Policy Implications of Nuclear Winter and Ideas for Solutions

The 5 May 1988 United Nations report clearly states that the nuclear winter theory is supported by current scientific evidence and that a major nuclear war would result in an unprecedented holocaust for the people of combatant and noncombatant nations alike. Nevertheless, nations of the world continue to produce nuclear weapons and make plans for their use. The number of nations with nuclear weapons continues to grow. Although the recent Intermediate-range Nuclear Forces (INF) agreement and Strategic Arms Reduction Treaty (START) talks demonstrate the political will to work on this problem, they would still not prevent nuclear winter when fully implemented. The principal political implication of nuclear winter is that nuclear weapons cannot be used as an instrument of war or policy. Even a "first strike" or a "limited nuclear war" would be likely to result in nuclear winter for the aggressor as well as for the rest of humanity. The only solution is to resolve conflicts in nonviolent ways. Star Wars is not the answer. Plans for first use of nuclear weapons exacerbate the problem. Obstacles on the road to solving the problem of nuclear weapons include the military-industrial-scientific-technical complex and regional conflicts.

Through the release of atomic energy, our generation has brought into the world the most revolutionary force since prehistoric man's discovery of fire. The basic power of the universe cannot be fitted into the outmoded concept of narrow nationalism. For there is no secret and there is no defense; there is no possibility to control of atomic energy except through the aroused understanding and insistence of the peoples of the world.

Albert Einstein, 22 January 1947.

INTRODUCTION

Nuclear weapons have existed for more than forty years. The use of just one of these weapons would be horrible, as evidenced by Hiroshima or Nagasaki. For most of these forty years, however, we now know that we have possessed not just the means to destroy cities but the means to destroy the world, a "Doomsday machine." Although many people, several hundred million, would die from the immediate effects of nuclear weapons in a full-scale nuclear war, many more would die from the indirect effects, from starvation. As the United Nations report (1) (the UN report) says, "... it appears evident that none would escape the awful consequences of a major nuclear war even if the theatre of conflict was geographically restricted to a small part of the northern hemisphere." (2) The recent mass starvations in Ethiopia and the Sudan, without any outside help, seem more appropriate models for the world after nuclear war than Hiroshima or Nagasaki. More people could die in India or China from a nuclear war, even if no bombs are dropped there, than would die in the United States and the Soviet Union combined. As the UN report concludes, "The direct effects of a major nuclear exchange could kill hundreds of millions: the indirect effects could kill billions" (3).

When the theory of nuclear winter was first brought to the world's attention in 1982 and 1983, it was shocking. Many critics did not accept the theory and tried to prove it wrong. They suggested that unknown factors not considered in the first simple climate models would ameliorate the climatic effects when considered in more detailed calculations. But these critics ignored the simple fact that unknown factors are, by definition, unknown. It is impossible, a priori, to determine whether an unknown factor, when considered, will make the results better or worse. In the intervening 5 years, it has turned out that not only has the theory been proven correct, but it also has been strengthened by the additional research into many of the detailed mechanisms involved. Some factors, when considered, indeed lessened the surface cooling from a major nuclear war, but other factors not only showed that the effects would last longer than previously thought, but also that the effects would be more devastating than previously thought for the planet's biosphere, including agriculture. And several new effects have been discovered, such as the recently calculated hemispheric-scale ozone hole (4-7). Furthermore, research into analogs has demonstrated the validity of several of the theoretical nuclear winter mechanisms by observations in our current climate system (8-10). In addition, there has come a growing realization that synergistic effects

will make the total consequences worse (11). Thus, as the UN report states: "The criticisms and objections that have been raised from time to time... do not invalidate the conclusion that a large-scale nuclear war would have a significant effect on global climate" (12).

It is my perception that the nuclear winter debate has raised the consciousness of the people of the world who have been forced by this debate to realistically confront the effects of actually using our nuclear weapons' stockpile. Now, with the UN report confirming the theory of nuclear winter, the nations of the world are forced to realistically face the policy implications of the environmental consequences of using nuclear weapons.

In this paper, the opinions of a scientist who is active in nuclear winter research and is interested in politics are expressed about the problem of nuclear weapons. I am not an "expert" in political science or an arms control and disarmament specialist, and in fact I reject their way of thinking about this problem. It seems obvious to me that the whole concept of nuclear deterrence is based on the false premise that nuclear weapons can actually be used without destroying the world. In the next section, the policy implications of nuclear winter are described. Then, some indications of progress in solving the nuclear problem are indicated and obstacles to further progress are discussed. Finally, ideas concerning what measures to take now are presented.

