tion of American Medical Colleges says some scientists support this idea, but "exactly how 'goals' would be defined is difficult."

Both Keyworth and Brandt lauded the achievements of NIH and underscored the importance of maintaining its eminence. But neither one gave any clue as to who would succeed Donald Fredrickson as NIH director. Thomas Malone, who was the deputy director under Fredrickson, is now acting director. Brandt said the Administration wants to select a director as quickly as possible but stated it has no specific timetable in mind.

Brandt, in his remarks to the committee, said that the federal government is rethinking its role in medicine and health and in some areas has concluded that its presence is inappropriate. For example, the Administration decided early on that Professional Standards Review Organizations (PSRO's) are primarily a professional responsibility, not a federal one, Brandt said.

One of Brandt's principal concerns is providing NIH with stability by supporting a fixed number of grant awards or research trainees. He said, however, that it is not clear what the number should be. Two years ago, after many negotiations the government announced it would support 5000 grants a year. For fiscal 1982, the number is 4800. "Should it be 6000, 4000, 1000? What number is appropriate and how should we arrive at it?" Brandt asked, apparently willing to start the discussion of stabilization levels over again.—MARJORIE SUN

Germplasm Resources Are Losing Ground

Despite international efforts to preserve genetic variety, massive land clearing threatens many species with extinction

Human population growth and economic development are rapidly encroaching on natural ecosystems throughout the world. The problem affects all life forms—animals, plants, and microorganisms. The threat to wild animals has received greater publicity, but the loss of potential food sources has prompted a more intense if less conspicuous international effort to conserve plant germplasm resources.

Food crop plants have come under particular pressure because radical changes in agriculture associated with the Green Revolution have caused replacement of indigenous, genetically varied plant varieties with a relatively few hybrid types that are genetically similar.

The resulting susceptibility of these crops to disease and insect damage was brought home in 1970 by the southern corn leaf blight epidemic in the United States (*Science*, 9 October, p. 161). The epidemic spurred both national and international efforts to increase genetic diversity in crop plants and also to preserve the germplasm pool from which future food crops and also pharmaceutical and other useful products might be developed.

Significant progress has been made in the past decade in creating better means for collecting, preserving, and using plant germplasm resources. Many experts warn, however, that this progress is being outpaced by the accelerated clearing of land for settlement, farming, grazing, and lumbering. Loss of genetic material in wild species and in primitive crop varieties developed from them is said by an official of the U.N. Food and Agricultural Organization to have created a "crisis situation."

At the same time, international cooperation is troubled by disagreement over what has come to be known by the shorthand term "plant breeders rights." Industrial countries have increasingly granted plant breeders the equivalent of patent rights for new plant varieties produced by selective breeding. Critics in less-developed countries (LDC's) argue that these proprietary rights and the royalties charged on seed protected by the laws are unwarranted exploitation of Third World countries.

The United States has a special incentive for cooperation. Despite its prodigiously productive agriculture, this country was originally a have-not in respect to indigenous food plants. Of the major cereals, for example, only maize was found here when the first European settlers arrived, and that had been introduced from Mexico by the Indians. Americans have excelled in breeding high-yielding "cultivars," but scientific breeding tends to narrow genetic variety. Interest has grown, therefore, in germplasm resources found in the so-called "land races," crop varieties domesticated from wild plant species over thousands of years in regions where they originated.

The chief international mechanism for conserving these germplasm resources is a network of gene banks and clonal repositories coordinated by the International Board for Plant Genetic Resources in Rome. A year ago at a meeting of the Internation Union for the Protection of New Varieties of Plants the executive secretary of the IBPGR, J. T. Williams, gave a forthright summary of the shortcomings of the international program in respect to preserving wild species and primitive cultivars.

Williams, also an official of the U.N. Food and Agricultural Organization, said that "for nearly all crops or species of economic interest these types of germplasm are barely represented in the germplasm collections. To give you an example, there is a very large collection of rice held now by the International Rice Research Institute, but this is relatively deficient in wild material. We have recently conducted a survey of the wheat collections of the world and even though this was a very difficult task, and in some cases some countries were unwilling to release their information, we were able to make relatively educated guesses and we found the taxonomic range to be completely inadequate. We find that the samples from geographical regions that are represented in these collections are also completely inadequate and this poses the question now whether we proceed from the base we have already got for an important crop like wheat or whether we really start again and go about it in a much more scientific manner. At the same time, the collections have been relatively deficient in primitive cultivars, largely because breeders in the past have not used them to any great extent." Williams concluded by noting, "It is this type of material which is being eroded in many parts of the world; in fact, for many crops we are facing a crisis situation."

