Biological Effects of Nuclear War

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James L. Farmer

Do we really need another article on nuclear war, on death and destruction? I suspect that we do. We need to be reminded about these grim subjects, just as we need to be continually warned about the wages of sin. War, like any other sin, is oddly attractive to many people. It is too often easy to send other people to their deaths in order to accomplish our political goals. War might become again the popular sport that it once was if we do not frequently remind ourselves of its terrible consequences. We must also share the little wisdom we have gained with each new generation so that they may avoid the mistakes of previous generations. Finally, there are occasionally new things to be said about this old subject.

Wars have been killing people for a very long time. People have been blown apart by high explosives for more than a century. They have been burned, drowned, poisoned, and killed by flying objects for millennia. Nuclear war does not provide us with any new ways to die.[1] Most of the people who die in a nuclear blast are killed by heat or flying objects. Even most of the people who die as a result of radiation exposure expire from such mundane and ancient causes as fluid loss caused by diarrhea, starvation caused by damage to the intestine, or infection complicated by damage to the immune system. Millions or billions of people would die very unpleasantly in a major nuclear war, but they would suffer no more than those who have died in conventional wars. Even the immense scale of destruction in a nuclear war is not unprecedented. Tens of millions of people died in World War II. Nor are wars the only cause of mass destruction. The black death of the fourteenth century killed about one-third of the people in the world.

There are two major differences between nuclear war and conventional war. Nuclear war could destroy the world in a matter of hours, while conventional war is waged gradually, with at least the possibility of reaching a settlement at some point before destruction has reached its maximum. Also, nuclear warfare potentially has long-term biological consequences which are far more severe than those of conventional warfare. Recent discoveries have even raised the possibility that these biological effects might cause the collapse of human civilization and, perhaps, the extinction of human beings.

How could nuclear war cause such a catastrophe? During World War II, Hiroshima and Nagasaki were destroyed by nuclear bombs and Dresden was destroyed by incendiary bombs. In all three cities, the bombing produced a

fire storm.[2] The fire was so large and so hot that gases and smoke rose at great speed high into the atmosphere. The decreased pressure at the base of the plume sucked surface air into the conflagration at hurricane speed. People were killed by flying objects, by being thrown into stationary objects, by cremation, and by suffocation, since the fire consumed the oxygen so rapidly. Huge amounts of dust and smoke were carried into the atmosphere.

It is well known that large amounts of dust, smoke, or ash in the atmosphere can change the climate of the earth. A volcanic explosion was responsible for the very cold summer of 1816 (known as "eighteen-hundred-and-froze-to-death"). There are good reasons to suspect that rare collisions between the earth and asteroids or comets have produced enormous dust clouds which have cooled the earth sufficiently to cause mass extinctions. If fire storms resulting from a nuclear war were to inject very large amounts of dust and smoke into the upper atmosphere, the results might be catastrophic.

When large quantities of dust and smoke get into the upper atmosphere, they do not immediately settle out. Atmospheric nuclear weapons rests have produced clouds of radioactive dust which have circled the earth several times before slowly dissipating by fallout.[3] The same pattern was seen following the nuclear accident at Chernobyl. Dust clouds from volcanic eruptions have also circled the earth repeatedly while falling out. The dust and smoke from a nuclear war could conceivably persist for some time and be carried around the world, at least in the Northern Hemisphere.

Considering the immediate massive destruction which would be caused by a nuclear war, should we be very concerned about the additional destructive effects of dust and smoke in the atmosphere? We have survived fire storms in the past, both those which burned cities and those which burned forests. However, we have never before experienced a large number of simultaneous fire storms. No one knows for certain what effects would result from large quantities of smoke and dust in the atmosphere, but studies in the United States, Europe, and the Soviet Union have pointed to an unprecedented climatic disaster.[4] According to these studies, a major nuclear war might produce what has been called a "nuclear winter." The "day after" would be cold, dark, and radioactive, and this condition might persist for days, weeks, or months. It is possible that little if any sunlight would penetrate to the surface of the earth. The average temperature drop over land away from the sea coasts might be very large. The magnitude of the cooling is in dispute. Thompson and Schnelder estimate, for a medium-size nuclear war, a temperature drop of about nine degrees C (sixteen degrees F). Turco et al., more pessimistically estimate it at about twenty-two degrees C (forty degrees F).

