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SCIENTISTS AGAINST NUCLEAR ARMS

NUCLEAR WINTER: THE GLOBAL CONSEQUENCES OF NUCLEAR WAR

"For goodness sake! Everyone knows that nuclear war would be horrific, and nobody wants to hear any more about it."

For most of us, the direct effects of nuclear explosions are so far outside our human experience as to be practically incomprehensible. Which of our friends ever saw a fireball brighter than a thousand suns? Who has been out in a wind of 300 mph? How could people be killed 50 miles away from an explosion by invisible radiation from dust? A million tons of TNT in one explosion, 1,000,000,000 non-combatants killed outright by nuclear war are beyond the grasp of our imagination, and so seem unreal compared with everyday life.

But recent scientific studies have revealed that nuclear war would very probably also have profound effects on the world's climate, imposing near-darkness and harsh winter conditions lasting for several months on countries in the Northern hemisphere. Except near the coasts, where the reservoir of heat in the oceans would offer some protection, soil and freshwater could freeze hard as temperatures fell to between $-15°C$ and $-25°C$ ($+5°$ to $-13°F$). Now to be cold, to be in the dark, to be without water, to be out of food and fuel — these things are more comprehensible. The impact of *this* aspect of nuclear war may well be clearer and more immediate than any others.

How do we know this will happen?

We can't know for certain, as scientists can only tell us their best available estimates, but in this instance they were so shocked by their computer predictions that they checked them with 100 physicists and biologists before publishing the results. Three independent groups in the USA and two in the USSR came to very similar conclusions to the probable effects on global climates.

Why hasn't this been thought about before?

The key factor omitted in previous atmospheric studies was the effect of smoke particles from fires. Although there were extensive conflagrations at Hiroshima and Nagasaki, atmospheric testing of nuclear weapons has mainly been carried out in desert areas and on islands, where dust was produced but there was relatively little combustible matter. Another reason is that the complex calculations in one of the new studies involved the longest computer program ever written. It shows how important it is not to rely only on official statements, but to encourage independent questioning by scientists of many disciplines.

Surely nobody will be worried about a bit of smoke on the Day After?

Perhaps not, but can you imagine 225 million tons of smoke particles, from fires simultaneously ignited by air- and groundbursts in urban and suburban areas and in forests, burning uncontrolled and fuelled by damaged gas and oil installations? One of the scientists' 26 possible scenarios involved:

* the detonation of 5000 Megatons (about one-third of the world's nuclear arsenals).
* the partial burning of 100,000 square miles of built-up areas (about one-sixth of the world's urban land area).
* 200,000 square miles of forest fires (only 1.3 per cent of N. hemisphere forests).

Won't the smoke just blow away?

Much of it would be carried into the upper atmosphere, soon forming an unbroken black 'cloud' around the Northern hemisphere, especially in the heavily targeted mid-latitudes. Particles of 'nuclear smoke', consisting mainly of graphitic carbon, are highly efficient at absorbing sunlight, and because they are very small they would stay aloft for days or weeks before settling out or being washed down in rain or snow.

How much sunlight would reach the earth?

For the 5000 Megaton case, the smoke particles, together with large amounts of dust in the atmosphere, would reduce light intensities *across the whole Northern hemisphere* to a few per cent of normal. Indeed the levels at the latitude of Britain may well be 2-3 times darker still. With light as dim as this, photosynthesis cannot meet the metabolic needs of green plants themselves, let alone provide any excess of stored food for consumption by animals or humans. This would be less serious in winter, but in spring or early summer, for example, cereal crops could fail to yield a significant harvest after as little as 1-3 weeks of dim light.

What about the temperature?

Because of the dark material it contained, the upper atmosphere would absorb the sun's rays and would become very hot (with temperatures rising by as much as 90°C/160°F.) Conversely, the earth's surface would get very cold, receiving so little energy from the sun. In the 5000 Megaton study, temperatures inland in the Northern Hemisphere drop to −23°C (−9°F) after 3 weeks, with sub-freezing temperatures persisting for several months. Even in summertime, the ground as well as lakes and rivers would be frozen hard, and there might be prolonged snowfall for months. Under these conditions, humans who had survived the prompt, delayed and indirect effects of explosions would be faced with keeping warm in semi-darkness despite shortages of many fuels, death of farm animals from thirst and cold, and loss of growing crops. The hardiest plants will succumb to just a few degrees of frost immediately following warm weather, for frost-tolerance is normally gained gradually in the autumn. Thus even the hardiest spruce and birch of the Siberian taiga or Canadian interior could not stand a 'dark winter' in the summer months.

