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TOWARDS A LIFE SCIENCES CODE:
COUNTERING THE THREATS FROM BIOLOGICAL WEAPONS

By Brian Rappert*

Introduction

1. In the last few years, much interest has been expressed in establishing an international code of conduct for those engaged in the life sciences as part of efforts to minimize present and future threats from biological weapons and bioterrorism. While not a new idea, today there is a greater amount of attention being given to considering what form such a code might take and to drawing a code or codes up. Yet despite the apparent wide ranging enthusiasm, so far the functions of such a code have been ill defined and little detailed elaboration has been offered in terms of its content or how such a code might be promulgated and implemented.

2. Particular attention is being focused on such a code at present because the States Parties to the Biological and Toxin Weapons Convention agreed[1] at the resumed Fifth Review Conference in November 2002 that the topic to be considered in the new process at which the States Parties would **'***discuss, and promote common understanding and effective action'* would in 2005 be:

- *The content, promulgation, and adoption of codes of conduct for scientists*.

3. This Briefing Paper examines the potential contribution of professional codes such as codes of ethics, codes of conduct and codes of practice. The purpose of this Briefing Paper is four-fold: **first**, it traces the origins of codes in general before addressing alternative concepts of biological weapon-related codes being considered in contemporary policy discussions. **Second**, varied issues are identified for consideration by drawing on lessons from previous attempts to establish professional codes in the sciences and elsewhere. **Third**, a widely applicable 'matrix of codes' comprising aspirational, educational and enforceable codes that might be adopted is outlined. As part of this, a detailed proposal is provided for a possible educational 'code of conduct' to minimize present and future threats from the misuse of the life sciences in regard to biological weapons. **Fourth**, overall this Briefing Paper sharpens critical attention to the place and purpose of codes in responding to security threats.

4. Although the adoption of codes has a certain common sense appeal, ensuring that a code makes a significant and effective contribution in combating security threats requires careful deliberation and concerted action. The utility of codes should not be presumed. With each stage in the formulation and implementation of codes, key issues need to be addressed about their aims and audience. These are issues which require consideration of the interactions between arms control, science, ethics, and politics.

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[1]United Nations, Fifth Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, Geneva, 19 November - 7 December 2001 and 11 - 22 November 2002, *Final Document,* BWC/CONF.V/17, 2002. Available at http://www.opbw.org

5. It needs to be recognized from the outset that as biological weapons are totally prohibited by the Biological and Toxin Weapons Convention, there is no sense in considering codes for biological weapons. The consideration has to be focused on codes for those engaged in work in the life sciences which might be misused for biological weapons.

The Origins of Codes

6. Codes of conduct have long figured as part of the activities of professional organizations; indeed in the 19th century the establishment of codes was central to the establishment of medicine, law, and engineering as professions that could be entrusted to largely manage their own affairs.[2] [3] Formal codes specifying standards of acceptable behavior for professionals to their clients, employers and the public were predated by earlier examples such as the Hippocratic Oath. In the 20th century, professional codes were further adopted and elaborated, often in response to high profile controversies.[4] In medicine, for instance, the human experimentation atrocities committed in World War II led to the agreement of the ten ethical principles of the Nuremberg Code.[5] This was later complemented by initiatives such as those of the World Medical Association's 1948 Declaration of Geneva Physician's Oath[6] and 1964 Helsinki Declaration[7] and the establishment of institutional review boards for biomedical research in many countries.

7. In the physical and biological sciences, the emphasis placed historically on adopting codes of conduct has been much less acute than in engineering or medicine, not least because the conflicts of interest that motivated many professional codes for the latter areas were less evident and also as some sought to characterize science as a value neutral activity. The lack of a formal code for scientists as a group and the level of awareness of ethical considerations has been a recurring topic of discussion since World War II[8] [9] [10] and continues to this day.[11] [12]

8. The appropriateness of the involvement of scientists in military R&D has been a topic generating significant attention in Western scientific circles, which has led to some calls for explicit guidelines. Concerns about biological weapons have played a significant part in science-military-society discussions. Amid the disarmament movement and the Vietnam War in the 1960s and early 1970s, biological weapons were the subject of resolutions and debates in professional organizations such as the American Society for Microbiology (ASM)[13] and the American Academy of Arts and Sciences.[14] With the signing of the

[2] Macdonald S. *The Sociology of the Professions* London: Sage; 1995.
[3] Fishbein M. *A History of the American Medical Association 1847 to 1947* Philadelphia, Pa: WB Saunders; 1947.
[4] Leake D. ed. *Percival's Medical Ethics* Baltimore: William and Wilkins; 1927.
[5] See, for example, http://ohsr.od.nih.gov/guidelines/nuremberg.html
[6] World Medical Association. *Declaration of Geneva* September 1948. Available at http://www.wma.net/e/policy/c8.htm
[7] World Medical Association. *Declaration of Helsinki* First adopted June 1964. Available at http://www.wma.net/e/policy/b3.htm
[8] Pigman W Carmichael E. An ethical code for scientists. *Science* 1950 111: 643-647
[9] Hedén C. Perspective on an identity card or certificate for scientists. *Scientific World* 1968 12: 24-28.
[10] Cournand The code of the scientists. *Science* 1977 198: 699-705.
[11] Simon J and Hersh M. 2002. An educational imperative. *Minerva* 40 2002: 37-55.
[12] Ten Have, H. Biology and codes of conduct. *Proceeding of UNESCO COMEST Third Session* Rio de Janeiro 1-4 December 2003: 95-105. Available at http://unesdoc.unesco.org/images/ 0013/001343/134391e.pdf

[13] Cassell G, Miller L, Rest R. *Biological warfare: role of scientific societies.* In: Zilinskas R. ed. *The Microbiologist and Biological Defense Research* New York: New York Academy of Science; 1994.

Biological and Toxin Weapons Convention (BTWC) in 1972 and its entry into force in 1975, debate shifted from the rights and wrongs of biological warfare overall which was totally prohibited by the BTWC to the appropriateness of activities undertaken as part of 'biodefence' programmes.

