alternative explanations for the increased cancer mortality.

The histories of the cancer patients and the controls would have to be matched with respect to a large number of variables suspected of involvement in cancer etiology in order to determine whether drinking river water added to the number of cancer deaths. Schneiderman estimates that up to 2000 control and 2000 cancer cases and about 2 years would be needed for such a study.

At the moment the situation with regard to cancer and drinking water is unsettled with all concerned saying that the evidence is suggestive but in no way conclusive. Naturally, everyone is calling for further studies. Should these further studies prove that there is indeed cause for alarm, EPA and the water treatment plants will have a big job on their hands.

—JEAN L. MARX

Solar and Geothermal Energy: New Competition for the Atom

A year or so ago the idea of developing solar and geothermal energy on a significant scale was regarded by most people, if they thought about it at all, as remote and perhaps a bit woolly. And, surely, precious few ranked these long-neglected energy sources alongside, or anywhere near, nuclear power as future alternatives to oil. Well, times are changing, and much faster than anyone might have imagined.

Within the last few months the Congress has enacted three measures authorizing the following:

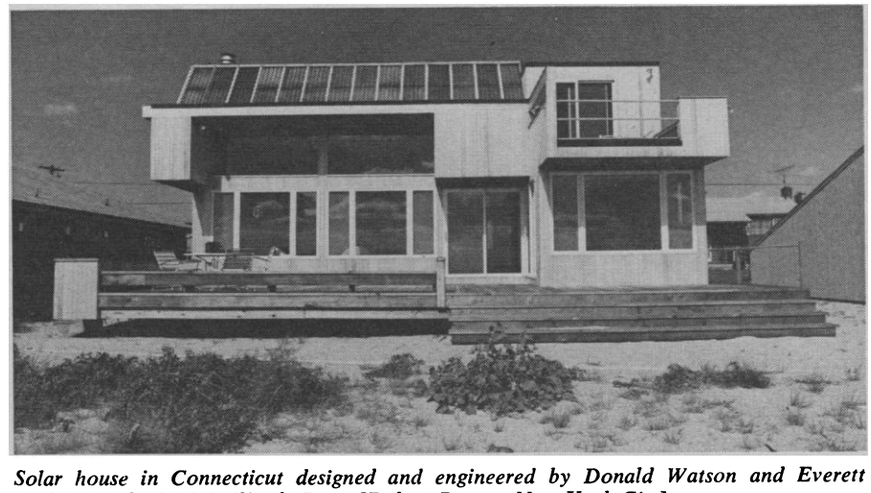
- A $60-million program to demonstrate, during the next 5 years, the practicality and marketability of solar heating and cooling systems for residential and commercial buildings.
- A large-scale research, development, and demonstration program to make possible the widespread application of a variety of solar energy concepts, including industrial process heating, thermal generation of electricity, bioconversion, photovoltaic conversion, and ocean thermal gradient and wind energy conversion. The initial funding authorization is for $77 million, to be committed by the end of fiscal 1976. But the act contemplates an intensive effort that may ultimately cost $1 billion or more.
- A major program to demonstrate, by the end of this decade, the commercial feasibility of tapping the nation's extensive geothermal resources. This will reinforce what was already a fast-growing program of geothermal energy R & D. Subject to further definition of the total geothermal R & D effort, Congress will authorize the major appropriations necessary. Already authorized under the act is a $50 million loan guaranty program to encourage industry to develop geothermal resources.

Apart from the three new energy acts, Congress has appropriated for the present fiscal year $50 million for solar energy (up from $17 million last year) and $44 million for geothermal energy (up from $11 million). These appropriations were in response to requests by the Nixon Administration, which for the first time last year made a serious commitment to development of solar and geothermal energy. As recently as 4 years ago, the total appropriation for these energy sources was only $1.4 million.

The initiative for the new legislation has come from members of Congress, especially Representative Mike McCormack (D–Wash.), chairman of the Energy Subcommittee of the Committee on Science and Astronautics and one of the two scientists serving in Congress (before winning his House seat in 1970, McCormack was a chemist at the Atomic Energy Commission's Hanford Reservation). The Administration initially opposed the solar and geothermal legislation, contending that it was unnecessary in light of the then pending—but since enacted—bill to establish an Energy Research and Development Administration (ERDA).

