Nuclear weapons, nature and society

Dr Sue Wareham, President, Medical Association for Prevention of War (Australia),
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Nuclear weapons represent mankind's ultimate confrontation with the natural environment that sustains us. The purpose of these weapons is wholesale destruction on a massive scale, which affects most forms of life. No other single human creation has such potential for harm.

Such is the threat to life posed by nuclear weapons that the International Court of Justice, the world's highest legal authority, in its 1996 landmark ruling on the general illegality of these weapons, stated:

> *"The destructive power of nuclear weapons cannot be contained in either space or time. They have the potential to destroy all civilisation and the entire ecosystem of the planet."*

There are two overwhelming threats to life on earth as we know it. They are climate change and nuclear weapons.

The Governor of California Arnold Schwarznegger said in October 2007:

> *"The attention focused on nuclear weapons should be as prominent as that of global climate change . . . A nuclear disaster will not hit at the speed of a glacier melting. It will hit with a blast. It will not hit with the speed of the atmosphere warming but of a city burning."*

It is certainly not Schwarznegger's intention, nor mine, to divert attention from the need to avert further climate change. That must remain an urgent imperative. However we must also recognise the gravity of the threat posed by the world's 26,000 nuclear weapons, and respond with a similar sense of urgency. If we do not, these weapons will be used again, with catastrophic consequences.

Some of the human and environmental implications of the following will now be briefly addressed:

1. The raw material - uranium
2. Nuclear weapons testing
3. Nuclear weapons facilities and their environs
4. The biological effects of radiation exposure
5. The use of nuclear weapons
6. Climatic effects of nuclear weapons use
7. Nuclear waste
8. The role of human error, human malevolence and human wisdom.

1. The raw material – uranium.

Nuclear weapons require either enriched uranium or plutonium as their fuel. As plutonium is found in only minute quantities in nature, virtually all the plutonium in the world is derived from nuclear reactors, with uranium as the original reactor fuel. Therefore uranium is the starting point for all nuclear weapons.

Uranium mining and milling produces enormous volumes of tailings, or waste, which contain over 85% of the radioactivity of the original ore. (This is because they contain radioactive breakdown products of uranium that have accumulated over many thousands of years.) One of the major products is thorium-230, whose half-life (the time taken for half of a radioactive substance to decay) is 75,000 years. Theoretically, tailings dams contain this waste, but claims that they will do so for tens or hundreds of thousands of years are not credible.

A severe example of the impact of uranium mine tailings is at the Jadugoda mine in India. A study conducted in 2007 by Indian Doctors for Peace and Development found increased rates of congenital deformities, cancers and sterility in those living in the vicinity of the mine.[i]

One of the lesser-known problems of uranium mining (and in fact the whole of the nuclear industry) is its enormous water requirements[ii]. The Olympic Dam uranium and copper mine at Roxby Downs in South Australia currently uses 35 million litres of water from the Great Artesian Basin every day (for which BHP Billiton pays nothing), and an expansion is planned.

Uranium mining also requires large amounts of electricity. It was reported in March 2008 that the greatly expanded Olympic Dam mine would need nearly half of SA's current electricity supply when it reaches full production in 10 years time[iii], a staggering statistic for an industry that claims to be part of the solution to our energy crisis.

2. Nuclear weapons testing

Approximately 1,900 nuclear tests have been conducted, of which just over 500 were in the atmosphere, underwater or in space, and the remaining 1,400 were underground. Radioisotopes produced by nuclear tests, such as carbon-14, caesium-137, strontium-90 and plutonium-239 (half-lives 5,730 years, 30 years, 28 years and 24,400 years respectively), pose risks to current and future generations by ingestion, inhalation and external radiation. Test sites around the world remain contaminated, including the Maralinga site in South Australia.

In 1991, International Physicians for the Prevention of Nuclear War and the Institute for Energy and Environmental Research published "Radioactive Heaven and Earth: The health and environmental effects of nuclear weapons testing in, on and above the earth"[iv]. This study estimated that the radiation exposure from carbon-14 (integrated over infinity) would result in a total of 2.4 million human cancer deaths. The study concluded that "Many aspects of nuclear weapons testing have been characterised by a disregard, sometimes willful, of public health and environment".

In the US, in 1997, the National Cancer Institute revealed that atmospheric tests at the Nevada site resulted in significant contamination of the nation's milk supply with iodine-131, with estimates of 11,000 to 212,000 excess thyroid cancers as a result.[v]

3. Nuclear weapons facilities and their environs

Evidence has accumulated of major health, safety and environmental problems at nuclear weapons complexes around the world. This is most apparent in the two

nations that are responsible for approximately 96% of the world's nuclear weapons, the USA and Russia.

