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SOME POLICY IMPLICATIONS OF NUCLEAR WINTER

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I. INTRODUCTION

The theory of nuclear winter has had as checkered a history as any new idea since Darwin published *The Origin of Species*. There have been questions of its scientific validity, reviews both laudatory and damning, pleas for arms reductions, hosannahs for a newfound hope that nuclear war has at last been rendered completely unthinkable, and frustration that two generations of human toil in weapons laboratories and think tanks may have been rendered redundant by a natural "doomsday machine". Some have even suggested that nuclear winter might be used as an offensive weapon.

Disturbingly, a substantial number of commentators have concluded that nuclear winter carries no immediate implications for policy, because to their way of thinking, nuclear winter is a) just one more of the many undesirable effects of nuclear war; b) the ultimate deterrent to nuclear use, and therefore should be welcomed rather than compensated for; or c) an unproven theory, meaning that consideration of policy questions is premature.

Those who overlook the policy questions are following a dangerous path. The nuclear winter theory contains serious short- and long-term implications for United States foreign and strategic policy. Although the theory may never be confirmed or refuted, discussion of these policy questions should begin now because many of the potential effects of nuclear winter--particularly in foreign policy--will come about regardless of whether or not the phenomenon can actually exist.

II. THE PHENOMENON

The theory of nuclear winter was first introduced to a wide audience in a study called TTAPS, for the initials of its five authors.¹ The best-known of those, astronomer Carl Sagan of Cornell University, has since devoted considerable time and energy to promoting the concept, first within the scientific community and now among the general public. This paper will not attempt a scientific criticism of the theory,² but instead will present and discuss the likely effects on policy should such a theory become widely accepted. To provide for discussion, a summary of the TTAPS study follows.

The nuclear winter theory postulates that even a minor nuclear exchange, especially if it targeted cities, would generate massive amounts of soot and dust that would be lifted by superheated air over burning target areas into the upper atmosphere, blocking sunlight from the Earth's surface and plunging much of the world into frigid gloom.³

¹ R.P. Turco, O.B. Toon, T.P. Ackerman, J.B. Pollack and Carl Sagan, "Nuclear Winter: Global Consequences of Multiple Nuclear Explosions," *Science*, vol. 222, no. 4630 (23 December 1983). The phenomenon was actually introduced in Paul J. Crutzen and John W. Birks, "The Atmosphere After a Nuclear War: Twilight at Noon," *Ambio*, vol. 11, no. 2-3 (1982).

² Such criticisms already exist. TTAPS' critics generally focus on their use of an unrealistic (1-D) model for projecting nuclear winter effects. Others feel that TTAPS' exchange scenario is unrealistic, and was developed simply to exaggerate nuclear winter effects. However, more sophisticated models have subsequently yielded results in substantial agreement with TTAPS (e.g. Lawrence Livermore, 1983, Soviet Academy of Sciences, 1983, and U.S. National Research Council, 1984).

³ This is not an unknown phenomenon, albeit in smaller and more temporary doses. "The pall of smoke from the 1950 Alberta fire was believed responsible for reducing the incoming (solar) radiation by 54 per cent and lowering the temperatures 10°F at Washington, D.C." E.S. Batten, *The Effects of Nuclear War on the Weather and Climate*, Rand Memorandum 4989, August 1966; a worldwide example can be found in Richard B. Stothers, "The Great Tambora Eruption in 1815 and Its Aftermath," *Science*, vol. 224, no. 4654 (15 June 1984).

The direct consequences of a nuclear winter--cold and darkness--are by no means the most severe problems envisioned by TTAPS. The lack of light (set by the study at as little as 5 percent of normal) would prevent or hinder photosynthesis, meaning a rapid extinction of most major plant species. This would slow or stop plants' conversion of carbon dioxide into oxygen, thus sharply reducing oxygen levels in the air.

Darkness would also mean the death of phytoplankton, the microscopic organisms at the very base of the marine food chain, which depend on sunlight for energy. Without phytoplankton, most species of marine life will die, and with them a major supply of food for the post-holocaust world.