One or two farsighted members of the Congress, including Senator Hubert H. Humphrey of Minnesota, were introducing solar energy bills as far back as the late 1950's and early 1960's, but their proposals died of neglect. In this Congress, however, interest in solar energy has been of bandwagon proportions: some 26 different solar bills had been introduced by this past September, and one of them (the solar heating and cooling bill) is reported to have had 185 cosponsors in the House alone. (Although geothermal energy has not excited the same degree of interest as has solar energy, it has been receiving serious legislative attention somewhat longer. In 1970, Congress passed a law allowing the leasing of federal lands for geothermal development.)

At the same time solar and geothermal energy have been gaining favor,



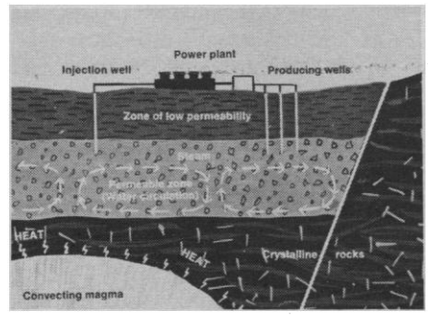
Solar house in Connecticut designed and engineered by Donald Watson and Everett Barber, Jr., both of Guilford, Conn. [*Robert Perron, New York City*]

nuclear energy has slipped back a bit, even though it claims 40 percent—by far the largest share—of the current federal energy budget of $2.2 billion. The Atomic Energy Commission (AEC) was once so bright a star in the bureaucratic firmament as to appear everlasting. But the AEC will soon be divided into regulatory and R & D components, with the latter forming the biggest part of ERDA.

The AEC is really being cut down to size, at least on paper. The ERDA organization chart shows, besides the administrator and his deputy, six assistant administrators, each responsible for a major field of activity. One such field is nuclear energy, another is "solar, geothermal, and advanced energy systems." The other fields of activity headed by assistant administrators are fossil energy, conservation, environment and safety, and "national security" or nuclear weapons.

Far more significant than the organization chart is the fact that the total budget for nonnuclear energy R & D programs, now at between $700 and $800 million, is expected to grow to between $2 and $3 billion over the next 5 years. Should this occur, the imbalance in favor of nuclear energy will have been redressed, with a vengeance.

Most members of Congress have not embraced solar and geothermal energy in order to put down nuclear energy, but simply as additional energy sources



Geothermal facility shown in profile. [*Pacific Gas and Electric Company*]

to be developed as alternatives to oil. There are some members, however, who do regard these sources, especially the solar source, as alternatives both to oil and to all-out development of nuclear power.

In congressional hearings last June on the solar energy R & D bill, Senator Humphrey took exception to the heavy emphasis that has been given the development of nuclear energy. "We are going to have to use nuclear energy for peaceful purposes but it is a hazard and no one has yet been able to make it . . . hazard-proof," he said. The senator expressed particular concern that, where reactors are given to less developed countries such as Egypt, plutonium might be diverted for the manufacture of weapons.

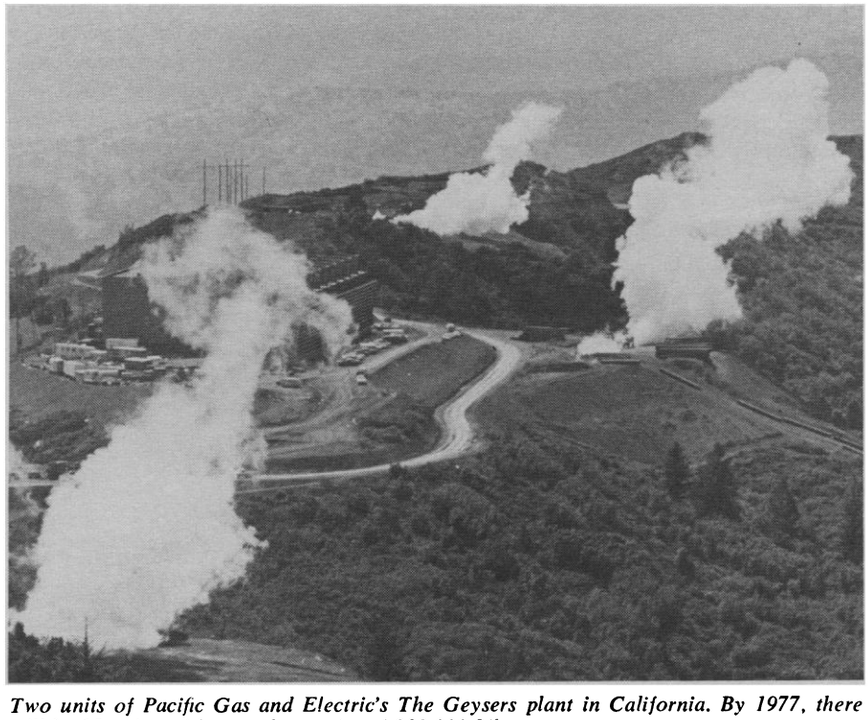
Solar energy, on the other hand, does not raise such problems, he said. "If we put ourselves to the task, in a short time we can develop solar energy that will not only meet much of our own needs but will be an exportable product," he observed. "We will therefore be able to help other people who are desperately in need of energy resources and help them in a way that in no way threatens the peace of the world."

