Letters

Biotic Energy Flows

Important aspects of the energy shortage are being ignored in both science and government. We tend to forget that most of the energy used by man is solar energy that has been fixed recently through photosynthesis. This energy provides food, fuel, fibers, and services that are essential for a habitable environment. Although the total amount of energy available as net primary production through this route has been estimated as 20 times the amount of energy in current use from fossil fuels, nuclear power, and hydropower, these flows of energy from the sun are being reduced (*1*). When the complex political, social, and economic systems of industrialized nations falter, as they appear to be doing at the moment, we turn immediately to biotic resources that are close to us. We substitute fish for beef, wood for fuel. Mounting world food shortages are contributing to the pressures on these resources. Shortages of both oil and food will get worse: worldwide demand is soaring, and supplies are limited. Reckless efforts to "solve" an energy problem that is unsolvable in the current context of growth threaten to speed destruction of renewable resources. Acid rains are a good example. Relaxation of air pollution standards for sulfur will result in continuation of the trend of rising acidity in rain in the Northeast. There is little doubt that a decade or more of precipitation with a *p*H of between 3.0 and 4.2 will reduce the net production of forests and agriculture. A 10 percent loss of net production in the New England states would be the equivalent of the power output of 15 1000-megawatt reactors. Would the people of New England agree to supply such a subsidy to the rest of the country if they had a choice?

There is no simple technical or social solution to the shortage of energy. Growth in energy consumption in the pattern of past years is over for the present. In addition, biotic flows of energy are now being lost, often irreversibly; the biota is being mined. Environmental problems are not simply those of adjusting techniques of energy production to reduce intrusions on the environment; they also include the preservation of the flows of energy—including food, materials, and services—through the biota to man. The shortage of fossil fuels presents a challenge to technologists to find more efficient ways of exploiting biotic energy flows on a renewable basis. The problem warrants, but does not have, major consideration in the President's energy program. Facilities comparable to those of a major national laboratory should be devoted to the problems generated by the worldwide spread of biotic impoverishment that is caused in large degree by current rates of exploitation of nonrenewable energy sources.

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References

1. R. H. Whittaker and G. E. Likens, in *Carbon and the Biosphere*, G. M. Woodwell and E. V. Pecan, Eds. (U.S. Atomic Energy Commission, Oak Ridge, Tenn. 1973), pp. 281–300; G. M. Woodwell, *Science* **168**, 429 (1970); *Sci. Am.* **223**, 64 (Sept. 1970); *BioScience*, in press.

Virus Cancer Program

As a contractor to the Virus Cancer Program (VCP), I am encouraged by the attention VCP has received in *Science* (News and Comment, 24 Sept. 1971, p. 1220; 14 Dec. 1973, p. 1110). I am glad to learn that at least I am part of a program that others feel is worth shooting at. It is, of course, unsettling to learn that John Moloney still feels there is room for improvement in the VCP.

Everyone knows that grants, peer group review, elucidation of basic mechanisms, motherhood, and the American girl are beyond reproach. Grant programs are directed by triannual review of the accumulated contents of the morning's mail. In such an impartial system, scientific bias and conflict of interest are impossible, and freedom of scientific inquiry is assured. On the other hand, contracts, targeted research, requirements for proposals, resources, and services are pedestrian and often uncouth. Clear identification and contractual control of such targeted programs permits everyone to keep an eye on us rascals.

If we assume that basic fundamental research will raise answerable questions, it seems reasonable to create targeted programs to attempt to settle matters. The answers may not be happy ones, but at least we will have tried. Arise goal-oriented pedestrians—you have only your tenure to loose!

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PCB's: Another Source?

The letter concerning the presence of PCB's (polychlorinated biphenyls) in microscope immersion oils (30 to 45 percent) from Bennett and Albro (14 Sept. 1973, p. 990) and the letter from Plimmer and Klingebiel (14 Sept. 1973, p. 994) indicating a novel method for PCB formation have served to stoke the fires of controversy and environmental concern. The validity of such concern is underscored by evidence indicating the possible manufacture of PCB's at waste treatment plants that receive textile mill discharges.

In November 1972, an investigation was requested of the suspected failure of a municipal sewage treatment plant using high-rate trickling filters. Three weeks of 24-hour sampling and analysis resulted in confirmation of failure (0 to 30 percent reduction of biochemical oxygen demand). Half the flow originated in a textile mill which was using at least 2 tons per week of commercial-grade biphenyl as a dye carrier for synthetic fiber. The waste treatment plant was using 150 to 190 kilograms per day of chlorine gas for influent odor control and effluent "disinfection," two procedures that are not at all uncommon. Filter rocks were scraped and flushed with 100 milliliters of distilled water. The PCB content of the resulting suspension, after suitable extraction, cleanup, and gas-liquid