9. Subsequently various attempts have been made to address these expressed concerns by means of formalized codes. For instance, at least partially with an eye to biological weapons, in 1985 the ASM published[15] its 'Code of Ethics' which obliged microbiologists to *'discourage any use of microbiology contrary to the welfare of humankind'* although the meaning of this phrase was left open for interpretation. In 1989 the US Council for Responsible Genetics (CRG) launched a pledge for scientists not to participate knowingly '*in research and teaching that will further the development of chemical and biological agents*'.[16] In the 1990s Student Pugwash developed a pledge for young scientists analogous to the Hippocratic Oath to promote ethical reflection which included the promise that individuals *'will consider the ethical implications'* of their work.[17] [18] Combining various oaths, codes, and declarations the International Network of Engineers and Scientists for Global Responsibility launched an appeal[19] to engineers and scientists which included the commitment that '*I pledge not to take part in the development and production of weapons of mass destruction and of weapons that are banned by international conventions.'* and also that '*Since the results of science ultimately belong to humankind, I will conscientiously consider my participation in secret research projects that serve military or economic interests. I will not participate in secret research projects if I conclude that society will be injured thereby. Should I decide to participate in any secret research, I will continuously reflect upon its implications for society and the environment*.' In 1999, the British Medical Association recommended[20] that *'Professional scientists and physicians have an ethical responsibility to reinforce the central norm that biological and genetic weapons are unacceptable. This should be explicitly stated in codes of professional conduct in order to safeguard the public interest in matters of health and safety'*. In a similar fashion, during the 1990s individuals such as Matthew Meselson made repeated calls for the adoption of codes of conduct.[21, 22]

10. The attention given to codes increased in 2001 after the failure to reach agreement on a legally binding instrument to strengthen the effectiveness and improve the implementation of the BTWC as well as following 9-11 and the US anthrax attacks. These two sets of events have resulted in various initiatives to establish codes of conduct for those engaged in the life sciences. At the government level attention to codes was given by the US and the UK as well as by the United Nations.

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[14] Geissler E Haynes R. *Prevention of a Biological and Toxin Arms Race and the Responsibility of Scientists* Berlin: Akademie-Verlag; 1991.
[15] Cited in Cassell G, Miller L, Rest R. Biological Warfare: Role of Scientific Societies In *The Microbiologist and Biological Defense Research* Zilinskas, R (ed) New York: New York Academy of Science; 1994.
[16] Wright S. ed. *Preventing a Biological Arms Race* Cambridge, MA: MIT Press; 1990: 412.
[17] Student Pugwash USA, SPUSA Pledge, n.d. Available at http://www.spusa.org/pledge/
[18] Rotblat J. *Science and Humanity in the Twenty-First Century* www.nobel.se/medicine/articles/rotblat/
[19] International Network of Engineers and Scientists for Global Responsibility, *INES Appeal to Engineers and Scientists,* 16 July 1995. Available at http://www.inesglobal.org/ines3.htm
[20] British Medical Association *Biotechnology, Weapons and Humanity* London: Harwood Academic Publishers; 1999: 101.
[21] Meselson M. The problem of biological weapons. Presented at AAAS Annual Meeting 17-22 February 2000 Washington, DC.
[22] Meselson M. Averting the Hostile Exploitation of Biology, *CBW Conventions Bulletin*, 48, 16-19, 2000.

11. In November 2001, following the US rejection of the legally binding instrument to strengthen the BTWC, President Bush made a number of proposals[23] emphasizing primarily national rather than international measures to strengthen the BTWC, including that State Parties consider how to *'Devise a solid framework for bioscientists in the form of a code of ethical conduct that would have universal recognition.'* In April 2002, the UK Foreign Office issued[24] a Green Paper about the BTWC which included among possible measures to strengthen the BTWC a call for a code in suggesting that it:

> *would be developed by academic and professional bodies to lay out standards internationally for work relevant to the prohibition of the Convention. Such codes could include, inter alia, a statement that scientists will use their knowledge and skill for the advancement of human, animal, and plant welfare and will not conduct activities directed towards the use of micro-organisms or toxins or other biological agents for hostile purpose or in armed conflict.*

Such a code or codes could help to realize the commitment long made by the BTWC States Parties at the Review Conferences such as that made in the Final Declaration[25] of the Fourth Review Conference that:

> *3. The Conference notes the importance of…Inclusion in textbooks and in medical, scientific and military education programmes of information dealing with the prohibitions and provisions contained in the Biological and Toxin Weapons Convention and the Geneva Protocol of 1925.*

Consequently, information about the prohibitions of the BTWC should be included in textbooks and in educational programmes.

12. In September 2002, the report[26] of the UN Policy Working Group on the United Nations and Terrorism included the recommendation that:

> *Recommendation 21*
>
> *Relevant United Nations offices should be tasked with producing proposals to reinforce ethical norms, and the creation of codes of conduct for scientists, through international and national scientific societies and institutions that teach sciences or engineering skills related to weapons technologies should be encouraged. Such codes of conduct would aim to prevent the involvement of defence scientists or technical experts in terrorist activities and restrict public access to knowledge and expertise on the development, production, stockpiling and use of weapons of mass destruction or related technologies.*

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[23] Bush G. *President's Statement on Biological Weapons* 1 November 2001, see http://www.whitehouse.gov/news/releases/2001/11/20011101.html

[24] Foreign and Commonwealth Office, *Strengthening the Biological and Toxin Weapons Convention: Countering the Threat from Biological Weapons,* London, April 2002. Available at http://www.fco.gov.uk/Files/kfile/btwc290402,0.pdf

[25] United Nations, Fourth Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, *Final Declaration,* Geneva, 1996. Available at http://www.opbw.org.

[26] United Nations. *Annex Report of the Policy Working Group on the United Nations and Terrorism* A/57/273-S/2002/875, 6 August 2002.Available at http://www.un.dk/doc/A.57.0273_S.2002.875.pdf

This recommendation was subsequently endorsed by the UN General Assembly and the Security Council and transmitted to the Organizations and Specialized Agencies in the United Nations System.

13. Another United Nations body, UNESCO, had at its General Conference in October-November 1997 approved the creation of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST)[27]. The establishment of this body reflected the increasing importance of ethical reflection in the light of the cultural and social effects of the rapid development of scientific knowledge and technology. As a unique forum of reflection, the task of COMEST is to formulate on a scientific basis ethical principles that can shed light on the various choices and impacts occasioned by new discoveries, and the values at stake. It seeks to motivate scientists by adding an ethical dimension to their intellectual freedom. The first meeting of COMEST was in Oslo, Norway on 28 – 30 April 1999, the second in Berlin, Germany on 17 – 19 December 2001 and the third in Rio de Janeiro, Brazil on 1 – 4 December 2003. At the first COMEST meeting in a round table on the protection of the rights and freedoms of scientists, Sir Michael Atiyah mentioned[28] the importance of whistleblowers *'in the context of biology and weapon production'* noting that *'although several international agreements had been drawn up with the object of preventing, limiting or banning the production of biological weapons, such weapons were unfortunately easy to hide. … Scientists must therefore have the right to denounce practises by their colleagues without having to fear reprisals.'*

