

objections, one industry representative has said: "Legal use of [biotechnology] equipment should not be put on the line... We don't want [parties] using us as political pawns..."¹⁸. However, trial visits in the UK and elsewhere have shown that commercial confidentiality is not threatened¹⁹. The number of sites involved will be small and in an industry which is already regulated in terms of worker and product safety, any extra burden will be minimal²⁰. Working via trade organisations and personal contact, the UK biotechnology and pharmaceutical industry should take a lead in promoting openness.

Individual scientists must also be held accountable for their actions and knowledge gained from research such as the Human Genome and Human Diversity Projects should not be used for furthering biological weapons research. In a recent survey, none of eight UK biological science societies had considered how their research might impact on biological weapons³. Such a situation is unlikely to prevail if it becomes a criminal offence to assist in the development of biological weapons.

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GENETIC ENGINEERING AND BIOLOGICAL WEAPONS

GeneWatch
UK

Briefing Number 6
June 1999

Whilst there is controversy about the relative risks and benefits of genetic engineering in the production of food, its use in biological weapons would probably bring unanimous condemnation in the UK. However, there is little awareness of the serious threat that genetic engineering is posing to the control of biological weapons proliferation.

A biological weapon is made from bacteria, viruses, other infectious agents or a toxin produced by an organism which can cause disease in humans, animals or plants. Biological weapons may be used to cause human illness, death or temporary disability or to disrupt food supplies and/or economies.

Examples of possible biological weapons agents¹:

Humans: *Yersinia pestis* (bubonic plague); *Vibrio cholera* (cholera); *Bacillus anthracis* (anthrax); smallpox virus; ebola virus; hanta virus; botulism; ricin (from the castor oil plant).

Animals: African swine fever (pigs); rinderpest virus (cattle); camel pox virus (camels); foot and mouth disease virus (cattle); Newcastle disease virus (chickens).

Plants: Citrus greening disease bacteria; sugar cane Fiji disease virus; sugar cane rust; tobacco mould.

The History of Biological Weapons

The use of biological weapons dates back to Roman times, when animal corpses were used to pollute the water supplies of their enemies. In 1763, the British gave smallpox infected blankets to North American Indians - an early example of attempted ethnic cleansing. Germany used anthrax and glanders (a disease of horses) during the First World War and many countries including France, the USA, Britain and Japan had offensive biological weapons research programmes between the wars².

Although the Biological and Toxin Weapons Convention (BTWC) outlawed offensive biological weapons research in 1972, several countries are thought to have conducted such research in recent times. These include Iran, Iraq, Israel, Libya, Syria, China, North Korea and Taiwan³. A Russian defector recently claimed that China had a biological weapons programme at least until the early 1990s⁴.

The extent of the biological weapons programme in Iraq surprised and shocked UN inspectors following the Gulf War. They discovered that Iraq was investigating the use of the gas gangrene organism (*Clostridium perfringens*), the toxin ricin, botulism, aflatoxin and anthrax against humans; haemorrhagic conjunctivitis virus, rotavirus and camel pox virus against animals; and wheat cover smut against plants⁵.

Israel, who have not signed the BTWC, have what is believed to be a biological/chemical warfare institute just twenty miles from Tel Aviv⁶. There is also suspicion that during the apartheid era, South Africa experimented with biological weapons targeted against the black population⁷.

Genetic Engineering and 'Designer' Weapons – the New Threat

For a biological weapon to be effective, it must possess the following characteristics:

- high infectivity;
- rapid action;
- able to survive transport and persist in the environment;
- easily produced in large quantities;
- allow the aggressor to be protected from its

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effects – e.g. by vaccination or lack of susceptibility.

Because these characteristics have not been attainable in natural organisms or toxins, biological weapons were considered too slow and unpredictable for effective battlefield use. However, genetic engineering, increasing understanding of the human genome and how organisms cause disease provide the potential to transform a biological weapon from one which is short-lived and uncontrollable to one which is targeted, reliable and even more deadly. A particularly disturbing possibility is that knowledge from the Human Genome and Human Diversity Projects could be used to identify genetic differences between ethnic groups - although this in itself is questionable - and:

“...recognise DNA from different people and attach different things that will kill only that group of people.... You will be able to determine the difference between blacks and whites and Orientals and Jews and Swedes and Finns and develop an agent that will kill only [a particular] group”⁸.

