Joe L. Evins

presents an interesting case study on the making of science policy. There is perhaps no "big science" proposal which has generated more agony or agonizing in recent years than the design to drill through the ocean floor from a free-floating platform. Over the last 3 years, Mohole survived reviews by the National Science Board, the Bureau of the Budget, assorted committees of the Congress, and a number of *ad hoc* bodies that were assembled to look into the matter. At this point, it was considered to be home free, but with Thomas no longer there to serve as its congressional guardian, it may turn out that Mohole has accumulated enough liabilities to become politically unviable.

The Mohole discussion opened with Evins inquiring, "In view of the Vietnam war emergency . . . is this project of a high priority? Can it be deferred?"

After Haworth had assured the committee that careful review had preceded the decision to go ahead with the project, Evins inquired about the criteria that were employed in making the decision. Replied Haworth: "It would be a fair statement to say it was reviewed in the context of the budgetary situation in the total science complex. I cannot say we put this in comparison to weapons in Vietnam or something of that sort, but we were realizing, at that time though not as fully as we realized later, that the total science budget had to compete in some sense with these other things. However, it was given a pretty high priority within the science realm. In other words, in effect I guess I am saying it displaced some other things in science."

Shortly after this, the conversation went off the record. But then Representative George E. Shipley (D–Ill.), apparently in reference to a remark that Evins made during the off-the-record discussion, said, "With the Vietnam situation as it is, I am in agreement with the chairman; that is, perhaps it can be postponed or completely done away with. That might be the thing to do."

In its report, the committee dealt with Mohole in one brief paragraph: "In view of the current world situation and the need to continually review priorities, the Committee has not allowed funds for project Mohole. This project has progressed slowly with considerable difficulty—the total estimated cost is in excess of $75,000,000. The cost of the project has already greatly exceeded the original estimate and promises to increase still further. The Committee suggests that the funds of the Foundation can be more advantageously used in other activities and no funds are included to continue this project."

At this point, the strongest political argument for Mohole is that the approximately $20 million expended so far will be largely wasted if the project is halted. On the other hand, the "cut-your-losses" concept has a lot of appeal when congressmen are cutting down on expenditures in other members' districts. Mohole no longer has an effective champion on Capitol Hill. Nor, for that matter, does it have any well-defined constituency within the scientific community. Years of conflict over the deep-drilling design served to split up or disaffect the scientists who supported the project in its early stages. Most oceanographers and geophysicists agree that it would be desirable to have the Mohole rig digging deep into the ocean floor, but no one wants to tie his career or professional reputation to the project —which, by the administrative folklore of "big science," is supposed to be a necessity for successfully running big projects. In any case, Gordon Lill, who has been widely praised for his performance as Mohole director on the NSF staff, is returning to Lockheed next month, after 2½ years on the job. NSF has yet to find an institution or a consortium to take over the project, and, as a consequence, Mohole has the unique status of being directly administered by NSF, which is only supposed to pay for, not run, research projects. But on the basis of past performance, Mohole must be likened to the serial hero who is sealed in a cyanide-gas-filled lead casket and dropped into the depths of the sea. The next episode opens with "After our hero's miraculous escape. . . ."—D. S. GREENBERG

Food: Postwar Experience Shows It Was Later Than We Thought

One of the sobering lessons being learned by the United States is that the problem of an incipiently disastrous food deficit in the less developed countries can't be solved simply by our shipping surplus food and fertilizer and proffering agricultural know-how.

After World War II our policy makers shared a widespread optimism about prospects of meeting world food demands even in the face of extraordinary population growth.

Typical of this sanguine outlook was the view of the first director-general of the United Nations Food and Agriculture Organization (FAO), Sir John Boyd-Orr. In 1952 Boyd-Orr wrote this.