POLICY IMPLICATIONS

The most important, overwhelming implications of nuclear winter are that nuclear weapons cannot be used as an instrument of war or policy, and that their use would be suicide for the peoples of this planet. This implies that continued production and plans for the use of nuclear weapons decrease, rather than increase, a nation's security. Therefore, it is necessary to drastically reduce the number of nuclear weapons on the planet.

Nations of the world, including the superpowers and developing nations, continue to consider the nuclear weapon as just a more powerful version of, and to be used in the same way as, past weapons. Only Sweden, among all the nations of the world, has reversed its policy and made a conscious decision to change its previous plans and stop the development of its own nuclear weapons. Other developed countries with the capability to build nuclear weapons, such as Canada, Germany, Japan, Australia, and the Netherlands, have also decided not to build them, but they feel "protected" by the nuclear weapons of superpowers. But some nations, such as Israel and India, have recently started to build their own nuclear weapons stockpiles. Other nations, such as New Zealand, however, have decided to reject any nuclear weapons on their territory, even if it means rejecting a nuclear defense.

What can we learn from the above examples? Why do some nations cling to nuclear weapons, and in fact work so hard to obtain them, and others reject them? Can these lessons be applied to other nations? These questions will be addressed in Section 5 of this paper.

Given that we accept the validity of the nuclear winter theory, the policy implications remain the ones that were obvious several years ago, and that led to the general conclusions already stated above:

No First Strike

If country A used enough nuclear weapons to attack country B so that country B could not retaliate, in what is known in nuclear jargon as a "surgical first strike," the resulting climatic and other consequences would be so severe that country A would not survive as we know it. Thus, the use of nuclear weapons becomes suicidal. At the Democratic Convention in Atlanta in July 1988. Senator Sam Nunn, chair of the United States Senate Armed Services Committee called for the maintenance of a "credible nuclear deterrence." This is incredible if nuclear winter is considered. Since nuclear weapons cannot be used safely, the threat of their use becomes empty. If the threat is indeed real, then it is insane, and dangerous for the whole world. This is an example of the needed change in the way we think, to take account of the realistic effects of nuclear weapons as described in the UN report.

United States nuclear targeteers (13) claim that it is not United States policy to target Soviet cities per se, and thus enough fires will not be started by a counterforce attack to produce nuclear winter ("counterforce" is nuclear jargon for an attack on the nuclear weapons of the enemy, including all the support facilities for using the weapons). But, this claim ignores two important factors. First, there are many military targets in and near Soviet cities, as there are in the United States, so that cities would be targeted de facto. For example, every airport becomes a military target in the event of a crisis. One of the first reactions of the United States military to the Cuban Missile Crisis was to disperse United States military airplanes to civilian fields. Second, studies done since 1985 show that even military targets outside of cities would produce a substantial amount of smoke from the associated fires.

No Limited Nuclear War

One of the original policy implications of nuclear winter, that even a "limited" nuclear war, if such a war could be limited, could produce significant and severe consequences has been confirmed by the UN report (14). Furthermore, once nuclear war is started, communications would be so disrupted by the smoke in the air and by the electromagnetic pulse (EMP) that would destroy all unprotected electronic gear, and people would be under so much stress, that it is unlikely that nuclear war could ever be limited. Thus, NATO plans for the nuclear defense of Europe (in which many cities would burn) and Israeli plans for their nuclear defense (in which many petroleum facilities could burn) are both also suicidal.

No First Use

NATO has a declared policy of "first use" of nuclear weapons in defense of an attack by conventional weapons ("conventional weapons" is nuclear jargon for all the nonnuclear weapons that have been responsible for the deaths and injuries of many millions of people in the history of the world, including 50 000 000 deaths in World War II. They are being used in the more than 40 wars being fought on our planet today. It is sad truth that use of these weapons is quite conventional today, but use of the term "conventional" should not imply any sense whatsoever of approval). As discussed above, any use of nuclear weapons would rapidly disrupt communications, intelligence gathering, and operations of weapons because of the resulting smoke, dust, and EMP, and could also kill those with the power to limit the ensuing retaliation (in what is known in nuclear jargon as "decapitation strategy"). First use of nuclear weapons would be very likely to be the last one.