A cooling as catastrophic as the larger estimates would probably destroy civilization in the Northern Hemisphere through large-scale failure of agriculture and the destruction of many native plants and animals. In addition, the disturbance of atmospheric circulation would probably cause the pall to spread to the Southern Hemisphere, causing substantial cooling there as well. If this estimate is correct, there would be few survivors to envy the dead.

Even a cooling as modest as the lower estimate would be disastrous if it occurred during the northern-hemisphere summer. The wheat and corn crops of Canada, Siberia, and the northern U.S., and the major rice crops of the world would probably be lost. The cooling would probably cause a change in the monsoon weather pattern, which would result in drought in south Asia. Mass starvation throughout the Northern Hemisphere would be the likely result. By this estimate, the news is better for countries in the Southern Hemisphere, since the climatic effects there would probably not be serious.

The well-known biological effects of nuclear explosions would still be serious even in the absence of climatic effects. Living things close to the point of impact would be incinerated. From a few hundred yards up to a few miles away, most living things would be killed by mechanical blast effects, by heat radiation, or by gamma radiation. Over large distances, in some cases hundreds or thousands of miles downwind, living things would be damaged or killed by radioactive fallout. Dangerous radioactive fallout levels would persist for days, months, or years.[5] If nuclear reactors were destroyed by nuclear weapons, the fallout would make large areas uninhabitable perhaps for millennia. Nuclear explosions produce large amounts of nitrogen oxides and inject them into the upper atmosphere, where they degrade the ozone layer. Holes in the ozone layer would allow more ultraviolet radiation to reach the ground. A large increase in ultraviolet radiation would cause extensive damage to plants, it would blind animals and greatly increase the frequency of skin cancer in human beings.

If nuclear winter were added to these effects, the prospects of survival would be much, much worse. Ehrlich et al., in "Long-Term Biological Consequences of Nuclear War," claim that after a major nuclear war a summer day in North America, Europe, or Asia might be as dark as night with a high of about fifty degrees F and a low of twenty degrees F;. These conditions would kill most plants and unprotected people and animals. As vegetation died, more animals would die of starvation. Rotting corpses would become reservoirs of infectious disease and would provide feeding places for insects, resulting in an enormous population explosion of flesh-eating insects. Although the temperature drop would probably be less extreme in the tropics, the results would still be disastrous, since many tropical plants and animals have no protection at all against low temperatures. There

could well be mass extinctions in the tropics. Although it would be winter time in the Southern Hemisphere, the effects there would not be negligible, since the lower temperatures might well persist into its summer. For the same reason, a nuclear war during the northern-hemisphere winter would still have disastrous effects since it would cause an extremely bitter winter, cold enough to kill many animals and perennial plants, followed by a cold, dim spring and summer unlikely to produce a harvest.

The first estimates of the climatic effects of nuclear war, by Turco et al., suggested that there might be a threshold level of nuclear explosions which would cause a nuclear winter essentially as severe as that which would result from any larger number of explosions. The threshold appeared to be fairly low, perhaps low enough to make a nuclear attack suicidal for the attacking country even if the attacked country did not retaliate. Thompson and Schnelder's more recent and more detailed analysis suggests that there is no threshold, but rather that the severity of climatic effects would increase in proportion to the number of nuclear explosions. The later analysis also suggests that the magnitude of the cooling and its effect on the Southern Hemisphere would he much less than that estimated previously, due to the moderating influence of the oceans. However, as its authors point out, the effects of even a modest cooling could be disastrous to rice and Canadian wheat crops, as described above. Since a major nuclear war would probably destroy American, European, and Soviet crops as well, a severe famine would be unavoidable, even in noncombatant countries. Thus even the most optimistic estimate makes disaster seem certain.

