

## Will There Be Life on the Farm After the Bomb?

In the midst of a series of bleak reports about the dire climatic and biological consequences of nuclear war (*Science*, 18 November, p. 822), a 2-year-old study forecasting that American agriculture would emerge in relatively good shape has been made public. It instantly became the object of widespread ridicule.

The report, prepared by a retired Federal Emergency Management Agency (FEMA) staff member in consultation with experts from the Department of Agriculture, was presented in early 1982 to a cabinet council that deals with food and agriculture issues.

The report "does not downplay the devastating effect of the nuclear attack on Americans and the American agricultural economy," FEMA says in a statement that points to at least six such references in the study's 41 pages.

The report focuses on a large-scale nuclear war, which it calls the "ultimate catastrophe." The report develops emergency plans using the unclassified intelligence exercise "Charlie," which envisages about 6000 megatons in 1200 weapons hitting both civilian and military targets in the United States. The heaviest damage would occur in a T-shaped area from Chicago eastward to the Atlantic, where it continues north to Boston and south to Washington, D.C. The only state spared a direct hit in the contiguous states would be Nevada.

According to the report, this is how agriculture fares, albeit in abbreviated form: because poultry and livestock would be "likely to survive blast and fallout better than our population," the balance of meat would be "slightly more favorable" than before the attack. Effects on crops, which are most sensitive to radiation during the planting season, would be more serious if the attack were in June rather than August. Fertilizer, energy, and water needs could still be largely met, although losses of veterinary drug and farm machinery production facilities would be severe. And, though there might be shortages of workers in the food-processing industry, "longer work weeks and product specializations" could overcome this temporary

problem. Likewise, restricted diets will allow survivors to make surviving food stocks stretch out 2 months or more, after which the "crucial" need to replenish supplies would be offset because the numbers of survivors "drops over time."

In a joint American-Soviet scientific forum, sponsored by the Nuclear Freeze Foundation and hosted by Senator Edward Kennedy (D-Mass.) and Senator Mark Hatfield (R-Ore.) on 8 December, FEMA's study was sharply criticized—not only for its recently outmoded risk estimates but also for its underlying attitudes. "This kind of thinking makes nuclear war more likely because it makes nuclear war seem more bearable," Kennedy said, referring to the FEMA report.

"That study would have been wrong even without the [more recent] information," asserted Stanford biologist Paul Ehrlich during the forum. "It's not right; it's not even wrong. They're not even close enough to join the discussion." He contends that a nuclear attack much smaller than considered in the FEMA briefing would "cancel" grain production in the United States by lowering temperatures. Moreover, he says that even a conventional war on the scale of World War II would lead to "tremendous starvation."

"Official pronouncements" on the effects of nuclear war inevitably "underestimate its consequences," said Cornell University astrophysicist Carl Sagan during the forum. He and Ehrlich are coauthors, respectively, of papers detailing the new forecasts for climatic and biologic devastation (see p. 1283 and p. 1293, this issue). Because the devastation from such a war would extend throughout the Northern, and likely into the Southern Hemispheres, regardless of which countries are directly involved, "Issues like first strike need to be rethought," Sagan said.

The four Soviet scientists who participated in the nuclear war forum said they are in close agreement with Sagan, Ehrlich, and their colleagues. One of the Russians, Sergei Kapitsa, who is senior scientist at the Physical Problems Institute of the Soviet Academy of Sciences, compared civil defense plans, such as the one outlined by FEMA for preserving the food chain, to "gadgets." In Russian, the acronym for civil defense spells the word for coffin, he pointed out. The

current threat posed by nuclear war is not a problem that can be solved with more gadgets, Kapitsa said. "The whole earth is held hostage. This is a time for ideas, not gadgets."

—JEFFREY L. FOX

## Agricultural Study Sees Big Changes After 2000

A recently completed study of the impact of new technologies on agriculturally important plants predicts that the main effects will be limited to ten major crops in 11 countries, and that dramatic economic impacts will not be felt until after the year 2000. "The New Plant Genetics," a copy of which costs \$30,000, was prepared by L. William Teweles & Company, a seed and plant science consulting firm based in Milwaukee, Wisconsin. The study is based on some 400 interviews with experts from 20 different countries; it took 2½ years to complete.

Some of the study's most important conclusions about eventual increases in crop values tie into forecasts about the steadily increasing importance of genetic engineering to the plant seed business. Sales of improved seeds are projected to grow at a 57 percent annual rate between now and the year 2000, according to George Kidd who helped prepare the report. By then, obstacles now barring the new technologies from being applicable to grain and oil-seed crop species will have been overcome, and genetic improvements will be adding \$5.9 billion per year in value (in constant dollars) to the seed market, Kidd says. The overall seed market is projected to grow to \$100 billion from the current \$50 billion.

This projection is made assuming—perhaps too predictably by a company whose main business for the past 12 years has been watching the seed industry—that seeds will remain the dominant vehicle for delivering plant genetic advances. "No one we interviewed suggested seeds will be replaced," Kidd says. The nearest competing technology, micropropagation based on tissue culture, is expected to grow as a business, he adds, but it will remain fragmented and low in profit.

—JEFFREY L. FOX