] states that "the bite of a harmless snake can cause a serious nervous reaction, and even death from fright may befall the person who doesn't know that he was bitten by a harmless snake." Some of the unfounded rumor about American rattlesnakes dates back to the early European settlers; for example, a visitor to the colonies in 1655 wrote that "a rattlesnake

PHOTOGRAPH BY THE AUTHOR

Newborn Pacific rattlesnakes at 6,500 feet elevation along the trail to Tent Meadows in Kings Canyon National Park.

has a head like a dog, and can bite a man's leg off as if hewn with an ax."

It is true that rattlesnakes have hollow fangs and a biting mechanism that has the mechanical perfection of hypodermic syringes; but, as Klauber points out, snakes have venom to use in obtaining their food, and it may have incidental value in protecting them from larger enemies. Biologists agree that rattlesnakes in general, and particularly the Pacific rattlers in the Sierra Nevada, are not aggressive; in fact they are often lethargic and retreating.

One illustration of the danger of rattlesnake bite is the U.S. Army Information Bulletin of 1945, which states that there are more deaths each year in this country from lightning strikes than from all snakebites; and if a soldier is protected from snakes by shoes and leggings, mosquitoes are 1,000 times more dangerous to him than snakes. During World War II in training camps in "snake-infested" areas of the southern United States, each year there was one snakebite for about every 12,000 men exposed; a total of 1,910 men was admitted to hospitals under the category of bites and stings of all venomous animals, yet there were *no* fatalities. Klauber found that even in the old days of the West (when people often went barefoot in snake country), only a small fraction of poisonous snakebites were fatal, even though "the treatments in those bygone days were often as dangerous as the bites they sought to cure."

Thus the first step in interpreting the rattlesnake at Cedar Grove was to try to dispel some of the confusion and fanciful fears on this subject that dominate the attitude of many visitors. As a naturalist conducting hikes in Kings Canyon, I seemed to have an uncanny knack for encountering rattlesnakes. I would keep the snake from retreating and, using a 6-foot stick, pester him enough to keep him coiled. (A coiled rattler can strike a distance of one-half the length of his body.) Then we would observe and discuss this colorful creature. Seeing the snake "in person," the visitors could readily detect the folly of the woman and her daughter who had run a mile down Sheep Creek trail earlier in the summer, screaming that a rattlesnake had "chased" them.

But how about the natural history of the rattlesnake? Like other "cold blooded" creatures, the rattlesnake has no internal heat regulator, so he has to seek out the most comfortable sites. In the pine forest zone the rattler spends much of its time in the sun. Often a cold rattler—encountered in early morning or above 7,000 feet elevation—will not strike even when someone annoys him with a stick. But on hot afternoons in this area, or most of the day in the desert, the rattler "plays it cool" in the shade or perhaps even in the cellar—an underground rodent burrow. He must avoid high temperatures and direct summer sunlight. Humans long ago learned the coyote's trick of cornering a rattlesnake beneath the desert sun and keeping him from reaching shade; the reptile will die in 10 to 15 minutes.

From about October until mid-April in this area even the afternoons are below 70° F. and thus too cold for the rattler; so he crawls into a ground squirrel hole or deep rocky crevice and hibernates. Because of his "cold-blooded" body metabolism, a snake at rest needs almost no food. In fact, Clifford Pope [2] says that records of snakes fasting for a year are fairly common. So, upon emerging from hibernation in spring, the rattlesnake's first "thoughts" apparently do not turn to food. He finds a mate, and the couple stays together for several weeks. During summer the female rattlesnake becomes noticeably enlarged, then she gives live-birth to from 1 to 15 baby snakes, each sealed neatly in its own transparent membrane, a little "plastic sack."

The baby rattlesnakes were carried inside their mother's body until they reached about 9 or 10 inches in length. From the moment they venture into the big world, they are on their own; they are equipped with enough poison from the start to kill their food. In fact, they have been observed to eat within 10 minutes of birth.

One day that August I met two new rattlesnakes 11 inches long on the trail to Tent Meadows. It was easier to tire them out for photographs than it would have been with a big rattler, and a little 2½-foot stick was adequately safe for manipulating them. But it was lucky that I took them seriously, because later the same day a visiting ranger from Big Bend National Park described having been bitten by a newborn rattler. Instead of getting an antivenom shot and resting, he had just sucked out some venom and blood and returned to his work. His activity allowed the remaining venom to spread through his system quickly, and he was sick for several days.

These new rattlers have only a "button" at the end of their tail, and it is still soft, so the youngsters cannot buzz. Each time the snake sheds its skin, or molts, it adds a new rattle to its equipment; then when it "sings," everyone listens! The snake molts two or three times each year in the Sierra Nevada, so a good-sized rattler, 3 feet long with 10 rattles, is probably close to 4 years old.

The snakes seldom have occasion to use their rattles in nature, and under continual harassment in captivity, such as at a roadside "free zoo," the rattle soon cracks and breaks apart. However, enterprising showmen soon learned the trick of snapping rattles together; thus the "giant" snake with 20 or 30 rattles used to attract the public.

