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# Towards a mild nuclear winter?

*Two years of introspection about the climatic consequences of a nuclear war come to a climax in Berne next week. The outlook seems less chilly than was thought.*

NEXT week's general assembly of the International Council of Scientific Unions (ICSU) will have a muddy issue on its hands, that of the reality or otherwise of what has become known in the past few years as the nuclear winter. The occasion is the formal delivery of the report on the consequences of a nuclear war commissioned by ICSU's off-shoot SCOPE (Scientific Committee on Problems of the Environment) from an *ad hoc* working group called ENUWAR. The formal report of this two-year study has been published in bits and pieces since the beginning of this year. Those going to Berne (where the meeting is to be held), or fearful of being mystified by reports of the occasion, should be sure to read the inconclusive but illuminating exchange of opinions on the subject which appears in the Fall issue of the journal Foreign Affairs (page 163 *et seq.*). Meanwhile, a summary of where things now stand may be of some assistance.

The first formal statement of the case for believing that a substantial nuclear exchange between the two major nuclear powers would have serious climatic consequences is due to R.P. Turco *et al.* (*Science* **222,** 1283–1292 1982) and was based on calculations made with a one-dimensional model of the radiative balance in an atmosphere laden with smoke from all the fires set by the explosion of a vast arsenal of nuclear weapons. Provided the amount of smoke was large enough, temperatures in northern mid-latitudes were expected to fall by an average of 15 degrees Celsius for some months. Amid expressions of scepticism about the accuracy of the result, a group from NCAR (National Center for Atmospheric Research) at Boulder, Colorado (Covey *et al. Nature* **308,** 21 1985), described the results of a three-dimensional study leading to a similar but less extreme result (which was only to be expected). The SCOPE report, whose summary was made public at the beginning of the year, concluded that nothing that had happened during the intervening interval had "lessened the probability that a major nuclear exchange would cause severe environmental effects".

## Cooling

There is now no substantial dissent from the opinion that fire-raising on the vast scale made possible by an exchange of nuclear weapons would load the atmosphere with so much smoke that there would be climatic effects of some kind. The question on which the argument now turns is the degree to which it is reasonable to suppose that the surface of the Earth would be cooled, and for how long. The SCOPE report might have helped to settle the issue more decisively had it had been published complete, and if it had been written by a single author, preferably one not identified with a declared position.

The argument in Foreign Affairs has taken a different tack, that of the strategic and political implications of the threat of a nuclear winter. Dr Carl Sagan set the ball rolling (in the Winter, 1983/84 issue) with the argument that the threat of nuclear winter implies, among other things, that the nuclear powers should aim at negotiating a reduction of their nuclear arsenals to the point at which they each have less than one per cent of their present stocks; this would be enough for "minimal deterrence", but not enough to cause a nuclear winter. In the summer of this year, and on the basis of a string of calculations at NCAR in the interval, Covey *et al.* begged leave to dissent, saying that the temperature might be reduced by only a third of the amount first calculated, although everybody agrees that there would be some deterioration of the climate in the hemisphere in which a nuclear exchange took place. (The comparison of the results of calculations with the two different kinds of models is not straightforward, so that little should be made of the discrepancy reported.) The interest of this development is that Covey *et al.* argue for a nuclear "autumn" rather than a winter, a climatic perturbation not severe enough to cause widespread cataclysm outside the regions in which the bombs fall. Dr Carl Sagan, one of the authors of the original account, dissents, insisting that not much has changed.

## Trigger-happy

Given the persisting uncertainties, it is understandable that some should ask impatiently what all the fuss can be about. On the principle that it is no better to be hung for a sheep than a lamb, it might be argued that contemplation of the consequences of a nuclear war would more prudently be based on nuclear winter, not merely nuclear autumn. But that is a short-sighted argument. Covey *et al.* in their rejoinder, argue cogently that a 99 per cent reduction of the superpowers' nuclear arsenals would lead to an exceedingly dangerous state of affairs if it were not accompanied by other safeguards, hitherto unspecified. Nuclear powers would be compelled to aim their surviving warheads at cities, not military targets, and would be made trigger-happy by the constant fear that the other fellow might strike first. (Sagan complains that Mr Richard Perle, US Assistant Secretary of Defense, has used the threat of nuclear winter to justify the Strategic Defense Initiative, but Perle is logically correct.)

George W. Rathjens and Ronald H. Siegal from the Massachusetts Institute of Technology take the argument further, suggesting that even Covey *et al.* may have overestimated the climatic consequences of smoke in the atmosphere and making the cogent point that preoccupation with the early extreme predictions can only distract people of goodwill from more urgent tasks in international relations, reducing nuclear arsenals by a half, for example.

What, in these circumstances, can ICSU say about the ENUWAR report? It might start by acknowledging that the authors of the original hypothesis of nuclear winter (which include Crutzen and Birks as well as Turco *et al.*) have hit on an interesting problem which is likely to run and run. As it happens, ICSU has an ambition to launch a programme of research on the global environment, intended to provide a kind of baseline for the later assessment of man-made effects, among which nuclear wars would certainly qualify. In due course, such a programme might provide a better basis for the kind of assessment that the nuclear climatologists have been attempting, although the persisting uncertainties are chiefly those inherent in climatic models at their present stage of development and the inevitable uncertainty about the precise pattern in which warheads would be scattered in a real nuclear war. Meanwhile, the letter from Mr Russell Seitz on page 116 of this issue (oddly enough, echoed in some

places word for word by a paper to be delivered next week in Berne by Academician G.S. Golitsyn of the Institute of Atmospheric Physics in Moscow) shows that there may be a rich vein of historical research yet to be tapped. ICSU itself might think of issuing a temporizing opinion on the matter, one that draws attention to the uncertainties running through all the arguments so far advanced to calculate the consequences of a nuclear war, to work that remains undone and, recognizing that the stated purpose of deterrence is to avoid nuclear war, urges those with good intentions to direct them at practical tasks. □