build a new generation of advanced fighter aircraft.

U.S. technology controls could also cause problems. On 4 September, a 30-member delegation of German government officials, industrialists, and scientists arrived in Washington to discuss their potential collaboration in SDI. High on the agenda are the terms of an eventual government-to-government agreement which, officials in Bonn argue, must include adequate provision for the subsequent use in a European context—including, possibly, a European Defense Initiative—of any technologies developed.

U.S.-originated constraints could also place limits on Britain's participation in a European scheme. "I doubt if we would be able to share much technical information [with France and West Germany] because of the bilateral agreements that we have with the U.S," says Farouq Hussein, director of studies at the Royal United Services Institute in London.

Political pressure from the United States is also likely to come at a higher level. Many ideas about the military uses of space technology are being developed in the framework of the Paris-based Western European Union, a body used by France to strengthen its defense links with Germany—but is seen by some as a counterweight to the North Atlantic Treaty Organization (NATO), of whose military components France is not a member.

The United States has already made it clear, in a letter to European leaders from then Assistant Secretary of State for European Affairs Richard Burt, that it supports the idea of a research program for an active antimissile defense based in Europe, but only if it is developed within the context of NATO and its own planning for SDI. Any independent initiative promoted by France through the European Union will inevitably generate an unenthusiastic response in Washington.

Finally, a European Defense Initiative, if fully developed, is also likely to become the new target of a coalition of protest groups, whose flagging energies, drained in the battles against the deployment of the U.S. missiles, have already been revived by a series of mass protests against the "Star Wars" program and the involvement of European governments.

"As an anti-nuclear missile system, I would be very much against a European initiative, just as I am against SDI, since I do not feel you will achieve cost or systems effectiveness with either," says Hans Peter Durr, director of the Max Planck Institute for Physics and Astrophysics in Munich, and one of the guiding forces behind a national petition against "Star Wars" which has already raised more than 13,000 signatures, including many prominent scientists and celebrities.

Durr argues, with a growing group of West German academics and arms control experts, that a case can be made for a European defense strategy using highly advanced microelectronics and other technologies, but one that remains at the level of conventional weapons and would therefore, he says, "decouple the nuclear arsenal" within the defense debate.

However, such ideas do not generate much support in France. Indeed, none of the above criticisms seem likely to significantly deter the French from their conviction that Europe must become a major space power, nor from their hope that a joint defense initiative might provide the same imaginative spark for doing this as President Reagan has been able to do with the SDI.—**DAVID DICKSON**

A Grim Portrait of the Postwar World

"Nuclear winter" may be the least of our worries, according to an international study; starvation seems more likely

A controversial theory that nuclear war will dramatically alter the earth's climate and environment has won a new endorsement from a prestigious scientific group. The group, a branch of the International Council of Scientific Unions, says that "there is substantial reason to believe" that such a war could produce a phenomenon popularly known as "nuclear winter." In addition, the group says, a major war could sufficiently disrupt agricultural productivity to create a substantial risk of mass starvation, even in countries untouched by bombs.

These are the principal conclusions of a 2-year, $600,000-study by the Scientific Committee on Problems of the Environment (SCOPE),* in which more than 300 scientists from 30 countries participated. Released on 12 September during a SCOPE meeting at the National Academy of Sciences in Washington, D.C., the 850-page study reflects the latest research on several aspects of nuclear war, according to Gilbert White, an emeritus professor of geography at the University of Colorado, who served on the steering committee. The chairman was Sir Frederick Warner of the University of Essex.

With regard to postwar climate, for example, the report suggests that temperatures in some regions of the Northern Hemisphere could indeed drop by as much as 35 degrees and that light reaching the earth's surface could be diminished by more than 90 percent, as dust and soot pour into the atmosphere.† But it discounts the relative importance of smoke from forest fires and emphasizes the necessary contribution of fossil fuel combustion in urban or industrial centers. It also highlights the seasonal nature of any adverse effects—if the war occurred in wintertime, ironically, the effect on light and temperature may be slight.

Once in the air, some of the smoke will be eliminated by precipitation. No one knows how much, but the study authors discount recent forecasts by Edward Teller, Fred Singer, and Jonathan Katz in *Nature*‡ that moisture in wood and fuels will condense and ultimately wash a lot of smoke from the atmosphere. "The significance of these quantities of water vapor for precipitation and particle scavenging is easily exaggerated because of a common misconception," they state. Specifically, they suggest that much of the moisture will not condense, and that any precipitation will occur well below the smoke layer.

Smoke that is not eliminated could start to spread to southern latitudes within 1 or 2 weeks, the report says, where it

*_The Environmental Consequences of Nuclear War_ is available in two volumes from John A. Wiley & Sons in New York.

†This is the amount estimated for "northern midlatitude continental interiors" after a summertime conflict in which 12,600 bombs had been detonated, generating roughly 150 million tons of smoke.