"Can the earth provide food on a health standard for this increased number? The author gives well-authenticated facts to show that there is no physical difficulty in doubling or redoubling the world food supply. If the farmers fail us, the chemist has already shown the way to synthetic food. The only practical limitations to food production are the amount of capital and labor human society is willing to devote to it."

A decade later the prognosis had altered radically. Boyd-Orr's successor as director-general of FAO, Binay R. Sen, recently said that, in the next 35 years, "either we take the fullest measures both to raise productivity and to stabilize population growth or we will face disaster of an unprecedented magnitude."

The misjudgment of the postwar

years is not hard to understand. The success of American food producers and the recovery of European agriculture after the war seemed promising portents for the underdeveloped countries. But the increase in population amounted virtually to a demographic chain reaction. And development proved a more difficult process than had been expected, in essence because the application of the technology of industrialized nations to preindustrial societies requires nothing less than the reorganization of those societies along radically altered lines.

This was recognized in a symposium devoted to the "Prospects of World Food Supply" on the first day of the National Academy of Sciences' annual meeting in late April, in that social and institutional aspects of the modernization of agriculture were given as much emphasis as the scientific and technological ones.

Not only were papers delivered by AID Administrator David E. Bell, J. Burke Knapp, vice president of the International Bank for Reconstruction and Development, and University of Chicago economist Theodore Schultz but scientists on the panel who addressed themselves to specific technical problems also put their contributions in broader perspective.

Productivity and Literacy

Paul C. Mangelsdorf of the Harvard Botanical Museum, whose paper treated "Genetic potentials for increasing yields of food crops and animals," noted that it is now possible to breed superior plant genotypes for any part of the world and even to provide improved environments for these genotypes. But he went on to add that "the rate at which the agriculture of underdeveloped countries can be improved is dependent in no small part on the general level of literacy and education in the population and on the willingness of governments to provide generous support for agricultural education and research. To change the ways of man is infinitely more difficult than to reshape our domestic animals and plants by genetic techniques."

Taking the view that "agricultural improvement in underdeveloped countries is necessarily slow," Mangelsdorf briefly examined the prospects of the United States' compensating for the food deficits in the underdeveloped countries. His analysis throws cold water on the comfortable assumption that we are riding a kind of endless escalator of agricultural abundance.

The mistake, he says, is to think of the future in terms of the immediate past. Agricultural production here has been increasing at the rate of about 2 percent a year since 1940, while acreage devoted to food production has actually declined. In the 30 years between 1930 and 1960, average corn production per acre doubled, from 26 to 52 bushels a year.

Chances of continuing this pace, however, are not at all good, says Mangelsdorf, "unless we can achieve some important 'break throughs' which are not now in sight."

The rise in corn productivity he attributes to three main factors: (i) improved genetic potential in the form of hybrid corn; (ii) greater use of fertilizer (between 1950 and 1960 consumption of nitrogen fertilizer more than doubled); and (iii) greater use of herbicides which kill weeds but do not kill corn plants.

Inputs in these three areas, however, have reached a point of diminishing returns. Mangelsdorf puts it this way.

"With more than 95 percent of the corn acreage already planted in hybrid corn, with the genetic potentials of the hybrids already having reached a plateau, with 87 percent of the acreage in the Corn Belt and Lake states already using fertilizer, and with many farmers already employing herbicides (not to mention pesticides), from where are the future improvements to come that will allow us to continue our present rate of improvement?"

Mangelsdorf feels that this question can't be answered until basic research is expanded in two key areas. He feels that the nature of heterosis, or hybrid vigor, is not well understood and merits more intensive research. He believes also that "research is urgently needed on the biological characteristics of the world's principal food plants." He points out that we know too little about the 15 or so plants which provide the bulk of the world's food crops. (His list: five cereals—rice, wheat, corn, sorghum, and barley; two sugar plants—sugar cane and sugar beet; three root crops—potatoes, sweet potatoes, and cassava; three legumes—the common bean, soy bean, and peanut; and two tree crops—the coconut and banana.)