Noncombatants Affected

Another implication confirmed by the UN report is that people far from a potential nuclear conflict will also suffer the consequences of nuclear winter. The citizens of Sweden, Egypt, India, and Brazil, for example, cannot sit this one out and then pick up the pieces. This implication has already resulted in the Five-Continent Peace Initiative, discussed in the next section.

Star Wars

Nuclear winter has been used to argue both for and against the Strategic Defense Initiative of President Reagan. If it would work perfectly and were available to all parties, then it could prevent nuclear winter. But, since even the staunchest supporters do not claim that it will stop all incoming ballistic missiles, and it will also not prevent low-trajectory submarinelaunched missiles, cruise missiles, bombs dropped from airplanes, or bombs smuggled into the country in marijuana bales, and since the computer software and hardware are too complex to work perfectly the first time (e.g. Challenger, Chernobyl, KAL (Korean Airlines) 007, Iran Air 655), it is clear that Star Wars is not a solution to the problem.

PROGRESS SO FAR

Although very much remains to be done, there have already been some political responses to the nuclear winter theory.

Five-Continent Peace Initiative

On 28 January 1985 the leaders of six nations from five continents, shocked by the fate that might await their nations as a result of a nuclear war between the superpowers, issued the Delhi Declaration. This appeal to the states of the world, and particularly to the United States and the Soviet Union, signed by President Raúl Alfonsín of Argentina, Prime Minister Rajiv Gandhi of India, President Miguel de la Madrid of México, President Julius Nyerere of Tanzania, Prime Minister Olof Palme of Sweden and Prime Minister Andreas Papandreou of Greece, states in part; "there have been new findings which indicate that ... nuclear war, even on a limited scale, would trigger an arctic nuclear winter which may transform the Earth ... posing unprecedented peril to all nations, even those far removed from the nuclear explosions. We are convinced that this makes it still more pressing to take preventive actions to exclude forever the use of nuclear weapons and the occurrence of a nuclear war".

United Nations Report

The UN report (1) is the result of the wishes of more than 100 nations of the world who requested in December 1985 and December 1986 that the Secretary-General investigate the nuclear-winter theory and report on its validity so that further political decisions could be made. And on 7 December 1988 the United Nations General Assembly voted (145 in favor, 9 abstentions, none against) to accept the validity of the nuclear winter theory (resolution 43/78 D). The vote was to give "the widest possible distribution" to the UN report. Thus, thanks to the tireless efforts of Derek Boothby of the UN Department of Disarmament Affairs, the world has accepted the validity of the nuclear winter theory.

The INF Agreement

The Intermediate-range Nuclear Forces (INF) treaty, signed by President Reagan and General Secretary Gorbachev in Washington on 8 December 1987 begins, "The United States of America and the Union of Soviet Socialist Republics, hereinafter referred to as the Parties; Conscious that nuclear war would have devastating consequences for all mankind This is clearly a reference to nuclear winter, and indicates that the threat of nuclear winter has been at least partially responsible for the improved negotiating climate between the superpowers that has resulted in this treaty and progress toward Strategic Arms Reduction Treaty а (START). It should however be pointed out that neither the INF treaty (15) nor a 50% reduction of existing nuclear forces being discussed at the START talks would prevent the occurrence of a nuclear winter in the event of a massive nuclear war, but they are certainly steps in the right direction of elimination of even more nuclear weapons.

Nuclear Free Zones

The decision by Sweden to stop development of nuclear weapons was a clear message to the world that security does not depend on, and can even be reduced by, the possession of nuclear weapons. The



Our planet Earth. Photo © ESA/EUMETSAT.

decision by New Zealand to renounce a nuclear defense and prohibit nuclear weapons on its territory is another such action. Indeed, nuclear-free zones are proliferating around the world. There are 5 Nuclear Free Zone treaties in existence, 4 of which (Antarctica, Outer Space, Latin America, and the International Seabed) are signed by both the United States and the Soviet Union, and 1 (South Pacific) which is signed by the Soviet Union and China, but not the United States, United Kingdom or France. There are 21 Nuclear Free Zone countries and 3954 Nuclear Free Zone communities in 24 countries in the world, but not all are enforced.