14. At the third COMEST meeting[29] in December 2003, a session was held on a code of conduct for scientists. In this, Mr Henk ten Have, Executive Secretary of COMEST, made a presentation entitled *Towards a universal ethical oath for scientists.* In this he outlined the history of recent moves towards ethical principles for scientists which included the UNESCO/ICSU (International Council for Science) which met in Budapest in 1999 and produced the '*Science Agenda – A Framework for Action.'*[30] This included the following:

> *The ethics and responsibility of science should be an integral part of the education and training of all scientists. It is important to instill in students a positive attitude towards reflection, alertness and awareness of ethical dilemmas they may encounter in their professional life. Young scientists should be appropriately encouraged to respect and adhere to the basic ethical principles and responsibilities of science. UNESCO's World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), in cooperation with ICSU's Standing Committee on Responsibility and Ethics of Sciences (SCRES) have a special responsibility to follow up on this issue.*

This paragraph was fully endorsed by the 30th General Council of UNESCO in 1999 which also decided that *'promoting debate, research on ethical issues related to the practice of science and to the application of science and technology … will be pursued in close*

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[27] United Nations Educational, Scientific and Cultural Organization, *What is the COMEST?* Available at http://portal.unesco.org/shs/en/ev.php_URL_ID=1856&URL_DO=DO_TOPIC&URL_SECTION=201.html

[28] Sir Michael Atiyah, Round Table on the Protection of the Rights and Freedoms of Scientists, Proceedings, First Session, World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), 17-19 December 2001, p.87. Available at http://portal.unesco.org/shs/en/ev.php-URL_ID=2010&URL_DO=DO_TOPIC&URL_SECTION=201.html

[29] World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), *Third session of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST),* Rio de Janeiro, Brazil, 1-4 December 2003, Proceedings, pp.95-105. Available at: http://unesdoc.unesco.org/images/0013/001343/134391e.pdf

[30] World Conference on Science, *Science Agenda – Framework for Action,* Budapest, Hungary, 26 June – 1 July 1999. Available at: http://www.unesco.org/science/wcs/eng/framework.htm

cooperation with UNESCO's World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), in cooperation with ICSU's Standing Committee on Responsibility and Ethics of Sciences (SCRES). The ethics and responsibility of science will become an integral part of science education and the training of scientists promoted by UNESCO.'

15. Henk ten Have went on to note that in September 2002, the UN Policy Working Group on the United Nations and Terrorism had made Recommendation 21 relating to codes of conduct. Following the endorsement by the General Assembly and the Security Council, this and other recommendations were sent to all Organizations and Specialized Agencies of the United Nations System. At the invitation of the Director General of UNESCO, a UN Inter-Agency Meeting was held at UNESCO Headquarters in Paris on 26 February 2003 specifically to discuss Recommendations 10 and 21 of the report. One of the outcomes of this UN Inter-Agency Meeting was a general recommendation towards *'encouraging ethical codes of conduct for scientists and engineers'* and *'promoting ethics of science education and awareness.'* The ethical task given by the World Conference on Science to COMEST and ICSU was recalled and reinforced. One of the final recommendations of the UN Inter-Agency Meeting was '*that "existing relevant bodies such as COMEST could play a decisive role in fostering a continued dialogue on education and ethics of science", also recommending the "specific involvement of the COMEST together with ICSU" in the field of the "responsibility of scientists"'* The presentation made at COMEST proposes that COMEST should seize the task received from the United Nations and the World Conference on Science so that work on this subject might be given at the next UNESCO General Conference in 2005 a mandate from the UNESCO Member States to prepare a declaration, including an oath or pledge, in this area by 2007. The next step would be to highlight this in the report to be submitted to the UNESCO Executive Board at its next session in April 2004. The Executive Board meeting met from 14 to 28 April 2004 and decided[31] in 169EX/SR.8 that it:

> *Welcomes UNESCO's new orientation with regard to the ethics of science and technology*
>
> *Further requests the Director General to prepare a study, in cooperation with the International Council for Science, on the advisability of elaborating an international declaration on science ethics to serve as a basis for an ethical code of conduct for scientists;*

16. At the same COMEST meeting in Rio de Janeiro in 2003, there was a presentation[32] entitled *Biology and codes of conduct* by Roque Monteleone-Neto of Brazil in which recent international developments relating to the regime for the prohibition of biological weapons were outlined. The paper examines how a code of conduct might be effective in regard to potentially dangerous research in biology and outlines some of the issues that need to be taken into account.

17. In addition to the government and UN interest in codes described above, in December 2001 and in 2002 several major scientific and medical organizations lent support to the

[31] United Nations Educational, Scientific and Cultural Organization, Executive Board, *Decisions adopted by the Executive Board at its 169th Session,* Paris, 14 – 28 April 2004, 169/EX Decisions, Paris, 25 May 2004. Available at: http://unesdoc.unesco.org/images/0013/001346/134685e.pdf

[32] World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), *Third session of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST),* Rio de Janeiro, Brazil, 1-4 December 2003, Proceedings, pp.109-113. Available at: http://unesdoc.unesco.org/images/0013/001343/134391e.pdf

suggestion that codes might have some policy utility. The ASM reaffirmed that bioterrorism and '*the use of microbes as biological weapons*' violated its Code of Ethics.[33] Pax Christi called[34] for pharmaceutical, chemical, biotechnological and other industries which have biotechnological installations to adopt an internal code of conduct to prevent abuse of their installations for biological weapons purposes. At its annual General Assembly, the World Medical Association adopted the Washington Declaration on Biological Weapons calling for *'all who participate in biomedical research to consider the implications and possible applications of their work and to weigh carefully in the balance the pursuit of scientific knowledge with their ethical responsibilities to society.'*[35]

18. In the UK, the Royal Society in its response.[36] [37] in November 2002 to the Foreign Office Green Paper, gave its support to '*codes of conduct that are developed by academic and professional bodies*' by stating:

> *Addressing issues of scientific responsibility and ethics in research is an important but complex undertaking, which can only be tackled in a number of complementary ways. One is the agreement of a universal set of standards for research that can be incorporated into internationally-supported treaties; another is a concerted effort to increase awareness of international treaties and implicit codes of ethical conduct amongst researchers.*

At about the same time, in September 2002, the International Committee of the Red Cross launched its *'Appeal on Biotechnology, Weapons and Humanity'* to the political and military authorities and to the scientific and medical communities, industry and civil society on the potentially dangerous developments in biotechnology**.** [38] As part of this it asked political authorities *'To encourage the development of effective codes of conduct by scientific and medical associations and by industry to govern activities and biological agents with potential for abuse'* and asked scientific and medical communities to *'To adopt professional and industrial codes of conduct aimed at preventing the abuse of biological agents'*.

