cules that affect cells." Encompassing all of pharmacology, it would erase artificial distinctions between natural and synthetic compounds. For example, Ward says, "we might discover that some toxic chemicals have the same effect as hormones."

Another way to cut across subject matter might be to structure the topic of energy utilization so that it can be compared between an ecosystem and an individual organism—or even with inanimate functions. The report observes, for example, that a goose and an airplane are analagous in that each optimizes its energy-to-weight ratio by carrying its fuel as saturated hydrocarbons. Another pivotal theme for the matrix might be feedback regulation, as it is expressed in everything from bacteria to ecosystems.

A knowledge system that strives to put "all of biological knowledge in relation to the rest of it" is "somewhat premature," comments Lindley Darden of the University of Maryland's philosophy of science department. Rather, at this point, it is the "Platonic ideal." Indeed, as the committee notes, a more urgent need right now is for a "data base of data bases."

For the moment, the NIH is advised to think more according to the concepts embraced by the report. Investigators should be encouraged to think of models along "many-to-many" lines. More research on nonmammalian species should be promoted, and good research should be supported "without taxonomic or phylogenetic bias."

NIH likes the report. James D. Willett, head of its new section on Biological Models and Materials, says it has "all the earmarks of being on the doorstep of a new theoretical biology." The National Science Foundation, which discussed some of the concepts at a December workshop on advanced computing in the life sciences, is also "very interested" in the data bank idea, according to Mary Clutter, director of the division of cellular bioscience. After sitting in on the final NAS panel meeting, says Clutter, "I had a feeling I had a glimpse into the future."—CONSTANCE HOLDEN

Host of Problems Threaten National Parks

Park officials, legislators, and environmentalists take stock and suggest solutions

During the past month, a rash of studies, meetings, and congressional hearings have suggested that America's national parks are in trouble and that the National Park Service is in need of serious reform before it can successfully tackle the problems. Encroaching development, pollution, and overcrowding by tourists has steadily intensified, making it even tougher for the park service to balance the goals of preserving the parks and providing a place for recreation.

The problems challenging the parks are legion. The haze over the Great Smokies is no longer blue, but gray from air pollution. The grizzly bear may be approaching the point of extinction in Yellowstone National Park. Last year, private owners of 160 acres within the Grand Teton Park boundaries sought to develop their property. Ozone is damaging the giant trees in California's Sequoia National Park. Cape Cod National Seashore is fighting a legal battle with people who want the right to drive dune buggies on the beach.

Conservation Foundation president William Reilly, recently announcing a new report on national parks, said that the park system "has entered an era for which its traditions and policies have not prepared it." Federal legislators at a House hearing 20 and 21 May called for better monitoring of air pollution in the parks. A panel of national park managers and scientists at the annual meeting of the American Association for the Advancement of Science stressed the need to beef up science and research to help management make better decisions. The Conservation Foundation study concluded that there is an "immediate need" for a comprehensive program that would address the many problems, from mending fences to changing management practices and recommended that the federal government undertake a new half-billion dollar initiative.

All this discussion comes at a significant time. Last month, William Penn Mott, Jr., was sworn in as the new National Park Service director and is highly regarded by environmental groups. Mott, 75, has spent 46 years in park work and was director of the California state park system between 1967 and 1975 while Ronald Reagan was governor. He is credited with doubling the state's park system and initiating new kinds of agreements to create parks in cities. Environmentalists are hopeful that Mott, with his past ties to President Reagan, will be able to spearhead reforms and secure the necessary money.

In addition, the legislation that has provided the principal source of money to buy more than 1.5 million acres for national and state parks will expire in 1989. The Conservation Foundation report says, "No other single decision will so fundamentally shape the National Park System of the future as the selection of the successor to [this legislation]."

The Reagan Administration has strongly supported the restoration of existing facilities but has actively campaigned against the addition of new park land. Under former Secretary James Watt, the Department of the Interior initiated a $1-billion, 4-year program to restore national park facilities that even environmental groups acknowledge needed repair. New sewer lines have been replaced, roads mended, and buildings renovated. But the Administration has discouraged the purchase of more park land and encouraged economic development on existing acreage. Nevertheless, Congress has been spending an average of $100 million annually since 1980.

The Conservation Foundation proposes that the federal government double its annual expenditures to buy park land and that it also spend an additional $50 million per year for the next 10 years on resource management, an increase of about 30 percent over the current budget. The report goes on to list many recommendations that emphasize preservation rather than recreation:

- The park service should create a new program to train specialists rather than generalists to help manage the parks. The complexity of the many problems confronting the parks needs to be addressed by experts in natural and cultural resources.
- Park management should look to new ways to establish new parks and protect present ones. Gone are the days

when the first park service director Stephen Mather in 1925 reportedly blew up a sawmill in Glacier National Park after the owners failed to remove it after repeated warnings. The foundation encourages the purchase of land even if the acreage would encompass privately owned lots. Partial protection is better than none, according to the report.