The low temperatures associated with nuclear winter--put by TTAPS as low as 40° Centigrade below pre-detonation levels--bring even greater hazards. Earlier studies have indicated that a drop of 1°C in the annual average temperatures would make wheat farming impossible in Canada and much of the USSR; 2-3° below normal would entirely eliminate wheat growing in the United States and USSR. With the effects of nuclear winter lasting for many months after a nuclear exchange, agriculture could largely cease to exist in the Northern Hemisphere.

Further, with temperatures 40°C or even 30°C below normal for extended periods, supplies of fresh water will freeze to a thickness of several inches, making very difficult the task of obtaining even so basic a resource. It takes no great stretch of imagination to realize the extreme difficulty of attempting to preserve or rebuild an economy in a radioactive environment, lacking basic food staples, water, and oxygen.

An important point is that according to several studies, it is possible that the cloud of soot and dust could spread throughout the stratosphere, bringing similar climatic effects to the Southern Hemisphere.

The upshot of the nuclear winter theory is that a nuclear exchange--or even an unavenged first strike--will have grave and possibly terminal effects upon not just the nations involved, but all of the nations of their hemisphere and quite conceivably the world.

Recalling that the nuclear winter theory has not yet been (and may never be) validated, this paper will both discuss the implications for policy should the theory become widely accepted, and also deal with the complications which arise from its being an unproven theory.

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III. IMPLICATIONS FOR FOREIGN POLICY

The United States seeks to guarantee the security of Western Europe by the deployment of theater and strategic nuclear weapons. We have pledged that U.S. nuclear weapons will, if necessary, be used to respond to attacks on our allies in NATO; we have even tied our security to theirs by agreeing that attacks on Europe could be countered with the U.S. strategic arsenal.

The Europeans have a great ambivalence about our nuclear guarantee. On one hand, they want assurance that we will do everything in our power to defend them short of actually using the weapons. On the other hand, they want to know that we will go nuclear if necessary. Tying our strategic forces to an attack on NATO invites reprisal against CONUS, a possibility that gives the United States an incentive to avoid conflict or, if it comes, to stay below the nuclear threshold. This posture largely satisfies the European need for assurance that the United States will exercise restraint in the use of its European nuclear forces.

Nuclear winter, while enhancing that security, lessens the credibility of the second point. If they accept the theory of nuclear winter, NATO's European members will suddenly have much greater reason to doubt our willingness to defend them with nuclear weapons. As even a battlefield nuclear exchange in Western Europe might now directly and seriously affect the United States, Western Europeans might reason, the United States could hesitate to order a nuclear defense of Europe. Thus, because the possibility of nuclear winter emerges as a new factor deterring use of U.S. nuclear devices in Europe, it is a new reason for NATO nations to doubt the U.S. commitment to their defense. A wide popular acceptance of the nuclear winter theory could produce an unprecedented crisis of confidence within the NATO Alliance.¹

¹ A distinction should be made between the reaction of NATO members such as Germany, on whose territory nuclear weapons would probably be used in the event of war, and nations such as Greece or Portugal, which would likely not bear the brunt of a Warsaw Pact attack. The latter countries will, with nuclear winter, face a substantial new threat, and can be expected to question NATO military policy and nuclear deployment more vociferously.

With the possibility of nuclear winter, third nations are for the first time placed at direct risk in a superpower nuclear conflict, as the winter effects are global in scale. The issue will thus have a profound impact on America's foreign relations. Regardless of our conclusions regarding nuclear winter, other nations will watch carefully how we address this issue. If, for example, we dismiss nuclear winter as not making a difference in our policy and the Soviets profess concern about it, they will score well in world public opinion.² Nuclear winter *will make a difference* to many nations, allied and nonaligned, and we ought not be seen as heedless of its consequences.

It is not yet known how far the effects of nuclear winter will spread. One may assume, however, that with nuclear stockpiles and major powers concentrated in the Northern Hemisphere, nuclear winter will affect the Southern Hemisphere less severely than the Northern. The Southern Hemisphere will thus become the breadbasket of the world after a nuclear exchange. Under these circumstances, it behooves us now to make among those nations reliable friends upon whom we can depend for food in the postwar world.