Anchoring the international program is

0036-8075/81/1023-0421$01.00/0

Edwin G. Huffman/World Bank

Cutting away

Colombians clear jungle for farming

a system of plant research institutes established originally to apply Western plant breeding techniques to improving the yield of food crops in LDC's. The prototype centers were a station founded by the Rockefeller Foundation and the Mexican government during World War II and the International Rice Research Institute in the Philippines established by the Rockefeller and Ford foundations in the mid-1950's. The Mexican station, which became the Centro Internacional de Mejoramiento de Maiz y Trego (CIMMYT) developed the semidwarf wheat varieties that served as a model for the Green Revolution.

There are now a dozen of the centers devoted to plant and animal development. International agencies have taken over from private foundations and policy is made and funds distributed through a Consultative Group on International Agricultural Research (CGIAR) based in the World Bank. The total budget for the systems is some $140 million a year provided by 45 member countries and organizations. The U.S. contribution amounted to about 25 percent of the total.

The International Board of Plant Genetic Resources is a CGIAR agency. IBPGR was established in 1974 in the aftermath of the southern corn leaf blight epidemic. The board's main responsibility is for the network of genetic resource centers to foster the collection, preservation, evaluation, and use of plant germplasm. Gene banks are operating in most of the centers in the CGIAR system; the board's network includes other international, regional, and national research centers. CIMMYT in Mexico has the largest collection in the world of maize germplasm.

Limits on resources have inevitably affected how well the network functions. One leading American seed company, Pioneer Hi-Bred International, has concluded an agreement with CIMMYT to cooperate in maize germplasm preservation. Pioneer officials' view is that the center was not able to replant the material it held sufficiently often to maintain it and some accessions would be lost. Pioneer agreed to establish a program to help. A Pioneer station in Florida will grow seed from CIMMYT and return the product to the center. As a quid pro quo, material that appears to have promise to Pioneer breeders will be intercrossed with Corn Belt species, and tried out in more northerly breeding stations. Some critics say that the international centers' preoccupation with increasing crop yields leads them to give lower priority to germplasm preservation.

Elizabeth Russell, who chaired a 1978 National Academy of Sciences report* on the implications of the diminution of global germplasm resources, says the apparent lack of concern about losses of indigenous plants continues to worry her. She notes that a decade ago gene storage banks and facilities to test seeds were being established and "everybody was feeling good about it." Money was available then for such activities, but subsequently inflation and level funding have undercut the effort to preserve plant germplasm resources. Russell, a senior staff scientist at Jackson Laboratory at Bar Harbor, Maine, says she sees evidence of growing awareness of the problem in U.N. agencies and in the U.S. government, but says, "I don't know if it will work fast enough."

The harmony of the international effort has also been disturbed by lingering differences between the industrial countries and LDC's. Earlier, the LDC's resented the freewheeling use of exotic germplasm by commercial plant breeders with no direct return to the LDC's. More recently, the focus has shifted to the provision by industrial nations of legal protection to new varieties of plants developed by selective breeding. In the United States, the Plant Protection Act of 1970 extended the equivalent of patent protection to new and distinct plant varieties.

Critics say these new laws restrict the exchange of genetic material and result in unnecessarily high costs for seed to LDC's. Scientists at CIMMYT and other international centers have opposed the laws and the issue has become a sore point in international discussions of the use of plant genetic resources.

Proponents of the new laws argue that they have encouraged investment in plant breeding activities and that an upswing in the development of new varieties in the past decade is attributable to the laws. In the United States, Congress last year, in amending the 1970 law, called for a study of the social and economic impact of the legislation. The debate on the matter seems to be muted while the 2-year study is under way by the food systems research group in the department of agricultural economics at the University of Wisconsin.

The effort of maintaining germplasm resources for food crops is only part of the overwhelming task of sustaining general biological diversity in the face of ecological assaults of unprecedented scale and rapidity. A growing number of scientists, however, are suggesting that the assumptions on which the strategy of germplasm preservation is based should be reappraised.

Peter Ashton, director of the Arnold Arboretum at Harvard, points out that

Conservation of Germplasm Resources (National Academy of Sciences, Washington, D.C., 1978).

"until the Industrial Revolution man was largely confined to the fertile sites of the earth." These sites, which provided the plants and animals which remain his major sources of food, are the most threatened by population growth. Man is being forced to farm poorer land, taking with him crops more or less unsuited to the new lands. The fragile ecosystems of these primarily tropical lands are being rapidly destroyed, leaving no time for the economic potential of indigenous plants to be evaluated and developed.

