BIOLOGICAL WEAPONS AND GENETIC TECHNOLOGIES

Briefing 1 - September 2000

Biological Weapons and the New Genetics

Over the centuries, humans have used new developments in science and technology to enhance their weapons capabilities. Whilst breakthroughs in genetics and the sequencing of the human genome could help to combat previously untreatable diseases, the outcomes could be horrendous if this knowledge is used in biological weapons development. How real is the threat of a new and even more horrific phase of biological weapons development? What is the potential for abuse? This briefing considers what is possible, why the dangers are more than simply theoretical, and the special role scientists can play in preventing the development of a new generation of biological weapons.

Harnessing new science

History shows that, as new knowledge has emerged, it has been used in developing and refining biological weapons. Organised military interest in biological weapons began in the early part of the 20th Century alongside increasing understanding of the role played by bacteria in producing disease. During the First World War, both sides used bacteria, particularly against animals.

Although the first use of biological weapons was banned by the 1925 Geneva Protocol, the development of offensive weapons for counterattack was still allowed. Military interest continued and, during the Second World War, Britain developed cattle cake infected with anthrax spores (although this was never used) and Japan conducted terrible large-scale human experiments with biological agents and used them against the Chinese. By 1944, the USA had 3,500 people employed in biological weapons research and later developed a range of readily deployable biological weapons. The spectrum of organisms considered as potential biological agents expanded with increased knowledge about the role of viruses in disease.

The easiest way of spreading biological weapons is via air, but their effectiveness will depend on how long an organism can survive, the wind, and other atmospheric factors. A lack of understanding of how bacteria and viruses behave in air had hampered the development of biological weapons, but after the Second World War, increasing knowledge about this subject (aerobiology) was rapidly applied to biological weapons by the military. Large-scale production and weaponisation of many organisms such as those causing brucellosis, tularaemia and anthrax subsequently took place in many countries including the USSR, the USA and the UK during the 1950s and 1960s.

In a unilateral declaration in 1969, the USA renounced the production of biological weapons. Although at the time the USA said this was because biological weapons were thought unreliable in a military context, it is now known that it was afraid that biological weapons could act as an ‘equaliser’ and erode its conventional and nuclear supremacy. By putting biological weapons ‘off limits’, they believed that the likelihood of their use would be reduced and established an important principle in their control.

A Protocol agreed by the 1972 Biological and Toxin Weapons Convention (BTWC) outlawed the

development, possession and production of biological weapons and has, so far, been successful in preventing the use of biological weapons. However, its lack of any provisions for verifying compliance (the subject of the next briefing in this series) means it may be unable to deal with the challenges of the new genetic technologies. The discovery of clandestine biological weapons programmes in the Soviet Union and Iraq at the beginning of the 1990s increased the urgency to strengthen the BTWC Protocol by incorporating verification provisions.

Genetic engineering and biological weapons

The striking potential of genetic technologies to 'enhance' biological weapons could prove especially 'attractive'

All other advances in scientific knowledge about infectious diseases have been harnessed to the biological weapons cause and the striking potential of genetic technologies to 'enhance' biological weapons could prove especially 'attractive'. Genetic engineering involves transferring genetic material between species and allows for dramatic changes to be made to the characteristics of an organism. The power of genetic engineering could be applied in biological weapons in many ways including:

- Facilitating the production of toxins on a large scale. It is now possible to genetically engineer micro-organisms to produce drugs in large quantities – insulin, growth hormone and other medicines are now made using such a process. Genetic engineering and the ability to use large-scale fermenters to grow organisms and isolate their products could enable the production of lethal toxins found in snakes, spiders or plants on a huge scale.
- Making previously harmless organisms able to cause disease by introducing genes which enable them to infect a wider range of species, infect cells, or produce a toxin.
- Making a disease organism resistant to the immune system or to treatment with antibiotics so defensive measures become ineffective. The Russians are believed to have used genetic engineering to make anthrax resistant to antibiotics during their secret (and illegal) development of biological weapons in the 1980s.
- Producing more virulent crop or animal disease organisms that are resistant to current methods of control.

