

developing atomic weapons as a deterrent for further war. At the same time the possibility that Egypt or other Arab countries could get A-weapons from China or even Russia was suggested.

**In spite of these threats**, U.S. arms control officials are hopeful that the Nonproliferation Treaty, once drawn up, will be adhered to by Israel and the Arab countries. They feel that a nuclear race, and the inevitable stalemate, would gain neither side any advantage, and hope to persuade them of this.

Israel's Government said that it has no plan to pursue nuclear weapons development, but its last statement on the subject was before the Mideast war broke out. There is little doubt that Is-

rael has the technical capability to build a bomb, and it also has a French-built atomic reactor, the highly secret 26 megawatt Dimona facility in the Negev, where bomb-quality plutonium can be produced.

Arms control people also doubt that China would take the risk of putting nuclear weapons into the hands of such volatile leaders as Egypt's Gamel Abdel Nasser. And they consider it inconceivable that the Russians would do so.

Dr. Lapp doesn't share that feeling. He points out that the Russians actually did send nuclear weapons to Cuba in 1962, and while the mood might have changed since that time, there's nothing to guarantee that it won't change back again.

and Technology and chairman of the food panel.

He personally feels President Johnson is interested in launching the kind of attack recommended by his science advisers, but political realities may forbid it.

"The difficulty in getting other advanced nations involved is very real," says Dr. Bennett. "Until now there has been a singular lack of interest in economic aid." And Congress itself is unlikely to move unless the U.S. public puts up a clamor.

Aside from politics, the key to increased agricultural yield is a thing called "adaptive research." Agriculture, like other types of culture, cannot simply be transplanted from one country to another. Each needs its own plant and animal varieties, according to soil and weather conditions, not to mention the tastes of the populace.

No one at the moment has the answers, but developed nations know how to find them.

Therefore, technical aid cannot be a "know-how, show-how" operation, says Dr. Bennett, but must be designed to promote scientific, technical and managerial skill in recipient nations. According to the food panel, skilled manpower capable of laying out agricultural blueprints is the scarcest and most needed resource in developing countries.

**Despite years of talk**, U.S. aid has never really come through on this score. Every 365 days, Congress doles out financial help, after calling up the aid agencies to justify their requests. "It's a kind of yearly show," says Dr. Bennett, "and Congress gets just the right response from the aid people when it teases them. They tend to do things that produce obvious results."

This trend must be reversed to long-term technical assistance if the United States is to have any impact on the food crisis.

#### PSAC REPORTS

## World Food Supply Faces 20-Year Deadline

The world food crisis has been treated so much and so often that its true dimensions tend to get lost in rhetorical overkill.

Yet predictions of impending mass starvation are real: Developing nations that once exported grain now import it. Those parts of the world where two-thirds of the people live will need twice as many calories in 1985 as they had in 1965, and food production is not increasing fast enough to meet that need. Programs of birth control, though essential, cannot show results quickly enough to modify food supply during the critical years—which for India should reach a peak in 1980. All in all, the world has about 20 years to work out a solution.

At the moment there is a chance to solve the problem of food shortages permanently—in 20 years, there may not be. But a solution will take considerably more intelligence, foresight, money, ingenuity, steadfastness and commitment than nations are prone to display during times of peace.

Commitment is what the President's Science Advisory Committee hopes to inspire with its three-volume report on world food supply released last week after a year's study by more than 100 authorities.

**The report spells out** in the strongest possible terms the action nations must take during the next two decades. Employing adjectives like "mandatory," "absolutely essential," and "unparalleled," the food panel calls upon hungry nations to revolutionize their agriculture and well-fed nations to help them do it.

"It is absolutely essential," says the report, that the developing world accept commercial farming. "There is no alternative." Nor is there an easy answer in exotic food stuffs, such as

single-cell protein or fungi. Though some new protein sources offer future promise as a food supplement, their commercial production is several years away; the critical period is now.

**The food panel** reached the unsurprising but crucial conviction that poor nations will have to feed themselves from conventional sources—farm crops and fish. Richer countries, on the other



Food needs will double by 1985.

hand, must design a long-range strategy of technical and economic assistance—the panel did not specify how much aid, but used the term "war-like mobilization."

Both parts of the world together must mount a financial and technical effort "unparalleled in the peacetime history of man."

What are the chances the world will take such advice?

"I'm pessimistic, but not without hope," says Dr. Ivan L. Bennett, deputy director of the Office of Science

#### GEOTHERMAL ENERGY

## Tapping the Heat Engine

Geothermal energy is simply energy extracted from heat in or under the ground. The ancient Romans bathed in natural hot springs centuries ago; the Italians have been extracting borax from steam and hot water vents in the earth since the time of the American Revolution, and natural hot water in Iceland has been used for almost as long to produce salt from seawater.

**In 1904**, however, came a milestone that has since resulted in a pounding at the gates of Congress and the U.S. Department of the Interior. In Larderello, Italy, engineers succeeded in hitching underground steam to a turbine in the world's first geothermal power

generating station. Intrigued, several other countries studied the idea, but until 1920 most of the effort went into talk. Finally Japan tried the idea, followed two years later by the United States, which made a primitive attempt in the Geysers district of California. Both nations failed, but subsequent successes in areas as diverse as Iceland, Mexico, New Zealand and the Soviet Union, as well as Japan and the U.S., have charged up the geothermal power business until the world now uses about one million geothermal kilowatts a year, equal to the energy of some 1.15 million tons of coal.

And if the business isn't booming in the U.S. the way its backers think it ought to—only 5 percent of the world's output is in the U.S.—the reason is the lack of adequate laws.

