

at the Princeton laboratory.

Energy from the Earth. What about geothermal-energy utilization? The nature of efforts to exploit geothermal resources, Hirsch told us, is one of "nuts-and-bolts" technology. Thus there is relatively little for the basic-level worker to get excited about, despite the fact that good things are happening in geothermal programs and the technologists are kept busy. From the standpoint of energy and energy policy, Hirsch noted, the limiting factors in the development of geothermal power are to a considerable degree nontechnical; they are associated with understanding the resource and its environmental effects. "You have to not only poke holes and get hot water out," he said, "you have to understand the extent of the resource at particular locations, because a bank or a power company needs to have assurances there's enough there before it puts up a permanent plant."

With respect to the environment, Hirsch was not certain whether or not geothermal energy should be regarded as a renewable resource. One extracts heat from water taken out of the ground and then, in most cases, returns the cool water whence it came. Clearly, if the Earth's water reserves constitute an isolated system there will be a net energy loss to them. According to Hirsch, there may in places be heat-transfer mechanisms that keep the water hot, in which case the resource would indeed be renewable. "There is a nontrivial geothermal resource there to be tapped," he said, "and the problems are questions of environmental impact and of economics."

Solar energy. Economics weighs heavily in the application of solar power as well. Solar heating, said Hirsch, is already competitive in a number of locations in the US, and the technology of solar cooling is under development. Use of solar energy for the production of commercial electricity is not yet economical; with photovoltaic cells, for instance, the price must come down by orders of magnitude. "If we can bring these costs way down—if we can do the kind of magic that was done in the transistor business—then that would make photovoltaics very attractive," Hirsch explained, "but we have a long way to go." In addition to photovoltaics, the agency is looking into solar-thermal systems, which employ mirrors to concentrate the Sun's energy. Two such projects being pushed by ERDA are a 10-megawatt plant that should begin to produce electrical power in the near future and a test facility at Sandia Laboratories in Albuquerque.

"Solar electricity, as we see it today, can only work for peak-loading applications," Hirsch said. "To expand solar's use to baseload applications, we must develop storage of either thermal energy or elec-

trical power, which is perhaps an order of magnitude or more away from what it would have to be to have solar electricity work over a 24-hour period, let alone a two-week interval when the weather's bad."

Timetable for energy. Hirsch characterized present progress among the various energy options as proceeding at a "moderate" rate. Development efforts, he feels, should be going on more vigorously. "At the rate we're going now," he predicted, "you might be able to look for a demonstration fusion plant just before the year 2000, and there might be some early solar-electric applications in the 1990's. The breeder reactor's date for commercialization lies in the early 1990's also." The breeder's disadvantages as well as its strong points are discernible at present, he said, while fusion development is not so far along, which means there are more hopes than established facts in that area.

ERDA has a mandate from Congress and the Executive Branch, Hirsch told us, to broaden its activities, particularly in the non-nuclear realm. In the past only nuclear fission was vigorously pursued, and even now—in the face of a more widely recognized energy problem—comparatively few options exist. "We're not playing fusion against fission or solar energy against something else," he said. "The prudent thing is to pursue a number of options until we get to the point where we can make sound judgments, which we can't do today."

Basic research. Asked how the high-energy physics program and other basic-level work in the agency's Division of Physical Research fits in with ERDA's mission, Hirsch said that drawing a line between basic and applied research is not an easy task. High-energy physics is in ERDA for historical reasons, he explained, and perhaps if past events had not occurred and a group of people had to decide where to put a high-energy physics program now, they might not choose ERDA first off. "The point is," he said, "there is a history, and I think there's been a very good working relationship between ERDA headquarters and the high-energy physics community."

There are two types of activities in the physical-research division: those that are quite abstract and those that more clearly apply to one or more of the different energy technologies. But even the latter group often involves very basic investigations of fundamental interactions and processes. Such work may be vital, according to Hirsch, in the search for new ways of burning coal, running internal-combustion engines or solving the radiation-damage problem in reactors. Basic research will remain strong at the agency, we were assured. Referring to cuts in ERDA's nuclear-science research budget for the 1977 fiscal year, Hirsch said "It's my intention to at least maintain a level program in the nuclear sciences. I'm going

to . . . fight for budgets that will do that and will also allow us to go ahead vigorously in a number of other areas."

Future prospects. Hirsch regards current predictions of energy shortages seriously. "The energy problem is one that must be measured in decades," he said. "We're not going to be able to turn things around overnight." He believes the physics community should make known its feelings about the severity of the energy problem to get the message across on a local, personal level. This, he said, is a matter wherein everyone can contribute.

—FCB

Argentine physicist jailed in Cordoba

An Argentinian particle theorist, Juan Carlos Gallardo, was arrested in Córdoba, Argentina on 3 April and charged with sedition, according to reports received from his family and friends.

Gallardo, who earned his PhD at Yeshiva University under the supervision of Leonard Susskind, was formerly director of the Institute for Mathematics, Astronomy and Physics at the National University of Córdoba. After Juan Peron came to power, campus activities were restricted to classroom appearances by faculty and students, and Gallardo resigned in protest. He had remained at the Institute as a professor, however, in the years since then.

Although sedition charges have apparently been dropped, Gallardo is being held in a Córdoba prison—Carcel de Encusados, where he is "being investigated." Gallardo's wife and others have expressed fears for his personal safety.

Protests by some students are being mounted, including letters to General Jose Videla, president of the Argentinian Republic.

in brief

S. Peter Rosen, a physics professor at Purdue University, and David F. Sutter of the Fermi National Accelerator Laboratory, have joined the staff of the High Energy Physics Program at ERDA's Division of Physical Research on two-year appointments.

Appointed as associate editors for a three-year term on the *Journal of Chemical Physics* are Ernest R. Davidson (University of Washington, Seattle), E. E. Ferguson (NOAA Environmental Research Laboratories, Boulder, Colo.), Jack H. Freed (Cornell University), Larry Kevan (Wayne State University), William H. Miller (University of California, Berkeley) and Michael R. Philpott (IBM Research Laboratory, San Jose, Calif.). □