Sponsors of the solar heating and cooling demonstration legislation see an opportunity for an early payoff. A 1972 report of a solar energy committee formed by the National Science Foundation (NSF) and NASA concluded that, eventually, solar energy could economically provide up to 35 percent of the total heating and cooling needed for buildings. (About 25 percent of all energy consumed in the United States is used for heating and cooling buildings and supplying them with hot water.) The NSF–NASA panel foresaw no technical obstacle to such progress. Furthermore, there appear to be virtually no environmental problems associated with the use of solar energy in this mode.

The use of solar energy for the generation of electricity will turn principally on economics, for there are no fundamental technical limitations to application of solar thermal conversion systems. An interagency task force for the Federal Energy Administration (FEA) has said that solar thermal conversion plants operated in the southwestern and southeastern United States in the late 1980's would be competitive with conventional power plants. With a major development effort, such solar plants could by the year 2000 meet 1 percent of the nation's total energy demand and supply a substantial part of the electricity used in the Southwest.

According to Wilson Clark in *Energy for Survival*,* a solar electric plant with an output equal to that of the huge coal-burning Four Corners plant in New Mexico (eventually to be rated at several thousand megawatts) might take up some 40 square miles with its solar collectors. But it would require no strip mining and would not pollute the air over a vast region. Such a facility might, however, change the albedo, or reflectance, of the earth's surface and alter the weather locally. Also, waste heat from the system would have to be disposed of, as in the case of any steam-electric power plant.

There is at present only one commercial geothermal power facility op-



Two units of Pacific Gas and Electric's The Geysers plant in California. By 1977, there will be 15 units, with a total capacity of 908,000 kilowatts.

* Published by Anchor Books, Garden City, New York, 1974.

erating in the United States, The Geysers facility operated by the Pacific Gas and Electric Company 90 miles north of San Francisco. It is to have 15 turbines by 1977 and a capacity of 908,000 kilowatts. By early this year, the U.S. Geological Survey had identified 1.8 million acres as Known Geothermal Resource Areas, plus another 99 million acres believed to have some potential. An interagency panel for the FEA has reported that, given an accelerated development program, geothermal facilities could be producing up to 111,000 megawatts by the year 1990.

Environmental problems arising from geothermal resource development could be troublesome, although possibly no more so than those arising from other kinds of power development. Land subsidence can result from the withdrawal of large volumes of fluids from geological formations. Also, earthquakes can be triggered by high-pressure injection of fluids into a formation if they come in contact with an active fault. Pollution of surface or ground water can result from the disposal of toxic and saline wastes.

A Mandate for ERDA

Inasmuch as ERDA is endowed with broad powers to develop all potential energy sources, the new solar and geothermal legislation is important chiefly as a clear mandate for ERDA to move ambitiously into these two fields of energy development. It also should help ERDA to obtain the congressional appropriations needed.

Actually, the solar and geothermal energy legislation was formulated in such a manner that the programs envisioned would be carried out whether ERDA was established or not. With ERDA, the interagency management mechanisms that were provided for simply will not be activated. The legislative history of the solar and geothermal legislation is such, however, as to make clear that Congress expects ERDA to give important roles to other federal agencies such as NASA and the departments of Interior and Housing and Urban Development. HUD, especially, will have a major part in implementation of the solar heating and cooling program.