19. Beside this support for codes of a general nature, some NGOs, who had expressed concern about activities carried out in some national biodefence programmes, had agreed draft recommendations for a code of conduct for biodefence programmes[39] in which the following understandings were recommended for inclusion in a Code of Conduct:

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[33] American Society for Microbiology. *Conducting Research During the War on Terrorism: Balancing Openness and Security* 10 October 2002. Available at http://www.asm.org/Policy/index.asp?bid=5703

[34] Pax Christi International, *Pax Christi International Statement in Biological Weapons,* Ref. SD.16.E.01, December 2001. Available at: http://www.paxchristi.net/PDF/SD16E01

[35] World Medical Association. *Declaration of Washington on Biological Weapons* 17.400, 2002. Available at http://www.wma.net/e/policy/b1.htm

[36] Royal Society. *Submission to FCO Green Paper on Strengthening the Biological and Toxin Weapons Convention,* Policy Document 25/02, November 2002. Available at http://www.royalsoc.ac.uk/files /statfiles/document-206.pdf

[37] See also May R Alberts B. Scientist support for biological weapon controls. *Science* 8 November 2002 298: 1135.

[38] International Committee of the Red Cross. *Appeal on Biotechnology, Weapons and Humanity Geneva,* 25 September 2002. Available at http://www.icrc.org/Web/Eng/siteeng0.nsf/iwpList515/ 274D020806432963C1256C3E005C4338

[39] In November 2002 the Federation of Atomic Scientists, Stockholm International Pease Research Institute, Verification Research, Training and Information Center, International Network of Engineers and Scientists for Global Responsibility, Acronym Institute for Disarmament Diplomacy, Sunshine Project, Pax Christi International, Physicians for Social Responsibility, and 20/20 Vision agreed draft recommendations for a code of conduct for biodefence programmes. These were published as an Annex to Barbara Hatch Rosenberg, Defending against biodefence: the need for limits, *Disarmament Diplomacy*, Issue No. 69, February – March 2003. Available at: http://www.acronym.org.uk/ dd/dd69/69op03.htm

a) The development, production, stockpiling, acquisition or retention of all microbial or other biological agents or toxins of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes are prohibited by the Biological and Toxin Weapons Convention. This prohibition covers biological agents and toxins that are capable of causing temporary or permanent damage, harm or death to humans, animals, plants, materials of any kind or the environment. Work with any agents of these kinds is permissible only for protective or other peaceful purposes, and should be conducted only within the restrictions specified in the following points.

b) The Biological and Toxin Weapons Convention contains no exemption for law enforcement, riot control or similar purposes. The development, production, stockpiling, acquisition or retention of microbial or other biological agents or toxins for these purposes, which are hostile, not peaceful, is therefore not permissible.

c) The design, construction or possession, for any purpose, of delivery mechanisms designed to use biological agents or toxins for hostile purposes or in armed conflict is prohibited by the Biological and Toxin Weapons Convention. There is no exemption for protective purposes. The Convention's stated goal is to preclude the use of biological weapons under any circumstance; therefore it is not permissible, even for defensive purposes, to construct delivery mechanisms designed for (i.e., having a design that is appropriate for) hostile use, whether or not hostile use is intended at the time of construction.

d) Secrecy in biodefence programmes raises suspicions and could promote a race for offensive capabilities under cover of defence. Whereas the results of defence activities may need to be kept confidential, secrecy concerning the types or locations of defence activities undermines the Convention and should be disavowed.

e) Construction of novel (i.e., not previously-existing) biological agents (including single-gene changes) for threat assessment is incompatible with the spirit and intent of theConvention, and should be disavowed.

f) Weaponisation of active biological agents (defined in Note i) for defensive purposes also violates the spirit of the Convention and should be disavowed. Aerosolisation or other dissemination of active biological agents should be performed only in fully-contained bench-scale environments and only for purposes of detection, prophylaxis or medical treatment.

20. In November 2002, at the resumed Fifth Review Conference, the BTWC States Parties agreed to hold a series of one week annual meetings of the States Parties prepared for by a two week meeting of experts in 2003, 2004 and 2005 in the run-up to the 2006 Sixth Review Conference in order to '*promote common understanding and effective action'* on one or two

topics each year.[40, 41] In 2005, the topic for the meeting will be *'The content, promulgation, and adoption of codes of conduct for scientists'.*

21. Since then attention to a code has continued to spread and its possible advantages repeated. In December 2002 the Foreign Affairs Committee of the UK House of Commons in its report[42] on the Foreign Office Green Paper of April 2002 expressed concern that the States Parties to the BTWC would not consider the topic of codes of conduct until 2005 and made a recommendation that '*We recommend that the Government take steps to promulgate an international code of conduct for scientists working with dangerous pathogens, even before the BTWC consider this matter in 2005.'* The UK Foreign Secretary in his response[43] in February 2003 to this report said that '*The Government plans therefore to begin work on a code of conduct this year. … Officials from the FCO, MOD and DTI met the Royal Society on 22 January* [2003] *to consider inter alia how such a code might be taken forward.*'

22. The UK biomedical charity the Wellcome Trust in 2003 stated[44] that '*In order to promote best practice in the conduct of research and maintain public trust, the Trust considers that the international scientific community must take proactive steps to ensure that its members are aware of potential risks and concerns relating to terrorist misuse of research, and of the regulatory and ethical responsibilities that they hold. The Trust considers that the development of a "code of conduct" for scientists could play an important role in this regard.'* Although it was noted that some reservations about the utility of a code were expressed by some industry and funding council representatives, the UK House of Commons Science and Technology Committee urged[45] British learned societies and funding councils to *'consider introducing an overt ethical code of conduct as a prerequisite of membership and back this up with programmes to heighten awareness of the issues involved.'* It went on to say that *'if the scientific community does not take stronger action to regulate itself then it risks having ill-judged restrictions placed on it by politicians.'* It also recommended that '*An ethical code of conduct for scientists has value in promoting awareness and providing basis for better education of researchers. Learned and professional societies and Research Councils should develop an understanding of what such a code involves and enforce it by denying grants or refusing membership. By insisting that a code of ethical conduct is unworkable they are ducking their responsibility.'* In its response[46], the UK Government said that *'The Government agrees that researchers should be*

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[40] United Nations, Fifth Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, Geneva, 19 November - 7 December 2001 and 11 - 22 November 2002, *Final Document,* BWC/CONF.V/17, 2002. Available at http://www.opbw.org

[41] Fifth Review Conference of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction. *Draft Decision of the Fifth Review Conference of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction* BWC/CONF.V/CRP.3 6 November 2002.

