SCIENTISTS AGAINST NUCLEAR ARMS
SCOTTISH GROUP

SSANA Factsheet no. 40

# Global Consequences of Nuclear War

The Earth, seen from the Moon

THE MAJOR GLOBAL CONSEQUENCES OF NUCLEAR WAR WILL BE CRUCIAL TO HUMAN SURVIVAL OUTSIDE THE TARGETED AREAS :-

* Water supplies would be reduced and contaminated in regions bordering nuclear explosions ;
* Starvation would follow in many parts of the world, because of reduced agricultural production and interrupted trade ;
* Smoke from widespread oil, gas and forest fires would darken the sky for several months ;
* Temporary climatic changes might lead to partial melting of the north polar ice-cap and altered sea-level ;
* Radioactive contaminants would accumulate, particularly in man, increasing the rates of cancer and mutation ;
* Skin cancer could also be increased if ozone depletion in the stratosphere was sufficient to increase ultra-violet penetration.

"it is clear that at present, with some twenty thousand megatons of nuclear explosive power in existence, and with more being added every day, we have entered into the zone of uncertainty, which is to say the zone of the risk of extinction.

But the mere risk of extinction has a significance that is categorically different from, and immeasurably greater than, that of any other risk, and as we make our decisions we have to take that significance into account."

"We have no right to place the possibility of this limitless, eternal defeat on the same footing as risks that we run in the ordinary conduct of our affairs in our particular transient moment of human history."

Jonathan Schell - "The Fate of the Earth"

# GLOBAL CONSEQUENCES OF NUCLEAR WAR

## Introduction

Few people doubt that, if nuclear war should occur, millions of people in many countries would be killed. For instance, recent estimates suggest that as many as 70% of the U.K. population might die from the initial effects alone.

With destruction on such a scale, it may seem academic to be concerned about effects on world environments. However, it is precisely because they would be crucial for human survival outside the targeted areas, and indeed in countries many thousands of miles away, that this factsheet has been written. It summarises some of the major global consequences of nuclear war, so far as they can be estimated. Others in the same series deal with specific aspects in more detail, their chief aim being to promote informed and serious debate about viable alternative policies.

## The Atmosphere

Besides producing radioactive fallout, air- and ground-bursts of nuclear weapons pollute the atmosphere in two further ways. Directly, they produce oxides of nitrogen (about 5000 tons for every megaton) and also (for groundbursts) inject dust into the stratosphere. Indirectly, by starting many fires, large quantities of smoke and gases are formed.

Nitrogen oxides, if forced up into the stratosphere, may reduce the protective ozone layer which filters out biologically harmful ultra-violet radiation. Nuclear explosions exceeding about 1 Mt seem to be required to force the nitrogen oxides high enough, and as trends are towards multiple warheads of

lower individual yield, this effect may be somewhat less serious than had previously been thought. However, some calculations suggest that the incidence of human skin cancer could be increased by as much as 10%, due to greater exposure to ultra-violet radiation. Any depletion of stratospheric ozone is expected to last for 2-4 years. The amount of dust injected into the stratosphere by one-eighth of the world arsenals of nuclear weapons could be of the same order as resulted from the 1883 eruption of the volcano Krakatoa (10-100 million tons). This took about 3 years to settle back to earth.

Fires would be started directly by the heat flash, or indirectly through damaged installations, but their numbers and extent would vary greatly according to season and weather conditions. Large areas of cropland, forest and urban areas could be burnt, with forest fires probably burning for weeks and oil and gas wells perhaps for much longer. Such fires could inject some 200-400 million tons of light-absorbing particles into the atmosphere, mainly over the Northern Hemisphere. For several months, sunlight at the Earth's surface would be reduced, at least to a half, and perhaps to less than 1% of its normal levels. Lower levels of the atmosphere could also be heavily polluted with gases such as carbon monoxide, various hydrocarbons and nitrogen oxides (which here would promote the production of ozone) in quantities that might be toxic or reduce plant growth. Alterations in oxygen levels are unlikely to be important, but carbon dioxide levels may be doubled. This would represent an increase 4 times greater than the one already concerning scientists, which has occurred because of the Industrial Revolution.