For feeding, the rattlesnake has a heat-sensitive organ in

its head that allows it to detect the presence of warm-blooded animals. The snake waves its forked tongue in order to pick up smells; it can locate prey by sight also, but probably only at close range. Rattlesnakes dine mostly on ground squirrels and mice, along with lizards, insects, and an occasional small bird. First the rattler bites its prey; he waits for the poison to take effect, then he begins the slow process of swallowing his supper whole. Later he discards the bones and undigestible debris.

During the summer of 1965 one of the Cedar Grove fireguards found a rattler with a bird stuffed halfway into its throat. Naturalist Steve Stocking tells of collecting one he had nearly stepped on while it was "digesting dinner"—a ground squirrel. Zoologist Joseph Grinnell described several rattlers he discovered in the San Bernardino Mountains. A small rattlesnake had its "mouth efficiently gagged by a half-swallowed adult meadow mouse." But even when the snake was handled and worried, it was unable to disencumber itself from its "bulging mouthful." Grinnell collected a 26-inch rattler that had just swallowed an 11-inch lizard and others that had chipmunks and gophers inside them.

However, the rattlesnake itself serves as prey for other animals. Redtailed hawks and eagles often have been observed killing rattlers and carrying them off, minus the head, to feed their fledglings. (Other animals, like man, have learned to stay away from the head of a freshly killed rattler because of "reflex actions" that still can inflict a bite.) Deer frequently kill rattlesnakes by jumping on the reptiles with their sharp hooves. Hogs readily attack rattlesnakes and do not sustain serious injury themselves when bitten. In fact, Klauber found that hogs often markedly reduce the rattlesnake population. Coyotes often kill rattlers and are apparently little affected by the bite, inasmuch as Frank Dobie [3] notes that 20 percent of Texas coyotes show rattlesnake bite scars. King snakes, which are found at Cedar Grove, are also renowned for their prowess at eating rattlesnakes.

One question that visitors commonly ask is, "How does a snake crawl?" If you could run a little experiment that Clifford Pope describes, it would make the process easier to visualize. Put a snake on a sheet of glass, and he will slip and slide; but glue a few pegs on the glass in a zigzag pattern, and the snake will "pull" and "push" himself along by bending around the pegs. The ground surface is rough and uneven, so a snake has plenty of "footholds" in nature for practicing what scientists call his "lateral undulatory movement." A snake also can move slowly in a straight line by contracting and expanding the joints between his plates of skin, like a caterpillar.

If a snake is tied in a knot, it can get out of this position by simply passing the knot along its body until it goes right off the tail. One might think, then, that the snake's vertebrae are very loosely attached, but actually they are firmly jointed together. The reason a snake can move so freely is that he has a very large number of vertebrae.

The American Indians knew the rattlesnake well, and they respected him. In fact, many western Indian tribes believed that the rattler has supernatural powers. Some southern California tribes thought that this serpent was an officer of punishment, used by the other gods to carry out penalties. An Indian who killed a rattler was thus jeopardizing his family's health.

Other snakes of the Cedar Grove area were also mentioned in our discussions. For instance, the rubber boa, or "two-headed snake," with its stubby tail that looks like its head, is a favorite with children and others because it cuddles around its handler's arm or fingers in order to absorb heat. Contrary to much popular belief, snakes are not slimy or dirty, and most of them have no odor.

I had a difficult time persuading my wife Bonnie to hold a small rubber boa for some photographs; but finally when she did let it wind around her hand, she found it such a delightful pet that I was hard pressed to persuade her to let it go again!

During the summer at Cedar Grove the naturalists detained several kinds of snakes for photographs. We placed each snake in a jar with a perforated lid and set it in the refrigerator for a few hours (like a cool night to the snake). Then the snake becomes so docile that a photographer can set him outside in the desired pose. Within a few minutes, however, he has warmed up and is ready to resume his workaday search for rodents, insects, lizards, and so on.

This is the gist of our public interpretation. Our goal is not to make people love snakes or any other animals, but rather to allay unwarranted fears and to promote understanding of "nature's ways." People have responded well to the story of the rattlesnake, especially when our groups encountered one. The largest party I guided that season was 96. In our 2-mile round-trip walk we met three rattlesnakes (*extremely* unusual); but after we had discussed the place of animals in this natural ecosystem, or environmental community, even this large group seemed to understand the policy on rattlers. Certainly most of the visitors appreciated the chance to observe a rattlesnake—a creature that adds spice to enrich the vacation stories of anyone who has come across him.