[42] House of Commons, Foreign Affairs Committee, *The Biological Weapons Green Paper,* 11 December 2002. Available at http://www.publications.parliament.uk/pa/cm200203/cmselect/cmfaff/150/150.pdf

[43] Secretary of State for Foreign and Commonwealth Affairs, *Response to First Report of the Foreign Affairs Committee, Session 2002 – 03, The Biological Weapons Green Paper,* February 2003, Cm. 5713. Available at http://fco.gov.uk/Files/kfiles/CM.5713.pdf

[44] Wellcome Trust. *Wellcome Trust Position Statement on Bioterrorism and Biomedical Research*. 2003 Available at <www.wellcome.ac.uk/en/1/awtvispolter.html>

[45] House of Commons, Science and Technology Committee. *The Scientific Response to Terrorism,* 6 November, 2003: paragraph 52. Available at http://www.publications.parliament.uk/pa/cm200203/cmselect/cmsctech/415/415.pdf

[46] Secretary of State for the Home Department, *The Government Reply to the Eight Report from the House of Commons Science and Technology Select Committee, Session 2002-03, HC 415-1, The Scientific Response to Terrorism,* January 2004, Cm 6108. Available at: http://www.homeoffice.gov.uk/docs2/stc_report_reply.pdf

aware of ethical considerations relating to science and its wider applications. The ethical code recommended by the Committee is an interesting proposal and we have already started consulting the research community on whether such a code is likely to deliver.' The response goes on to note that *'Further consultations will take place in 2004 in preparation for the meetings in 2005 under the auspices of the Biological Weapons Convention, where the issue of a Code of Conduct is to be considered. The United Kingdom will chair the three weeks of discussion in Geneva.'*

23. As part of a wider education strategy to alert scientists about the dangers of bioterrorism and dual-use knowledge, in 2004 the US National Research Council report[48] *Biotechnology Research in an Age of Terrorism* argued that *'it is the responsibility of the research community, including scientific societies and organizations, to define what'* steps are needed to minimize the possibility that scientific knowledge will further biological weapons or bioterrorism and *'to provide scientists with the education, skills, and support they need to honor these steps. These principles should be added to the codes of ethics of relevant professional societies'*. In part as a response to this report, the goals[49] specifically charged to the recently established US National Science Advisory Board for Biosecurity include developing *'Professional codes of conduct for scientists and laboratory workers that can be adopted by professional organizations and institutions engaged in life science research*'.

24. In March 2004 the International Physicians for the Prevention of Nuclear War indicated its support by stating that *'Science must be regulated by a code of ethics and guided by the Precautionary Principle.'*[50] In April 2004, as part of a document[51] entitled *The Individual and Collective Roles Scientists can Play in Strengthening International Treaties*, the British Royal Society further elaborated its expectations for a code, shifting its explicit emphasis towards devising an enforceable code of practice. It stated that such codes *'could include common elements such as general safety and ethical standards such as potential conflicts of interests, plagiarism and misrepresenting or exercising bias in recording and publishing data, as well as practical requirements such as the keeping of comprehensive and auditable laboratory records. Specific elements may cover specific aspects of safety and security such as the handling of potentially dangerous material. Good practice should also include the responsibility of scientists to be aware of and comply with the requirements of international conventions and treaties in their research area, This needs educational and research institutions to put in place the appropriateness measures to enable this requirement to be met.'* In May 2004, Pax Christi further elaborated[52] its expectations for a code and other responsive measures necessary to prevent the spread of biological weapons. It specifically stated that it was in favour of the following elements of such a code of conduct for scientists and industrialists:

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[47] House of Commons – Science and Technology Committee. *The Scientific Response to Terrorism* 6 November London: HMSO; 2003: paragraph 52.

[48] National Research Council. *Biotechnology Research in an Age of Terrorism* Committee on Research Standards and Practice to Prevent the Destructive Application of Biotechnology Washington, DC: National Academies Press; 2004: 112. Available at http://books.nap.edu/catalog/10827.html

[49] National Science Advisory Board for Biosecurity. Available at http://www4.od.nih.gov/nsabb/

[50] International Physicians for the Prevention of Nuclear War, *International Cooperation in Addressing the Risks Related to Biological Agents,* 16-17 March 2004. Available at: http://www.ippnw.org/BiosecMcCoyNATO031604.html

[51] Royal Society, *Paper on the individual and collective roles scientists can play in strengthening international treaties,* Policy Document 05/04, April 2004. Available at: http://www.royalsoc.ac.uk/files/ statfiles/document-256.pdf

[52] Pax Christi International, *Pax Christi International Calls for Ethical Approach to Biological Weapons,* Ref.: SD.08.E.04 Brussels, June 2004. Available at http://www.paxchristi.net/PDF/SD08E04 .doc

• Life science research projects should systematically be evaluated by peers and funding bodies not only on scientific quality, but also on ethical aspects including the potential for use of the results for hostile purposes;

• Research associations, institutions and individual researchers should maintain generally accepted standards for Good Laboratory and Manufacturing Practice, and take action against "bad science";

• Researchers who suspect colleagues of potential abuse of life science research and materials for hostile or illegal purposes should contact their superiors or the relevant authorities and blow the whistle;

• Research associations should include regular debates about ethics in their meetings and publications, and include research into ethical legal and social aspects of science on a structural basis;

• Life science students should be educated in ethics of science.

25. **Summary.** There is a renewed interest in codes to apply to the scientific and industrial life sciences community. Despite the extent and varied interest in a code or codes, there is a lack of detailed proposals about just what such a code or codes would entail. A close reading of the initial proposals shows that there are different concepts about who should devise codes; whether they should be voluntary or enforceable; what purpose they might serve (e.g., raise awareness, proscribe specific actions); what issues they should cover; by what mechanisms they could be agreed; whether a new code is necessary or existing ones should be augmented; and whether there should be a single universal code or various local ones. Taking these points together, a number of objectives and audiences can be identified:

* Those engaged in the life sciences largely unaware of the possible 'dual use' implications of their work;
* Those engaged in the life sciences actively deliberating what to do in relation to 'dual use' experiments and experimental findings;
* Members of professional life science organizations who believe concerns about biological weapons need to be addressed;
* Conscientious practitioners in the life sciences in regard to less scrupulous colleagues;
* Members of 'the public' who wish to see that concerns are being explicitly addressed;
* Politicians seeking evidence that the scientific community is responding (so that it need not);
* Would-be state and non-state actors that are considering initiating prohibited biological weapon programmes.