He mentions as a model the rice research institute sponsored jointly by the Rockefeller and Ford foundations in the Philippines. Geneticists, plant physiologists, mycologists, biochemists, engineers, and others combine forces in an effort at "understanding the rice plant and learning how to improve both the plant and its environment."

Nobody suggests that the American experience is irrelevant to the problems of developing countries. What is important, however, is how this experience is applied. What works in Iowa in the way of seed, fertilizer, herbicides, and farming methods is likely to work much less well on the banks of the Indus. Adaptation is the key. "Victories" in agriculture tend to be local, limited, and temporary. What matters is being able to cope with problems as they arise.

Dangers of Bad Advice

At the NAS symposium, Elvin C. Stakman, University of Minnesota, who spoke on "Pest, pathogen and weed control for increased food production," put it this way. "To capitalize fully on presently known methods of plant protection will require widespread rural education; to increase and safeguard future food supplies will require continuous research, for pests and pathogens are indeed 'shifty enemies.' There are hundreds of species of noxious weeds, thousands of kinds of insects, and thousands of kinds of plant pathogens ranging from invisible viruses, microscopic bacteria, fungi, and nematodes, and on up to the larger fungi and parasitic higher plants. There is no panacea for controlling these numerous and diverse enemies of numerous and diverse kinds of crop plants. And there is no one kind of crop-protection specialist who is competent to prescribe for all the special cases. Yet precise prescriptions are needed because the wrong procedure may do more harm than good, just as the wrong prescription for treating animal or human diseases may result unfortunately or even fatally."

Cultivating land in tropical areas poses special problems, particularly in those areas where the available nutrients are concentrated in the vegetation rather than in the soil. When such land is cleared and exposed to the characteristically heavy rainfall, leaching and erosion occurs, which often makes farming or grazing impossible.

One group of agronomists have all but written off large areas of the tropics as potential agricultural lands.

Others, like Charles E. Kellogg, deputy director of the Department of Agriculture's Soil Conservation Service, believe that the means are at hand—in the form of plants, fertilizer and new machinery to apply it, herbicides to fight the overbearing tropical weeds, and management methods—to make sizable areas of the tropics arable and, with the addition of water for irrigation, some desert and semiarid areas as well.

The two classic ways to increase agricultural acreage, of course, are to put additional land under cultivation or to find ways of increasing the yield of land already in use. In the case of the tropics, however, putting new land to productive agricultural use would involve much the same sort of inputs as are required to raise yields on land already being cultivated.

An Agriculture Department economist, Lester R. Brown, who has written a good deal on world food needs and prospects, has observed that "the ability to raise yields also seems to be closely related to the level of income. Increasing the food supply by expanding the area under cultivation requires relatively little capital. Increasing output per acre, however, requires a substantial increase in capital inputs in the form of fertilizers, pesticides, and improved implements."

The implications of this statement are very broad when it is viewed in the context of the underdeveloped rather than the industrialized countries. At the NAS symposium, J. Burke Knapp of the International Bank suggested the range when he said, "The Bank is fully aware of the fact that capital is only one of the essential elements required to bring about productivity increases. The factors limiting growth do not spring from any capital shortage but, in degrees varying from one country to another, from the need for extensive land reform, the lack of remunerative market opportunities, shortage of farm requisites, inadequate knowledge of soil and climatic conditions in many parts of the developing world, the limited knowledge of the farmer himself, and insufficiently strong agricultural administrations capable of planning and preparing agricultural projects suitable for financing. The provision of capital

HUAC: Stamler's Challenge Draws Academic Support

One manifestation of increasing political activity in the American academic community these days has been its support of the attempt of Chicago heart-research specialist Jeremiah E. Stamler to challenge the constitutionality of the House Committee on Un-American Activities (*Science*, 23 July 1965).