It is a sad footnote to remember that it was on March 31, 1985, after giving a talk on nuclear winter at the Second International Conference of Nuclear Free Zone Local Authorities in Córdoba, Spain, that the leading Soviet nuclear winter researcher, Vladimir Aleksandrov, mysteriously disappeared after checking into a hotel in Madrid.

Pastoral Letter on War and Peace

The Catholic Conference of United States Bishops (17) issued a pastoral letter which addressed the morality of current nuclear strategic doctrine. Specifically, they condemn the use of nuclear weapons against cities and the first use of nuclear weapons, and the concepts of limited nuclear war, nuclear war-fighting capability, and nuclear deterrence, and they question the concept of civil defense. They call for an immediate bilateral halt to testing, production, and deployment of nuclear weapons, and for negotiated deep cuts in nuclear arsenals. This statement was made before the risk of nuclear winter was known, and serves to remind us of the clarity with which some can see the dangers of the direct effects of nuclear weapons. It also shows the potential role of religious leaders in solving the nuclear problem.

New Visions of the Future

The arms race has been produced by humans and can be ended by humans. It is encouraging that visions of how the world can function without an arms race are appearing in many publications, such as that of Sagan (18), which describes a race to dismantle nuclear weapons, or that of Foell and Henneman (19).

There are encouraging developments in the field of conflict resolution, which emphasize collaboration and compromise among nations in conflict. These techniques, in which disputants are oriented toward win-win rather than win-lose scenarios, are being successfully used by United Nations mediators in several conflicts around the world today.

Ideas for non-nuclear defense include that of organized "civilian-based defense" advocated by Sharp (20). Invasion will be deterred if an invader realizes that it will never receive cooperation or acquiescence of the people and institutions of a country, upon which political power ultimately depends.

OBSTACLES TO FURTHER PROGRESS

While the theory of nuclear winter has certainly awakened the world to the danger of global catastrophe, there are certain existing social, technical, political and psychological barriers to further steps to reduce nuclear weapons. A few of the most important are discussed here.

The Military-Industrial-Scientific-Technical Complex

In President Dwight D. Eisenhower's Farewell Address on 17 January 1961, in

addition to his familiar warning about the military-industrial complex, he stated:

We must never let the weight of this combination endanger our liberties or democratic process. We should take nothing for granted. Only an alert and knowledgeable citizenry can compel the proper meshing of the huge industrial and military machinery of defense with our peaceful methods and goals, so that security and liberty may prosper together.

Akin to, and largely responsible for the sweeping changes in our industrial-military posture, has been the technical revolution during recent decades.

In this revolution, research has become central; it also becomes more formalized, complex, and costly. A steadily increasing share is conducted for, by, or at the direction of, the Federal government.

Today, the solitary inventor, tinkering in his shop, has been overshadowed by task forces of scientists in laboratories and testing fields. In the same fashion, the free university, historically the fountainhead of free ideas and scientific discovery, has experienced a revolution in the conduct of research. Partly because of the huge costs involved, a government contract becomes virtually a substitute for intellectual curiosity. For every old blackboard there are now hundreds of new electronic computers.

The prospect of domination of the nation's scholars by Federal employment, project allocations, and the power of money is ever present—and is gravely to be regarded.

In the more than 28 years since this statement, its truth has become self-evident. And it provides not only a brilliant description of the problem, but some of the means for its solution. "In the councils of government, we must guard against the acquisition of unwarranted influence..." and we need "an alert and knowledgeable citizenry."

President Eisenhower's statement also makes it clear that an intrinsic part of the problem is the interweaving of the scientific and technological components of our society with the military and industry. In fact, 3 universities in the United States (MIT, Johns Hopkins, University of California) are among the top 50 military contractors. Thus, we have an even more complex societal construct to deal with: a military-industrial-scientific-technical complex.

Industry in the United States now has a tremendous financial interest in perpetuating the arms race. To put it bluntly, you can make a lot of money in the United States by keeping Americans afraid of the Commies. With a president who is sympathetic to this way of thinking, the process has mushroomed in the last 8 years, with the doubling of the military budget. The United States has spent USD 200000000000 (USD 21999 for each American family) preparing for war since 1981. Preparations for nuclear war have cost USD 427 000 000 000 (21).