With the range of objectives and audiences envisioned, multiple criteria could be used to judge the effectiveness of any code. These could include whether they bring about compliant behavior, challenge existing ways of thinking about the implications of the life sciences, promote a basis for an equitable disarmament agenda, raise connections between hitherto unconnected security and research issues, and are responsive to future scientific innovations.

Issues for Codes

26. Today there are many examples of codes that might serve as a model for devising a code for those engaged in the life sciences.[53] [54] While professional[55] and business[56] codes and oaths defining the responsibilities and rights of individuals and organizations have existed for some time, in recent years they have proliferated. As indicated in the previous section, there is unlikely to be a single type of code that might be adopted. Professional codes are often classified according to whether they aim to be *aspirational*, *educational/advisory* or *enforceable* (or a combination of these).[57] This section distinguishes between different types of codes and offers some initial considerations for each in relation to a code for those engaged in the life sciences.

27. ***Aspirational*** *codes* (often designated as 'codes of ethics') set out ideals that practitioners should uphold, such as standards of research integrity, honesty, or objectivity. These may be realistic or idealistic. In the case of a code for those engaged in the life sciences, following the concepts outlined earlier, this might include the call for those engaged in the life sciences to '*consider the ethical implications*' of their work or to discourage any use of biology '*contrary to the welfare of humankind*'. A particular problem in drawing up codes that merely aim to aspire is that they may set out principles of such a general or banal nature as to be ineffective in regard to everyday work. Another is that they will almost certainly fail to dissuade those determined to breach them. While aspirational professional codes on their own might not be effective in securing certain forms of individual behavior, they can nevertheless serve to draw further attention to particular areas of ethical and social concern and to enhance the awareness of those engaged in the life sciences.

28. ***Educational/Advisory codes*** (often designated as 'codes of conduct') would go further than merely setting aspirations by providing guidelines suggesting how to act appropriately. In the case of biological weapons, this type of code could serve as a means for those involved in the life sciences to become sensitive to implications of their activities that they might otherwise have ignored. A key issue in assessing the value of such educational/advisory codes is whether other initiatives might serve the same purpose in a more effective fashion[58, 59].

29. Although there might appear to be widespread enthusiasm today for codes of ethics and conduct, this is not shared by many social scientists and ethicists. Such analysts on the whole offer a more mixed (if not in the main skeptical) assessment of the overall effectiveness of professional and corporate codes that are not backed by formal requirements and enforcement mechanisms.[60] Although there is often a presumption that ethical codes in science and engineering foster certain forms of behavior, little is known about their effectiveness in practice.[61] Many analyses of corporate and professional codes cite the general lack of compliance as a major (perhaps the most significant) point of criticism; this arises from

[53] See www.codesofconduct.org for many examples.
[54] Soskolne C Sieswerda L. Implementing ethics on the professions. *Sci Eng Ethics* 2003 9: 181-190.
[55] American Association for the Advancement of Science. *Science and Society to Pledge or Not to Pledge: An Oath for Scientists?* 19 February 2001.
[56] Kaptein M. Business codes of multinational firms. *J Business Ethics* 2004 50: 13-31.
[57] Fisher C. Developing a code of ethics for academics. *Sci Eng Ethics* 2003 9(2): 171-179.
[58] Harvard-Sussex Program. *Draft Convention to Prohibit Biological and Chemical Weapons under International Criminal Law* See http://www.sussex.ac.uk/spru/hsp/Draft%20Convention%20Feb04.pdf
[59] Medical Research Council. 1997. MRC Policy and Procedure for Inquiring into Allegations of Scientific Misconduct London: MRC.
[60] Cash M. Codes of ethics, organizational behaviour and misbehaviour. *Research in Corporate Social Performance and Policy* 1987 9: 107-130.
[61] Iverson M, Frankel M, Siage S. Scientific societies and research integrity. *Sci Eng Ethics* 2003 9: 141-158.

reasons such as the failure to punish contraventions.[62] [63] Some evidence suggests that such codes are rarely consulted or even known about by those they are meant to guide.[64] Much, of course, depends on the rigor of the mechanisms in place to promote and uphold them.

30. A further problem is that general stipulations within codes often leave much scope for interpretation[65]. An example is provided by the 1985 code of ethics adopted by the American Society for Microbiologists which discouraged *'any use of microbiology contrary to the welfare of humankind'*. Reference to this code has been made by some[66] as an example of what might be done in terms of a code for those engaged in the life sciences in regard to BW related concerns. Yet, what would count as adherence or deviation from such a call is unspecified and unclear. According to Cassell, Miller, and Rest[67], historically just what counts as acceptable practice vis-à-vis work in the life sciences in regard to biological weapons has been a matter of much debate and division within the ASM reflecting wider disputes about the legitimacy of the involvement of scientists in military R&D. In 1970, for instance, the then ASM President R. Hungate supported continuing research into BW despite US President Nixon's policy to end the production and use of biological weapons, attempts to agree the Biological Weapons Convention, and an ASM annual meeting resolution call to '*convert offensive biological warfare facilities to peaceful uses*'. He did so by suggesting BW research could aid in the prevention of disease, facilitate the development of incapacitating weapons, and minimize fears about what activities were being conducted. The establishment of the ASM Code of Ethics did not provide a retrospective resolution of any such debates. With an increasing US interest in 'non-lethal' weapons and biodefence activities today, neither does it provide a clear guide for assessing action for many topics of international dispute.