Most people are brought up in places far removed from the rattlesnake's habitat, and of necessity we cannot tolerate such creatures roaming freely in our developed environments. However, in the scenic and scientific reserve of Kings Canyon National Park the Pacific rattlesnake is an important citizen. ■

NOTES

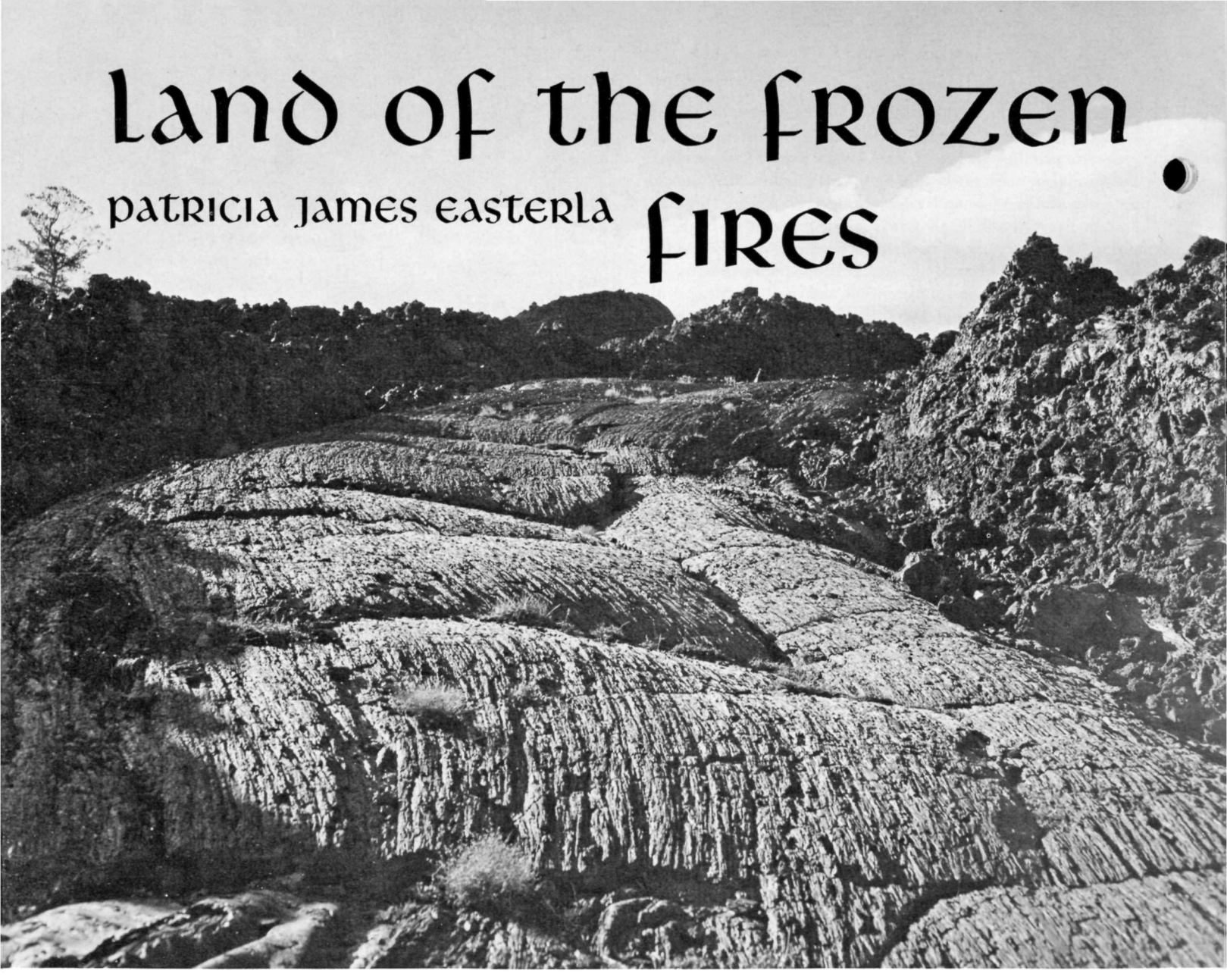
[1] Laurence Klauber. 1956. *Rattlesnakes (Their Habits, Life Histories, & Influence on Mankind)*. 2 vols. University of California Press. 1,476 pp. 140 pp. of references.

[2] Clifford Pope. 1949. *Snakes Alive and How They Live*. Viking Press. 238 pp.

[3] J. Frank Dobie. 1961. *The Voice of the Coyote*. University of Nebraska Press. 386 pp. (First published in 1947 by Curtis. Mr. Dobie published a book on *The Rattlesnake* in 1965.)

land of the frozen fires

patricia james easterla



The earth was angry. She twisted and heaved, her explosions lighting the skies of northern California. With great belches, gaseous eruptions formed what would one day be cinder cones. Great rivers of molten basaltic lava spewed forth from fissures in the ground.

Her wrath spent, the earth began to cool. As the surface of the lava cooled and hardened into a strong crust, the lava below remained liquid and continued to flow. As pressure built up against the end of the flow, it would break, and the liquid material would pour out leaving a tube or tunnel.

So it was that the land of frozen fires came into being and is known today as the Lava Beds National Monument, located in north-central California 12 miles from the Oregon line. The formations of the Lava Beds National Monument are recent, geologically speaking, probably not exceeding 100,000 years, with the most recent flows possibly less than 1,000 years in age. The monument contains some 293 caves, 190 of them explored.

These underground labyrinths are all distinct in floor, ceiling, or wall development. Catacombs Cave, the longest single cave, derives its name from the peculiar niches in the wall resembling the underground burial places of ancient Rome. Here are smooth floors resulting from slowly cooling lava flows. Valentine Cave presents examples of varying flow levels that have resulted in a terracing or curbing within the cave. "Lava-cicles"—formed when hot gases above the lava remelted the ceiling and allowed the lava to drip—and "blisters"—thin-skinned patches of lava that burst and splattered over the surrounding space—are to be seen in many of the caves.