Insight into the military component of this problem can easily be gained by reviewing the response of the United States Department of Defense (DOD) to nuclear winter. On the one hand, they have initiated a research program into what they

call "Technical Effects" of nuclear holocaust, funded at the level of USD 400 000 to USD 2 500 000 per year. This has been virtually the only source of funding for scientists outside of the government, since the traditional funding agencies have found the topic too political for them to get involved. This research program has produced not only a large amount of high-quality new research results, many of which are described in the UN report, but also has had important spin-offs in advancing the capabilities of climate models for use in investigating other problems. It should be noted that virtually all this funding goes for research into the physical effects of nuclear war and there is no source of government funding for the biological effects. The Department of Energy, the agency which designs and manufactures nuclear weapons in the United States, spends about the same amount per year on nuclear winter research as the DOD, but the vast majority of this is spent in-house. The resulting research, conducted mostly in Los Alamos and Livermore National Laboratories, has also been first-rate.

On the other hand, DOD has been singularly unresponsive to Congressional requirements embodied in the Authorization Acts for the DOD for each of the last 3 years, that they conduct a "detailed review and assessment" of scientific findings on nuclear winter, including the theory's environmental and biological dimensions, and a "thorough evaluation of the implications" these findings have for the United States' nuclear weapons, arms control and civil defense policies. On 1 March 1985 they produced a brief, 17-page report (13) which evaluated only two scientific studies of nuclear winter and devoted five pages to policy implications of the theory. They state that the main policy implication is that nuclear war must be prevented, and that the way to do this is by deterrence, arms control and Star Wars. To maintain effective deterrence requires "maintaining a modern, effective strategic Triad by strengthening each of its legs (missiles, bombers and ships) and emphasizing secure and survivable command, control and communications" (22). With regards to Soviet work on nuclear winter, they say that "it is hard to tell the difference between scientific workers and propagandists" (23). Environmental and biological effects were not addressed. The report's brevity was in part attributed to the scientific uncertainties surrounding the theory.

After one more year of research, the second report (24), issued 9 May 1986, presented an even briefer 5-page analysis, with no new discussions of policy implications. Although details of some new research projects were mentioned, no synthesis or evaluation of ranges of uncertainties was presented. Again, environmental and biological effects were ignored. In response to the latest Congressional requirement (Box 1), the one-page response (Box 2), which was a month and a half late, claims that we still have insufficient information to understand nuclear winter, and that there is no guarantee that three years from now the situation will be any better. The reader is invited to compare this response to the UN report.

In virtually every other possible scenario for military action, the DOD uses the "worst-case" approach; they plan for the worst possible outcome. Only in the case of nuclear winter do they use a best-case approach. They say that because the theory is uncertain they will wait many years before acting on its possible implications.

The situation in the Soviet Union has some similarities. Even though not as much monetary gain is involved, generals and missile factory managers, for example, clearly have a personal stake in keeping the system from changing. The Soviets, however, in their public statements have accepted the validity and implications of the theory of nuclear winter, and have pledged not to use nuclear weapons first in a conflict (25).

Regional Conflicts and Proliferations

Many areas of conflict exist in the world that do not directly involve the superpowers. Israel and its neighbors, Iran and Iraq; India and Pakistan; Cyprus; South Africa; Afghanistan; Vietnam and Cambodia; and Central America are only some of them. The danger always exists that either the superpowers will be drawn directly into these conflicts and use nuclear weapons (26), or that the parties in these conflicts will use nuclear weapons. As indications that such behavior could be contemplated it should be noted that poison gas, not now acceptable in "civilized warfare", has been used recently in the Iran-Iraq war.

Several of the countries involved in these disputes have recently acquired or attempted to acquire nuclear weapons. In addition to the declared nuclear weapons states of France, Britain, China, and the United States and the Soviet Union; Israel (50–100), South Africa (10–20), India (20–50) and Pakistan (2–4) now have nuclear arsenals (estimated numbers of weapons in parentheses); Brazil, Argenti-

Effects of nuclear winter on vegetation, exemplified by widespread biocide. Photo: A. Westing.



The United States National Defense Authorization Act for Fiscal Year 1987 (1 October 1986-30 September 1987). For the Defense Department response, see Box 2.