A Personal Statement

The religious beliefs of some people might lead them to argue that divine intervention would moderate the effects of nuclear war or, conversely, that nuclear war would cleanse the earth in preparation for the coming of the Messiah. Perhaps one of these beliefs might be true, but as I read the scriptures, I find another message: When people are sinful, even God's chosen people, he allows them to suffer the consequences of their folly, even to the point of extinction. With only rare exceptions, the innocent suffer along with the guilty. The scriptures indicate that God might nor approve of some of our weapons systems, since he has spoken plainly against preemptive strikes (see Morm. 3:8–15, 4:1–5). He has also told us to strive for security in his way rather than seeking it our way (see 2 Ne. 1:6–11).

Nuclear weapons are the most visible symbols of our failure, the triumph of evil over good in our world. They are symbols of the temptation to use Satan's ways to overcome what many people perceive to be satanic forces. Even if we cannot have a triumph of good over evil in this world, we should not surrender to evil. God does not excuse us from obeying his commandments

when obedience is difficult. Why should we expect him to excuse us from loving our neighbors or from being peacemakers at a time when the world needs love and peace? We are fond of saying that Christians should be in the world but nor of the world. We should carefully consider how that philosophy might shape our attitudes toward political and military policies.

I do not wish to leave the impression that I favor unilateral disarmament or some equally foolish action. It seems clear that the fear of nuclear weapons is largely responsible for the tenuous peace we have endured since World War II. Although disarmament should be our goal, the nations of the world must disarm carefully if we are to avoid the war that no one wants. The strategy for achieving disarmament is not clear and will undoubtedly be difficult to find. Perhaps the mutual fear of destruction will keep the peace a little longer while we seek a solution.

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1. The standard source for data on nuclear explosion is Samuel Glasstone and Phillip J. Dollan, eds., *The Effects of Nuclear Weapons,* 3d ed., Document Col. D. 1.2:N88/2 (Washington D.C.: U.S. Dept. of Defense and U.S. Dept. of Energy, 1977). A detailed description of the damage done to humans by radiation can be found in Arthur C. Upton, "Effects of Radiation on Man," *Annual Review of Nuclear Science* 18 (1968): 495–528. A very thorough analysis of the biological effects of nuclear war, but not including nuclear winter, is J. Carson Mark, "Global Consequences of Nuclear Weaponry," *Annual Review of Nuclear Science* 26 (1976): 51–87.

2. Glasstone and Dolan, *The Effects of Nuclear Weapons,* 299–300.

3. Ibid., 387–460.

4. Paul R. Ehrlich, Carl Sagan, Donald Kennedy, and Walter Ore Roberts, *The Cold and the Dark: The World after Nuclear War* (New York: W. W. Norton, 1984). The major part of this book is the transcript of the Conference on the Long-Term Worldwide Biological Consequences of Nuclear War, Washington, D.C., 31 October–1 November 1983. The two major research papers on this topic are reprinted as appendices. They are R. P. Turco, O. B. Toon, T. P. Acketman, J. B. Pollack, and Carl Sagan, "Nuclear Winter: Global Consequences of Multiple Nuclear Explosions," *Science 222* (23 December 1983): 1283–92; and Paul R. Ehrlich, John Harte, Mark A. Harwell, Peter H. Raven, Carl Sagan, George M. Woodwell, Joseph Berry, Edward S. Ayensu, Anne H. Ehrlich, Thomas Eisner, Stephen J. Gould, Herbert D. Grover, Rafael Herrera, Robert M. May, Ernst Mayr, Christopher P. McKay, Harold A. Moohey, Norman Myers, David Pimentel, and John M. Teal, "Long-Term Biological Consequences of Nuclear War," *Science 222* (23 December 1983): 1293–1300. Independent analyses, whose conclusions differ in some important respects from the above, may be found in more recent publications, such as the following: National Research Council, *The Effects on the Atmosphere of a M*ajor Nuclear Exchange (Washington, D.C.: National Academy Press, 1985); and Starley L. Thompson and Stephen H. Schneider, "Nuclear Winter Reappraised," *Foreign Affair* 64.5 (Summer 1986): 981–1005.

5. It has now been about twenty-five years since the last nuclear explosion on the Bikini Atoll. In spite of the millions of dollars spent to clean up the atoll, the natives still cannot return because the food grown there would be too radioactive for them to eat.