The search for food may well lead to heightened competition with other major powers seeking access to the same resources from the same nations. We (and the Soviets) will be at a clear competitive disadvantage as Southern/Third World nations perceive their vastly increased interest in preventing nuclear war. We will be asking for favors at precisely the moment they see us as a new and major threat.

Given the global nature of nuclear winter and uncertainty about its intensity or the level of exchange necessary to set it off, any conflict involving nuclear possessors now directly threatens the United States. This country may need a more interventionist foreign policy to secure, ensure, and enforce peace in nuclear-capable nations. Again, more intervention using this justification is also to be expected from the Soviets and other powers. In cases where clearly irresponsible regimes

² This political gain, says Richard Turco of the TTAPS team, is the Soviets' main objective. He claims that their research effort, much less substantive than first believed, does not really go beyond the minimum necessary to project an image of concern. R. Jeffrey Smith, "Soviets Offer Little Help", *Science*, vol. 225, no. 4657 (6 July 1984).

(such as those in Libya or Iran) possess nuclear weapons, covert or even overt action to destroy the weapons and weapon-making capacity or to remove the worrisome government will become both more advisable and more justifiable in world public opinion.

Another concern regarding nuclear winter--one that affects both foreign and military policy--involves nations that maintain their own nuclear arsenals independent of the two great powers. While any nation capable of building or deploying nuclear weapons would, as mentioned earlier, be of heightened concern to the United States, it must pay particular attention to those such as Britain, China, and France.

Sagan wrote in a letter to *Foreign Affairs*: "The present French *force de frappe*, said to target Soviet cities exclusively, may itself be adequate to trigger a global Nuclear Winter."³ According to George Seignious and Jonathan Yates, "Both Great Britain and France are on the verge of nuclear build-ups ambitious enough to turn either one into the world's third nuclear superpower....Each British and French missile-firing submarine that survives an initial Soviet strike will have the capability to attack all major cities in the Soviet Union."⁴ These views confirm the desirability of maintaining close and dependable relations with such nations, which are not by nature unstable or hostile to the United States, but are nonetheless in a position to cause us very great harm.

The prospect of European nations being able to initiate a nuclear winter may have another detrimental impact on the future of the NATO alliance. If Britain can by itself or in consort with (nonaligned but friendly) France cause a nuclear winter, the Europeans render the U.S. nuclear deterrent redundant, as American nuclear weapons can threaten no additional harm. Public realization of this fact could lead to or reinforce calls on both sides of the Atlantic for a decoupling of the U.S. strategic arsenal from European defense (making NATO a conventional-defense-only treaty) and so would drive another wedge into the gap between the allies.

³ Vol. 62, no. 4 (Spring 1984), p. 1001.

⁴ George M. Seignious II and Jonathan Paul Yates, "Europe's Nuclear Superpowers", *Foreign Policy*, 55 (Summer 1984), p. 40.

Some commentators fear that nations could deter or blackmail others by threatening to cause a nuclear winter with large nuclear explosions on the blackmailer's own soil.⁵ This concept totally ignores the effects of such a move upon the initiating nation, although the question of how this would work as bluff--and how much damage a nation would be willing to accept in order to destroy another--would make for some interesting gaming.⁶ Also, any nuclear-capable state may attempt to extract political concessions from the existing powers in return for agreeing not to develop or deploy nuclear weapons.⁷

There may be a bright side to the effects of the nuclear winter theory in the foreign relations arena. With independent nuclear states an increased threat to the two great powers, nuclear deproliferation becomes of intense--and more importantly, common--interest. The concept of U.S./Soviet recognition of that common interest through joint action to bar further entrance to the nuclear club (and perhaps even decrease its rolls) can only be an encouraging one.

⁵ One such is David V. Forrest, "Nuclear Winter: A Doomsday Concept's Strategic Implications", letter to *The New York Times*, 12 August 1964.

⁶ This is particularly true if the employing nation accepts the philosophy that the rest of the world's populace are sinners to be expunged while the virtuous who are martyred with them will receive posthumous salvation for causing the annihilation (Iran perhaps?).