The most conspicuous features of the monument are the cinder cones, miniature volcanos rising 100 to more than 500 feet from the lava beds. There are about 17 cinder cones in the monument, one of the largest being Schonchin Butte, named after one of the Modoc Indian war chiefs.

Early visitors to this area christened it "Dark and Bloody Ground of the Pacific" because immigrants were extremely exposed to Indian attack here. Valley settlers in the late 1800's began to use the area as a picnic ground. Loading

BOTH PHOTOGRAPHS FROM NATIONAL PARK SERVICE

the makings for ice cream into the wagon, they would head for Bear Paw Cave, where they would chip ice from this natural freezer and enjoy a summer treat. This cave, renamed Merrill Ice Cave, is one of the best examples of the numerous ice caves in the monument.

The earliest human history of the area is evidenced by the petroglyphs (carved symbols) and the pictographs (painted symbols). Petroglyph Point provides a good view of the carved symbols, whereas Fern Cave offers pictographs. The pictographs in Fern Cave probably were left by a nomadic people who lived off the land. Both types of symbols apparently existed before recorded trips of white men to the west, as the Indians encountered on these trips did not mention either petroglyphs or pictographs in their folklore.

But the greatest human epic to occur within this rugged sea of petrified black waves was the Modoc War of 1872–1873, the only Indian conflict fought in California. Considering the number of Indians the army was fighting, the Modoc War was to prove the single most costly Indian war in United States military history in terms of both money and human life.

The Modocs were always a small tribe. Before 1800 they numbered only 400 to 800. They occupied an area known as the Lakes District that extended through Oregon into California. Using arrows and spears tipped with obsidian, or "volcanic glass," from nearby Glass Mountain, they hunted and lived from the game they found in their 5,000-square-mile hunting range. The seeds of the wocus, a pond lily, were ground in mortar stones made of lava and provided one of their primary food staples. Another water plant, the tule, provided material for the skillful Modoc basket weavers. This, then, was the life of the Modoc before 1800.

The influx of the white man had a tremendous impact on the culture of the Modocs. They began to wear clothing patterned after the white man. The white man's religion caused an upset in their code of ethics as, for example, in their custom of automatically killing a medicine man who allowed his patient to die. What had once been law was regarded by the non-Indian as murder. However, the abominable act of scalping was introduced to the western Indian by the white man, with Modocs and white men alike practicing scalping and mutilation.

Even the names of the Modocs changed. *Ski-et-tete-ko* (Left-handed Man) became Shacknasty Jim because, it is said, of his mother's lax manner of housekeeping. Steamboat Frank was named in honor of his mother's resounding voice. Scarfaced Charley's name came from a large scar extending across his cheek, the result of being run over by a stagecoach. So such names as Black Jim, Boston Charley, and Hooker Jim emerged, but the name destined to stand out above all others was *Kei-in-to-poses*, Captain Jack, leader of the Modocs.

The story of the Modocs is similar to stories of many other Indian tribes of early America. As more white men poured into the Northwest, more land was needed to accommodate them. There was an inevitable clash between

Lava tube showing terracing effect along the sides and "lava-cicles" on the ceiling.

white man and Indian with much bloodshed on both sides. The problem of the Modocs reached a peak in 1864.

The solution, it seemed to the white people of the area and eventually to the government, was to place the Modocs on a reservation where conflict could be avoided and the Modocs could be watched. The Modocs were placed on a reservation located near what is today Klamath Falls, Oregon, where they were to live on an equal basis with the Klamath and Snake Indians. This was a great error in judgment because it was fostered on the premise that all Indians are alike. On the contrary, the Klamaths and Modocs had always been rival tribes and friction quickly developed between them. The problem was ignored by the superintendent of the reservation, and finally, in 1870, 301 Modocs left the Klamath reservation to return to their homelands.

In the following two years, Captain Jack and his band roamed free, but in 1872 an attempt to return the Modocs to the reservation was made. Realizing that war had indeed come to them, the Modocs selected as their battlefield the Lava Beds. There Captain Jack, 53 warriors, and their families took their stand.

The unique terrain of the Lava Beds and the Indians' innate understanding of how to survive and use that terrain is one reason the Modocs were so successful. The Indians' knowledge of the fissures and cracks that cut down into the lava enabled them to shuttle quickly back and forth over the battlefield, baffling the federal troops, who were never sure just where the Indians were. Two or three Indians could successfully hold off large numbers of soldiers by making use of these natural trenches. The Modocs understood the hazards of the terrain and stripped off their clothes and bound themselves with rawhide bandages to protect themselves. Sagebrush tied to their heads served as a form of camouflage. Their primary fortress, known as Captain Jack's Stronghold, was a tortuous, jumbled, and broken mass of rocks and fissures, replete with caves and other hiding places. A captain of the U.S. army of that time described the terrain: "I could find only one battleground in all our military history which compared at all with the Lava Beds in difficulty—the Florida Everglades of the Seminole Wars of 1840–41."