There could well be significant climatic disturbances due to changed heating of the Earth's surface, though these cannot be

predicted accurately. Climate could be modified by the wholesale loss of forests and by the changes in atmospheric gas composition. For example, although less radiation would penetrate to the Earth's surface, more of that which did would be retained because of the higher carbon dioxide levels. Also surface absorbtion could be increased by soot deposited over ice and snow, for some time after a nuclear war. Initially, global temperatures may be lowered somewhat, but in the longer term the doubled carbon dioxide level could be the predominant influence. This could cause an increase of as much as 7-10$^{o}$C in North Polar winter temperatures, which would partially melt the ice cap, and lead to alterations in sea level.

Freshwater: water supplies and aquatic environments

Initially, water supplies would be dislocated by damage to the distribution system and loss of power supplies to the pumps. This would not only interrupt human and reduce farm water supplies, but it would also affect purification and sewerage systems so that drinking water might actually contribute to the spread of disease. Moreover, both local and global fallout are likely to contaminate fresh water sources with radioactive material. Groundwater reservoirs would be least contaminated, followed by lakes, then rivers, and finally by rainwater, which would be the most seriously affected. In areas with local fallout, rainwater would be highly contaminated and would not only be dangerous to drink, but would also affect human health through skin contact. Lack of adequate shelter following nuclear attack could expose many people to this extra source of radiation damage, and it is likely that many people would be forced to drink water contaminated with fallout, toxins and disease vectors. Use of fertilisers, particularly those containing calcium, potassium and ammonium,

would tend to displace strontium and caesium isotopes from the soil, causing increased radioactive pollution of streams, lakes and groundwater supplies.

Some freshwater habitats in the Northern Hemisphere might well be damaged by the prompt effects of nuclear weapons - blast, heat and radiation. More widespread ecosystem damage, and reductions in productivity including yields of fish, could occur thereafter from acid rainfall, global fallout and reductions in incident radiation.

The Oceans

The deposition of nuclear fallout in the oceans would have relatively minor direct effects, because of the large dilution of radionuclides, the lower sensitivity of most marine organisms to radiation and the inherent stability of these ecosystems. More serious would be a large reduction in sunlight penetration in the Northern Hemisphere, which could lead to phytoplankton depletion and a general lowering of productivity. Thus if photosynthesis was reduced, the partial removal of this first link in the food web could disturb the whole ecosystem. Any increase in ultra-violet radiation could also be harmful to certain marine organisms.

Although fallout might not cause major disruption of ocean ecosystems, experience of atmospheric testing shows that there would be some accumulation of radionuclides through the food chain which could affect higher organisms, including man. In particular, caesium-137 is accumulated in soft tissues, and strontium-90 in bones and scales. The strontium-90 occurring in inedible parts of fish would cause less of a hazard than caesium-137, which would tend to be accumulated by humans eating fish.

In the initial post-nuclear war period the most important sea water areas for human use would be estuaries and coastal

regions, and these may be expected to be more severely affected than the open ocean. Thus the short term utility of the ocean environment would be reduced, though it is likely that in the long term these habitats should persist less disturbed than most.

Forests

Forests will suffer extensive damage from blast and fires (which with limited fire-fighting services may burn for a long time), from air pollution including highly acidic rainfall and smog conditions, and from the ionizing radiation in fallout. Trees are known to be more sensitive to radioactivity than most plants, and conifers particularly so. Radiation-weakened trees are especially susceptible to attack by insects and disease. In general the loss of large areas of forest would cause significant changes in terrestrial habitats, with lower rates of carbon dioxide fixation, changes in amount and quality of water runoff, and increases in soil erosion rates amongst the major probable consequences.

