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a personal letter objecting to the statement that "it does not pay to recycle these minerals," pointing out that when the price of virgin metals rises, there is a well-known tendency for scrap to appear in abundant quantity at the furnaces. A doubling of the average cost of raw materials would make feasible forms of recycling that are now too expensive to consider; yet a doubled price of raw materials would not raise their share of the total cost of the national product to as much as 10 percent.

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Hydra-Headed Pesticides

In his presentation of the rationale for pest control by the Agricultural Research Service (19 June, p. 1419), George W. Irving, Jr., capsulizes the many alternatives or complements to the use of the synthetic organic pesticides. . . . [He] states that American agriculture has evolved a monoculture system and that the use of persistent pesticides has been an essential element in the successful production of the cheapest, highest quality food with only 5 percent of the labor force. One would infer that our monoculture system and its results are good and provide the only viable pattern for the world in the future. But the burgeoning degradation of our natural and social environment indicates that perhaps we are paying too little for food that is unnecessarily free of blemishes, that we have driven more people off the land than our cities can support, and that we have an unrealistic standard of living which the environment cannot sustain and the rest of the world can never achieve. Neither the world's fossil fuel and mineral reserves nor the capital resources of the developing nations can long support any major expansion of modern agriculture or U.S. life-styles. Serious doubt exists as to whether the quality and essential diversity of the environment can be maintained either.

The reasoning of the pest control specialist seems to be that man must "fight" so-called pests to survive and that the "balance of nature is not an achievable ideal, if it is an ideal at all." Man creates pests when he so simplifies an ecosystem that a particular insect group experiences a massive

population increase. His repeated retaliation with chemical pesticides further unbalances the ecology by stimulating the development of resistant pests and eliminating effective natural controls. Man must achieve a viable, dynamic balance within the global biosphere of which he is a part. The alternatives are frightening.

Alternatives do exist to the inexorable increase in use of pesticides, fertilizers, and machinery. Irving mentions several innovative plant protection systems being investigated by ARS. Unfortunately these techniques are not always economical in a monocultural system, particularly in the absence of long-term environmental cost accounting.

Extensive research, education, and incentives will be required to develop practical, ecologically sound systems of agriculture in which truly integrated insect control can function. Less conventional practices which tap the productivity of an agriculture modeled after natural ecosystems must replace the forcing of output through heavy energy and chemical subsidies. Such systems are particularly suited to the developing nations where capital inputs are scarce and conventional monoculture has had limited success.

We should question the assumption that agriculture has the responsibility to raise agricultural productivity to feed unlimited numbers of people. To irreparably damage the earth's life support system in an effort to extend conventional agriculture would be technologically difficult, economically unsound, and poor ecology.

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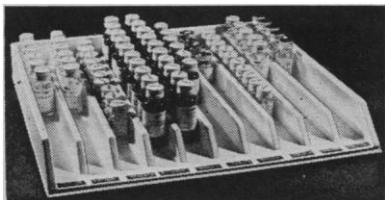
Rachel Carson (1) emphasized the importance of thoroughly testing all pesticides under controlled laboratory and *field* conditions before introduction of any chemical into the marketplace. The broadcast application of mirex is contrary to these scientific principles (2); for example, studies on mammalian systems are practically nonexistent (3).

Mirex, included with aldrin, dieldrin, and heptachlor in the same chemical family, may degrade into intermediates with a similar or higher level of general toxicity. I am not aware that such tests have been made or whether medical procedures exist to diagnose acute or chronic mirex poisoning. Human fetuses contain dieldrin and hepta-

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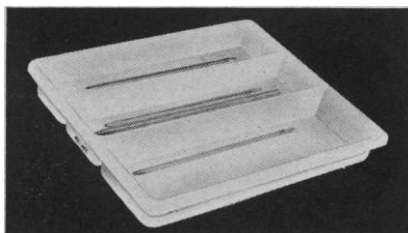
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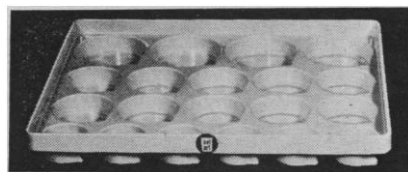
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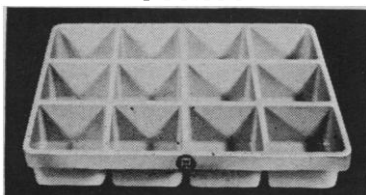
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chlor epoxide in their tissues; placental transfer studies using mirex would be of significant value. It is important to know if this chemical is incorporated into plant tissues or whether, by prolonged vaporization, mirex is released into the atmosphere (3).

... George Irving, responding to Ferguson's criticism of the Agricultural Research Service's fire ant eradication program (Letters, 14 Aug.), admitted that this insect predator is more significant as a "people pest." This statement can be applied to beneficial hymenopterans, spiders, or venomous reptiles. In these cases, however, action is restricted with the purpose of limiting the population to a reasonable level.

Ferguson objected with good reasons to the broadcast application of mirex for fire ant control. There are alternative procedures to combat *Solenopsis* which will eliminate the queen ant and reproductive capacity of the colony (2): place the mirex bait around the nest sites (close proximity of the fire ant may discourage consumption by nontarget animals); or burn the mounds during the seeding or harvesting seasons or in the winter when the fields lie barren and the colonies are inactivated by cold weather (avoid soil contamination due to leeching of mirex from the bait). These methods could be executed during low night temperatures and would present a minimal danger to farm workers and to the quality of the rural environment. The project would be under local or district control, the reaction to infestation would be precise and, most likely, less expensive than the \$200 million now allocated for control by the ARS.

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References

1. R. Carson, *Silent Spring* (Houghton Mifflin, Boston, 1962).
2. D. Ferguson, *Environ. Action* 2, 11 (1970).
3. *Biological Effects of Pesticides in Mammalian Systems*, H. Kraybill, Ed. (New York Academy of Sciences, New York, 1969), vol. 160 of *Ann. N.Y. Acad. Sci.* 1 (1969).

Cancer Research: Once-Over-Lightly

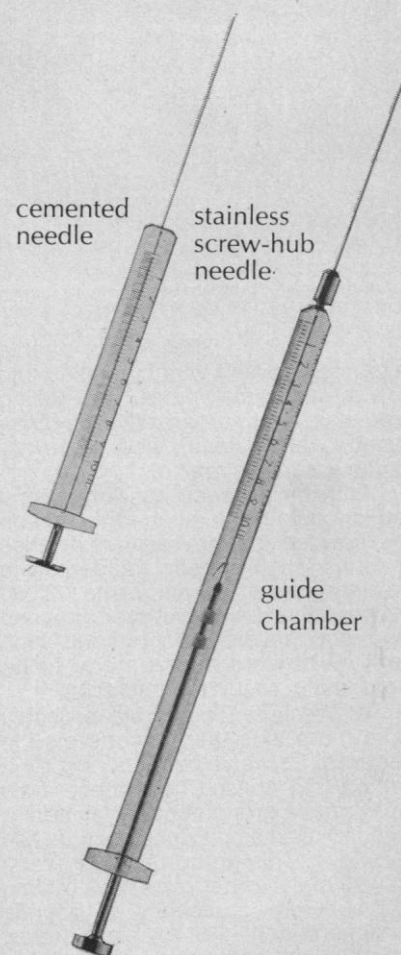
I believe Robert J. Bazell's commentary on "Cancer research" (16 Oct., p. 304) was based on several rather brief and superficial discussions with some of the people mentioned in his article, rather than on any real comprehension of the very exciting new discoveries

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