

The chilling facts about nuclear

Recent scientific studies have shown that the survivors of the direct effects of even a "limited" nuclear war could face months of darkness and freezing cold. Plants, animals and humans would die from the war's climatic and environmental effects on a similar catastrophic scale to the casualties from the short-term effects of blast, fire and radiation. Civilised life as we know it would come to an end. In a large-scale nuclear war it is at least possible that the human race would become extinct, along with most of the animal and plant species that share the Earth with us today.

These "nuclear winter" predictions are shocking and unexpected. They add a new dimension, a new urgency, to the nuclear debate.

NUMBERS OF SURVIVORS

Whereas previously, "optimists" claimed that survivors of a nuclear attack on Britain would number 25 million or more, and "pessimists" feared they might be 5 million or fewer, it now seems that even these disastrous estimates should be scaled down. Whereas previously, the neutral and non-aligned countries remote from the nuclear powers—above all, those in the Southern Hemisphere—might hope to survive even a holocaust wiping out most of the USSR, Europe, North America and China, they now face the same catastrophic effects as the rest of us. Whereas previously, some could argue that, as a last resort, a nuclear war might be the only way to defend freedom, the stakes have now been raised so much that this is no longer credible.

Any war today, even if fought only with so-called "conventional" weapons, is terribly destructive for those involved. Any nuclear war, even without a nuclear winter, would be a disaster without precedent, not only for the warring countries but for the world as a whole. The immediate and short-term effects of a global nuclear war, involving (as one assumes) the USA and the USSR, might wipe out between one and two billion people—up to half the world's population. Nuclear winter would threaten the survival of the rest.

WHAT IS NUCLEAR WINTER?

Recent studies of nuclear war have concentrated on features not previously examined in detail. These are the climatic effects of the vast quantities of matter released high into the atmosphere by thousands of nuclear explosions occurring within a brief period of time (hours or, at the most, days). The main constituents would be dust from explosions near the ground and sooty smoke from extensive fires, especially in cities, industrial centres (fuel stores, oil refineries, chemical works) and forests. It is calculated that a major war involving the use of 5000 megatons (Mt; 1Mt=77 Hiroshimas) might discharge into the atmosphere nearly 1000 million tons of dust and over 200 million tons of smoke. Five thousand Mt is one-third of the combined arsenal of the USA and USSR.

The resulting dark cloud would extend over most of the Northern Hemisphere

(where nearly all the likely targets are located) within a few weeks, and might also extend south of the Equator because the normally prevailing wind systems would be disrupted. The suspended fine dust particles would reflect some sunlight back into space and the soot would absorb most of the rest. So the amount reaching the Earth's surface might be only a few per cent of normal. However, the longer wavelength heat radiation from the Earth would escape into outer space without much absorption.

The average surface temperatures beneath the cloud would therefore fall rapidly, perhaps by as much as 20 to 30 °C for the main land masses, but by only a few degrees for the oceans. An additional effect from this temperature difference would probably be devastating and continual storms in coastal regions such as Britain and Eastern Europe.

The fall in temperature would turn summer into winter, or winter into arctic conditions, depending on the season of the year. Combined with a loss of sunlight (giving the equivalent of a moonlit night), this would be enough to stop all plant growth. With these conditions persisting for only a few weeks—let alone several months as seems possible—most crops and many wild plants would be destroyed. The animal and human populations dependent on them would be faced with starvation. Thirst would be another killer as much surface water would be frozen hard.

AFTER THE WINTER

These conditions would not be permanent. There would be a gradual fallout of the dust and smoke particles, although the finest particles in the stratosphere (upper part of the atmosphere, above about 10-15 km) might continue in suspension for years.

