'Nuclear winter' research heats up

Five atmospheric and space scientists shocked the world last year when they unveiled an analysis of how the earth's climate might be severely perturbed by soot and dust flung into the atmosphere by even a "modest" strategic nuclear battle (SN: 11/12/83, p. 314). That analysis, now known as the TTAPS study (from an acronym of the authors' names), posited that even a 100-megaton exchange between the superpowers might be able to prompt a 60°F drop in surface temperatures in the northern midlatitudes during the first month after a war and initiate a "nuclear winter." Other scientists added that if the lofted soot filtered too much sunlight—as the TTAPS study suggested it would—plants might shut down their photosynthetic activity. Most sobering was the speculation that these effects might eventually circulate to southern latitudes too.

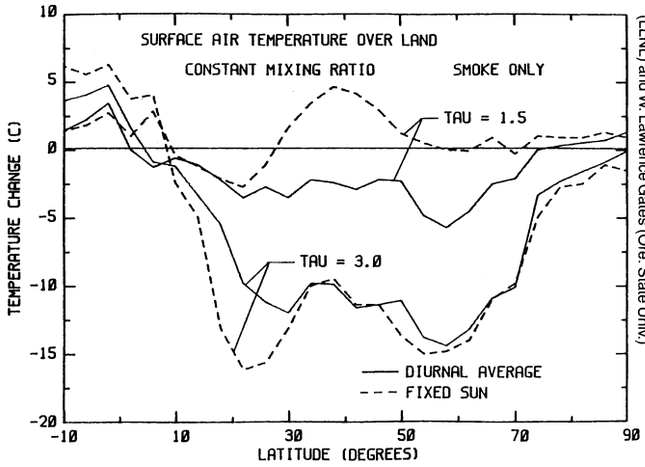
The TTAPS study and its nuclear winter hypothesis have not only sustained intense scrutiny but also served as a catalyst for scores of related research efforts. And the result? Most scientists now concede that based on existing data, TTAPS appears to have flagged a valid threat to the global environment. But that qualification, "based on existing data," is a big one. As dozens of scientists explained in graphic detail last week at the Conference on Large [Nuclear War] Scale Fire Phenomenology, when it comes to studying nuclear winter, there exist only sketchy experimental data on which to base any of these analyses.

Held at the National Bureau of Standards in Gaithersburg, Md., the conference presented new research on the dynamics of fires and combustion plumes—sources for those light-blocking soot particles so crucial to nuclear winter modeling. However, according to conference organizer Michael Frankel of the Defense Nuclear Agency (DNA) in Washington, D.C., "Basically, everybody's running around rehashing old data. What we need are well-thought-out new studies."

Frankel says DNA's interest in cosponsoring the conference was to make the research community aware of the agency's serious and growing interest in funding research that will generate those data. Not only do "the powers that be at DNA take it [nuclear winter] seriously," he says, but DNA is also one of the two major players in nuclear winter research today, at least in funding. That other player is Lawrence Livermore National Laboratory (LLNL) in Livermore, Calif.

Edward Teller was part of the LLNL contingent at the meeting. In his keynote address he cited a host of preliminary research findings that suggested the TTAPS analysis may have exaggerated the likely climatic aftermath of a nuclear Armageddon. As an example he cited research by a team of climate modelers that showed how sensitive climatic-effects projections are to the way key parameters have been modeled. Just replacing the normally "fixed" or static sun (used in nearly all climate models today) with one that appears to move across the sky was enough in some cases to turn a nuclear winter into a nuclear summer — large-scale warming instead of cooling (see graph). Cornell University astronomer Carl Sagan, an author of the TTAPS study, countered with citations of new research showing how the original TTAPS conclusions may have underestimated the climatic changes.

One point all the conferees could agree on—including Sagan and Teller—was the value of a new interagency federal research program to study nuclear winter. Under the direction of Alan Hecht at the National Oceanic and Atmospheric Administration, a research plan mapping its priorities is nearing completion. According to Hecht, highest priority will be placed on resolving those thorny unknowns involving the dynamics of large-scale fires and clouds. —*J. Raloff*



Temperatures for day 10 after a nuclear war. Tau represents measure of smoke in atmosphere. In TTAPS's baseline case, a tau of 3 was predicted. A value half that (tau = 1.5) shows biggest discrepancy: maximum 5° warming for "fixed" sun, and up to 5° cooling for moving sun.

Evicting an unwelcome mouth guest

Bacterial infections can be countered with antibiotics or prevented with vaccines. In the case of the cavity-causing bacterium *Streptococcus mutans,* toothpaste and fluoride have been but feeble weapons in what for many is a losing battle against dental caries.

But hope may be a swallow away. A clinical trial of an oral vaccine is about to begin, and work continues on another potential immunity inducer.

The role *S. mutans* plays in conjunction with sugar in causing cavities is unquestioned. Germ-free rats get no cavities no matter how much sugar they eat; when they have *S. mutans* in their saliva, as 95 percent of humans do, and they eat sugar, caries are inevitable.

Since humans are for the most part unwilling to give up their sugar, and long-term antibiotic use would be difficult to administer, promote resistant strains and disturb the bacterial balance, the effort has been toward an *S. mutans* vaccine. Studies have shown that vaccines prepared with entire *S. mutans* cells provoke the body into producing antibodies that attack not only the bacteria but also the heart and kidney. So the current research is focused on two proteins from *S. mutans,* glucosyltransferase (GTF) and spaA.

The Food and Drug Administration this summer approved a clinical trial using GTF, an enzyme *S. mutans* uses to line up long strings of glucose into a polymer that is a major component of plaque, where *S. mutans* and other bacteria roost and excrete tooth-destroying acid. Daniel Smith, one of the researchers conducting the trial at the Forsyth Dental Center in Boston, says the immediate goal is to determine if GTF will provoke an immune response in the saliva. Fifteen to 30 people will receive the vaccine.

Roy Curtiss and colleagues at Washington University in St. Louis are part of an international effort to characterize spaA, the most prevalent protein on *S. mutans'* cell surface. At a National Institute of Dental Research lecture this week, he described their work with *S. mutans* genes transplanted into *E. coli* bacteria. Curtiss and his colleagues have gotten weakened *Salmonella* bacteria to carry the spaA gene, an arrangement he feels they may be able to work into a vaccine. Other laboratories have successfully vaccinated animals with the protein, he says, but no human trials have been done.

An anticavity vaccine is not going to be the answer to a sugar freak's prayers, Curtiss predicts. Dental hygiene and fluoridation will still be important, as will gum care. "I think it's still going to be a collective effort," he says. — *J. Silberner*