studies to see whether an anti-idiotype vaccine might be developed to protect against the virus that causes AIDS (acquired immune deficiency syndrome).

The immune responses produced by immunizing mice with anti-idiotype vaccines have proved capable of improving the animals' resistance to infection by viruses, bacteria, and a unicellular parasite, a trypanosome that causes a form of sleeping sickness. However, in the case of the parasite, David Sacks and Alan Sher of the National Institue of Allergy and Infectious Diseases (NIAID) found that only certain strains of mice were genetically capable of developing the immunity.

Even if the anti-idiotype antibody does not induce protective immunity by itself, it may do so when attached to an appropriate carrier that boosts an otherwise weak immune response, according to Heinz Kohler and his colleagues at Roswell Park Memorial Institute. They found that they could protect mice against a lethal bacterial pneumonia by immunizing them with an anti-idiotype antibody coupled to keyhole limpet hemocyanin, a protein used by immunologists to increase the ability of antigens to stimulate antibody production.

Kohler suggests that an analogous approach might be used to develop cancer vaccines. The tumor-associated antigens that might serve as such vaccines have been difficult to isolate and there is also

Nuclear Winter Won't Blow Away

Nuclear winter is still far from confirmed, but the results of a recent study add new support for the theory. Presented at last month's National Academy of Sciences Nuclear Winter Symposium, the study shows that at least one step leading from fiery nuclear holocaust to climatic chilling is not likely to be short-circuited by natural atmospheric processes. Critics had conceded that the detonation of 25,000 nuclear weapons with 6500 megatons of explosive force could possibly ignite forests and cities, create huge amounts of smoke, blot out the sun, and chill the land below. The catch, they said, was that even if the fires created enough smoke, rain and other natural removal processes would likely cleanse the atmosphere too rapidly to allow any significant climate change. The new study and others show that the smoke would create its own defenses against atmospheric cleansing, keeping much of its original mass in the atmosphere for many months.

The new study, conducted by Robert Malone, Lawrence Auer, Gary Glatzmaier, and Michael Wood of Los Alamos National Laboratory and Brian Toon of NASA's Ames Research Center, uses a third-generation computer model to predict the behavior of the smoke-laden atmosphere. The simplistic first-generation model on which the original nuclear winter theory was based was an easy target for critics. It was one-dimensional—a vertical line up through an atmosphere that had no winds to disperse the smoke, no ocean to warm the land, no seasons, and no way to calculate how fast rain would remove smoke particles.

Subsequent second-generation, three-dimensional models containing far more realistic atmospheres, continents, and oceans also indicated that, given a large enough initial injection of smoke, continents would cool by tens of Celsius degrees and take months to recover. The cooling would on the whole be a bit lower than first calculated, coastal regions would be much less affected, and wintertime temperature effects would be much reduced, but on the other hand regions of dense smoke might quick-freeze the land beneath them.

The Los Alamos model is the most sophisticated of four third-generation models now simulating nuclear winter. These models allow the smoke to move about and respond to the atmospheric changes that it induces. Smoke is free to move in any direction; it is warmed by the absorption of sunlight; and it is washed out by rain at a rate determined by the precipitation rate that the model actually predicts. The smoke is released over North America and Eurasia below the tropopause, the boundary between the troposphere where weather and rain removal occur and the far more stable stratosphere. As critics warned, rain in the model begins to remove tropospheric smoke rapidly. But as proposed earlier by Carl Sagan of Cornell University and suggested by second-generation models, much of the smoke did not stay in the troposphere.

Warmed by the sun, the upper parts of the model's smoke clouds become buoyant and rise away from the cleansing rain. In addition, the warming of high smoke clouds pushes the tropopause downward from its usual altitude of 10 to 13 kilometers to 4 to 8 kilometers, confining the weather below the remaining smoke. During the winter, when less sunlight reaches the Northern Hemisphere to induce this lofting of smoke, rain would still remove 95 percent of the smoke within the first 40 days. During summer, scavenging by rain would get a jump on lofting of the smoke, removing 50 percent of it in the first week. But only two-thirds would have been lost by 40 days; and the remaining third of the smoke would by then be largely out of the reach of efficient tropospheric removal. Once it escapes, the smoke in the atmosphere decreases by a factor of 3 every 180 days, according to this model. The maximum summertime cooling of more than 15°C would occur over North America and Eurasia during the first 2 weeks, assuming an initial release of 170 million metric tons of smoke. Even 40 days later, continental cooling of 5° to 15°C would persist. That is still a significant nuclear winter effect.

Thanks in part to the lofting of smoke due to solar heating, the atmospheric component of the nuclear winter theory is proving rather robust. Not that even this latest model is sufficient to predict accurately the behavior and effects of smoke. Researchers will be further refining their atmospheric models, but they will never be able to include some processes that operate on too fine a scale for their global models to portray. One such process is the condensation and resulting scavenging that might occur in smoke plumes rising over a burning city.

The greatest uncertainty now, atmospheric scientists say, is the initial amount of smoke. The National Research Council committee on nuclear winter settled on a baseline amount of 180 million tons of smoke, but found plausible amounts to range from 20 million tons—which would have negligible climatic effects—to 650 million tons—which might plunge the Northern Hemisphere and perhaps the globe into a deep freeze. No one sees a quick way to reduce those uncertainties.—**RICHARD A. KERR**