ical and social decisions because "it turns on the goals of the society and what trade-offs are deemed acceptable."

The third compilation, *Assessing Ecological Risks of Biotechnology*, focuses on ecological issues in its 17 chapters. Introductory chapters deal with the effects of biological introductions on communities and planned introductions in the biological control of arthropod and weed pests. I would have preferred the use of microorganisms as examples in these chapters, because the remaining chapters focus on microorganisms. There are five chapters on the ecology and genetics of microbial populations, providing overviews of surface transport of microorganisms by water, soil and groundwater transport of microorganisms, aerial dispersal of bacteria, transfer of genetic information among soil microorganisms, and genetic stability in bacterial populations. There are also chapters on modeling the dynamics of transposable elements, quantifying fitness and gene stability, quantifying risks of invasion of genetically engineered microorganisms, and quantifying the spread of recombinant genes and organisms. Finally, there are four chapters dealing with regulation (by the Environmental Protection Agency, the Department of Agriculture, and in the European Community) and a chapter on risk analysis associated with biotechnology of waste treatment.

The final chapter is a provocative essay "On making nature safe for biotechnology" by Mark Sagoff. In a wide-ranging discussion of ecological restoration, agricultural economics, and history of agriculture, Sagoff presents scenarios for agriculture, forestry, and aquaculture that are revolutionized by biotechnology. He points out that some fear biotechnology not because some genetic monster will be set loose but because "the nation will drown in a sea of surplus agriculture commodities." He is concerned that "the unparalleled speed and magnitude of the expected productivity gains" will overwhelm saturated world markets and suggests that the issues have nothing to do with the *unpredictable* risks of biotechnology but concern the profitable, predictable, intentional, and successful effects of biotechnology. Sagoff argues that the major effects of biotechnology will be twofold. First, many ecosystems may be converted to species and processes suitable to large-scale, highly controlled production. Second, as agricultural surpluses begin to be seen as infinite, and as the factory replaces the field as the location where food and fiber are fabricated, many farms will go out of production, which will allow large tracts of land to be restored to their "natural" state. Sagoff argues that esthetic, moral, cultural, and historical arguments for preserving nature are being lost in the intricacies of arcane arguments over speculative risks and that the policy issue is whether increased efficiency of production can be compatible with maintaining the integrity of the global environment.

The introduction into the environment of genetically modified microorganisms and plants is considered by some to be a risky business. In one sense, it is ironic that risk issues have played such a dominant role in agricultural biotechnology despite its history of self-regulation since the Asilomar conference in 1975. By the end of 1989, more than 52 engineered plants and 56 engineered microbes had been released into the environment with no detectable harm.

The debate on the role of biotechnology in agriculture has expanded. Whether the revolution in agriculture that could result from the use of genetically engineered microorganisms and plants can be managed so that cultural, historical, moral, and esthetic values are upheld is the core of the problem.

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Reprints of Books Previously Reviewed

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Embryos, Genes, and Evolution. The Developmental-Genetic Basis of Evolutionary Change. Rudolf A. Raff and Thomas G. Kaufman. New introduction added. Indiana University Press, Bloomington, 1991. $49.95; paper, $24.95. *Reviewed* **221**, 257 (1983).

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Alternative Energy Sourcebook 1991. John Schaeffer, Ed. Real Goods Trading, Ukiah, CA, 1991. 398 pp., illus. Paper, $14.

Atom. Journey Across the Subatomic Cosmos. Isaac Asimov. Dutton (Penguin), New York, 1991. xii, 319 pp., illus. $21.95. Truman Talley Books.

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Calculus. James Stewart. 2nd ed. Brooks/Cole, Pacific Grove, CA, 1991. xviii, 1086 pp., illus. $65.

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