EFFECTS

Nuclear war

Poor outlook for tropical weather

from A. Barrie Pittock

THE most important environmental effect of a major nuclear war in the Northern Hemisphere may be caused by reduced rainfall in the tropics and subtropics. This conclusion was reached at a recent conference* and will be incorporated in a report later this year (see *Nature* **315**, 534; 1985).

SCOPE (the Scientific Committee on Problems of the Environment) has run a series of scientific workshops, this being the first to be held in the Southern Hemisphere. New results from computer simulations were reviewed, incorporating explicit modelling of smoke dispersion from target areas in North America, Europe and the Soviet Union, and fully interactive smoke (that is, smoke that modifies the atmospheric temperature and wind structure and is then moved around by the modified circulation). This overcomes two of the major weaknesses of the earlier simulations, which assumed an initial uniform smoke distribution over Northern Hemisphere latitude zones and did not allow for smoke movements.

A common feature of the results from simulations performed by the three different laboratories in the United States (Los Alamos, Livermore National Laboratories and the National Center for Atmospheric Research) and in the Soviet Union, was that smoke was 'lofted' from its initial height of injection to around 10 to 20 km in altitude and then moved south, because of heating by absorption of solar radiation. This effect occurs only in the northern spring and summer seasons when the solar radiation is sufficient to cause the lofting to take place. In winter the smoke tends to move towards the Arctic and is more quickly removed.

This lofting effect and the increased stability of the lower atmosphere (which reduces precipitation) quickly separates the smoke from the washout processes in the spring and summer. Such results make it seem more likely that the smoke will last long enough and move far enough south to affect seriously the tropics and the Southern Hemisphere.

In mid-northern latitudes, full-blown nuclear winter effects will probably occur but, as this is the zone where most damage will be done by the direct effects of the nuclear explosions, this 'lofting' effect will be irrelevant. But as the smoke spreads southwards it will stop the solar heating of continental land surfaces that drives the south-west monsoon, halting the rainfall necessary for survival over most of southern and south-east Asia. This could be far more disastrous than temperature decreases in the tropics of 10 – 15°C, even though rice is particularly sensitive to this degree of cooling.

Further south, rainfall over mainland Australia is expected to decrease, initially because of strengthening of the descending arm of the Hadley Circulation in the southern sub-tropics, and later from a general decrease in the hydrological cycle. A pre-'nuclear winter' study by B. Hunt (*Mon. Weather Rev.* **81**, 3677; 1976), where an 18-level primitive equation model was run with the solar insolation turned off, showed a rapid decline in the water vapour content of both the atmosphere and the eddy kinetic energy (strength of the synoptic weather disturbances). As Australian agriculture is mostly limited by precipitation, this effect will have a major effect on productivity, whereas the relatively modest temperature reductions may be less serious. New Zealand and Tasmania, on the other hand, are further south, so temperature is more limiting and even modest cooling may significantly reduce production.

Australia, New Zealand and Argentina currently have food surpluses, so that even large reductions in production may not lead to mass starvation in these countries, unlike much of southern Africa and the tropics. Thus, the greatest impact of the 'nuclear winter effect' may result from reduced rainfall in the highly populated countries of Asia and Africa rather than in countries in the mid-northern latitudes.

Several major uncertainties have been given more adequate treatment in recent, as yet unpublished, work discussed during the workshop. Areas still to be investigated are the rates of smoke washout in the initial plume-rise phase, the optical properties of aged smoke (especially at infrared wavelengths) and the possible smoke removal processes in the stratosphere. Better knowledge of effects on the Southern Hemisphere also requires computer simulations to be run for longer periods and to consider the effects of a war fought in the northern winter. □

* The workshop on the environmental effects of nuclear war was held in Melbourne, 28–29 March 1985, sponsored by the Australian National Committee for the Environment and the New Zealand Committee for the Scientific Committee on Problems in the Environment.

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