Drinking Water: Another Source of Carcinogens?

As if life were not already hazardous enough, there is now one more environmental alert with which we have to contend: Drinking water may cause cancer. Lost in most accounts of this possibility, however, were several important qualifications related to the preliminary nature of the reports.

On 7 November, the Environmental Defense Fund (EDF) reported the results of studies* that show a possible link between certain cancers and consumption of Mississippi River water by persons living in Louisiana. The next day, the Environmental Protection Agency (EPA) entered the picture and confirmed the presence of a number of organic chemicals, some of them suspected carcinogens, in the New Orleans water supply.† Studies conducted by a number of other investigators throughout the country indicate the probability of widespread contamination of water supplies.

All this made a dramatic prelude to a House vote on the Safe Drinking Water Act on 19 November. The bill, already approved by the Senate, passed by a 296 to 85 vote, more than enough to defeat a threatened presidential veto.

The Safe Drinking Water Act would enable EPA to set limits for chemical contaminants or, where monitoring contaminants is not possible, to establish standards for treatment techniques designed to remove impurities from community water supplies. Individual states, however, would have the power to issue exemptions or variances to the EPA standards. Current Public Health Service standards, which are met by the New Orleans water supply, are concerned with preventing the spread of communicable diseases but not with the presence of toxic or carcinogenic chemicals.

In the EDF study, a statistical analysis, performed by Robert Harris of EDF and Talbot Page of Resources for the Future, Inc., indicated that the cancer mortality rate was 15 percent higher among white males who drank water from the Mississippi than among those who obtained their water from wells. Groundwater supplying the wells—in contrast to river water—is unlikely to be contaminated with chemicals. The analysis included consideration of the effects that degree of urbanization, income, and certain occupational exposures could have on cancer mortality. Other variables, such as smoking, diet, alcohol consumption, and air pollution were not considered because the necessary data were unavailable. Harris emphasized that the study did not prove that chemicals in drinking water cause cancer, but he thinks that the evidence is highly suggestive of this possibility and that further studies are warranted.

Chemicals in New Orleans Tap Water

The New Orleans water supply, which is obtained from the Mississippi River, does contain traces of many organic chemicals, according to EPA. The water analyzed was treated water taken from three treatment plants. Although most of the 66 compounds identified are present in concentrations of less than 1 microgram per liter of water, chloroform, a suspected carcinogen according to officials of the National Cancer Institute (NCI), is present at a concentration of over 100 micrograms per liter. Other possible carcinogens include carbon tetrachloride and the pesticide dieldrin.

This investigation was a confirmation and extension of a previous EPA report on the presence of chemicals in New Orleans water. The earlier report, completed in 1972, generated little interest until this summer when Harris, writing in *Consumer Reports*, discussed it and its implications. The current EPA and EDF studies were both initiated in July of this year at the request of New Orleans and Louisiana officials.

Compounding the growing concern about the safety of drinking water are reports that chlorination of the water supply may be a source of some of the hazardous compounds. Chlorine destroys bacteria, such as those causing cholera and typhoid, but chlorine may also react with hydrocarbons in the water to form their chlorinated derivatives. These derivatives are generally thought to be more carcinogenic than the parent hydrocarbons. John Laseter and his colleagues at the University of New Orleans have found that tap water in New Orleans contains more chlorinated hydrocarbons than does untreated Mississippi River water. Furthermore, he has identified several chlorinated hydrocarbons, including carbon tetrachloride, in blood plasma collected from human volunteers; drinking water, however, is only one of several possible routes by which such compounds could enter the body.

These reports, all admittedly preliminary in nature, have raised or reemphasized a number of complex issues, some of which have resisted resolution for years. Determining the extent of the chemical contamination of water is probably going to be one of the easier problems to solve, despite technical difficulties in sampling and analyzing the water. Russell Train, administrator of the EPA, has ordered a nationwide survey of water supplies to be conducted in representative cities. Some results should be available in 3 to 5 months.