- There are "hundreds" of repair and restoration projects to be undertaken. Money is needed, for example, to stabilize dunes, and repair forts.
- The parks must cooperate with local and state governments and others to tackle pollution problems that originate outside the park. The report points out that oil and gas leasing in Yellowstone threaten the grizzly's habitat and that water pollution is a problem at Everglades and Mammoth Caves.

The scientific basis to evaluate these problems, however, is generally very weak, according to park service scientists and managers. John Dennis, a biologist and 12-year veteran of the park service, said at the AAAS meeting that the park service currently spends about $18 million or 3 percent of its operating budget on natural and social science research and monitoring, which is far too little, he says.

Air pollution is believed to be a significant problem, even for parks located seemingly far away from urban areas. Visibility in the Grand Canyon, the Smokies, Yosemite, and other parks is deteriorating. At Sequoia, ozone is believed to have caused moderate to severe damage to more than one-third of the trees at concentrations that are less than limits set by the Environmental Protection Agency.

Solutions to the air pollution problem in the parks are difficult because the exact nature and source of the pollution is often largely unknown. The parks' air quality program was created 9 years ago, and now has a yearly budget of $3.9 million for the entire park system. Just 29 of the 48 national parks that are larger than 6000 acres currently measure air pollutants. Even so, not all the important contaminants are monitored. Park service scientist William Malm testified that although nitrous oxides and particulate matter are significant sources of air pollution in the West, none of the parks test for them."

There are gaps in other kinds of data too. Only ten parks have undertaken detailed studies of the pollution's impact on fauna. None of the Alaskan national parks currently measure the quality of air or water to establish baseline data to evaluate any biological changes. The park service just recently started to measure acidity levels in lakes and streams. The database of the park service is "inadequate," Malm said.

Academic scientists conduct research in the parks, but their findings are frequently irrelevant to park management, according to Robert Barbee, the superintendent of Yellowstone, the nation's first national park and one with a host of complex problems. Barbee, who received his training in zoology and wildlife management, said at the AAAS symposium that research in the parks "has only recently been accepted as having a role in management, and it hasn't quite made the grade even yet. Research was never part of the service's mission."

Conservation groups were encouraged when Mott met last week with their leaders and senior park managers at Yellowstone and vowed to protect the parks. In fact, the park service under his direction ordered for the first time limited access to Yosemite this past weekend to prevent overcrowding. He also pledged to add more land to the park system in the future. Mott stated, "We've got to err on the side of preservation."—**MARJORIE SUN**

GM Buys Hughes for $5 Billion

On Tuesday 4 June, the Howard Hughes Medical Institute (HHMI) sold the Hughes Aircraft Company, its only asset, to General Motors for somewhat more than $5 billion. The sale makes the medical institute the nation's largest private philanthropy. It also marks an important step for General Motors which began a strategy of diversification last year with the purchase of Electronic Data Systems, a data-processing company and major supplier to the military. Hughes Aircraft, a leader in electronics and satellite communications, is the seventh largest contractor to the Defense Department.

In anticipation of the successful sale of Hughes Aircraft, the medical institute has been poised for growth (*Science*, 7 June, p. 1178). It currently supports some 200 Hughes scholars at official HHMI units on 17 research campuses and is evaluating ways of spending its new funds. HHMI president Donald S. Fredrickson, former director of the National Institutes of Health, estimates that, on the basis of the General Motors deal, the institute will have $200 million to spend this year, double present expenditures and four times the amount it dispersed in 1983.

General Motors bought Hughes Aircraft with $2.7 billion in cash and 50 million shares of its new Class H common stock. According to a statement from the auto company, the new Class H stock "provides a means of maintaining the highly successful Hughes Aircraft Company as an independent and separate subsidiary, while simultaneously combining the company with GM's automotive electronics businesses and a portion of GM's defense operations." The acquisition is expected to "accelerate the rate of application of electronics" into General Motors cars and is seen as a way of increasing the company's competitive position vis-a-vis foreign industry, particularly in Japan.

General Motors chairman Roger B. Smith says U.S. industry must succeed in developing highly efficient new forms of manufacturing and management, dependent on computers. "At the present time, throughout industry worldwide, there is only limited systems engineering expertise in this new area of computer-integrated manufacturing," he said in a statement. "The Hughes Aircraft Company is one of the few organizations that has extensive experience in systems engineering."

While General Motors looks to the future in the automotive and defense industries, the medical institute is thinking about areas in biomedical research that need more support now and that will be at the forefront a decade from now. "Molecular biophysics" is one it has identified in the latter category; "molecular medicine" is one that is targeted for attention in the near term. The influence of HHMI on the direction of biomedical science is likely to be substantial as it pours new money into the enterprise. Fredrickson estimates that in the future Hughes may be supporting as much as 10 to 15 percent of basic biomedical research in the United States.

—**BARBARA J. CULLLITON**