How about the oceans?

Dim light, particularly in summer, would greatly restrict photosynthesis in the marine phytoplankton which provides the basis for the fishing industry. If it persisted or a month or more, it would be quite likely to lead to the extinction of certain fish species.

Because of its very large reservoir of heat, the sea would not freeze, and coastal areas of the land would also be kept warmer. They would however be subject to violent storms, because of the great contrast between land and sea temperatures. The scientists point out that the oceanic margins had often been considered a major source of sustenance for survivors of a nuclear war, but people would also have to contend with the destruction of ships and the concentration of radioisotopes in shallow coastal waters.

Presumably those in the Southern hemisphere would be all right?

Normal global air circulation and wind patterns are relatively separate in the two hemispheres, but the patterns could be greatly disturbed by the heated upper atmosphere and cold continental land masses in the Northern hemisphere. Rapid interhemispheric mixing of nuclear debris is now forecast, with the impact on the Southern hemisphere greater still if large nuclear explosions and firestorms in cities drive smoke and dust up into the stratosphere. Thus it is not necessary for a single nuclear explosion to take place in the Southern hemisphere for serious effects to occur there.

Could one survive more easily in the tropics?

No, the inland temperature is expected to go well below freezing point as far south as the equator, and perhaps in the southern tropics also. Lowland tropical plants, and sub-tropical crops like maize and soya bean, are often damaged or killed by cool temperatures (0°-10°C or 32°-50°F). Rice may fail to set seed if temperatures fall only as far as 13°C (55°F). The major storehouse of the world's genetic diversity of animals and plants, the tropical forests, could thus be lost together with about half of all living species. Problems for people in the tropics would also be compounded by the loss of imports of food and agricultural technology, due to the disruption of world trade.

Would there be a shortage of oxygen with all these fires?

In the neighbourhood of the fires, yes, but not on a global scale because of the immense reserves in the atmosphere, and the probable recolonisation of devasted areas by green plants. However, various poisonous gases such as carbon monoxide, ozone, dioxins and furans would be released near the earth's surface, and 'smog' and acid rain are likely to persist after the initial gloom has begun to disperse. Oxides of nitrogen forced into the stratosphere may reduce the valuable ozone shield there, allowing in greater amounts of harmful UV-B radiation, although scientists are not agreed on the extent of this. Carbon dioxide levels will be increased by the fires and by reduction of photosynthesis by green plants. This might lead to a very small rise in global temperatures after the smoke and dust have gone, as the loss of heat from the earth's suface would be slightly reduced.

They'll never explode as many nuclear weapons as that!

The scientists studied many scenarios, with widely different numbers of weapons and targetting strategies. Surprisingly, they found that if the attack was limited to 100 Megatons (comprising 1000 warheads of 100 kilotons) airburst over cities it would still, because of the extensive fires, produce a 2-month period of sub-freezing inland temperatures in the Northern hemisphere, with a minimum near −23°C (−9°F). Thus using less than one per cent of the world's nuclear arsenals could have these substantial global consequences, rebounding on the user's own countryside.

How can these things be true, when successive governments have told us we need *more* nuclear weapons?

In the Atomic Age, many assumptions are overturned. As the title of an article in the November 1983 issue of the Bulletin of the Atomic Scientists puts it, 'Nuclear Security: the enemy may be us'. The machinery of government does not easily respond to such a basic change in thinking, but independent groups of scientists can re-examine a subject, and tell us what they find. And in the case of nuclear war, the warning is that the consequences might far outweigh any possible transient goal of a particular government. Indeed it now seems that our possession of nuclear weapons places at hazard the stability of the global climate, and of the natural and agricultural ecosystems on which we all depend. Actual conditions could well be even worse than those predicted, because the combination of gross climatic disturbance with increased radiation burdens may disrupt biological control systems, allowing for instance a build-up of pest, disease and weed species while other organisms become extinct.

Is there any hope of changing course?

Yes, because respected professional groups like doctors and scientists are now openly warning of the grave dangers of nuclear weapons. Yes, because the new information technology is allowing us to calculate and visualise the probable global results of our activities, and to communicate across the world the dangers and the need to avoid them. Yes, because we all know we have no right to place at risk the fragile environment which sustains life on earth. Yes, because many are becoming aware of the opportunities to reduce the risks by starting the process of nuclear disarmament.

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