⁷ This type of behavior is banned under the Nuclear Non-Proliferation Treaty, but that pact has been of little concern to some of the signatories, Iraq being a good example.

IV. IMPLICATIONS FOR MILITARY AND STRATEGIC POLICY

As mentioned in the introduction, a substantial body of opinion (particularly within the U.S. government) dismisses nuclear winter as not significantly affecting policy. In their view, it represents "just another horror" in the litany associated with nuclear weapons.

This is a dangerous argument in several ways. First, this attitude urges inaction, which brings upon us the above-cited diplomatic problems should we seem to ignore the issue. Second, it ignores the double-edged capacity of nuclear winter, the fact that eventual effects upon the attacking country may be more severe than those on the nation attacked. Third, because claiming that something which adds more "horror" does not require a reexamination of policy implies that the prospect of nuclear war is already as horrific as can be, a position which completely devalues the credibility of the deterrent capability of U.S. nuclear forces.

To be effective, deterrent forces require a belief by those at whom they are aimed that they might someday be used. It naturally follows, though, that if we believe a nuclear war already means total apocalypse (as the "just another horror" crowd implies), we will avoid such a war at any cost, and our deterrent forces lose all credibility. Even without the presence of the nuclear winter theory, claiming that it has no policy implications because nuclear war is already as bad as it can be creates in the minds of our adversaries--and friends--great doubt as to the credibility of our deterrent capability.

Further, some basic military concepts would be radically changed by the acceptance or validation of the nuclear winter theory. For example, one nation could no longer launch a massive preemptive first strike against another and expect to emerge unscathed or only lightly damaged. Tactical and theater nuclear weapons in the traditional sense would cease to exist: Any nuclear weapon could, by initiating nuclear winter, have adverse global effects.¹

¹ In conversation with the author, Dr. Sagan expressed the opinion that even a tactical nuclear exchange in Europe would by itself be

The search for preemptive capability thus leads elsewhere. The best way to decrease nuclear winter effects might be simply to move toward more sophisticated conventional weapons. If nuclear use were desirable, a nation might use smaller, low-yield weapons on highly accurate delivery systems to deliver a different sort of knockout strike. By using tactical weaponry to target an opponent's C³ hardware rather than command personnel or large facilities like airfields and silo complexes, one nation could cripple a foe's retaliatory capability with minimal nuclear winter effects.

If elimination of command personnel were also desired, the use of enhanced radiation weapons (ERW) would have much less severe nuclear winter effects than conventional nuclear devices of similar yield.² Such weapons become viable alternatives to typical nuclear arms particularly in tactical applications on the battlefields of Europe, where dense population centers and thick forests yield a heavy combustible fuel load, multiplying the soot generation effects of standard dirty nuclear devices. ERW and (debatably) chemical weapons (CW), as the only super-conventional systems whose effects can be restricted to theater or battlefield, thus become more important as deterrents to conventional attack.³ As nuclear winter may lead us to reduce our emphasis on standard nuclear weapons to defend Europe, precipitous action to restrict our ERW or CW capacity prior to that decision may be ill-advised.

sufficient to start a nuclear winter, due to the heavy forestation and city densities there.

² The reader will recall that nuclear winter is caused by soot and ash from combustion, and dust raised by compression waves striking solid objects. An ER weapon releases large amounts of radiation with minimal blast and heat, and so does not contribute significantly to generation of that soot and ash. Sagan, however, posits that ERW would not greatly ameliorate nuclear winter effects because ER weapons as currently postulated would replace very low-yield dirty weapons which would not have contributed much to nuclear winter in any event, and even the reduced heat output of ERW is sufficient to ignite large fires. (Conversation with the author, 12 September 1984.)

³ The question of who leads in CW is irrelevant here, as this discussion concerns the alternatives to standard nuclear weapons for *defensive* purposes in tactical situations. If we are superior in CW, we can use it defensively; if not, it will likely have been employed by the invading forces from the beginning of their assault, and we would already have responded in kind.

