What happened to nuclear winter?

Calculations of nuclear winter are become mainstream academic work, and thus less contentious than a few years ago. They may, in this new role, point usefully to solutions of other problems.

THE paper by Schneider and Thompson (this issue, page 221) is not the end of nuclear winter but a proof (if one were needed) that nuclear winter has come of age, and has become an accepted ingredient of academic study. In what other circumstances do people write review articles?

By now, the essence of the problem is widely understood. If there were a nuclear war, many parts of the surface of the Earth would be set alight, the fires would carry large amounts of smoke into the atmosphere, the passage of solar radiation to the surface of the Earth would be impeded, we should all, for a time, feel cold and, seriously, there would be a chance that the climatic consequences would persist for weeks or even months, not just days — long enough to interrupt processes such as photosynthesis on which continued survival depends. Nobody can quarrel with that statement; the practical question is that of what, for a given prospective nuclear war, is the chance that the survivivors will have only a short time in which to envy the dead?

The Schneider and Thompson paper derives from one delivered at a symposium in Bangkok arranged at the end of 1986 by the ENUWAR executive of the Scientific Committee on Problems of the Environment (SCOPE), itself an offshoot of the International Council of Scientific Unions (ICSU). It is important that, by then, the threat of nuclear winter had widely seized the public mind for only just over two years, since the publication of the paper by Turco, Toon, Ackerman, Pollack and Sagan in *Science* (**222**, 1283; 1983) describing the predictions of a one-dimensional atmospheric model of the climatic consequences. That, in turn, had been stimulated by an earlier calculation by Crutzen and Birks (*Ambio* **11**, 115; 1982) that nuclear wars would send huge amounts of smoke into the atmosphere, with potentially catastrophic consequences. Soon afterwards, Thompson and Schneider were in print (Thompson, Schneider and Covey, *Nature*, **310**, 625; 1984) urging the benefits, in such calculations, of more sophisticated climatic models. The list of references on page 227 will show that others have not been idle.

So what has been learned about and from nuclear winter? The first thing to say is that Crutzen and Birks stood impeccably on solid ground by publishing their calculation of what might happen if there were a lot of smoke in the atmosphere. But, a year later, a bandwagon had been set rolling, press conferences had been arranged, the paper by Turco, Toon, Ackerman, Pollack and Sagan had been renamed "TTAPS" (presumably in emulation of the respect accorded to the paper on nucleosynthesis by Burbidge, Burbidge, Fowler and Hoyle) and the late Mrs Gandhi had taken to complaining that a nuclear war between the superpowers might destroy others than themselves. The present position, mentioned in passing by Schneider and Thompson, is that ENUWAR has sought to standardize the models people play with by presupposing certain quantities of carbon discharged as smoke into the atmosphere (the basic unit is the Tg, one million tonnes).

What researchers of these questions have not properly understood is the effect of their ratiocinations on the world at large. (Crutzen and Birks were seemingly archless in this respect.) But by the following year, the TTAPS team was planning to make what is called an "impact", and did so. *Nature*, having decided (wrongly) that a different press conference in Washington would make better copy, was probably over-sour in its comments on the affair. But the plain truth is that, three years ago, most ordinary people were scared stiff by the threat of nuclear winter: one might survive the blast, but after that would be only the cold and the starvation.

All this on the strength of a one-dimensional model? The complaint embodied in that question must be understood for what it is. Many one-dimensional models are remarkably predictive. There is no reason why a simple model of the atmosphere should not faithfully reflect its behaviour under the influence of external forcing circumstances. Technically, the chief weakness of the TTAPS model was more probably its understandable omission of consideration of what would happen in the first few days of the aftermath of a nuclear war; even now, Schneider and Thompson have little to say on that question, but that is understandable. There are also technical difficulties about the difference between the formation and effects of clouds rather than of "average cloudiness", still much more easily incorporated into climatic models.

What this implies is chiefly that four years of public anxiety about nuclear winter have not led anywhere in particular. At the outset, people in general were convinced that any substantial nuclear war would be a catastrophe and did their best to arrange that there should be agreements between potential combatants to minimize the chances. The hype of nuclear winter might in principle have extended the circle of those eager for the same outcome, but chiefly served to make people cynical; does it matter if you would be dead even if you survived?

So, inevitably, the issue has become academic in the best sense; professional people think it worth study. Schneider and Thompson, and the host of documents they cite or are unable to cite for lack of space, testify to the interest of the problems nuclear winter has thrown up. What really happens at the edges of clouds? (In this case, would induced precipitation wash out the clouds?) What coupling would there be between the atmosphere and the oceans? Would it always be possible to rely on Le Chatelier's principle for a mitigation of the consequences of simple predictions?

For the time being, at least, the issue of nuclear winter has also become, in a sense, irrelevant. At the back of the mind, most people know that the superpowers are about to tell each other of their impending ratification of the agreement not to aim nuclear missiles at each other from bases in Europe, which will go some way to reduce the immediate risk of nuclear wars such as TTAPS supposes, but there are more urgent reasons why people should be worrying about the refinement of climatic models.

The problem of the ozone layer caused by chemically inert aerosol propellants and refrigerants has qualified as daily-newspaper fodder, but the greenhouse problem will eventually be a harder nut to crack politically, if only because burning of fossil fuel (and even of biomass) is so crucial to economic activity. Even when meteorologists are able to put their hands on their hearts and say that they have detected signs of global warming, it will fall to the model-builders to say what the consequences will be. When that time comes, it is to be hoped that they will respond more confidently than to the issue of nuclear winter with opinions properly hedged with specific qualifications about the ways in which the models are incorrect.

John Maddox