31. A further point is that general stipulations within codes sometimes conflict with each another[68]. An example is given by the ethical code[69] of the Australian Society for Microbiology which reads as follows:

> *'The Society Requires Each Member:*
>
> *1. to promote the aims of the Society;*
> *2. to behave in such a way as to bring credit to the profession of microbiology;*
> *3. to use all proper means to maintain the standards of the profession;*
> *4. to respect any confidence gained in the conduct of the profession;*

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[62] Doig A Wilson J. The effectiveness of codes of conduct. *J Business Ethics* 1998 7(3): 140-149.
[63] Higgs-Kleyn N Kapelianis D. The role of professional codes in regulating ethical conduct. *J Business Ethics* 19: 363-374 1999
[64] Luegenbiehl, C. Codes of ethics and the moral education of engineers. In: Johnson D. *Ethical Issues in Engineering* Upper Saddle River, NJ: Prentice Hall; 1991: 136-154.
[65] Shrader-Frechette K. *Ethics of Scientific Research* Lanham: Rowan & Littlefield; 1994.
[66] See for example, US Department of State (Bureau of Arms Control) *New Ways to Strengthen the International Regime Against Biological Weapons* Washington, DC 19 October 2001 and Royal Society. *Submission to FCO Green Paper on Strengthening the Biological and Toxin Weapons Convention* November 2002.
[67]Cassell G, Miller L, Rest R. Biological Warfare: Role of Scientific Societies In *The Microbiologist and Biological Defense Research* Zilinskas, R (ed) New York: New York Academy of Science; 1994.
[68] So, for instance there might calls for engineers to both serve the interests of their clients and the public. Along these lines in relation to BW issues, a code might both include provisions stating the importance of conducting work to further knowledge and to consider limits on activities out of concern for its implications.
[69] The Australian Society for Microbiology, *Ethics.* Available at: http://www.theasm.com.au/docs/ethics/default.asp

5. to ensure that public statements are fair and objective;
6. not to engage in microbiological practices restricted by law or professional agreement;
7. to avoid unwarranted statements that reflect upon the character or integrity of other members of the profession;
8. to recognise the responsibility to subordinates in terms of professional guidance and dissemination of information;
9. to maintain professional competence by keeping abreast of new information and developments;
10. to support fellow members who find themselves in difficulties on account of their adherence to this Code, and the Society in its efforts to protect them;
11. to recognise responsibility to the community and the environment in protecting each from exposure to undue actual or potential microbiological hazards;
12. not to engage knowingly in research for the production or promotion of biological warfare agents.'

Item 12 prohibits knowingly contributing to the production or promotion of biological warfare agents. In addressing '*research'* rather than '*development and production*' in its language the Code could be seen on the one hand as going beyond the prohibitions set out in the BTWC and on the other hand the omission of specific reference to development and production provides further ambiguity. There is much to be said for using the all embracing word '*work*' instead of '*research'* in item 12.

32. Despite this apparent breadth, it is not explicit what the Australian code should be taken to proscribe in practice. Consider the case of biodefence activities. Historically 'biodefence' has been subject to competing interpretations about the acceptability and definition of various activities justified for protective measures. Few[70] have advocated a complete halt to such activities, allowing only civilian studies of naturally occurring infectious diseases that might aid in the basic understanding of virulence. Yet the potential for defensive projects to further offensive capabilities (in terms of knowledge, techniques, or the availability of materials) has led some to express unease about the wisdom of taking part in biodefence work. Even within the biodefence community, there has been some recognition of the need to ask questions about the ends that might be served (however inadvertently) by their activities.[71]

33. If item 12 were taken to apply to all biodefence research it would prevent microbiologists from undertaking any research to protect their nations' troops and populations; a call which would be difficult to justify. Also, such an interpretation could be reasonably be presented as conflicting with the provisions of items 9 and 11 which calls for microbiologists to keep '*abreast of new information and developments*' as well to protect the community and the environment from '*actual or potential microbiological hazards*'. Even if biodefence is not ruled out altogether, the general point is that at any stage determining where the line should be drawn between '*acceptable*' and '*unacceptable*' activities, competing views about what is appropriate could justified by pointing to alternative Code items.

[70] One such example is the Council for Responsible Genetics *Call for a Ban on the Genetic Alteration of Pathogens for Destructive Purposes*, n.d. Available at http://www.gene-watch.org/programs/biowarfare/call-for-ban.html
[71] In *The Microbiologist and Biological Defense Research* Zilinskas R. (ed) New York: New York Academy of Science; 1994.

34. This can be further illustrated by the report[72] in the *New York Times* in September 2001 that *'Over the past several years, the United States has embarked on a program of secret research on biological weapons that, some officials say, tests the limits of the global treaty banning such weapons'*, specifically the article reported: (1) plans by the Defense Intelligence Agency (DIA) to genetically enhance the potency of the bacterium that causes anthrax, purportedly to test existing vaccines against a variant identified by Russian scientists; (2) the Central Intelligence Agency's assembling and testing of an old Soviet cluster germ bomb; and (3) a project by the Pentagon to determine if a bioweapon plant could be fashioned from commercially available materials. The latter two completed projects used simulants to test the devices built. While these activities were officially justified as falling under the banner of 'threat assessment', the legitimacy of this designation was widely disputed. If a code similar to the one adopted by Australian Society for Microbiology had been in place in the US or internationally, those arguing for and against the undertaking of these 'biodefence' activities could have justified their opposing positions through reference to the code.

35. The argument can be made[73] that the basic assumption that the abstract guidelines typically found in codes could resolve debates about what constitutes appropriate conduct misconstrues the nature of ethical decisions which cannot be made by fiat ahead of time.

36. In response to criticisms of codes of ethics and conduct, those supportive of them have argued they play more varied functions than guaranteeing certain forms of behavior. These include raising awareness, suggesting considerations for reflection, fostering norms, enabling individuals to re-interpret their actions, clarifying individual and collective responsibilities, increasing public trust and establishing minimal ethical standards.[74] [75] [76] [77] The prospect is recognized that ethical codes can impact decision making for topics in which positions have not formed.[78] Against such claims it has been countered that other activities might fulfill the same function more directly. In practice codes have the disadvantage of being perceived as more a public relations device for professionals that act to stave off other and sometimes more prudent forms of regulation.[79]

37. ***Enforceable*** *codes* (often designated as 'codes of practice') seek to further codify what is regarded as acceptable behaviour. Rather than inspiring or educating in the hopes of securing certain outcomes, enforceable codes are embedded within wider systems of professional or legal regulation. While enforceable codes may share with other types of codes aims such as raising awareness, fostering norms, and clarifying individual and collective responsibilities, the focus here shifts to setting out certain permissible processes and ways of carrying out work.

