The Natural Way

That a plant grown "organically" will somehow be healthier because it was nourished by animal manures instead of by manufactured anhydrous ammonia is a silly argument, as was correctly pointed out by Hildebrand (Letters, 15 Sept., p. 944). However, Hildebrand's use of this nonsense as a straw man with which to impugn the rationality of those who seek to restore the chain of life from soil to producer to consumer and back again to the soil reflects a lack of ecological sophistication.

Organic agriculture acknowledges the interdependence of nature and the finite resources of the spaceship Earth. We can continue to insult the ecosystem with broad-spectrum pesticides and herbicides only with grave risk to the stability, also, of those portions of the environment which we parochially view as "beneficial." The continued throwing "away" of animal and vegetable materials which we cannot utilize directly both exhausts the abilities of natural systems to recycle these residues within the very small disposal areas which we select, with consequent pollution of land and water, and leads to further pollution and waste of resources during the mining, processing, and distribution of artificial substitutes for the discarded natural nutrients.

Organic gardeners are aware, on a practical if not always on a theoretical, level that no amount of mineral salts will increase the moisture-holding capacity of a light soil or prevent lateralization in a clay soil. Organic materials are necessary to maintain a favorable soil structure and to buffer variations in soil chemistry.

It is unlikely that the exploitation of the land by ever more ingenious methods can sustain our species on a long-term basis. Organic agriculture seeks to reestablish the ethical concept of stewardship of the land. In spite of the chimerical abstractions of Hildebrand, this is what it's all about.

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Those for and against "organic gardening" both seem to be a bit confused as to exactly what they are arguing about. It is true that ammonia is ammonia, no matter what its source. If your soil tests as needing ammonia, by all means apply the synthetic if you want to. However, it is scarcely debatable that steer manure contains much more than ammonia. Furthermore, regarding the take-up by a plant of the nutritional elements from its soil, it simply cannot pick up what isn't there. The most aggressive spinach root cannot dig more iron out of its environ than is already there, no matter how highly that species is rated as an iron-bearing vegetable. (Not that spinach is all that great.) Commercial fertilizers are fine—as far as they go. However, their compilers might do well to multiply the ingredients so as to cover the multitudinous requirements (not the merely "get-by needs") of fully healthy vegetation. Trace elements, for example, are now a fact of life. Soil analyses, and fertilizers—artificial or "natural"—ought to take *everything* into account.

The chemical ingredients of foods can be argued ad extremis and ad inflammatorio (or whateveris), but one fact does firmly stand: foods truly, or even halfheartedly, "organically" grown *taste* so much better than ordinary products that there is simply no comparison.

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Fast Breeder Reactors

Allen L. Hammond's report (News and Comment, 28 Apr., p. 391) on the study (*1*) by T. B. Cochran of the LMFBR (liquid-metal fast breeder reactor) program is provocative. I would like to comment on five points mentioned in Hammond's report: (i) the use of a 7 percent, rather than a 10 percent, discount factor; (ii) the demand for electrical energy; (iii) the technical performance and cost of LMFBR plants; (iv) a crash program to build the breeder; and (v) the amount of uranium reserves.

In most analyses, the discount factor is selected to represent the value of money. A 10 percent discount rate might be appropriate for an analysis in a highly inflationary period or in a period of capital shortage. The LMFBR cost-benefit analysis was based on the 1970 dollar and a 7 percent discount rate. If a 10 percent discount rate were

used with a 3 percent per annum inflation factor, which may be a reasonable long-term rate, the results would be much the same as those obtained by the Atomic Energy Commission (AEC). Depending on the frame of reference, even a 7 percent discount rate might be based on some inflation. The present electrical utility discount rate is between 7 and 8 percent; this includes some inflation effects.

The estimate used by the AEC of the demand for electricity of 10,000 billion kilowatt-hours in the year 2000 is not out of line with other estimates. A recent report by the National Academy of Engineering (*2*) contains the projection of 10,000 billion kilowatt-hours for the year 2000.

According to Hammond's report, Cochran believes that technical problems and safety considerations are likely to result in LMFBR plant designs which have poorer technical performance and higher costs than those used by the AEC in its cost-benefit study. Before commenting, I would like to repeat what every *Science* reader knows—the results of research and development are uncertain. Analyses of LMFBR plant benefits have been made at the Argonne National Laboratory with different assumptions and with somewhat different objectives from those made by the AEC. A number of parameters were examined in the Argonne analyses, which centered about a reference LMFBR plant that had lower performance in terms of required plutonium inventory, a higher initial capital cost differential (even higher than Cochran's), and a longer cooling-off period for fuel than those of the AEC's plants. Cost escalation rates of 1.5 to 4 percent with a 7 percent discount rate were used in various components of the study. The main interest was only for the year 2000, although some results were carried through the year 2020. For a fixed nuclear penetration, the LMFBR benefits do start, but not until about the year 2000. Also, the advent of the HTGR (high temperature gas reactor) delays those benefits. The study convinces me of the probability of benefits from the LMFBR R & D effort.

The article also states that there is a crash program to build the breeder. Those who have been involved with the development of the breeder will attest that there is no crash program; the first experimental breeder began operation in 1951. Subsequent and ever increasing breeder developments in the United States and abroad are well documented. John Kenneth Galbraith (*3*) points out that the time span from the beginning to completion of any task increases as more sophisticated technology is involved and that the commitments of time and money for the task tend to become inflexible. We are seeing this with the development of the breeder. With the present level of effort, some electric utility companies may decide in the 1980's that commercial LMFBR plants starting operation in the 1990's are their lowest cost alternative.

The cost of available uranium reserves as a function of tonnage was a prime variable in the Argonne study, which indicated that following the LMFBR path may require from 3 to 4 million tons of uranium oxide. The study also showed that, with no increase in the uranium oxide real cost with tonnage, the breeder has no net benefits. Should we delay the breeder until we prove the cost and availability of uranium oxide within the United States and examine other alternatives? Considering the present energy situation and the future energy needs, I say no. We can analyze alternatives without halting the breeder.

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References

1. T. B. Cochran, "An Economic and Environmental Analysis of an Early U.S. Commitment to the Liquid Metal Fast Breeder Reactor," to be published.
2. Committee on Power Plant Siting, *Engineering for the Resolution of the Energy-Environment Dilemma* (National Academy of Engineering, Washington, D.C., 1972).
3. J. K. Galbraith, *The New Industrial State* (Houghton Mifflin, Boston, 1967).

Technology Assessment

Robert Gillette's commentary (News and Comment, 6 Oct., p. 41) on the bill establishing the Office of Technology Assessment opened with the observation that this was a proposal which "languished in congressional backrooms for the better part of a decade. . . ." The technology assessment concept was some years in the making. The bill to establish the Office of Technology Assessment was first introduced in April 1970.

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