Letters

Technological Hazard

"The nature of technological hazard" by C. Hohenemser *et al.* (22 Apr., p. 378) may provide a taxonomy for studying certain hazards, but it should not be taken as a guide for public policy decisions. It considers only a piece of the issue, and only part of that.

The taxonomy omits the entire subject of benefits and, in so doing, ignores the hazards to society and the environment of curtailing or being without the contributions of the technology itself.

While calculations of these downside risks (from energy shortages, lack of new medicines, loss of productivity, and so forth) are much harder to do, even rough estimates often show that such risks dwarf the environmental hazards. Predictions are uncertain, but in some areas, like energy shortages, the risks should be minimized: the consequences of such shortages would be much worse than those due to any combination of hazards from energy production.

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Hohenemser *et al.* provide a rich framework for a broadened conception of risk. However, a critical class of dangers is missing from their listing of 93 sample hazards—those posed by the accumulation of materials. The authors compare policy choices of triage, when dealing with the most hazardous individual items, with cost-effective reduction when trying to remedy those one can handle effectively. I suggest adding the disquieting choice of dealing with an accumulation of materials that are individually sanguine but deadly in sum.

Certain chemical accumulations appear somehow to overload otherwise healthy human immune or detoxification systems, or both. The resultant "environmental illness" is marked by varied, extreme allergic symptoms in some numbers of people. The critical question is whether many others will get sick as chemical varieties and concentrations increase and the total accumulation diffuses over large regions.

The Clark University group's framework shows the enormity of the danger if one just scans the dozen hazard descriptors with the wealth of commercial chemicals in mind. As the authors state, "we cannot make extraordinary efforts on each of the 100,000 chemicals." There may, however, be effective ways to minimize affronts within structures or to increase bodily resistance with individually tailored diets or genetic engineering. We need to research the effects of cumulative chemical hazards to learn the limits of the problem, the mechanisms involved, and corresponding courses of action.

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The letters from Rossin and Porter are helpful because each, in its own way, highlights the limitations of our analysis. Meeting their demands, however, will not be easy.

Comparing risk to benefit, as suggested by Rossin, is of course essential to all decisions about hazardous technology. But risk-benefit comparisons are not so much uncertain as afflicted by unresolved, and possibly unresolvable, value questions. How should benefits be measured? If in dollars, what is the value of human life? What value should be placed on more subtle "goods," such as wilderness, species diversity, or unlimited energy supply? How should society handle the typical case in which one group receives the benefits and another bears the risks?

In the light of such questions, I do not share Rossin's conclusion that "the consequences of energy shortages would be much worse than those due to any combination of hazards from energy production." It depends on who judges. In such value conflicts about hazards and benefits, it may therefore be useful for participants to share a relatively objective, commonly held analysis of hazards, such as that provided by our article. Separating the issues is often the first, best step toward useful decisions; in this sense, I believe our work does contribute to policy decisions, even though it cannot by itself resolve them.

The cumulative effects of many individually innocuous materials hazards is, as noted by Porter, an important issue; and it is, I admit, not handled well by our recent article. In earlier work (*1*), our group has discussed two possible approaches: (i) adding up the estimated consequences of individual materials exposures and (ii) estimating cumulative impact through the use of global measures of exposure, such as employment in industry. We concluded that approach (i) is at present hopeless, whereas approach (ii) yields answers with large error bounds. For example, we estimated that "10 to 30 percent of cancer is correlatively associated with technology." Because I find such necessarily vague conclusions unsatisfactory, I strongly support Porter's call for further detailed research on cumulative effects.

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References

1. R. C. Harriss, C. Hohenemser, R. W. Kates, *Environment* **20**, 6 (1978).

Alcohol and Pregnancy

Mukherjee and Hodgen report (Reports, 12 Nov. 1982, p. 700) that a single intravenous dose of ethanol administered to pregnant monkeys produced a transient "collapse" of umbilical circulation and significant changes in umbilical vein blood gases (hypoxia and acidosis). This confirmation in primates of blood gas changes reported earlier in sheep fetuses (*1*) may indeed bring us closer to an understanding of mechanisms involved in the fetal alcohol syndrome (FAS), as Mukherjee and Hodgen suggest. However, they end their report with a recommendation that may be unwarranted.

Mukherjee and Hodgen suggest that "this striking interruption of feto-placental circulation may explain one of the mechanisms of mental retardation, a frequent manifestation in children afflicted with fetal alcohol syndrome." While there is evidence that a single injection of alcohol in pregnant mice with no previous exposure to it produces altered patterns of fetal brain and craniofacial morphogenesis (*2*), when alcohol was administered under conditions that more