Subpoenaed to appear before HUAC in Chicago last May, Stamler and an associate, Yolanda Hall, decided, with the support of counsel, neither to go along with the committee in its investigation of an alleged resurgence of communist activity in the area nor to take the Fifth Amendment. Instead they initiated legal action against the committee. At the hearings, they submitted brief statements, then left the hearing room. As a result of their departure—and of the anti-HUAC demonstrations that also characterized the session—the committee later voted to cite them for contempt. The illness of committee chairman Edwin Willis (D–La.) has prevented the requested citations from reaching the floor of the House, whose approval is necessary to initiate formal action. But Willis is expected to return shortly, and, according to a spokesman for the committee, will take up the matter quickly when he does.

In the meantime, however, Stamler's legal battle against HUAC is pending in the U.S. Court of Appeals and has attracted substantial support. The only formal organization in the picture is a Legal Aid Fund headed by Paul Dudley White, Robert W. Wissler, and John F. Perkins. White is the well-known Boston heart specialist; Wissler and Perkins are chairmen of the departments of pathology and physiology, respectively, at the University of Chicago. Their efforts have resulted in donations of about $49,000 from more than 3000 people, mostly in the academic community. In addition several petitions are now being circulated to Congress urging it to vote against HUAC's effort to obtain citations.

One petition, signed by about 700 biomedical scientists and physicians, was the result of efforts by the three sponsors of the legal aid fund. The others, however, were initiated independently. They include a list of about 1000 political scientists, organized by Theodore Lowi, Hans Morgenthau, C. Herman Pritchett, and Quincy Wright, all of the University of Chicago; D. F. Fleming of Vanderbilt; and David Truman of Columbia. Another list of about 250 historians was organized by Walter Johnson and John Hope Franklin (Chicago), Henry Steele Commager (Amherst), John Caughey (U.C.L.A.), and William Willcox (Michigan). There is also a list of about 400 professors of law, organized by Clark Byse, David Cavers, Vern Countryman, Mark De Wolfe Howe, Louis Jaffe, John Dawson, and Albert Sacks, all of Harvard; and Dean Robert Drinan, S.J., and William J. Kenealy, S.J., of Boston College Law School.

The petition, which was formulated by law professors, briefly traces the events leading up to the citations. Its concluding paragraph reads: "Because of the Committee's disregard of its own rules, because the entire matter may be rendered moot by pending litigation, and because this is merely one more instance of this Committee's continuing abuse of its powers to no apparent legitimate legislative purpose, we urge you to vote against all the contempt citations."

Why the Stamler case has drawn so much interest at this time is a question to which nobody, not even Stamler, has the answer. It may be in part that he is prominent both locally and professionally; or that there is something in the particular style of his counteroffensive with which the academic community can readily identify. And it may not be too much to guess that at least one of the moving forces is that question intellectuals recurrently ask themselves: "When McCarthy was around, where were we?"—E.L.

must therefore be coupled with agricultural policies and actions that extend far beyond finance. When the preconditions of capital investment are met, spectacular increases in productivity can follow as the Bank itself has witnessed."

Limitations on investment in agriculture, therefore, are not simply those imposed by the scarcity of capital in most underdeveloped countries. Brown points out that, in subsistence economies, agriculture is not "market oriented." Relatively little food is available for marketing, and as a result cash incomes are low and farmers don't acquire the capital needed to purchase the inputs which result in higher yields.

Furthermore, prices for farm commodities in underdeveloped nations are generally unfavorable with respect to the price of inputs needed to raise yields—fertilizers and pesticides, for example. It is estimated that 1 pound of rice in Japan will buy as much ammonium sulfate as 3 pounds of rice in India.

Breaking the vicious circle requires not only reform of the landholding, credit, and commodity pricing systems in underdeveloped nations but also transformation of the society which has generated these systems. Increasing the food production and decreasing the rate of population growth ultimately depend on rapid changes in societies which may have been well adapted for survival a hundred or five hundred or a thousand years ago but are now producing too many people and too little food.