In the US, Physicians for Social Responsibility has reported on the task of dealing with the toxic and radioactive legacy of 50 years of nuclear weapons production, which "is said to be the most technologically challenging and costly public works project ever conceived". The US Department of Energy has estimated that minimal remediation of the nuclear weapons complex will cost $230 billion over 75 years. Even at this level of expenditure, many sites and buildings will remain out-of-bounds for human access for the foreseeable future.[vi]

At Hanford, the former plutonium production complex in Washington state, approximately 800 billion litres of low-level liquid radioactive waste were discharged directly into the soil over a 50-year period.[vii] Groundwater at Hanford has been contaminated with cesium-137, iodine-129, plutonium-239, heavy metals and other radioactive or toxic substances. High-level radioactive waste at Hanford is stored in 177 underground tanks, 70 of which have leaked. Hanford is possibly the most contaminated site in the US nuclear weapons complex.

In Russia, the situation is probably worse than in the US. Vast quantities of radioactive waste, including nuclear reactors, from Soviet and Russian nuclear-powered ships and submarines were dumped into the Pacific and Arctic Oceans.

The Mayak complex in the eastern Ural mountains (also called Chelyabinsk-65, or Kyshtym) is the largest of the former Soviet Union's three plutonium production centres. The Chelyabinsk-65 military complex covered as much as 2,700 square kms in the 1950s. The highly contaminated site lies on a region of interconnecting lakes, marshes and waterways at the headwaters of the Techa River.

Between 1948 and 1956 radioactive waste from the Mayak nuclear complex was poured straight into the river, the source of drinking water for many villages. Cesium, strontium and other liquid radioactive waste that had been dumped was detected in the Arctic Ocean nearly 1,000 miles away. The waste discharge point at Lake Karachay in the Ural Mountains remains so radioactive that a person standing there would receive a lethal dose of radiation in less than one hour.[viii]

In 1957 there was an explosion of high-level liquid nuclear waste at Kyshtym, contaminating 20,000 square kms. Some villagers were evacuated, but many were not.

While the USA and the former Soviet Union, due to the sheer number of nuclear weapons produced, present by far the most disturbing pictures of radioactive contamination from weapons production , the problem is not confined to those two countries. Radioactive contamination globally from nuclear weapons production will take an incalculable but heavy human and environmental toll for a very long time.

4. The biological effects of radiation exposure

Studies on both plants and animals have repeatedly shown that exposure to ionising radiation causes genetic mutations, and we know that mutations can lead to the development of cancers. Cancer rates among Hiroshima and Nagaskai survivors are significantly increased, and, over 60 years after the bombings, they have not yet reached their peak. Rates of microcephaly and intellectual disability were also increased among those who were *in utero* at the time of the bombings.

It is important however to understand the difficulties encountered in assessing the biological effects of radioactivity, especially low-level radioactivity. Attributing with certainty a specific cancer to a specific episode of radiation exposure is generally not possible, for a number of reasons:

- cancers may occur decades after the exposure;
- there is no way of distinguishing a cancer caused by radiation from any other cancer;
- cancer is a common illness, with many other possible triggers;
- radiation can spread over large distances, depending on weather patterns, and be dispersed in such a fashion that determining the dose received by specific people or animals is extraordinarily difficult.

Hard statistical evidence of genetic damage from radiation exposure being passed on to progeny in humans has long been lacking, despite overwhelming evidence of radiation-induced mutations in plant and animal experiments. Specifically, such damage in the descendants of Hiroshima and Nagasaki survivors has not been demonstrated thus far. However new evidence from New Zealand on survivors of the 1957-58 UK Operation Grapple nuclear tests in the Pacific shows three times the frequency of total chromosome changes (translocations) in the test veterans as in a control group.[ix] Statistically, this is very significant, and indicates the potential to result in intergenerational effects. More research in this area is needed.

5. The use of nuclear weapons.

Nuclear weapons are indiscriminate in every sense, and the ultimate weapon of mass destruction. Their effects cannot be contained in time or space, nor do these weapons discriminate between children and adults, humans and any other species, combatants and non-combatants or according to any other criteria.

The weapons that destroyed Hiroshima and Nagasaki were approximately 15 and 21 kilotons respectively (a kiloton being 1,000 tons of TNT equivalent). The two cities were destroyed. Nuclear weapons built since then have been up to many megatons (million tons of TNT equivalent). The largest US and Soviet nuclear tests were, respectively, a 15 megaton test (codenamed Bravo) in 1954, and a 50 megaton test in 1961.[x]

Nuclear weapons cause an initial intense (often blinding) flash of light, then an enormous fireball, which generates heat in the order of tens of millions of degrees centigrade. The fireball rises and cools, forming the characteristic mushroom cloud appearance. A powerful blast wave causes the collapse of buildings and flying debris. Firestorms, fanned by hurricane force winds, break out. In addition, there is an electromagnetic pulse that destroys electrical equipment. Initial radiation is emitted at the moment of the explosion, and causes radiation sickness.