SEC. 1371. NUCLEAR WINTER STUDY AND REPORT

(a) STUDY.—The Secretary of Defense shall conduct a comprehensive study on the atmospheric, climatic, biological, health, and envicommental consequences of nuclear explosions and nuclear ex-changes and the implications that such consequences have for the nuclear weapons, arms control, and civil defense policies of the United States.

(b) REPORT.-Not later than November 1, 1987, the Secretary shall submit to the President and the Congress an unclassified report suitable for release to the public, with classified addenda if neces sary, on the study conducted under subsection (a). The report shall

contain the following: (1) A detailed review and assessment of the findings in the current body of domestic and international scientific literature on the atmospheric, climatic, biological, health, and environmental consequences of nuclear explosions and nuclear exchanges.

(2) A thorough evaluation of the implications that such findings have on-

(A) the nuclear weapons policy of the United States, especially with regard to strategy, targeting, planning, com-mand, control, procurement, and deployment;

(B) the nuclear arms control policy of the United States; and

(C) the civil defense policy of the United States. (3) A discussion of the manner in which the results of such evaluation of policy implications will be incorporated into the nuclear weapons, arms control, and civil defense policies of the United States.

(4) An analysis of the extent to which current scientific find ings on the consequences of nuclear explosions are being stud-ied, disseminated, and used in the Soviet Union.

(5) A plan for a five-year research program to advance understanding of nuclear winter and an estimate of the funding nec-essary to carry out such a research program. (c) EVALUATION OF REPORT.—Upon submission of the report under

subsection (b), the Secretary shall contract with the National Academy of Sciences to-

(1) make an independent evaluation of the material contained in the report; and

(2) not later than April 1, 1988, submit a report to the Secre-tary of Defense and to the Committees on Armed Services of the Senate and of the House of Representatives, setting forth the results of the evaluation and any recommendations pertaining to the contents of the report, including the plan for the five-year research program.

na, Iraq, Iran, North Korea and Taiwan are engaged in research towards production of nuclear weapons, and Libva has attempted to purchase nuclear weapons (27). The Nuclear Non-Proliferation Treaty does not seem to be working.

Use of nuclear weapons in a regional conflict may even produce global climatic changes, and any use in a period of tension could result in escalation by neighbors and superpowers, and breakdown of communication and leadership that would be necessary to limit the conflict. And the arsenals of Britain, France, China, and possibly Israel are enough by themselves to produce nuclear winter, if targeted at cities or petroleum facilities.

The Old Modes of Thinking

Carl Sagan tells the story of how, after he had conducted a briefing for members of Congress about nuclear winter, a participant called him aside and said, "Carl, if you think the mere prospect of the demise of humanity is going to change the way people in Moscow or Washington think, you clearly haven't spent much time in either place". In 1946, Albert Einstein said, "The unleashed power of the atom has changed everything save our modes of thinking and we thus drift towards unparalleled catastrophe". He said this almost 40 years before the theory of nuclear winter.

As alluded to in previous sections, the idea of indirect consequences of nuclear holocaust has had a limited impact on the world. Although lip service is given to nuclear winter, nuclear weapons production continues as do plans for the use of nuclear weapons. Production of submarines, aircraft carriers, cruise missiles, ballistic missiles and various bombers, each of which uses nuclear weapons, continues. Nuclear weapons continue to be treated as just larger versions of the types of bombs that have been used throughout history with no indirect effects.

The political right-wing in the United States has attacked nuclear winter as a communist plot, and as a threat to the security of the United States, which they continue to identify with a strong nuclear deterrence and a vigorous nuclear weapons industry. Articles in conservative publications such as The Wall Street Journal and The National Review imply that lack of exact agreement between different computer simulations means that the nuclear winter theory is invalid. And the DOD helps to disseminate such views, as in the 2 April 1987 issue of their internal publication Current News, which reproduced and distributed throughout the DOD an article by Seitz (28) subtitled, "Nuclear Winter" Melts Down. Clearly, nuclear winter is perceived as a threat to the military-industrial complex, to those

who maintain the fiction that nuclear superiority is possible or that technically advanced weapons systems will keep us secure.

Nuclear Fall

There has been considerable debate in the press in the United States about the validity of the original nuclear winter results, which has caused confusion in many minds. With the introduction of the term "nuclear fall", Thompson and Schneider (29) cast doubt in the minds of the public not only about the validity of the large coolings calculated by Turco et al. (30), but also about all the ensuing implications. Although Thompson and Schneider clearly say in their article that the climatic consequences they calculate remain severe for life on the planet, it is my perception that the validity of this conclusion is now questioned by many (31).