In the industrialized countries the present favorable balance between food production and population growth is usually attributed to industrialization, luck in the possession of raw materials, urbanization, growing literacy, and a rising standard of living. There now seems little cause for optimism that the underdeveloped countries will somehow naturally follow the same path.

After the war, what was possible was mistakenly taken as probable. Hopes for the development of major alternative sources of food, for example, have proved exaggerated or at least premature. Food from the sea, predominantly fish, still provides only about 1 percent of the food energy for man. And overfishing in the best fishing grounds has already become a serious problem. Production of fish flour from species not now commercially sought after provides one new potentially important source of protein, but other schemes, such as those for converting plankton and seaweed into major food resources, have made little progress.

Food can be synthesized from such raw materials as petroleum, but the problems of making it both economic and palatable have not been solved.

The best immediate prospects seem to lie in the expansion of arable lands through irrigation made possible by conversion of sea water and brackish water in nuclear-powered desalinization plants. In parts of Asia, Australia, the Middle East, and North Africa the desert could probably be made to bloom.

But even this will take time and money, and a good deal of both. Meanwhile the United States, with its food-producing potential, its agricultural know-how, and its money, is inevitably type cast as a combination benefactor and banker to the underdeveloped countries, the noncommunist ones at least.

In the last few years a realization of what the consequences of this involvement may be has been growing in Washington. As a result, President Johnson early in the year announced that, henceforth, recipients of Food for Peace shipments would be expected to carry out effective self-help measures (*Science*, 6 May). This, in short, means effective measures to control the rate of population growth and to modernize agriculture at a faster rate. What happens if a country doesn't help itself and then asks us for food to stave off a devastating famine is a question which suggests the sort of moral and political dilemma that will confront the United States if, as now seems certain, the world population curve continues to rise faster than the food production curve.

—JOHN WALSH

Announcements

Three institutions in Texas have joined in a cooperative program for research to help meet the state's needs for **water resources**. The University of Texas, Texas A&M University, and Texas Technological College signed an agreement in March to coordinate their efforts in long-range research and academic projects. The agreement makes the Water Resources Research Institute in Texas (established at Texas A&M in 1964) the agency through which state-supported universities will present proposals for research funds to federal and state agencies. A three-member Water Resources Research Program Committee representing the institutions will formulate programs and priorities for funding requests, keep track of research and education in the state, and recommend means of coordinating programs and exchanging information. The group will also appoint a panel of at least a dozen members, to advise on "matters that are in the public interest concerning the role and scope of water resources research in Texas."

The newest AEC exhibit, **Life Science Radiation Laboratory**, was put on display last month at the Smithsonian Institution in Washington, where it will remain through July. A "working lab" designed by Oak Ridge Associated Universities for extended showings in major cities, it uses live plants and animals, as well as inorganic materials, to illustrate the beneficial uses of radiation in medicine, agriculture, and biology. Lecture-demonstration programs lasting 20 to 30 minutes are presented by personnel trained at Oak Ridge.

Scientists from academic, governmental, industrial, and military organizations are invited to contribute planning advice for the expansion of the Joint Oceanographic Institutions **Deep Earth Sampling** (JOIDES) program. The program is being carried out by the Institute of Marine Science, Lamont Geological Observatory, Scripps Institution of Oceanography, and Woods Hole Oceanographic Institution, with support from the National Science Foundation. JOIDES has completed a "modest drilling project" on the Blake Plateau (*Science*, 5 Nov. 1965, p. 709), and is now planning a broader program, expected to begin next year, during which there will be opportunities for scientists to participate in the drilling and research operations. Drilling in both the Atlantic and Pacific Oceans will be at depths to 6000 meters, and may penetrate as much as 1000 meters into the ocean floor. Resulting materials and data will be available to scientists regardless of their affiliations, provided that the results of their research are published promptly. Sugges-