The first battle of the campaign, which pitted 330 soldiers against the Modocs, ended in a complete rout of the army, leaving many dead and wounded. It began in complete optimism on the part of the army; clearly they expected to kill or capture every Modoc who had moved to the Lava Beds. But soon they discovered that to obey the command "advance" was not the same task it had always been. Fog had settled down around them; and not only were there rocks to be detoured, but a seemingly level stretch of land would suddenly yawn into a chasm. The sharp-edged rocks began to find their marks, leaving lacerated hands and cut shoes. In the fog it was not only difficult to know where the Modocs lay, but knowing the position of each other became a problem. One young soldier was wounded twice though he never once saw an Indian.

After 10 hours of battle, the army retreated, completely demoralized. The official report of this first campaign concluded that it would take at least 1,000 men to dislodge the Modocs.

Although the Modocs suffered no casualties in this battle, it is interesting to note that the first actual Modoc casualty, one of very few during the war, was the result of a curious Indian who discovered a cannonball. The Indian attempted to defuse the ball by pulling the detonator with his teeth. His experiment was costly to him; his head was blown off.

Patricia James Easterla has a special interest in and is especially well qualified to write about Lava Beds National Monument and the Modoc War inasmuch as she is a quarter Modoc Indian. Her great-grandfather was Shacknasty Jim, from whose name her maiden name James was derived.

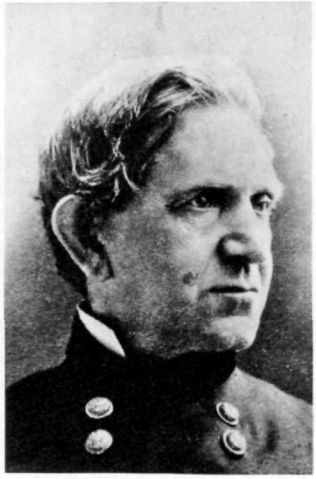
The next phase of the war was one of attempted peace parleys. Here General E. R. S. Canby personally took command of the troops whose numbers had now risen to 1,000. He offered to head a peace delegation that would meet with the Modocs in an endeavor to arrange some sort of peace.

By this time popular opinion had cast Captain Jack as a bloodthirsty renegade, the term "savage" often being applied to him. While still on the reservation, however, he had attempted to hold the peace with the Klamaths, and now once again he spoke for peace. But Jack was not destined to live in peace, for at each turning point in his life he was thrust into the role of war, sometimes by his own stubborn pride, sometimes by the acts of the white man, and sometimes by his own people. At the crucial council of the Modocs, Captain Jack spoke for peace; and although 11 others stood with him, he was strongly opposed by the remaining Modocs. The debate grew more heated until finally one Indian who favored assassination of the peace commission threw a woman's shawl and a basket hat upon Captain Jack, taunting, "You are a fish-hearted woman." So it was that Jack was overruled and plans for assassination laid. The Indians succeeded in killing General Canby and Reverend Eleasar Thomas, another member of the four-man peace commission. A large cross that now marks the spot where the conference was held bears the following inscription on the horizontal bar: "General E. R. S. Canby was murdered here by Modocs April 11, 1873."

The war continued in greater heat as the Modocs once again proved their elusiveness and fighting skill. But on April 16 troops advancing west and east joined along the lakeshore of what was once Tule Lake and cut the Modocs off from their water supply. The disheartened Modocs abandoned their stronghold but were to have a final thrust at the army 10 days later; a pursuing troop of 70 soldiers walked into an ambush that killed or wounded two-thirds of the force.

Finally, in June of 1873, Captain Jack surrendered, saying only, "Jack's legs give out." He and three of his warriors were found guilty of murder. On the day of his execution Captain Jack was asked if he had a last request. His request, "I should like to live until I die a natural death," was not to be accorded to him. He and his warriors were hanged and later buried at Fort Klamath.

The final scene of the war that subdued 53 Indian warriors had been enacted. Seventeen Modoc warriors had died in the course of battle, by gallows, suicide, or assassination; but for each one, at least a dozen soldiers had fallen. The



BOTH FROM NATIONAL ARCHIVES

Left, Captain Jack, leader of the Modoc Indians. General E. R. S. Canby, right, was the only United States general killed in an Indian war. George Custer, killed in the battle of the Little Big Horn in 1876, was a lieutenant colonel in the regular army. As a dramatic cavalry officer in 1863, he had been promoted to the rank of brigadier general of volunteers, which rank lasted only until the end of the war.

remaining Modocs, about 150, were exiled to the Quapaw agency in Oklahoma territory. Wrenched from familiar land and sent to a strange land far to the east of them, the Modoc existence became a painful one. One thing is sure: The spirit of the Modocs was broken, and they were a subdued tribe.

The greatest tragedy of this war is that it was not a single, isolated incident in the policy of the United States government toward the Indian but one in a long chain of Indian disputes and wars.