‡ 23 August 1984 and 4 October 1984.

will begin to play havoc with local precipitation and, consequently, agricultural productivity. In particular, "the convectively driven monsoon circulation, which is of critical importance to subtropical ecosystems and agriculture and is the main source of water in these regions, could be essentially eliminated," the report says. What rainfall occurs will probably be at sea, or strictly along the coastline. As a result, much of the Sahel, India, Southeast Asia, China, and Japan could suffer both unusually low temperatures and a prolonged drought. El Niño, the natural warming of the ocean at the equator, might also be disturbed.

Agricultural production will be hampered not only by the adverse climate but also by "radioactive contamination, uncontrollable fires, loss of fertilizers and pesticides . . . and destruction of major ports and facilities of the global food distribution network," the report says. In some countries, mass starvation would result if a single growing season was eliminated, due to inadequate food stores and a cessation of trade. As net food importers, China and Japan are particularly vulnerable, but even nations that feed their own populace—such as Brazil or Australia—would suffer from lack of access to liquid fuels needed for food production. Many of the countries that export such commodities will be directly attacked.

The report goes so far as to suggest that starvation could be the primary cause of death after a nuclear war. "This vulnerability is . . . not currently a part of the understanding of nuclear war," it says. "Not only are the major combatant countries in danger, but virtually the entire human population is being held hostage to the large-scale use of nuclear weapons."

On a more positive note, the report indicates that a major conflict probably will not cause the extinction of mankind, as some suggested when the "nuclear winter" phenomenon first came to light. "That a person or group in a combatant country might find a way to escape the effects of radiation, societal disruptions, climatic alterations, and the host of other potential disruptions, and still continue to survive seems possible, even in devastated areas," the report says. "That billions of people could do so" is considered unlikely.

The authors also note that a large proportion of the world's population will not die of cold; that the earth's climate will eventually return to normal; and that, contrary to wide belief, global fallout is "comparatively not of major concern" as a cause of death, particularly in the Southern Hemisphere. Radiological doses there will probably be 5 percent of the Northern Hemisphere dose.

Finally, the authors explicitly caution that their study should be seen as "a point of departure rather than a completed investigation," and suggest that a permanent committee be formed to keep tabs on the latest research and issue periodic reports. They also support continued exchanges on the topic between scientists and military planners, and between biologists and physical scientists. Numerous uncertainties, relating to smoke generation and global weather effects, as well as the distribution of food and agricultural recovery, remain to be addressed, although some may never be solved.—**R. JEFFREY SMITH**

No Trace of Soviet Researcher

"It is with considerable sorrow that we learned of the unexplained disappearance in Madrid of our colleague, Vladimir Aleksandrov." So report the authors of a study by the Scientific Committee on Problems of the Environment (SCOPE) on the effects of nuclear war, in their sole, discrete reference to an event that has unsettled the U.S. community of atmospheric scientists for months.

In March, Aleksandrov, the director of climate modeling at the Computing Center of the Soviet Academy of Sciences and for a time the major Soviet contributor to research on "nuclear winter," vanished. He had just finished lecturing to an international political conference in Córdoba, and had returned by car to Madrid. Apparently, he failed to appear for an appointment at the Soviet embassy, and a search turned up only his passport and plane tickets, dumped in an outdoor trash bin.

An enthusiastic, engaging researcher, Aleksandrov had become close to a number of U.S. scientists during extended visits to the United States. Word of his disappearance first came when the Federal Bureau of Investigation and the Central Intelligence Agency began making inquiries. Then, in June, his wife telephoned John Wallace, chairman of the department of atmospheric sciences at the University of Washington, seeking information about her husband. Neither Wallace nor others have been able to make any headway since. "We are still concerned," says a spokesman at the Soviet embassy in Washington. "The proper authorities are still investigating."

One theory, discounted by various sources, is that Aleksandrov defected. During the 1970's, he had done some research on plasmas generated by ballistic missile reentry vehicles, making him a valuable catch. But he was also permitted to travel widely by himself, suggesting unusual trust by the authorities. He is also considered close to his wife and daughter, who remain in Moscow.

Another theory is that he was forcibly detained. Several scientists wonder if his attempts to obtain some medical treatment for his wife in England rankled the KGB. But evidence of an ideological split with the Soviet Union is lacking, and Soviet authorities have denied any knowledge of his whereabouts.

A third possibility, which has aroused the most concern, is that he was victimized by an independent group. An American who attended the meeting in Córdoba, a Socialist town, reports that security was extremely tight, apparently because of threats from rightist groups. Again, no supporting evidence has been unearthed by Spanish investigators, according to a recent Madrid newspaper account.

Suspicion about Aleksandrov's fate generated some tension between U.S. and Soviet scientists at a SCOPE workshop in England last June, but relations have been smoothed over since then. "He was a good, close friend of mine, and I have no idea what's happened to him," says Robert Cess of the State University of New York at Stonybrook. "It's extremely frustrating." Similarly, Michael MacCracken of Lawrence Livermore National Laboratory says that Aleksandrov set a high standard for U.S.–Soviet collaboration. "It'll be difficult to reestablish the same ties," he says.

—R.J.S.