CORRESPONDENCE/

Another View of Scope

To the editor:

In his recent article (Bio/Technology **10**:248, March 1992), Russ Hoyle characterizes the [Bush] Administration's long-awaited policy on the scope of biotechnology regulation as a "largely philosophical exercise." Mr. Hoyle's report stands in sharp contrast to the editorial in the issue of Nature ["U.S. Biotechnology Policy" 356:6365, page 1, March 5, 1992] that arrived on the same day as Bio/Technology. The editorial applauds the scope policy as "utterly in keeping with good science" and a product of "clear thinking . . . at the White House." Indeed, the scope policy is consistent with recommendations of the National Academy of Sciences and National Research Council on oversight of field research.[1,2]

The reason for the nearly decade-long "bureaucratic haggling" over environmental regulations is, in fact, that since 1984 and in the face of broad scientific consensus arguing the opposite, EPA has repeatedly proposed regulations that would capture primarily experiments using organisms modified by rDNA techniques—and virtually all of those—regardless of indications on actual risk. Jerry Caulder of Mycogen is quoted by Hoyle as expressing concern about regulatory "uncertainty." He is justified in worrying about the uncertainty of his products appearing on the market in 1993 or 2003. but the kind of certainty offered by EPA is simply that rDNA products alone will be subjected to "every case" governmental risk assessments. rDNA research will be subjected to costly data requirements, delays, and stigmatization.

This is precisely what Germany's new rDNA law has wrought, characterized in Science (255:524, 1992) as, "Bureaucracy, regulation, and delay: Molecular biologists fear for their research as enforcement of the "gene technology law" begins in earnest and an unsympathetic public looks on." The only certainty that German researchers, companies, and consumers have gained is that the new biology and products derived from it are in great peril.

The importance of the Administration's scope document is that it renders such a scenario contrary to U.S. federal policy. Applied to EPA, it would ensure certainty for researchers that their experiments will be subject only to regulatory requirements that are commensurate with risk. It is consistent with the National Research Council's assessment of the applicability of past effective oversight practices to products of the new and more precise biotechnology. Science, scientists, and consumers are all winners. Quoth *Nature*, "This approach is entirely sound and long overdue." Amen.

[1]"Introduction of Recombinant DNA-Engineered Organisms into the Environment: Key Issues," National Academy of Sciences (1987).

[2]"Field Testing Genetically Modified Organisms: Framework for Decisions," National Research Council (1989).

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Arresting Resistance

To the editor:

"*Bacillus thuringiensis*: Insects and Beyond" (*Bio/Technology* **10**:271-275, March, 1992), provides an excellent discussion of the diversity of toxins and their commercialization for pest mangement. The authors fail to mention, however, that at least five different species of insects (including representatives of Lepidoptera, Coleoptera, and Diptera) have already developed resistance to *B.t.* in laboratory selection experiments. Perhaps more important, some field populations of diamondback moth, a worldwide pest of vegetables, have developed resistance to *B.t.* in Hawaii, Florida, Japan, and the Philippines. Because relatively small populations responded to selection with *B.t.* in the laboratory and resistance has developed in several widely separated field populations of diamondback moth, we know that genetic variation for resistance to *B.t.* is not unusual.

Most of the cases of resistance, including those from the field, represent evolutionary adaptation to commercial formulations of *B.t.* that contain mixtures of several different toxins. Although a more thorough assessment of mixtures of toxins is needed, there is no reason to think that mixtures of toxins will prevent resistance development. Furthermore, laboratory experiments show that selection with one toxin or group of toxins can cause cross-resistance to other toxins. Although the array of *B.t.* toxins is diverse, only a limited number of toxins are effective against any given pest. This number may dwindle rapidly if excessive use of *B.t.* promotes development of resistance and cross-resistance in pests.

Resistance development may be slowed by providing spatial and temporal refuges from selection. For example, by mixing transgenic plants that produce *B.t.* toxins with non-transgenic plants, one can enhance survival of susceptible insects and thus reduce selection for resistance. Crop rotation can also help to retard resistance development. These tactics can be integrated with other cultural and biological controls to avoid heavy reliance on *B.t.* for pest suppression. Other techniques such as limiting expression of *B.t.* genes to periods when the pest is most susceptible or to particular portions of the plant are also promising, but suitable regulatory elements have not yet been identified.

In any case, it will be important to evaluate genetic variation for resistance, and the potential magnitude of resistance in target and non-target pests exposed to *B.t.*, as well as the patterns of cross-resistance among *B.t.* toxins. Until these data are available, it is prudent to treat susceptibility to *B.t.* as a limited resource, and concerted efforts should be made to delay the evolution of resistance.

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Correction

The following disclaimer was inadvertently omitted from the letter to the editor from Dr. Henry I. Miller that appeared in the April, 1992 issue of Bio/Technology: *"Dr. Miller is at the Food and Drug Administration (FDA, Rockville, MD). This letter reflects his personal views, which are not necessarily those of FDA or the U.S. government."*