A second phase of the planned EPA study will try to locate the sources of any contamination and then evaluate techniques for either preventing it or for removing it from community water supplies. Since numerous sources, including the chemical and petroleum industries, agricultural runoff, and local sewage treatment plants, contribute to pollution of river water, preventing contamination may be difficult. After contamination has occurred, treatment of water with activated charcoal is one way of removing at least some of the organic chemicals. Ozone may also be used instead of chlorine to purify and disinfect water.

A number of considerations about the techniques used for evaluating the carcinogenic potential of chemicals, especially for humans, point up the difficulty of evaluating the seriousness of the situation in New Orleans and perhaps elsewhere.

► Compounds are screened for their carcinogenicity in animals, and there is always some question about the applicability of the results, whether positive or negative, to man. Carbon tetra-

* *The Implications of Cancer-Causing Substances in Mississippi River Waters* (Environmental Defense Fund, Washington, D.C., November 1974).
† *Draft Analytical Report: New Orleans Water Supply Study* (Lower Mississippi River Facility of the Environmental Protection Agency, Slidell, Louisiana, November 1974).

Agricultural Research under Fire

The long-neglected realm of agricultural research has been receiving attention from the outside world in recent months, but not all of it has been favorable. One eminent group of critics has castigated the research establishment for being inert and resistant to change, another for its isolation from the mainstream of academic science.

A report on U.S. farm policy* issued last month by the Committee on Economic Development, a New York–based research group, holds agricultural research institutions to blame for "signs of age and a lack of imagination" in dealing with critical problems. "Administrators of agricultural research institutions have often become identified with maintenance of the status quo at the expense of innovation," the committee says. Its report goes on to note a lack of evident breakthroughs in areas such as soybean research and production efficiency in the cattle industry.

The sources of these criticisms are not wild-eyed radicals. They include the chief executive officers of Ralston Purina, the Del Monte Corporation, Universal Foods, H. J. Heinz, and Deere and Company. The chief author of the report's section on research is John A. Schnittker, an agricultural economist who was Undersecretary of the Department of Agriculture (USDA) during the Johnson Administration.

The agricultural research establishment has tried several times in the past to reform itself, Schnittker said in an interview, but these have all been self-reviews which were not terribly successful. Part of the fault lies in the inflexible nature of the congressional appropriations process, which leads to research stations being sited in congressmen's favorite states. Congress also allows itself to be used as an instrument to repress researchers, Schnittker believes. "The research community by and large is afraid to raise its head on questions of chemical pollutants, of the environmental fall-out from agricultural practices. This is because the big companies will go to Congress, and the researcher who is too independent will get his money cut off," he says. Schnittker has not kept in close touch with USDA affairs since he left in 1969, but considers the basic situation to be unchanged.

Asked about the committee's comments the administrator of the Agricultural Research Service, Talcott W. Edminster, said that continuing cuts in budget and staff are the cause of any semblance of status quo. The present purchasing power of the ARS budget is about the same as in 1964, while the staff has been cut from 10,000 in 1969 to 8,000. With these dwindling resources the ARS has had to mount a host of new programs in environmental matters and food safety. "I think our flexibility has been almost amazing," Edminster says.

A more philosophical critique of the agricultural research establishment is presented in the summer issue of *Daedalus* by Harvard nutritionist Jean Mayer and by André Mayer, a historian of science at the University of California, Berkeley. Their central theme is that intellectually and institutionally, agriculture has been and remains an island, "a vast, wealthy, powerful island, an island empire if you will, but . . . separated from the mainstream of American scientific thought." For lack of effective outside criticism, the Mayers say, "a great deal of agricultural research has proceeded on assumptions which are very much open to question." For example, genetic research on crops and animals has been pursued without reference to nutritional values. In both Congress and the USDA, agricultural policy is conducted as a closed shop, immune from outside criticism. There is a serious lack, the Mayers believe, of "scientific critics from outside looking at agriculture in an informed and constructive way."