Understanding what makes an organism cause a disease could also be used to ‘improve’ the rate at which a particular organism can kill. By identifying genes which code for the production of a toxin, the toxin could be made in larger quantities through genetic engineering techniques or it could be used to make an organism even more harmful. These are not fanciful suggestions. US Defense Advanced Research Projects Agency officials are reported to have said: “...the Japanese Aum Shinrikyo cult successfully reengineered an *e-coli* agent to ‘place’ botulinum toxin ‘inside’ the original agent”².

The increasing use of genetic engineering and other molecular biological techniques in the civilian domain means that the skills required to develop such weapons are becoming more widespread. Larry Harris, an American Neo-Nazi, ordered three vials of bubonic plague bacteria from the American Type Culture Collection (ATCC) which were delivered by Federal Express³! He also authored a manual ‘Bacteriological Warfare: A major threat to North America’ which is said to be available on the Internet for \$28.50 and describes not only protection from biological weapons but also likely candidate organisms and how organisms can be grown⁵. The ATCC also supplied 17 shipments of organisms to Iraq between 1986 and 1991, one of which was tularaemia³.

The USA is particularly concerned over the increasing availability and effectiveness of biological weapons since, as the US Secretary of State William Cohen warned in 1997, countries may feel that using such weapons is the only way to overcome US military supremacy⁵. As a result, in a desperate attempt to develop an effective biological weapons detection system, the US Department of Defense is funding research under its ‘DARPAesque’ project which would normally be thought too ‘audacious’ or belonging to the ‘lunatic fringe’⁹.

The Biological and Toxin Weapons Convention

The 1972 Biological and Toxin Weapons Convention (BTWC) is widely agreed to have been unable to control biological weapons proliferation and reviews of the Convention have recognised the need for a strengthened Protocol. Defensive research is allowed under the BTWC and proposals under discussion include non-accusatory random and invited visits to declared installations and for

challenge inspections where there is suspicion that undeclared biological weapons research is taking place. Declared installations include high level containment facilities (where dangerous organisms are used) and sites which conduct work with micro-organisms in air, where genetic engineering is used, or where there is the potential to produce organisms in large quantities. However, only the *most relevant* sites have to be declared - not *all* possible sites.

Because biotechnology may be used for peaceful or warfare purposes, industrial civilian facilities could be misused. The so-called ‘dual use’ problem has led to commercial resistance to inspections as the industry fears that commercial confidentiality may be breached. The proposals also make many exclusions for medical research and the numbers of declared sites are only likely to number between 20-40 in European countries¹⁰.

There are also calls for a treaty to make it an international crime for any individual to help a state to develop biological weapons¹¹. Under the BTWC, it is up to individual countries to act and they are reluctant to do so.

Conclusions

Reluctance to curtail the proliferation of biological weapons is fuelled by suspicion about other countries’ intentions, and tightening controls is proving difficult as some nations perceive double standards on the part of well armed countries. The only logical solution is to ban *all* research into biological weapons since there can be little justification even for research which is allegedly defensive. A programme for defensive research will be very similar to that of an offensive programme and even if research can be shown to be defensive, it is questionable whether such work is valid since it is almost impossible to mount an effective defence against a biological weapons attack¹². The exact nature of the weapons cannot be known in advance and although troops in the Gulf War were vaccinated against anthrax and plague¹³, Iraq was equipped with aerial bombs filled with botulinum and aflatoxin as well as anthrax⁵.

The UK should set an example by suspending its own research into biological weapons. Current UK defensive research is extensive and is co-ordinated by the Defence Evaluation and Research Agency (DERA) at Porton Down. Each year between 1987 and 1997, 8 to 20 projects involved the genetic manipulation of micro-organisms and, according to public records, Porton Down is genetically modifying *E.coli*, *Salmonella typhimurium* (salmonellosis), *Bacillus subtilis*, *Bacillus brevis*, *Clostridium perfringens* (gas gangrene), *Francisella tularensis* (tularaemia), *Yersinia pestis* (bubonic plague) and vaccinia virus¹⁴. No details are available about this work but the stated aim is to ‘provide safe and effective protection for the UK armed forces in the event of a chemical or biological attack’¹⁵. DERA also contracts with extramural institutions such as universities, research institutes and industry. There were 60 such contracts for chemical and biological weapons research worth £5.9 million in 1998¹⁶, an increase of about £0.5million since 1996¹⁷. Details of these are also not disclosed without prior approval of the researchers and this is rarely granted¹⁷.

The biotechnology industry also has a crucial role to play by not opposing inspections on the grounds of commercial confidentiality. Justifying their

Genetic engineering provides the potential to create biological weapons which are targeted, reliable and even more deadly

The US budget for biological weapons research increased from \$36.7 million in 1998 to \$42.1 million in 1999

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