If a lack of funds hampers conservation of germplasm resources, a lag in policy is also deplored by some. Ashton notes that the economics of world agriculture are not static. The era of cheap energy, fertilizers, and pesticides from petroleum is ending. Current methods of farming rely on large inputs of fertilizer and water and little human labor to raise a narrow range of crops. Population growth, a shortage of arable land, and rising oil prices make it advisable to consider different approaches. Many LDC's have a wide variety of indigenous crops. These are not as productive as hybrids under present conditions, but it may be advantageous for some LDC's to turn to agro-forestry, for example, planting fast-growing trees for fuel in rotation with food plants. Multiple cropping of several crops in the same field may be the answer to higher production in other places.

The point, says Ashton, is that a totally different attitude toward agriculture should be encouraged, suggesting that the small-is-beautiful approach to alternative technology advocated by Ernst Schumacher has much to commend it.

Ashton concedes that the problem is "many faceted and, therefore, difficult to get across." More organizations are showing interest—USDA and AID, for example, as well as nongovernmental organizations such as the World Wildlife Fund and International Union for the Conservation of Nature, says Ashton. But "there is a lack of communication. Nobody is running the show." Moreover, he sees far too little evidence of concern in influential political quarters.

The possibility of change in that respect may be read into the scheduling of a U.S. Strategy Conference on Biological Diversity in Washington on 16 to 18 November sponsored by the State Department and AID. The agenda calls for a discussion of "crop and noncrop plants, trees, domesticated and wild animals, microbial organisms, ecosystems, aquatic resources and genetic engineering applications." About 100 resource managers and technical experts from the United States are being invited along with some foreign participants. The aim is to consider steps the United States might take to preserve biological diversity throughout the world. Since the strategy session is the first such conference convened by the Reagan Administration, it is considered a boost for biological diversity.

Meanwhile the voices crying in the wilderness are warning that the wilderness is fast disappearing.—JOHN WALSH

Gore Investigates Radiation Clinic

Hearing finds no evidence that patients were mistreated in research on space hazards

Congress recently looked into some well-publicized charges that cancer patients at a hospital in Tennessee were given nontherapeutic doses of radiation to produce data for the space program. The results were mixed. While the findings raised questions about the quality of care at the clinic, they did not substantiate the charges of misconduct, which had received national attention in August (*Science*, 4 September, p. 1093).

The hearing was held on 23 September before the House science and technology subcommittee on investigations, chaired by Representative Albert Gore, Jr. (D–Tenn.). Gore picked his way carefully through the evidence, laying out a record that essentially faults the clinic for operating at less than the highest medical standards in the 1960's and 1970's, but fails to support the charge that patients were used in a callous fashion to generate data on space hazards.

Much of the testimony focused on the case of Dwayne Sexton, a child with acute leukemia who was treated at the Institute of Nuclear Studies (INS) in Oak Ridge, Tennessee, from 1966 to 1969. He died there in 1969 at the age of 6½. Early press accounts suggested that Sexton was needlessly given radiotherapy as part of a program to collect data for the National Aeronautics and Space Administration (NASA). The evidence did not support this allegation. Indeed, the hearing produced little new information on the NASA-sponsored research.

Witnesses did raise questions about the quality of care Sexton received, however. One physician said that it may have been wrong to involve the child in an immunologic experiment at INS before he had been given a standard course of chemotherapy. Gore questioned some of the former INS researchers about the wisdom of conducting experiments in which people were exposed to radiation at low dose rates for prolonged periods. But medical witnesses said the experiments seemed reasonably well run, given the state of knowledge about radiotherapy in the late 1960's.

The inquiry was limited because there were many gaps in the record. Andrew Stofan, a NASA official, disclosed that all of NASA's documents on the INS research, which ran from 1964 to 1974, had been thrown out in the course of routine housecleaning. Gould Andrews, INS' chief medical investigator, whose testimony would have been valuable, died last year.

The INS clinic was closed in 1974 after a review committee decided that it would cost too much to bring the facilities into compliance with the health and cleanliness standards enforced at that time by the big insurance companies. The staff and facilities were incorporated into the Oak Ridge Associated Universities.

As the hearings revealed, INS had several goals, which at times may have been in conflict. First, the clinic sought to help cancer patients by giving them a variety of treatments, including chemotherapy, which one INS staffer referred to as a "competitor" with the clinic's specialty: radiotherapy. A second goal was to develop new techniques for treating cancer with radiation. Third, some of the researchers were being paid by NASA to collect information on the effects of small doses of radiation on man. NASA wanted to know, for example,

0036-8075/81/1023-0423$01.00/0