In the aftermath

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Nuclear Winter: The Human and Environmental Consequences of Nuclear War.
By Mark A. Harwell.
Springer-Verlag: 1984. Pp.179. DM 54.

WITH a fresh spate of books on the "nuclear winter" about to reach the marketplace, it is appropriate that Mark Harwell's sober and detailed account of the biological aspects of the subject should be available first. It deals not only with the effects of a possible nuclear winter but also with the more direct, and inevitable, blast, fire and radiation damage caused by nuclear explosions. The book is based on a technical support document produced, in collaboration with other biologists and ecologists, for the conference "The World After Nuclear War".* It was at this meeting, held in Washington DC in late 1983 and the culmination of a series of exercises designed to assess the scientific validity of the nuclear winter theory, that the first detailed findings concerning the possibility of widespread cooling and concomitant damage to the biosphere were announced.

Shortly after the Washington conference, two summary papers were published in *Science* (222, 1,283-1,300). One dealt with the atmospheric component of the theory; the other with the biological aspects. To those aware of developments only through these papers or through brief, sometimes opinionated, accounts in the scientific press and the news media, there seemed to be a lot of fuss about a rather speculative notion. This was a mistaken impression. A great deal of carefully documented background research was available to anyone who cared to look for it, as Harwell's account of the rigorous analysis supporting the biologists' case clearly demonstrates.

But how certain is the atmospheric scientists' case? Since 1983, the principal conclusion of the initial investigators, the *possibility* that a nuclear war would cause a major climatic excursion — an abrupt, marked but short-lived change — has been confirmed by other researchers and by two review projects mounted by the US National Academy of Sciences (NAS) and the Royal Society of Canada (RSC). There are many areas of uncertainty, and the NAS and RSC reports carefully define them, but the *risk* of a nuclear winter now seems undeniable.

The NAS committee concentrated on the atmospheric aspects of the problem, but noted that the impact of the climatic excursion on those who survived the initial effects of a nuclear exchange and on the biosphere as a whole "deserves careful independent study". Progress on the physical side has been rapid since the Washington conference. Many points in the original investigations have been clarified and the computer simulations of the nuclear winter effect have been substantially improved. On the biological side, progress has been slower. In part, this has been an unfortunate by-product of the understandable reluctance of atmospheric scientists to provide the type of detailed information on climate needed for rigorous impact assessment. Computer models of the climatic system tend not to be sufficiently accurate on the spatial and time scales of concern.

One solution to this problem is to use scenarios for possible, in the sense of physically plausible, nuclear winter climates in much the same way as atmospheric scientists assessing the climatic effects use a range of strategically plausible nuclear war scenarios. This is Harwell's philosophy. While concentrating on the consequences of a nuclear exchange in the 5,000 megaton range, the book provides the data necessary to assess the implications of any scale of exchange (or nuclear winter).

Beginning with the development of a nuclear war scenario, which provides the input data for the "consequence analyses", the direct effects of blast, fire and fallout (both local and global) are considered first. This area has been addressed in depth in a number of studies, and Harwell's main contribution is to quantify the impact in terms of casualties and damage to the biosphere in the United States. This section is an excellent introduction to the literature on these aspects of the post-nuclear world. The concept of the nuclear winter is then introduced and a detailed discussion of its effects on the biosphere forms the main part of the rest of the book.

In considering the consequences of the principal assaults — temperature and sunlight reductions, radioactive fallout, and the loss of technical and social support for agriculture — Harwell assesses the net impact on the human population and on the flora and fauna, the food supply for the survivors. Using numerical models whenever available, the impact is quantified in terms of human casualties and food availability. The emphasis is, for the most part, on the northern middle latitude combat zone, and grassland, forest, freshwater and estuarine ecosystems are subject to particular scrutiny. Inevitably, some conclusions are more speculative than others, but the reader is given all the information necessary for a personal assessment of the uncertainties.