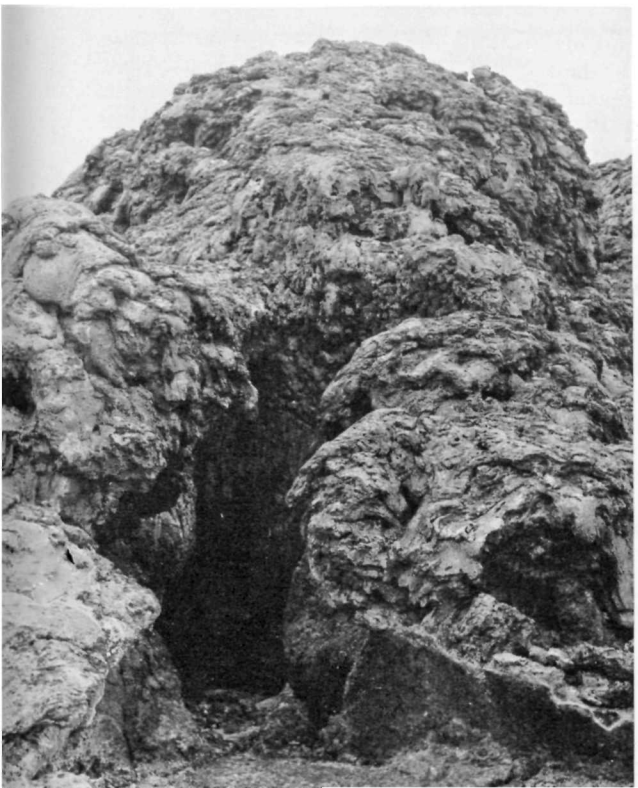
As one walks through the lava trenches of Captain Jack's Stronghold, the words of Captain Jack in his plea for peace seem to fill the stillness: "It is true we have killed many white men. The Modoc heart is strong. The Modoc guns are sure. But hear me, oh muck-a-lux [my people]! The white men are many. They will come again. No matter how many the Modocs kill, more will come. We will all be killed in the end." ■

KEN E. FREY

Jennie Clinton, the last survivor of the Modoc War, lived well into her 100's. After the Modoc War, she became a Christian missionary; and although she eventually became blind, she was able to continue to preach, having memorized much of the Bible. She would often talk of being sent into the battlefields after dark to lift ammunition and arms from the fallen soldiers. She is pictured here in 1947 with a great-nephew and two great-nieces, one of them the author, seated at the left.

Caves in Captain Jack's Stronghold (below left) afforded the Modocs convenient hiding places from their aggressors, and their familiarity with such features as the natural trenches throughout the area (below) enabled them to shuttle back and forth over the battlefield, thus eluding and utterly confusing federal soldiers.

BOTH PHOTOGRAPHS FROM NATIONAL PARK SERVICE



news & commentary

INTERIOR SETS LIMITS ON ALASKA OIL PIPELINE

One of the more disturbing aspects of the rush to develop Alaska's north slope oil is the proposal to bisect the state with a gigantic pipeline from the oilfields at Prudhoe Bay to the port of Valdez on the south coast. It is feared that the pipeline will be the ecological equivalent of a hatchet-slash dividing the state into two biologically incommunicado parts.

The pipeline would have to cross federal lands for most of its route, and the Department of the Interior is in a position to grant or deny right of way. Conservationists have urged the Department to go very slowly in giving such permission. In a letter to President Nixon, National Parks Association President Anthony Wayne Smith has pressed for public hearings to be held before the granting of right of way. At these hearings the advice of scientists would be sought on the question of whether a pipeline can be built without ecological disaster and, if so, how it must be built.

So far, fully public hearings have not been held, but the Department has issued a set of stipulations to be met if right of way is to be granted. These stipulations have been aired at a hearing before the Senate Committee on Interior and Insular Affairs, chaired by Senator Henry M. Jackson of Washington; they fared not so well. Senator Jackson called them unsatisfactory, and conservationists testifying pointed out that at best the stipulations go only halfway and are unlikely to be enforceable. NPA's previous call for public hearings was repeated and inserted in the Committee's hearing record upon invitation.

The real problem is that no one knows much about the tundra ecosystem. What is known provides a sound basis for great caution. Most of the proposed route of the pipeline crosses land that consists of a thin blanket of mosses, lichens, and other tundra vegetation that insulates the permafrost subsoil. Without the blanket of vegetation the permafrost would melt during the long Arctic day and the tundra would become a soupy morass.

The vegetation of the tundra cannot withstand the impact of heavy machinery. The path of a tractor in winter will be marked the next spring and summer by small twin canals. Multiply this by all the activity that must surround installation of a 4-foot-diameter pipe, and the cause for worry is obvious. Even worse is to be expected when the oil begins to flow. The oil must be kept hot in order not to congeal in the pipe, and this heat is capable of melting a really large canal that could be the Berlin wall of the Alaskan interior ecosystem. Caribou and the state's other migratory species of animals could pass in very few places, for instance; and, if nothing else, the Indians and Eskimos dependent on these animals for meat would go hungry.

At the Senate hearings conservationists wondered aloud why there is so much hurry, with so many basic ecological and technical questions unanswered. Development of the oil fields has hardly begun.