Outside criticism and advice is a commodity the agricultural research community is likely to receive in increasing surplus as others take interest in its problems. But, as Edminster remarks, "At least it means that agriculture is no longer being taken for granted."—N.W.

* *A New U.S. Farm Policy for Changing World Food Needs.*

chloride, for example, has been found to cause cancers in mice, hamsters, and rats, but it is not known whether it will do the same in people.

► Another unsolved problem of cancer research is whether there is a threshold concentration below which a carcinogen has no effect. The chemicals found in water are generally present in very low concentrations.

► A further complication in assessing carcinogenicity arises when mixtures of chemicals are involved. Chemicals in mixtures may interact with one another to enhance or diminish their capacity to cause cancer. Carcinogens in water could also interact with those from other environmental and occupational sources.

Despite these uncertainties, however, most investigators, when confronted with strong evidence of a chemical's carcinogenicity in animals and no unequivocal demonstration of a threshold—and there has been none at this time—would prefer to minimize or eliminate human exposure.

Many of the 66 compounds present on the EPA list have not been assayed for their carcinogenicity. Some, according to scientists at NCI, are not particularly suspect because they belong to classes of compounds found not to be carcinogenic; others are more troublesome. Herman Kraybill, Scientific Coordinator for Environmental Carcinogenesis at NCI, is assisting EPA in its assessment of the hazards of the chemicals. He is especially interested in determining the carcinogenic effects of mixtures of chemicals. Kraybill said that concern about potential problems with drinking water has been growing for the last 20 months. He himself is less concerned about the effects of chlorination than about chemical contamination from sources such as oil spills and industry.

Cancer causes may also be identified by epidemiological studies. Marvin Schneiderman, Associate Director for Field Studies and Statistics at NCI, said that the statistical approach used in the EDF study was a useful first step in identifying possible causes of disease. But he suggested that the next step should be a retrospective case control study. In this type of study, the case histories of individuals who have died of the cancers implicated by EDF—mainly cancers of the urinary tract and the gastrointestinal system—would be compared with the case histories of patients who have died of other causes. The idea is to rule out

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:

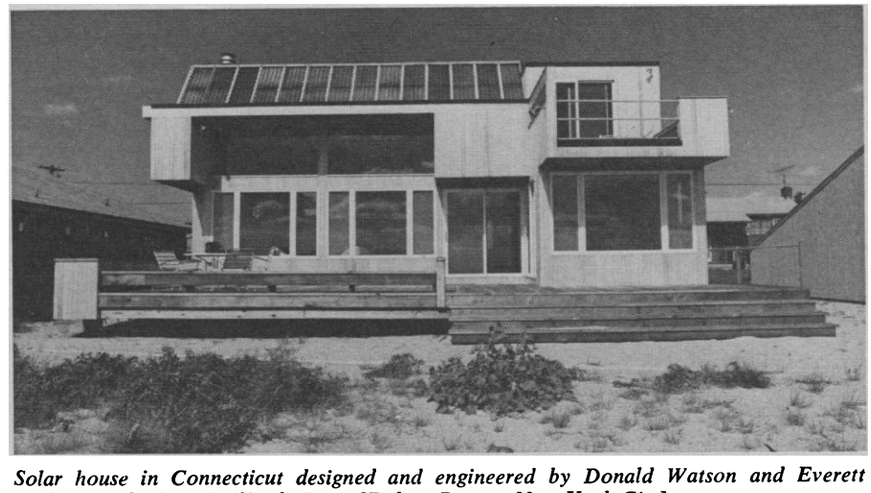
- A $60-million program to demonstrate, during the next 5 years, the practicality and marketability of solar heating and cooling systems for residential and commercial buildings.
- A large-scale research, development, and demonstration program to make possible the widespread application of a variety 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*]