Radioactive particles called fallout will be present immediately, but they can also travel the globe and have very delayed effects, causing increased cancer rates and genetic changes, as explained above.

6. Climatic effects of nuclear weapons use.

Recent studies have resurrected the "nuclear winter" fears of the 1980s. It is estimated that the use of just 100 Hiroshima-sized weapons in urban areas, for example a war

between India and Pakistan where each side used 50 weapons, could cause severe global climatic consequences.[xi] Fires ignited would release copious amounts of light-absorbing smoke and debris into the upper atmosphere, causing persistent surface cooling even a decade later. In such a scenario, there would be decreases in growing seasons in many of the most important grain producing parts of the world, with severe reductions in food production.

A scenario of this magnitude could lead to a total global death toll of one billion from starvation alone, major epidemics of infectious disease, and immense potential for war and civil conflict.[xii]

7. Nuclear waste

Not a single country, anywhere, has in place a satisfactory long term solution to the problem of nuclear waste. Unless a solution is developed, all future generations of humans will inherit this problem.

In the US alone, nuclear waste has accumulated at 120 sites around the country. This includes approximately 55,000 tons of high level waste from civilian reactors, and 15,000 tons from nuclear weapons production.[xiii] All of them are intended as temporary sites, but there is currently nowhere for the waste to go. The proposed Yucca Mountain site has experienced prolonged delays, and is still not approved, despite many billions of dollars of research.

Because the nuclear waste problem is not resolved, some eyes scan the globe for a place that is less densely populated, in which it could be dumped, and look to Australia as a possibility. While both the previous and current governments have ruled out Australia accepting high-level waste from other countries, it is likely that pressure for such a facility will surface from time to time. Australia already has an unresolved problem of what to do with our low and medium level nuclear waste, including reprocessed waste that will return here from France and Scotland (Dounreay) from about 2011.

8. The role of human error, human malevolence and human wisdom

Nuclear weapons have not been used (except as a political tool) since 1945. Some commentators attribute this to the role of "deterrence", the notion that nuclear devastation is so unthinkable, and the threat of nuclear retaliation so unacceptable, that the weapons will remain forever unused. These assumptions are flawed.

They assume that leaders will always, without exception, care what happens to their own country and all its people. We can think of instances where this is not the case. And they assume that no major errors of judgement will be made, nor accidents in the monitoring and oversight of nuclear weapons will occur. This is contrary to what we know of human nature, which is that people make errors, especially when working under intense pressure. There are well-documented instances where the world has come frighteningly close to nuclear conflict.

During the 1962 Cuban Missile Crisis, there were huge miscalculations on both sides. Former US Defense Secretary Robert McNamara says of those 13 days, "We were a hair's breadth from absolute disaster."

The 1996 report of the Canberra Commission on the Elimination of Nuclear Weapons stated, "The proposition that nuclear weapons can be retained in perpetuity and never used – accidentally or by decision – defies credibility."

We also know however that humans have profound capacity for wisdom and discernment. Jonathan Schell reminds us that our past need not determine our future :

> *"Whether [nuclear weapons] are merely a monstrous leftover from a frightful era that has ended, and will soon follow it into history, or whether, on the contrary, they are seeds of a new, more virulent era, in which nuclear weapons are held more widely and rooted more deeply, is not a matter of prediction; it is a matter of choice."*

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[i] http://www.nuwinfo.se/black-magic-at-jadugoda2007idpd.html
[ii] www.foe.org.au/campaigns/anti-nuclear/issues
[iii] BHP to use half of state's electricity. *The Australian*, March 27, 2008.
[iv] Apex Press, New York, and Zed Books, London.
[v] Steven L Simon, Andre Bouville, Charles E Land. Fallout from nuclear weapons tests and cancer risks. *American Scientists online*, Vol 94, No 1, p 48
[vi] http:www.psr.org/site/PageServer?pagename=security_legacy_military_weaponscomplex
[vii] MGS, March 1995, page 28
[viii] Nuclear Wastelands: A Global Guide to Nuclear Weapons Production and its Health and Environmental Effects. MIT Press 1995. p 2.
[ix] R E Rowland et al. Elevated chromosome translocation frequencies in New Zealand nuclear test veterans. *Cytogenetics and Genome Research* 121:79-87 (2008)
[x] Nuclear pursuits. *Bull At Scientists*. Sept/Oct 2003, p72
[xi] Robock A et al. Climatic consequences of regional nuclear conflicts. Atmospheric Chemistry and Physics Discussion 2006; 6 :11817 - 11843
[xii] I Helfand. An Assessment of the Extent of Projected Global Famine Resulting from Limited, Regional Nuclear War. Presented at "Nuclear Weapons: The Final Pandemic" conference. October 3-4, 2007, London.
[xiii] A Macfarlane. Stuck on a solution. *Bull At Scientists*. May/June 2006.