And the feasibility of ocean transport of the oil has just been demonstrated by the journey of the giant tanker-icebreaker *Manhattan* through the Northwest Passage. Furthermore, no one has answered the question of whether immediate development of the oil is worth the environmental damage that might be caused. Oil interests say that haste is necessary because of the huge amount already invested in the north slope. However, haste should have little to do with the government's business here, which is to administer public lands in the public interest.

TO THE AID OF THE DEFENSELESS GRIZZLY

Ursus horribilis, the horrible bear, the grizzly, may be thought to be aptly named and hardly defenseless. But in the wild the grizzly has yielded to the gun; and now, near extinction as it is in the United States, in the courtroom sense it is indeed almost without defense. The grizzly bear is probably the only higher animal in modern times whose extinction has been advocated by supposedly reasonable people. *The Night of the Grizzlies* by Jack Olsen, detailing the killing of two girls in Glacier National Park several years ago, is merely the latest in a long line of writings tacitly or openly to promote the extinction of grizzlies.

It just goes to show. When it gets to the crunch man is as wild as the beast. An animal that is as capable of killing people as the grizzly must be killed, regardless of how easy it would be for man to avoid ever confronting the bear. The fact is that the bears of Yellowstone and Glacier (the last significant grizzly populations in the "lower 48") have been perverted and made dangerous by man. They have been enticed with garbage, sometimes to entertain tourists, right into the back yards of park chalets. After a while their fear of the sight and smell of man vanished, with tragic consequences.

Nobody should attempt to prove that grizzlies are not dangerous. They are probably among the world's most dangerous animals, their natural diet of berries and fish notwithstanding. But many things in nature are dangerous—cliff edges, rapids, avalanches, riptides, even sunburn; and some of man's works are the most dangerous of all. Each year, in Yellowstone and Glacier, more people die in auto accidents than have been killed by bears since the parks were opened, and be it noted that bears, not cars, are among the parks' outstanding attractions. People are intelligent enough not to walk off cliffs; they should also be able to keep a safe distance from grizzlies.

Hard as it may go against man's more selfish instincts, the grizzly has a right to the fragment of existence left to it. The future will not thank us should we commit genocide on such an animal.

POTOMAC CONSIDERED AS CAPITAL WATER SOURCE

For many years the National Parks Association has led the opposition to plans of the Army Engineers for the construction of a series of dams in the Potomac River basin. It appears that as far as the Engineers are concerned, the dams are their own justification; plans have remained remarkably consistent while the reasons given the public have changed kaleidoscopically. Various mixtures of flood control, water supply, and pollution control have been sugared with very generous estimates of the dollar value of the benefits from each factor. Lately

the arguments for the dams have rested heavily on the claims that low-flow augmentation is needed to flush Washington's sewage downriver during dry weather, and that the city needs the water that the dams would store. NPA and others reply that sewage should be dealt with by adequate treatment plants, and that the Potomac estuary in front of the city can supply all the water the city will need for the foreseeable future. The Corps' only answer to these suggestions is that the estuary is too polluted and too saline near the city (which is simply not true, as can easily be demonstrated).

Recently two agencies within the Department of the Interior announced that they would undertake a new study of the estuary as a source of fresh water for the city. The joint study by the Federal Water Pollution Control Administration and the U.S. Geological Survey will take a year and will cost $260,000. Assistant Interior Secretary Carl L. Klein says recent agreements for improving sewage treatment in the capital area make the estuary much more promising as a source of fresh water than it has been. One such step forward is the award by FWPCA of a $744,000 contract to the District of Columbia for constructing a pilot waste treatment plant using a new, cheaper, and more efficient process called physical-chemical treatment.

Interior, incidentally, says it will call on the Corps in the study to provide estimates of distribution costs connected with using estuary water. That is like asking a trucker the cost of rail freight.

SNOWMOBILE INFECTION SPREADS IN MAINE

Snow on the ground smothers the rough darknesses of the spirit as it does mud, junkyards, and the death of winter. The air is tonic and still, and in the silence nerves uncurl and rest. Time stops. In the pause the few events that occur—the thud of pillows of snow, the thrumming whirr of a grouse, a whiff of bark—are experienced totally, not just seen or heard or smelled.

This felicity being so, it was inevitable that America would take up a craze for something that would utterly pollute it. So it has, the snowmobile, the season for which is upon us again. Whereas once this motorcycle on skids was a piece of gear affordable only by those with real business crossing snow country in a hurry, now affluence, leisure time, and the apparent desire never to stand up for more than 30 seconds have combined to make it the toy of thousands.

Baxter State Park in Maine is only the latest place proposed for opening to the infestation of snowmobiles. For some unaccountable reason snowmobiles are to be admitted where no other kind of motorized vehicle is allowed to go. It should be noted that snowmobiles in the hands of youngsters have been used to run deer to death. They chew up young trees and low-growing shrubbery. They can be as noisy as a chain saw and audible for miles. And, like any gasoline-powered vehicle, they stink. Every man to his taste, and presumably a legitimate winter sport can be made out of snowmobiling. But the machines should not be permitted to run wild everywhere, any more than is any other motor vehicle, and they certainly should be kept out of the roadless areas of parks, which were set aside by the people, at least in part, in order to escape noisy machines.