In the hearings, there was much sentiment expressed by Senator Humphrey and others to the effect that solar technology will be adopted more widely, and more quickly, if there is strong interagency and industry participation in the R & D effort.—LUTHER J. CARTER

APPOINTMENTS

Paul H. Newell, Jr., chairman, industrial engineering department, Texas A & M University, to president, Newark College of Engineering. . . . **Fujio Matsuda**, vice president for business affairs, University of Hawaii, to president of the university. . . . **William A. Jenkins**, dean, School of Education, Portland State University, to vice president for academic affairs, Florida international University. . . . **Barry A. Marks**, chairman of literature, American University, to dean, College of Arts and Sciences, University of Rhode Island. . . . **John W. Jutila**, professor of microbiology, Montana State University, to dean, College of Letters and Science at the university. . . . **Helen P. Gouldner**, professor of sociology, University of Delaware, to dean, College of Arts and Sciences at the university. . . . **Edward M. Melby, Jr.**, director, laboratory animal medicine division, Johns Hopkins University, to dean, New York State Veterinary College, Cornell University. . . . **Leonard A. Levy**, dean, California College of Podiatric Medicine, to dean, School of Podiatric Medicine, State University of New York, Stony Brook. . . . **Gardner Lindzey**, vice president, University of Texas, Austin, to director, Center for Advanced Study in the Behavioral Sciences. . . . **Leslie F. Malpass**, vice president for academic affairs, Western Illinois University, to president of the university. . . . **Cecil K. Byrd**, dean of faculties, American University, Cairo, to president of the university. . . . **Frank H. Blackington III**, director, Honors College, Michigan State University, to president, University of Pittsburgh. . . . **Lee H. Smith**, vice president for academic affairs, University of Texas, Dallas, to president, Southwest Texas State University. . . . **Arliss H. Roaden**, vice provost for research, Ohio State University, to president, Tennessee Technological University. . . . **Lewis W. Bluemle, Jr.**, president, Upstate Medical Center, State University of New York, to president, University of Oregon Health Sciences Center. . . . **Joseph C. Burke**, vice president for academic affairs, State University of New York College, Plattsburgh, to president of the college. . . . **Jill K. Conway**, vice president for internal affairs, University of Toronto, to president, Smith College. . . . **Harold H. Haak,** vice president, University of Colorado, Denver, to chancellor at the university. . . .

RECENT DEATHS

William E. Adams, 71; professor emeritus of surgery, University of Chicago; 25 November 1973.

H. O. Burdick, 77; former chairman, biology department, Alfred University; 8 July.

Joseph P. Canty, 67; former associate professor of mathematics, University of Maine; 29 May.

Archie B. Carran, 43; professor of psychology, State University of New York College, Brockport; 3 July.

Frederick M. Clement, 89; former dean of agriculture, University of British Columbia; 9 June.

John W. Cline, 76; professor emeritus of surgery, Stanford University; 10 July.

Lyman C. Craig, 68; professor of chemistry, Rockefeller University; 7 July.

O. W. Davison, 68; former professor of education, University of Oklahoma; 7 June.

Samuel H. DeVault, 85; former chairman, agricultural economics and marketing department, University of Maryland; 23 June.

Leo Friedman, 59; director, toxicology division, Food and Drug Administration; 6 July.

Alfred N. Goldsmith, 86; former director of research, RCA Corporation; 1 July.

Frank A. Graig, 59; professor of medicine, New York Medical College; 12 June.

Estill I. Green, 78; retired executive vice president, Bell Laboratories; 24 June.

William F. Hall, 82; professor emeritus of agricultural education, Pennsylvania State University; 17 June.

James R. Hastings, 50; professor of meteorology, University of Arizona; 30 June.

Leonard M. Logan, 83; professor emeritus of sociology, University of Oklahoma; 27 June.

George D. Lukes, 58; retired senior scientist, National Security Agency; 13 June.

Theodore R. Lusebrink, 46; research chemist, IBM Corporation; 14 May.

Kurt Salomon, 76; retired professor of radiation biology and biophysics, University of Rochester School of Medicine; 17 June.

Lucy Wing, 59; chairman, School of Psychology and Counseling, State University of New York College, Oswego; 16 July.