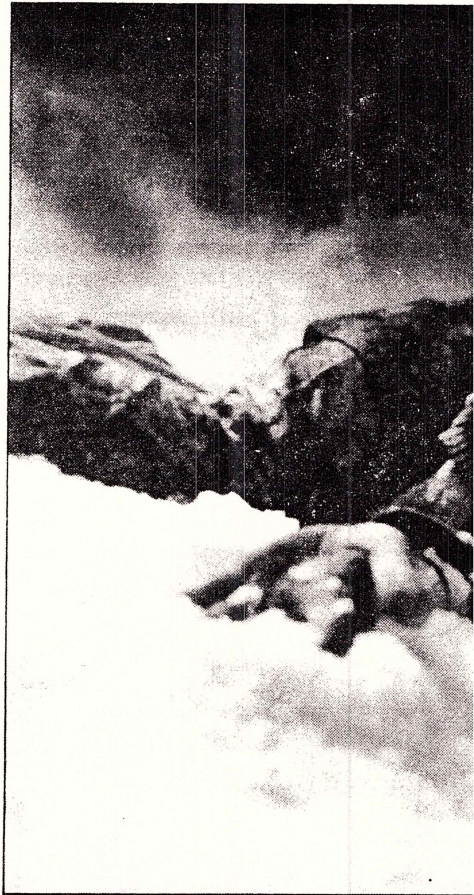
When the cloud finally disappeared, there would be a new hazard facing any survivors. Multiple nuclear explosions would generate immense quantities of nitrogen oxides. If the more powerful warheads (1Mt and upwards) were used, these gases would rise into the atmosphere on the currents resulting from nuclear fireballs and from firestorms, and would react chemically with the thin layer of ozone in the stratosphere, partially destroying it.

The ozone layer is the Earth's protection from dangerously high levels of ultraviolet (UV) radiation from the sun. It might be two years or longer before it was fully reconstituted. The excess UV would harm plants and animals, cause intense sunburn and blindness in human survivors and reduce resistance to disease. It would be particularly destructive to the myriads of tiny organisms (plankton) in the surface layers of the oceans, on which all marine food-chains ultimately depend.

Another hazard not previously recognised is "intermediate time-scale" radioactive fallout. This is so named to distinguish it from local fallout—which comes to the ground within a few hundred miles in a few days after a nuclear explosion—and global fallout—which consists of fine particles injected into the stratosphere

and taking many months to reach the ground, by which time it has been widely dispersed by winds and much of the radioactivity has decayed.

The intermediate time-scale fallout would result from "less powerful" explosions (below 1Mt) which would inject particles into the upper troposphere (the lower part of the atmosphere, up to 10-15km) rather than the stratosphere. They would spread over much of the Northern Hemisphere and fall to the ground after a few weeks. The resulting radioactivity might



not in itself be fatal. But, added to the local fallout dose already received in these first weeks, it might make the difference between survival and death. It would in any case significantly reduce resistance to disease.

The scientists carrying out these studies are leading experts from USA and USSR, as well as from Australia, Canada and several European countries including Britain. Most of them are cautious, even conservative, by temperament. They insist on checking and double-checking their calculations, especially when the results are surprising and disturbing as these have been. They are accustomed to develop a theory step by step, testing it by experiment as they go along.

Of course, there can be no question of experimenting with a nuclear war, even a "small" one! But there is, in fact, a considerable body of experimental evidence to work with. Some of it comes from the nuclear explosions in Japan nearly 40 years ago and the hundreds of atmospheric nuclear tests in the two

winter

decades that followed, before they were ended by the Partial Nuclear Test Ban Treaty. Some of it comes by analogy from volcanic eruptions or the study of global dust storms on Mars (observed at close quarters by the American "Mariner" spacecraft). Much evidence comes from the young science of atmospheric modelling. It must also be emphasised that the studies summarised here have been subjected to stringent examination and debate during the past year or more, involving literally hundreds of well-qualified specialists in

He writes in the American journal *Foreign Affairs* (Winter, 1983).

There is an indication of a very rough threshold at which severe climatic consequences are triggered—around a few hundred nuclear explosions over cities, for smoke generation, or around 2000 to 3000 surface bursts at eg missile silos, for dust generation and ancillary fires. Fine particles can be injected into the atmosphere at increasing rates with only minor climatic effects until these thresholds are crossed. Thereafter, the effects rapidly increase in severity. He regards the climatic threshold for smoke in the troposphere as about 100 million tonnes, and for sub-micron sized dust in the stratosphere, about the same quantity.

His conclusion is that, roughly speaking:

- If fewer than 500 warheads are exploded, the climate *will not be* at great risk, as far as we can tell at present.
- If 500 to 2000 warheads are exploded, climatic catastrophe *may or may not occur*, depending on the targets attacked and other factors.
- If more than 2000 warheads are exploded, climatic catastrophe and a nuclear winter *must be expected*.

The US stockpile of strategic nuclear weapons crossed this threshold of 2000 warheads, into what Sagan calls the "Doomsday Zone" as far back as 1954, followed by the Soviet Union in the 1960s.