Almost half a century ago, Congress passed what is still the only legislation giving access to the country's underground resources: the Mineral Leasing Act of 1920. This multifaceted document covers petroleum and natural gas leases, mining claims and general mineral rights on Federal lands, but says nothing at all about hot water, rocks and steam.

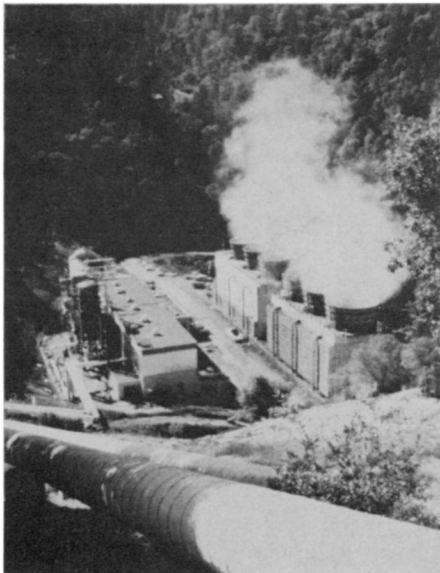
The only commercially operating geothermal power plant in the country, therefore, is one located on privately-owned land in Sonoma County, Calif., in the same Geysers area where the first U.S. experiments were tried. "The Government has dug no holes," says an Interior Department official, "and it doesn't plan to." Industry will have to do it all.

**Frustrated industry**, however, dependent on rights to Federal lands for most of the country's heat reservoirs, has no way to do it under present law. As a result, companies hopeful of getting a piece of the geothermal action have been stepping outside at least the spirit of the law in trying to get in on the ground floor. The effort to draft a new piece of legislation has occupied the House Interior Committee for a hot week of hearings and promises to take even longer in internal deliberations before doing the same thing in the Senate later this year.

In about 1960, says the Interior Department, these companies began obtaining rights to work the Government's land for oil, natural gas, potash, sodium or whatever was available under the Mineral Leasing Act. Much of this land, however, was obviously not going to yield much of what it was claimed for. Instead, the Government maintains, the companies only wanted to get some kind of advance claim on the land that could, under a "grandfather clause," be transferred to geothermal energy rights when an appropriate law came into being.

Last year a law came along that was

just what industry had ordered. With considerable pushing, it passed both houses of Congress, only to be vetoed by President Johnson. The Johnson Administration was, and still is, violently opposed to the grandfather clause, and wants a fresh start and competitive bidding for all geothermal energy rights. All leases should be short-term—in fact the shorter the better—and renegotiable



Pacific Gas and Electric Co.

The U.S. geothermal power plant.

at the Government's discretion every 10 years.

Industry wants leases that run indefinitely until the steam or hot water runs out, and competitive bidding only for previously identified geothermal sources. Rights to unidentified sources, or wildcats, would go to the discoverer; it is not unlikely that a number of previously registered but strangely unproductive oil, gas and mineral claims would suddenly be discovered to be rich geothermal wildcats as well.

**Once the legalities get ironed out**, the technology looks simple. The U.S. Geological Survey estimates that even with present technology the world geothermal power production could be increased as much as 10,000 percent and that heat reserves within our present reach could keep up that rate for half a century.

Getting down to where the heat is is much simpler than drilling for oil. Oil wells are now getting down as deep as four miles below the surface, while the heat miners are discussing depths of only a few thousand feet.

Extracting the heat, on the other hand, poses some special problems. Getting it up through the rock, which is a relatively poor heat conductor, is one. A proposed solution is to drill deep enough to puncture a large number of the heat carrying channels or fissures in the rock; but these get fewer and

fewer at greater depths as the weight of the rock above crushes them shut. Another remedy may be atomic energy, which could be used underground to crush the rock and make it heat-permeable without violating the nuclear test ban.

Whatever the problems, the value of the goal will hasten their solution. The heat available in the outer 60 miles of the earth's crust is equal to more than 12 billion times the energy of all the coal consumed in the U.S. in 1965. The world's coal resources are diminishing, but the great global heat mine has barely been tapped.

## LAKE ECOLOGY

### Dead Fish by the Ton

A freshwater lake is not a permanent thing. No matter how large, how deep or how apparently pure its waters are, every lake, according to limnological theory, has a finite life cycle.

Generally, a lake will go from a cold, deep body of water to a warm, shallow pond and then turn into marsh and, eventually, dry land as vegetation and decaying animal matter slowly fill it in. As the lake passes through each stage of its life, its animal forms also change, typically from trout in the early stages to lesser fish such as perch and carp and then to frogs, snakes and, perhaps millions of years after it formed, to foxes and deer.

This process, inevitable in any case, has proved especially sensitive to the effects of mushrooming civilization. Nowhere have the effects of thoughtless conquest of nature become more apparent than on the Great Lakes where entire fish populations have vanished.

**So when vast numbers** of fish turned up dead in Lake Michigan last week it seemed to point to another in the continuing series of disasters to natural populations caused by pollution. Yet, Michigan, thanks to Chicago's practice of flushing its sewage down the Mississippi River, has been one of the cleanest of the Great Lakes.

As it turned out, the hundreds of tons of dead fish washing up on the beaches had not been killed by pollution, although the incident is another result of the human impact on the Great Lakes.

The fish are alewives, originally an Atlantic Ocean fish, according to M. R. Greenwood, director of the Bureau of Commercial Fisheries' Exploratory Fishing and Gear Research Base at Ann Arbor, Mich. They would not be in the Great Lakes at all if it were not for the existence of the Welland Canal and St. Lawrence Seaway, he says.

Construction of the canal, it became apparent some years ago, made