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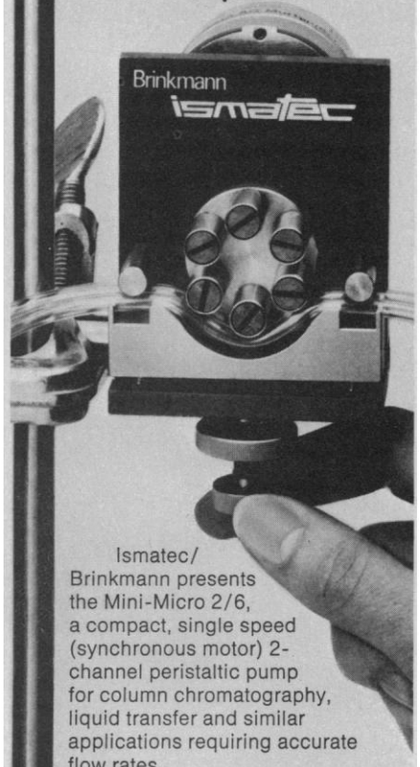

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The Fertilizer-Ozone Connection

Deborah Shapley's article (News and Comment, 18 Feb., p. 658) is not fair to some people and is 9 months late. The article is based on a paper I gave at the April 1976 meeting of the American Geophysical Union in Washington, D.C. Eight other papers on the same subject were presented at the symposium. Most of these papers consisted of original contributions, whereas mine was only a review of the work of others. Also, my paper is now one part of an undigested, unapproved, preliminary report being prepared by the Panel on Nitrates of the National Academy of Sciences–National Research Council, which apparently was "leaked" to Shapley. I think it is ludicrous that my 9-month-old review paper was rushed into print as if it were a hot news item.

Shapley's article appears to give me credit for discovering that nitrogen fertilizers (manufactured and managed legumes) may conspicuously reduce stratospheric ozone, but this is an injustice to the actual discoverers and developers of the case. That man-induced fixed nitrogen might reduce stratospheric ozone was implicit in 1971, after the publication of three papers (*1*) showing that nitric oxide is chemically formed in the stratosphere from soil-produced, inert nitrous oxide and two others (*2*) showing that nitric oxides catalytically reduce ozone. An illustration of how well this was recognized then is a quotation attributed to a spokesman for an aircraft company early in 1972: "Blame the farmers; don't blame us."

In 1971 so little was known about the natural amount and distribution of nitrogen oxides in the stratosphere that it was not timely to pursue the fertilizer problem. However, in the period 1972 to 1975, the Climatic Impact Assessment Program obtained enough measurements of stratospheric oxides and learned enough about the sensitivity of stratospheric ozone to nitrogen oxides that it became appropriate to consider the problem. Although it is difficult to assign priorities, it is my impression that Crutzen (*3*) first took up the subject again, and McElroy (*4*) was the first to deeply probe the complicated biological bases for the problem.

Shapley says the problem has been "hampered by vigorous disputes," but any "vigorous disputes" I know of are evidence of the vitality of the subject and have tended to speed up work on the problem and get new people (*5*) (including soil scientists) interested in it.

In the discussion of possible partial answers, Shapley apparently misunderstood what I said in a telephone interview. Although recycling of fixed nitrogen could reduce the amount of manufactured nitrogen fertilizer, organic farming in terms of cultivated legumes also represents added nitrogen fixation.

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Radioactive Wastes

The article by Luther J. Carter on radioactive wastes (News and Comment, 18 Feb., p. 661) is full of numbers but devoid of information that gives an understanding of what they mean. It constantly mentions millions of gallons and tens of thousands of tons of waste from the entire nuclear industry over the next 25 years and creates the impression that we are being inundated by vast quantities of this waste. If that's the game, why not mention the trillion gallons (10 million tons) of carbon dioxide, the 10 billion gallons (150,000 tons) of sulfur dioxide, or the 100 million gallons (1 million tons) of solids produced by SO_2 scrubbers that are the wastes from a single coal-fired power plant in 1 year? An understandable figure for the high-level wastes is 2 cubic meters per year from a nuclear power plant, an amount that could be stored under a typical dining room table. The electric power produced by such a plant is worth $200 million per year, so one could spend $2 million in handling this small quantity before increasing the cost of electricity by as much as 1 percent.

Carter says this material must be isolated "for what, in the human perspective, must be forever," but after 500 years, the amount one would have to eat (after conversion to edible form) to give a good probability of injury is about a half-pound. (In the case of military