OTHER IMPLICATIONS

The only way for the world to emerge from the shadow of Doomsday is for the global nuclear arsenals—those of the two superpowers—to be reduced rapidly below the threshold figure. This would not involve the slightest loss of military security on either side, since weapons which risk mutual suicide cannot credibly be used and must be ineffective as a "deterrent".

Such a rapid reduction—to less than 10% of present nuclear arsenals—must go further and faster than any of the current proposals for "Freeze and then Reduce" or "Deep Cuts" or "Build Down" (which in any case, in President Reagan's version, only starts after an unprecedented building-up!). As a start, three propositions stand out.

Firstly, no one part of the world, however remote from a nuclear conflict, can now hope to escape the climatic consequences. This point has been taken by the leaders of India, Mexico, Sweden, Greece, Tanzania and Argentina in their Joint Declaration of May 22, launching the "Four Continents Peace Initiative":

The people we represent are no less threatened by nuclear war than the citizens of the nuclear weapons states. It is primarily the responsibility of the nuclear weapons states to prevent a nuclear catastrophe, but this problem is far too important to be left to those states alone.

Secondly, the Soviet Union and China are already pledged to the policy of "No First Use" of nuclear weapons. It is now even more urgent that the USA, Britain and France should come into line, which will

involve a major re-think of NATO's force structure and military planning. Once this process is under way, we can confidently expect the USSR to do the same.

Thirdly, it is now even less realistic than previously to suppose that Civil Defence can provide any serious protection for the British people in the event of nuclear attack.

WHAT CAN WE DO?

To measure up to this new challenge to our existence, we need to think, to discuss and to act. We need to do all three at the same time, in the knowledge that each will reinforce the other two. I can only give my own personal suggestions.

Thinking. For me, the first thing was to re-read Jonathan Schell's *The Fate of the Earth* (Pan Books, £1.95). He says in a key passage:

If we admit the reality of the human predicament—that present levels of global armament are great enough to possibly extinguish the species if a holocaust should occur; that in extinction every human purpose would be lost; that... once the species has been extinguished there will be no second chance...; that *therefore this possibility must be morally and politically dealt with as though it were a certainty*; and that either by accident or by design a holocaust can occur at any second—then, whatever political views we may hold on other matters, we are driven almost inescapably to rid the world of nuclear arms. (My emphasis.)

Discussion. There are meetings and conferences we can attend, to learn and to influence others. There are pamphlets and leaflets we can take to our neighbours and workmates, to our churches, clubs, trade unions and political parties. We can draw into the debate and seek support from the many not previously involved, whether they be animal lovers or social workers, ecologists or sports fans, ramblers or bookworms. All share the same predicament in a nuclear world. All have a right—and, indeed, a *duty*—to form their opinions and make their voices heard.

Action. Each of us must choose what to do, but everyone can do something. As Edmund Burke said:

Nobody made a greater mistake than he who did nothing because he could only do a little.

My own selection is to strengthen the work for a nuclear freeze; to increase support for the Greenham women; to encourage peace organisations (and peace-lovers not yet "organised") to look outwards and co-operate; and to publicise the "Four Continents Peace Initiative" as a means of increasing the pressure on our own government—one of the "nuclear five" whose hands at the moment hold the future of the world in an uncertain grasp!

CHRISTOPHER MEREDITH

This piece is abridged and adapted from the Scientists Against Nuclear Arms publication *Nuclear Winter—A New Dimension for the Nuclear Debate* by Christopher Meredith, Owen Greene and Mike Pentz. Available from SANA, 112 Newport Rd, New Bradwell, Milton Keynes MK13 0AA, price £1 post free.



many different fields. There have been differences of opinion on many points of detail, but there has been scarcely any serious challenge to the major conclusions.

THE CLIMATIC THRESHOLD

It is important to appreciate that the scale of a global conflict seems likely to affect the *duration* of the nuclear winter rather than its destructive characteristics. In the computerised simulations a wide range of "war scenarios" was used. Once the attacks exceeded a certain level the blocking off of sunlight and the rapid fall in land temperatures resulted in all cases, with a duration varying from one month upwards. Even a "small" war involving "only" 100Mt would be sufficient to trigger a nuclear winter if this total was delivered by 1000 warheads and exploded entirely over the major cities in the Northern Hemisphere.

Professor Carl Sagan of Cornell University, who has played an important role in these recent studies, has defined what he terms the climatic or "Doomsday Threshold".