Traditional coercive strike theory does not apply under nuclear winter. We have long worried that if the Soviets achieved a sufficient degree of nuclear superiority they could attack our forces effectively while leaving our cities untouched. We might then have no suitable retaliation available, since we would no longer be able to destroy Soviet forces and would not want to attack their cities (lest they retaliate against ours). Nuclear winter, though, has effects upon the populations of both the target nation *and* the attacker. TTAPS found that a pure counterforce strike of 3000 MT would yield a severe nuclear winter throughout the Northern Hemisphere, thus presumably visiting great hardship upon an attacking nation, and so defeating the entire purpose of a coercive strike.

A targeting strategy that takes nuclear winter into account will differ significantly from the one used in the current Single Integrated Operations Plan (SIOP), since it will have more rules to satisfy. For example, a counterforce attack would result in a substantial reduction of nuclear winter effects as opposed to a strike on a populated areas, where combustible substances are concentrated.⁴ Current targeting strategy also considers a remote military target as different from a similar target located near a population center, as a strike on the urban target will result in greater civilian casualties. Nuclear winter both enhances and erodes this difference; since the effects of nuclear winter triggered by a strike on even a remote base will affect the civilian populations in the aggressor and victim nations alike, population-based targeting distinctions become blurred.

Clearly, though, we must still avoid striking cities and other highly combustible areas, no longer purely out of consideration for the population, but now also to diminish the effects of nuclear winter worldwide (including on the attacker's population). Targeting decisions are thus further complicated. A mobile missile launcher located in a forest is a higher-winter⁵ target than one on an open plain; an air base

⁴ TTAPS.

⁵ To discuss the likely nuclear winter effects of various attack postures, strategies, and targets, this paper will describe them according to their relative contribution to nuclear winter as having "high-winter" or "low-winter" attributes.

near a large, modern city (where construction may be primarily steel and concrete) may be a lower-winter target than one near a smaller, older city (where most construction will be of wood).⁶

Still, what is most important in any strike utilizing nuclear weapons is to minimize the yield employed, so that nuclear winter effects will be similarly lessened. The primary emphasis is thus moved onto small-yield and even nonnuclear weapons delivered with high accuracy. This rewards our current development of manned bomber programs and low-CEP delivery systems, and would seem to reduce the threat posed by the Soviets' monster launchers and silo-busting warheads.

Other possible "technical fixes" could reduce the winter effects of nuclear weapons. One already given some discussion is a shift to greater use of earth-penetrating munitions (as the blast and heat effects will be partially absorbed by the surrounding dirt). However, penetrators are best against hard targets such as military installations, which are already lower-winter than cities. What they might offer is the ability to strike targets near a city without igniting the city itself, perhaps giving substance to the idea of a truly "surgical" strike.

Another theoretically possible way to paralyze an opponent's response with minimal nuclear winter effects is to target his C³ using high-altitude detonations to generate a large electromagnetic pulse (EMP) that would disrupt his communications. This offers most of the advantages of anti-C³ strikes using tactical nuclear weapons without risking *any* of the effects of nuclear winter; unfortunately it is not yet reliable. We can nonetheless construct an ideal nuclear first-strike scenario for a nation that seeks to preempt its opponent's retaliatory capability with minimal nuclear winter effects: Generation of a large EMP through high-altitude detonations followed by low-yield counterforce strikes with ERW and penetrators.

⁶ In this way, the collocation of United States cities and military installations is actually a help rather than a hindrance. As the Soviets know that the boomerang effects of an attack on a base near an urban area will be more damaging to them than an isolated one, they may choose to preferentially target installations away from urban centers. As a corollary, they may place new installations near cities, so as to protect the installation.

Others see in nuclear winter a prime argument for President Reagan's Strategic Defense Initiative. If nuclear detonations carry the threat of so much more harm than previously believed, they argue, then SDI's prevention of detonations is that much more valuable.⁷ This logic would encourage sharing our SDI technology with the Soviets (as the President has suggested), since detonations on their territory could initiate a nuclear winter that would affect us just as severely as one started on our own soil.