In the midst of this description of the gross distortion and near-destruction of the ecology of the combat zone, some surprising insights into possible diets emerge. Ducks, for example, through metabolic generation of heat, could survive temperatures of −40°C for a couple of weeks (in the unlikely event that enough food was available). The analysis ends with a brief section entitled "Recovery Processes". I find the use of the word "recovery" in this context somewhat inappropriate. "Coping" and "adaptation" seem more suitable terms given that many aspects of the pre-nuclear environment (and civilization) might never be recovered.

Harwell also discusses possible psychological responses to the devastation that would occur, but wisely steers clear of dogmatic statements. Similarly, the nature of the fragmented post-nuclear social structure is covered but no firm conclusions are reached. These areas have yet to be considered in any depth but, as the author observes, such factors might well be crucial in determining whether or not use could be made of what limited food supplies would be available. Of particular concern, on the individual level, is the prospect of "psychic numbing" through which unacceptable aspects of reality are shut out and which could severely handicap the ability to survive in the aftermath of nuclear war. Would any form of social organization, whether voluntary or enforced, be possible in such circumstances?

The final section, "Summary of Consequences", is a sobering account of the conclusions of the study: the state of the world after nuclear war. It left one question uppermost in my mind. What can be done to provide viable civil defence and support for those who survived the initial attacks in the face of the multiple hazards of the post-nuclear world?

Harwell's stated intention is "to provide a more comprehensive view of what the world would be like to the immediate survivors of a nuclear war" (p.xv). With the assistance of some (rather harrowing) imaginative effort on the part of the reader, a portrait of the world after nuclear war does indeed emerge from the text. But the main strength of the book lies in the clear, dispassionate accumulation of the technical information needed to assess the implications of the use of nuclear weapons. Harwell has produced an exhaustive, wide-ranging and, in many respects, pioneering treatise which will be an invaluable reference tool for anyone concerned about nuclear issues. □

*The book resulting from the conference, *The Cold and the Dark*, has been published in paperback in Britain by Sidgwick & Jackson under the title *The Nuclear Winter: The World After Nuclear War* (price £5.95).

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"Nuclear Winter" Models

Discussions abound over what would be unleashed on our planet during a "nuclear winter" (Articles, 23 Dec. 1983, p. 1283 and p. 1293; Editorial, 24 Feb. 1984, p. 775; News and Comment, 6 July 1984, p. 30; Letters, 25 Jan. 1985, p. 356; News and Comment, 15 Mar., p. 1320; Research News, 12 Apr., p. 163). The thought of such an event is indeed serious from the standpoint not only of the human tragedy but the effect on atmospheric-oceanic balance.

In this same realm it would seem prudent and appear within the capability of our great technological and modeling expertise to carry the "nuclear winter" simulation one step further. McCracken and Luther (*1*) have shown that smaller amounts of aerosols—typical of Mother Nature's injections from volcanic sources such as El Chichón, Agung, or Krakatau—cause shifts in atmospheric circulation patterns high into the troposphere and even into the stratosphere. Would a "doughnut-like ring" of soot in the atmosphere over the Northern Hemisphere amplify such alterations? Such a shift could have major impacts on oceanic circulation with redirected heat distributions from these currents. Might it be possible that results from such modeling work would reveal effects, in addition to those already described so vividly, that would be more devastating than those attributed to the recent record El Niño?

Our study of the past 100 years of record shows statistically that warm oceanic conditions along the Pacific coast of South America are enhanced after injections into the stratosphere from sulfur-rich volcanoes located between 20°N and 20°S (*2*). We have found that for the 2 years after strong eruptions (70 events) sea-surface temperatures (SST) responded positively 86 percent of the time, whereas, for those years without major eruptions (34 events), only 65 percent gave positive SST indications. These initial results suggest a "nuclear winter" might perturb atmosphere-ocean interactions such that certain upwelling cold currents (for example, those off the west coast of the Americas) would cease and the affected areas would be anomalously warm, as in intensified El Niño–like conditions. These modifications together with Arctic-like weather over the continents would enhance storminess through promotion of strong meridional circulations in the atmosphere.

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References

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