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1. Sales through dealers and carriers, street vendors, and counter sales	None	None
2. Mail subscriptions	42,413	45,504
C. Total paid circulation	42,413	45,504
D. Free distribution (including samples) by mail, carrier, or other means	523	527
E. Total distribution (sum of C and D)	42,936	46,031
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G. Total (sum of E & F—equals net pressrun shown in A)	44,239	47,742

I certify that the statements made by me above are correct and complete: *Eugenia Horstman Connally*, editor

What do you think?

My favorite features in National Parks Magazine this month were (in order of preference):

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2. _____
3. _____
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COOK APPOINTED NPA POPULATION CONSULTANT

Robert C. Cook has been named population consultant to the National Parks Association. For several years an NPA trustee, Mr. Cook has been president of the Population Reference Bureau in Washington for 18 years. In this position and as editor of the Bureau's *Population Bulletin* he has earned a national reputation as an authority on the population crisis. Overpopulation being the source of so much environmental evil, it is a prime concern of the Association, and Mr. Cook's expertise is sure to prove most valuable.

SETTING THE PACE ON UNDERGROUND WIRING

NPA has been following with interest the moves that are being made by the Maryland Public Service Commission on the eventual placement of all telephone and electrical power lines underground in that state—a philosophy which, if it were to spread beyond the boundaries of Maryland, would in our opinion constitute one of America's great esthetic leaps forward. There has been a good deal of talk in federal circles over a number of years on the same subject, but so far as we are aware the matter is still quite nebulous in the bureaus on the Potomac. But not so in Maryland. About a year ago the PSC of that state required undergrounding of power and telephone lines to new residential subdivisions of five or more lots, the additional cost to be divided between the utilities and the users. In an order announced this fall by Commission Chairman William O. Doub, utility lines to new commercial and industrial buildings must be placed underground as of October 1, additional costs to be shared as above.

Now the Commission's experts are studying the next logical step, which is conversion of existing overhead lines to underground—a phase that Chairman Doub admitted would be "astronomically costly." For the present the Maryland PSC will not tackle the problem of high-voltage transmission lines because methods and materials are not yet available at a cost that either utilities or users could afford; but the chairman has said that he sees the day when all utility lines in the state will be underground. We think that in this matter Chairman Doub and his fellow Commissioners are to be congratulated, and one might wish that the program could be included on the list of other good things that Maryland exports.

"I wish to know an entire heaven and an entire earth."—*Thoreau*

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AMERICA THE RAPED

By Gene Marine

Simon and Schuster, 1969. 312 pages. $5.95.

We are so bombed by media full of dire warnings that most of us at times feel as doomed and friendless as a *kamikaze* pilot who has changed his mind. So it is with considerable relief that one reads the dire warnings of Gene Marine, a senior editor of *Ramparts* magazine, in *America the Raped*. It is hard to remember ever smiling before at proposals to dam the Grand Canyon, chew a hole in Storm King Mountain, or flood Alaska with the Ramparts dam. But Marine has found a way into our hearts and minds with gloom. That way is to show the utter absurdity of the manner in which we as a people have managed our land, turning over custody of our most fragile treasures to the crudest and most hamfisted elements of society. Only later, after the macabre chuckle allowed us, does fury set in. One is left with the desire to rush forth raging, to destroy the Engineers the way Samson destroyed the temple of the Philistines.

Of course it is absurd to be such slaves and victims of that which should be in our service. Marine's term Engineers refers to the engineering mentality, the attitude that says the natural environment is worthless unless it can be made to yield a dollar profit immediately; that says a river that floods occasionally should be dammed, regardless of the long-term consequences; that refuses to bother following all the threads of cause and effect spreading from an action; that believes something is "progress" if someone profits now, and blast the hereafter.

Marine's book is a kaleidoscope of accomplished or proposed engineering rape. He says that laissez faire in America has let the industrial thug with the biggest economic gun, the softest footstep, the most saccharine ad firm, and the most friends in Congress commit civic and ecological murder.

The author is a journalist, which shows sometimes in the pell-mell succession of reports of incredible outrages. But it shows also in his adherence to the facts. Anyone can look up the record. Marine did. Collected together, the records scream.

But saddest of all that the author turns up is the implicit record of our gigantic indifference to the needs of the community of life that sustains us. Perhaps this indifference already has doomed us. Perhaps not. But we must fight it. "If the world is to survive," Marine writes, "then let it say that we—the momentary inhabitants of the only remaining continent where it can be done—preserved and enhanced its legacy. If it is not to survive, then at least let us perish in an activity more dignified than surrender."

Chris Weathersbee

INDEX

NATIONAL PARKS *Magazine*

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The abbreviation (edit.) indicates an editorial.
Month of issue is followed by the page number.

Although 58,000 acres of redwoods in California were designated in 1968 as Redwood National Park, more protection is needed for these magnificent trees. National Parks Association is dedicated to redwood protection, which should include scientific forest management in other coast redwood lands outside the park. You can help in this work by contributing to the Association over and above regular dues or by remembering the Association in your will. Such contributions and bequests are deductible for federal tax purposes.

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