Agriculture and Food

Croplands and farm animals would suffer in target areas from both prompt and delayed effects of radiation, while eventually all agricultural areas of the world might receive some increase in radioactivity from global fallout. Radiation in local fallout can move quickly through the food chain to man, and milk would initially be very dangerous to drink because of high levels of iodine-131 (half-life 8 days) as well as strontium and caesium isotopes which could persist for centuries.

Some food surpluses presently exist, especially in N.America, and there would of course be a much reduced population to be fed. However, it is evident that food shortages would soon occur, due

to direct losses of animals, crops and stored food and forage; and indirectly through animal diseases and breakdowns in energy supplies, marketing and communications. Following a nuclear conflict, trading between the developed countries and the Third World is likely to be much reduced, and since many of these poorer countries depend on imports of food and agricultural technology, they too may suffer severe food shortages. All over the world there would be a drop in crop yields due to lack of fertilisers, pest control, plant breeding, and other high technology inputs; and because of the effects of radiation directly on yield, and indirectly due to extra mutation. Crop production may also be reduced in the Northern Hemisphere by unfavourable atmospheric conditions.

After an initial period which would probably include widespread starvation (especially in the second winter), agriculture would perhaps stabilise at much lower yields than at present, in most areas using primitive farming techniques. Global fallout would ensure that virtually all food would contain increased levels of radionuclides, which are implicated in the incidence of cancer and genetic damage.

## Conclusions

The global consequences of nuclear war are serious, in spite of being difficult to estimate accurately. Whilst deep ocean habitats might remain relatively undisturbed, terrestrial and freshwater environments would in many areas be severely affected, with large expanses of forests and croplands destroyed, and some lakes and rivers acidified. Atmospheric conditions and weather patterns might be temporarily altered, with reductions in photosynthesis and in production of crops, dairy products, meat and fish. Together with a reduction in

trade, if not the collapse of the world economy, this would be bound to result in starvation in many parts of the world.

Following nuclear war, various imbalances in ecological relationships may occur; for example, insects, bacteria and fungi are generally 100 to 1000 times more tolerant of radiation than mammals. Similarly, species with specialised site requirements may find post-nuclear war environments unfavourable, whereas pioneer types may thrive. Accumulation of radionuclides moving through food webs may also place stress particularly on carnivores (including man). The functioning and stability of many ecosystems may be affected for periods of years, although in unpredictable ways. Their composition could for instance be changed permanently if particular species became extinct.

Following a nuclear war much of the world would be contaminated with radioactive isotopes which people would unavoidably ingest, as they have done with the global fallout from atmospheric bomb tests. Increased levels of radiation are likely to raise the number of deaths from cancer and genetic deformations by 1000 for every Megaton exploded. This may be the most enduring consequence of nuclear war, persisting long after ecosystems, agricultures and societies have stabilised; unless of course there were other damaging interactions not so far appreciated.

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"As there is no guarantee that the risk of war can be avoided, the need for nuclear disarmament is imperative."

1980 UN Report on Nuclear Weapons

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## famous last words

**. . . overheard by Arthur Horner . . .**

SCIENTISTS AGAINST NUCLEAR ARMS (SANA) is an independent organization formed in 1981 in response to the escalation of the arms race and the consequent danger of nuclear war. Its membership includes natural and social scientists, engineers and technologists, statisticians and psychologists.

Its purpose is to provide reliable and objective information on scientific and technical matters concerning nuclear arms and other weapons of mass destruction. It seeks to serve all sections of the peace and disarmament movement, Members of Parliament, local Councillors, Church and Trade Union leaders and others with influence upon public policy, and to inform the media and the general public.

SANA maintains contact and exchanges information with groups in other countries having similar aims.

Membership is open to all scientists - in the broad sense referred to above - who share its aims. Subscription is £12 a year (£3 for students, pensioners and unemployed). For further information, send s.a.e. to the Secretary, Christopher Meredith, 8 Medland, Woughton Park, Milton Keynes, MK6 3BH

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Vice Admiral J M Lee's Address (see Factsheet no. 5)
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T A I L - P I E C E

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" We do not inherit the Earth from our parents -

we borrow it from our children "

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