The normal scientific process involves constant testing of various hypotheses and processes. It is the norm to investigate a problem by starting with a simple model, such as the one used by Turco et al. (30), and then to move on to more sophisticated (and expensive) calculations if the original results warrant. New results always differ from previous ones because new factors are considered. Because this normal process has taken place in public in the case of nuclear winter, and the public does not always understand the process, the whole theory has been called into doubt in many minds. The UN report conclusively demonstrates the seriousness and validity of the theory. It is imperative that we convey this conclusion in an unambiguous way to the public.

IDEAS FOR SOLUTIONS

A. What Must Be Done

So, what do we do? Nuclear winter is a credible threat to humanity if nuclear weapons are ever used, but society is virtually ignoring the warning, and going about life as usual. What can we as scientists, politicians, and citizens, do to change the way the world thinks, to take this danger seriously and override selfish interests to prevent the possibility of global holocaust? The answers are not obvious or easy

I will state what I believe should be the ultimate goal toward which we should work.

We should work towards the acceptance by the world of the idea that no matter how frustrated by, insulted by, jealous of, or angry at others we feel, we will not use violence as a means to get what we want. In the meantime, when we are violent we will not use nuclear weapons because they are too dangerous for us and for the rest of the world.

Clearly, universal acceptance of the nuclear winter theory will hasten this change in the way we think.

B. Steps To Take

There are some actions we as individuals, we as a group, and we as nations, can take both to hasten acceptance of the nuclear winter theory and to lessen the chances of a nuclear winter happening.

More Research on Nuclear Winter

There are still aspects of the theory of nuclear winter that require more research. And new discoveries will undoubtedly result, such as the recently discovered massive ozone depletion. More funding for nuclear winter research, especially for biological work and for the case studies that are now being conducted in Japan, China, India, Venezuela and Africa, would be very useful. But the call for only doing more research is a call for doing nothing (Box 2). In addition to more research there are actions that can be taken now that will improve the situation, consistent with the existing uncertainties in the nuclear winter theory.

Education and Publicity

The fundamental action that is necessary, as mentioned by both Eisenhower and Einstein, is to educate the populace and the political decision makers about the true nature of the consequences of the use of nuclear weapons. The UN report and this Ambio issue are two examples of this type of action. Until the theory of nuclear winter is generally accepted, it will be too easy for the public to accept political leaders who continue to think and act in the old way. The DOD report (13) argues that deterrence, and the old way of dealing with the nuclear problem discussed above, are still necessary because we can never know how seriously the Soviets take the nuclear winter theory. This problem will persist until leaders in both countries force the military to seriously consider the effects of nuclear winter. And this will not happen without widespread acceptance of the theory by scientists and by the public. The journal Environment continues its praiseworthy efforts in this regard with a special issue (32) on the latest results about nuclear winter, including a summary of the UN report.

There are many cases in recent history of massive shifts in the way people think. For example, until the last century the concept of slavery, that one human could own another human, was widely accepted. Justification for this practice was found in the Christian bible. But a massive change in the way people think resulted, because of education, and now slavery is considered evil throughout the world. Other outmoded concepts that have disappeared lately include the divine right of kings, the superiority of men over women, and the superiority of people with a particular skin color (except in South Africa). With education, nuclear weapons will be added to this list.

Avoid Nuclear Jargon

Jargon is a useful tool in any specialized field. A short word or expression can convey an entire concept in a precise and brief manner when discussing a topic that the speaker and listener both understand. In the field of nuclear arms, however, the jargon that has developed acts also to sanitize the true horror of the subjects being discussed, and allows people to emotionally insulate themselves from what they are working on or contemplating. The language causes them to think about the



Dear Mr. Chairman: As you know, Section 1371 of the National Defense Authorization. Act for FY87 requires the Department to submit a report on the impact to the climate as a consequence of a nuclear war. The requirements for this report are similar to those contained in the FY86 and FY85 Authorization Acts.

The FY85 report, The Potential Effects of Nuclear War on the Climate, detailed DoD's understanding of the implications for U.S. policy. Additionally, this report included a scientific baseline related to the "Nuclear Winter" phenomenon; an update to this body of knowledge stemming from the Interagency Research Program (IRP) was furnished in DoD's FY86 report.