The Human Genome Project and biological weapons

Genetic differences could be used to target weapons at ethnic groups

The genome of an organism is all the genetic (hereditary) information it contains. The Human Genome Project aims to map the order of the chemical letters making up the genome (a process known as sequencing) and then identify its constituent genes. This work has been further extended by the Human Genome Diversity Project to discover what each gene actually *does* since it is only by understanding the function of a particular gene that it can then be exploited in, for example, the development of medicines. This research inevitably involves comparing the genetic makeup of different groups of people – those who are and are not susceptible to a certain disease for example – in order to identify the genes responsible for the differences.

However, knowledge about such genetic differences between groups of people could be used to target weapons at ethnic groups. Whilst the Royal Society recently stated that: "*…these developments are some years away and*

in some cases are likely to be more fictional than real " it is clear that there must be genetic differences between those with, say, blacker or whiter skin in the control of pigment production and distribution. As our society becomes more and more interested in the genetic basis of ethnic, social and health differences, it seems increasingly likely that the Human Genome Project will look for – and find - such differences. Although genetic differences will not be absolute because there are no clear dividing lines between groups of people, it is unlikely that those developing such weapons would be concerned about so-called 'collateral damage' outside the intended targets.

Plants and animals

Humans are not the only potential target for future biological weapons since the new genetic technologies are also being applied to crops and animals, both of which have been subjects of biological weapons research in the past. For example, inspectors in Iraq after the Gulf War found evidence of work with wheat smut, a fungal disease of wheat. This was probably intended for use in Iran where wheat is an important crop. In the USA, delivery systems for anti-crop agents were developed in the 1950s.

Causing famines or destabilising economies by using bio-weapons against crops and animals could prove a very effective way of waging war

In keeping with the changing nature of warfare since the end of the Cold War, where conflicts are often smaller scale, covert and played out in third

Bio-weapon development under the shield of the 'drugs war'?

As part of their 'war against drugs', the USA and UK are involved in developing the use of disease organisms to kill coca and opium plants. The USA is assessing the effectiveness of the *Fusarium* fungus - including a genetically engineered version - against the coca plant, from which cocaine is derived, and has persuaded the United Nations Drug Control Program to carry out field trials of the non-GM version of the fungus. The UK, meanwhile, is co-funding a UN project in Uzbekistan to develop another fungus (*Pleospora papveracae)* to attack opium poppies.

Are these biological weapons? Under the Biological and Toxin Weapons Convention, biological agents cannot be produced "*for hostile purposes or in armed conflict"* and agents are not allowed *"that have no justification for prophylactic, protective or other peaceful purposes"*. If the fungi were used to destroy plants without a country's consent, the Convention would clearly be breached.

However, these agents are likely to be used in areas where no effective government control exists. In Columbia, for example, the war against drugs is intertwined with a political struggle of the central government against rebel forces. Even if the government agrees to the use of the fungus, if seen in this context, the situation is reminiscent of Saddam Hussein's use of chemical weapons against the Kurds, something which would not be considered a 'legitimate' government action.

These projects are gravely worrying. Both raise environmental concerns about the long-term persistence of the fungi in the soil which could cause disease in other plants and the knowledge and experience gathered will be invaluable to those wishing to develop anti-crop biological weapons.

countries, causing famines or destabilising economies by using bio-weapons against crops and animals could prove a very effective way of waging war and may be easier to disguise as a 'natural' event. The application of sophisticated genetic knowledge of different crop species and varieties could greatly increase the dangers.

Conclusions

Whilst genetic technologies may revolutionise the treatment of disease, they also have the potential for creating new weapons of mass destruction. Scientists involved in genetic technologies today cannot abrogate responsibility should such weapons be developed in the future. It is the scientific community which has privileged access to information and understanding of the implications of the technology and scientists, whether in the private or public sector, must therefore position themselves as society's watchdogs. This means that scientists must be made aware of the potential for abuse of the technology; that openness must be encouraged to dispel fear and build confidence abroad in the peaceful intentions of work undertaken here; and 'whistle-blowers' must be protected if they are to continue to play a vital role in alerting society to potential abuses. Civil society must demand accountability of its scientists so that they are made to justify their work and think through its implications. It is only through vigilance and maintaining an atmosphere where biological weapons are universally rejected that security can be achieved.

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