Following the onset of nuclear winter and through its duration, such optical reconnaissance satellites (and SDI system sensors) as survived countermeasures during the exchange will be effectively blinded as soot fills the Earth's atmosphere. The lack of light will also sharply reduce the imaging ability of airborne cameras (as well as interfering with the propulsion systems of recon aircraft). Infrared sources will be more easily detected because of their contrast with the cooling atmosphere, but could well be masked by the massive fires generated by the exchange. We may have to develop alternative intelligence-gathering measures, particularly to detect long-term delayed launches from reloadable silos. Also, the erosion and friction effects of an upper-altitude soot layer on outbound missiles--possibly causing damage and/or gross inaccuracy--must be evaluated.

Regardless of possible fixes, if nuclear winter can happen (or if we have reason to believe that it can), the list of possible responses available to National Command Authorities in the event of a nuclear strike should include an estimate of the boomerang effect of each use of nuclear weapons. NCA must know the likely effects on the United States of every given detonation before they issue orders.

⁷ For an example, see Leon Goure's testimony of 12 September 1984 before the House Committee on Science and Technology. Many critics, including Sagan, see realistic SDI porosities as too great to significantly reduce nuclear winter effects. Former State Department Director of Policy Planning W. Anthony Lake sees a danger in possible fixes to nuclear winter. He posits that finding either postural or technical solutions to nuclear winter could encourage warfighting, since nuclear use will have been rendered "safe." (Letter to the author, 30 October 1984.)

The chilling climatic effects of nuclear winter may, as has been discussed, have a chilling psychological effect on any nation considering employment of nuclear devices, since even a low-level exchange can trigger a nuclear winter harmful to the employing nation. The effects on subsequent rounds of the exchange, though, are debatable. Commanders may be emboldened to respond to nuclear attack in kind since, as long as nuclear winter seems inevitable anyway, they have no reason to hold weapons back. Alternatively, they may be increasingly reluctant to authorize further nuclear strikes, since the chances of their nation surviving the winter decrease with each bomb exploded. This debate again points up the need for a clearly-established policy which takes into account the effects of nuclear winter to guide NCA in the exigency of nuclear use, so that responses are not delayed by uncertainty.

STRATEGIC POLICY AND THE PERCEPTION PROBLEM

Fable gives us the story of the blind men and the elephant; as each man touched the elephant, he believed it to be something else; one a wall, another a rope, the third a tree. We are in essence blind when it comes to any new theory; we can but touch the general idea, the skin. Without experimental evidence, no finer detail exists to be examined. However, in the present case grave consequences may result should we adduce the nuclear winter "elephant" to be something different from what our equally blind Soviet counterpart concludes.

The Soviets could share NATO members' doubts regarding our willingness to set off nuclear weapons in defense of Europe. They might bet that our fear of nuclear winter is such that we would not, and could thus be emboldened to launch a conventional attack on Alliance nations. We should make our policy clear to the Soviets. Even if the nuclear winter theory does not become widely believed, the Soviet general staff is well aware that we might consider its effects in nuclear-use decisions.

The present state of nuclear deterrence is based on uncertainty; since our enemies do not know what level of attack will bring a nuclear response, they will, we hope, refrain from attacking at all. Nuclear winter, though, *swings the preponderance of doubt in the other direction*. Now, the other side may be just as uncertain about our intentions, but could believe that we are sufficiently afraid of nuclear winter that we will *not* respond with such weapons.

If, following a consideration of likely nuclear winter effects, we decide that nuclear use is still permissible, that decision (although not the conditions under which nuclear weapons would be used) must be definite and known to the Soviets. Neither the decision nor the notification may be left to the situation of the moment, lest the Soviets be willing to gamble that we have ruled out any nuclear use.