The IRP has completed its second year of a five-year study plan. As was the case last year, this effort has added to the body of scientific knowledge as a result of some excellent contributions made by both government and civilian research institutions funded under this program. We are, however, still far from understanding the physical cause-and-effect relationships that underlie the theories of Nuclear Winter. Hence, the FY85 report represents the most comprehensive, responsible analysis possible, given the relatively high level of scientific uncertainty, which was well defined in the National Academy of Sciences' 1984 report.

Since we cannot mandate scientific progress, we cannot promise definitive answers, even at the end of our fifth year of study. I want to assure you, however, that we will continue to pursue this effort to its completion. At such a time, we will of course furnish the Congress a report on what we found. Until then, the Department's FY85 report coupled with the NAS' report will continue to Jerve as basis for our position on Nuclear Winter.

Sincerely. 24389

survival of weapons, not humans. An excellent article on this subject, which also discusses the sexual content of nuclear jargon and points out how this aspect further allows men to pursue this field, is that by Cohn (33). See also Chilton (34) and Iklé (35) who, 15 years ago, said:

The jargon of American strategic analysis works like a narcotic. It dulls our sense of moral outrage about the tragic confrontation of nuclear arsenals, primed and constantly perfected to unleash widespread genocide. It fosters the current complacence regarding the soundness and stability of mutual deterrence. It blinds us to the fact that our method of preventing nuclear war rests on a form of warfare universally condemned since the Dark Ages—the mass killing of hostages.

There are many examples, but I will give just a few to illustrate. A global nuclear holocaust in which billions of people could die is called a nuclear exchange. When I think of *exchange*, I think of going back to

a store to return a sweater that was the wrong size. By using the word exchange, military planners can discuss a horrible tragedy without thinking of the true consequences. Other examples, such as "countervalue targets" instead of cities where millions of innocent people would be horribly burned, irradiated or blasted apart, or "device" for a nuclear warhead itself, further illustrate the point. Nuclear weapons, each of which is larger than the one that killed 150 000 people in Hiroshima, are called "theater" nuclear weapons. When I think of the "theater" I think of a performance at the Kennedy Center, not the horrible suffering of thousands and thousands of people. I think that even the word "war" should be avoided when discussing the use of nuclear weapons. When most people think of war they think in terms of images of World War II, Vietnam, Afghanistan or Iran-Iraq—all terrible tragedies for the combatants and nearby civilians, but on a much smaller scale than

would occur with the use of nuclear weapons. I think the word "holocaust" is a more realistic way to describe what would happen.

Improve Soviet-American Relations

Any actions which improve the relations between the superpowers will help to ease the tension that has been part of the driving force in producing the current inflated nuclear arsenals. More than 500 such exchanges, collaborations, spacebridges, sister cities programs and other projects are described in the latest issue of Surviving Together (36). Even the military leaders of both countries have had recent exchange visits. Getting to know each other on a personal basis does away with unreal stereotypes and humanizes the people of the enemy. News reports of the visit of Marshall Akhromeev with Admiral Crowe told of the many common problems the two men discovered. Reports of the dismay of the experts in the State Department at these direct contracts without their control only serve to illustrate the usefulness of these exchanges.

Not only must the danger of nuclear weapons be made apparent to the peoples of the world, but also the idea of using force to solve problems must become obsolete. The more cultural, scientific, and commercial ties that are established between the Soviet Union and the United States, and the more personal contacts that are made between Russians and Americans at all levels, the more inane will become the idea that threatening each other with nuclear weapons will solve any problems. On the contrary, it lessens the security of the people of both nations as well as threatens the rest of the world. As the Soviet Union and the United States set an example for the rest of the world of how to coexist peacefully, perhaps a more constructive environment for the resolution of regional conflicts will develop.

CONCLUSIONS

The nuclear winter theory is supported by current scientific evidence. A major nuclear war would result in an unprecedented holocaust for the people of combatant and noncombatant nations alike. Therefore, nuclear weapons must never be used. Society should work towards the elimination of nuclear weapons. The only solution is to resolve conflicts in nonviolent ways. Although there are obstacles on the road to this goal, there are also signs of progress. By continued research on nuclear winter, by education and publicity, by avoiding nuclear jargon, and by working to improve Soviet-American relations we can hasten this process.

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