The Soviets have also studied the possibility of nuclear winter. Four Soviet scientists participated in the Conference on the World after Nuclear War, and the USSR hosted leading U.S. experts at a similar conference in Leningrad in May 1984. Further, Sagan wrote that, "Y.P. Velikhov, Vice-President of the Soviet Academy of Sciences, told me that he has held long discussions with both Foreign Minister Gromyko and with Defense Minister Ustinov about the Nuclear Winter results, which Velikhov takes very seriously."⁸

Dr. Thomas Malone, who led the U.S. delegation to Leningrad, thinks that "they're not pursuing it as vigorously as we are," noting that in Leningrad, "...I heard the same damn presentation by [Soviet Academician Vladimir] Alexandrov as I have two or three times before." Nonetheless, it is Dr. Malone's impression that the Soviet government is willing to accept nuclear winter as a fact, citing as an example Soviet television's broadcast of the exchange between Soviet and American scientists at the Conference on the World After Nuclear War, which the Soviets claimed drew 60 million to 90 million viewers.⁹ Articles

⁸ Unpublished letter of February 23, 1984, from Sagan to Richard DeLauer, then Under Secretary of Defense for Research and Engineering. Velikhov also claims that Soviet research into the effects of nuclear war was personally initiated by Brezhnev. (See his testimony before the Kennedy-Hatfield Joint American-Soviet Scientific Forum on Nuclear War, reported in *The World Wide Consequences of Nuclear War*, Nuclear Freeze Foundation, 1983, p. 75.)

⁹ When asked directly about his government's belief in the nuclear

describing nuclear winter and the scientific investigative efforts-- both Soviet and American--have appeared in *Pravda*, *Izvestiya*, *Soviet Life*, *Moscow News*, *Zarya Vostoka*, and *Moskovski Komsomolets*. Also, Gromyko is said to have brought the topic up during a meeting with Italian president Andreotti, and Velikhov told Sagan that the Soviet military had promised him 2 million rubles toward research in the area. However, regardless of the publicity accorded the theory, it is difficult to tell whether nuclear winter is being integrated into Soviet policy formation.

The problem, simply, is this: If both the United States and the Soviet Union believe that a) nuclear winter may occur and b) it is not survivable, the constraints on both nations' behavior should be similar. However, great danger may result if the United States integrates avoidance of nuclear winter into its military policies and the Soviets do not. Any government that does not take the threat of nuclear winter seriously will be less restrained in its nuclear-use policies than one that does, as it might believe that a nuclear war could be fought and won. Symmetry of belief is important; if the Soviets know that we fear nuclear winter or at least consider it a possibility and they do not, they could become more aggressive, gambling that we are too afraid of initiating a nuclear winter to respond.

The key here is perception. It is important that we make the Soviets realize the seriousness of nuclear winter and incorporate it into their policy thinking. They need not appease an aroused public, as our leaders must, so it will be easy for them to ignore the phenomenon. If nuclear winter becomes a concern here, we must also make it one over there.

winter theory, Velikhov referred back to previous Soviet official statements regarding the impossibility of winning nuclear war. (Kennedy-Hatfield transcript, p. 105.)

V. SUMMARY

Nuclear winter is not itself an issue to be debated or negotiated any more than the rotation of the Earth around the sun. There is a clear answer; like the presocratic astronomers with regard to the sun, we just don't yet know what that answer is. For now, we must function on belief. But if we believe that it can happen and our enemies do not so believe, dangerous asymmetries can develop in our foreign and military policies.

If we assume the plausibility of nuclear winter--or even if the theory simply becomes well enough known to affect world perceptions--we must revise our warfighting, C³I, and foreign policies.

Pending scientific determination of a firmer basis for the theory of nuclear winter, we are faced with the wager of Pascal. To operate and plan as if nuclear winter were not real could prove detrimental if, indeed, it can exist. On the other hand, planning as if it were an proven theory costs very little if--and this is a very serious consideration--we have reason to believe that the Soviets are taking the same view of nuclear winter that we do. Without that knowledge, we face a great hazard which may not be easily remedied. If we cannot trust the Soviets to tell us accurately whether they fear nuclear winter, we thus must assume that they do not believe in it, and our planning would remain unchanged, as if we ourselves had never heard of it. But even if we have reason to believe that the Soviets are planning as we are, nuclear winter could ultimately move the arms competition back to conventional systems, with their attendant cost and existing Soviet numerical superiority. Then, suddenly, we will be on the wrong side of Pascal.