38. While such codes do not suffer from the same degree of *prima facie* doubt about their effectiveness that surrounds aspirational or educational types, their particular role with regard to those engaged in the life sciences in regard to BW issues may be less clear. In recent

[72] Miller, J., Engleberg, S. and Broad, W.J., US Germ Warfare Research Pushes Treaty Limits. *New York Times*. 4 September 2001, p. 1.
[73] Ladd J. The question for a code of professional ethics. In: Johnson D *Ethical Issues in Engineering* Upper Saddle River, NJ: Prentice Hall; 1991:130-136.
[74] Davis M. *Thinking Like an Engineer* Oxford: Oxford University Press; 1998.
[75] Meselson M. Averting the exploitation of biotechnology. *FAS Public Interest Report* 2000 53: 5.
[76] Unger S. Code of engineering ethics. In: Johnson D *Ethical Issues in Engineering* Upper Saddle River, NJ: Prentice Hall; 1991: 105-130.
[77] Reiser S Bulger R. The social responsibilities of biological scientists. *Sci Eng Ethics* 1997 3(2): 137-143.
[78] Lere J Gaumnitz B Impact of codes on Ethics of Decision Making. *J. Business Ethics* 2003; 48: 365-379.
[79] Backof J Martin C. Historical perspectives. *J Business Ethics* 1991 10: 99-110.

years, a raft of national biosecurity legislation has been agreed in some countries to define appropriate behavior in relation to the physical and biological containment of pathogens. In addition, various restrictions and requirements have been introduced on who can perform experiments, such as foreign nationals, and active attempts are continuing to introduce international legislation to criminalize individual's engaged on biological weapons.[80] To the extent any codes for those engaged in the life sciences in regard to biological weapons merely reiterate the provisions of such legislation, they risk being redundant. However, the key requirement is enforcement whether it be of legislation or of a code of practice. To the extent that a code may appear redundant, it risks being regarded as an inadequate measure by those seeking concrete reforms.

39. ***Codes in general.*** Much of the attention to codes today centres on getting those engaged in the life sciences to consider the risk of novel threats stemming from their experimental results or techniques; such considerations can be difficult to legislate through highly formalized codes. Following on from fairly high profile experiments such as the insertion of the interleukin-4 gene into the mousepox virus and the artificial chemical synthesis of the poliovirus, contemporary policy discussions are not only concerned with development efforts or physical security requirements, but also with the security risks posed by findings and techniques stemming from otherwise acceptable academic, industrial or medical activities (so called 'contentious research' or 'experiments of concern'). Making determinations about the wisdom of undertaking a particular line of work or how it should be communicated could require assessing complicated and uncertain matters about its future beneficial and negative consequences.[81] Yet, in relation to such speculative concerns, what is foreseeable, desirable, or even relevant to assessing risks and benefits has[82] [83] and almost certainly will be a continuing source of debate.[84] Just who should or could make determinations of risks and benefits is yet another issue.

40. Such points raised suggest that there is little justification for assuming the establishment of a code of conduct in and of itself will be advantageous. This underlines the importance of paying careful attention to the motivations for codes and what specific functions they are supposed to fulfill. These might include abating professional criticism, altering inappropriate actions, making informal community standards formal, or bringing a new way of thinking to old issues. Closely related is the question of who is the primarily audience for codes; whether that be individuals engaged in the life sciences, government policy makers, industry or the public. The question needs to be asked as to whether a code is primarily seeking to dictate terms of acceptable behavior, to encourage active reflection on what constitutes appropriate behavior or to set out a routine process of evaluation.

Issues to be Considered in Responding to BW Threats with Codes

41. In light of these general observations about codes, this section considers some of the issues especially pertinent in thinking today about codes for those engaged in the life sciences in regard to biological weapons concerns. Some of the issues are especially relevant to

[80] Harvard-Sussex Program. *Draft Convention to Prohibit Biological and Chemical Weapons under International Criminal Law* See http://www.sussex.ac.uk/spru/hsp/Draft%20Convention%20Feb04.pdf
[81] Nixdorff K Bender W. Ethics of university research, biotechnology and potential military spin-off. *Minerva* 2002 40: 15-35.
[82] Dennis C. The bugs of war *Nature* 17 May 2001: 232-5.
[83] Müllbacher A Logbis M. Creation of killer poxvirus could have been predicted. *J Virol* September 2001: 8353-5.
[84] Rappert B. Coding ethical behaviour. *Sci Eng Ethics* 2003 9(4).

particular types code, but each also has a generic relevance. Examining these further highlights the need to attend to the motivations and expectations for introducing codes.

One Code or Many?

42. As indicated in the statement by the United States[85], it has been proposed that a single code with universal recognition be adopted. Agreeing one code for the whole of the international life sciences community would have certain obvious practical advantages. Because of the transnational values and norms of science, many past discussions regarding codes have also emphasized the importance of universality.

43. However desirable, achieving universality in practice would depend on the nature of the code. It might be relatively easy to adopt an aspirational code internationally and the same could be true of an enforceable code of practice especially if this were to be incorporated in an existing widely adopted code of practice. It should be noted however that the general approach of seeking to specify appropriate behavior through codes of conduct is much more prevalent in Western countries (and particularly the US) than the rest of the world.[86] Second, to the extent the code attempts to set out enforceable standards specifying good practice, it is likely to require considerable effort to result in 'universal' practices as a code embedded into different regulatory contexts could result in different practices. Elsewhere, Jasanoff contends that despite the long interest in setting standards for scientific integrity, the diversity of practices between scientific specialties means that the establishment of uniform standards has proven ever elusive.[87] In addition, whatever its desirability, today considerable disparity exists across the globe in how ethical reviews are undertaken for biomedical research.[88] [89] Local and national reviews of the implications of research in relation to biological weapons concerns could face the same difficulties. Even current biosafety[90] standards which also provide much of the basis for biosecurity containment measures vary considerable between countries.[91] With the establishment of the US National Advisory Board for Biosecurity in the US and the introduction of additional vetting of research proposals, the disparity in regulatory environments is likely to become more pronounced over the next few years. More productively, the establishment and negotiation of a code that strove toward universality could serve as a vehicle for benchmarking different standards internationally.

44. However, if codes were to be aspirational and thus contain statements condemning the use of work in the life sciences for hostile purposes by basically reiterating Article I of the BTWC, then universal codes might be adopted widely. However, what such aspirational codes might mean for what is permissible is not likely to be a matter of unanimity. In the past what has counted as the '*prophylactic, protective or other peaceful purposes*' of

[85] US Department of State (Bureau of Arms Control) *New Ways to Strengthen the International Regime Against Biological Weapons* Washington, DC 19 October 2001

[86] Kaptein M and Wempe J. Twelve Gordian knots when developing an organizational code of ethics. *J Business Ethics* 1998 517: 853-869.

[87] Jasanoff S. Innovation and integrity in biomedical research. *Academic Medicine* 1993 S91-S95.

[88] Nuffield Council on Bioethics *The Ethics of Research Related to Healthcare in Developing Countries* 24 April London: Nuffield Council; 2002.

[89] MacPherson C. Research ethics. *Developing World Bioethics* 2001 1: 57-69.

[90] In this Briefing Paper the term biosecurity is taken as in the UK Foreign Office documents to refer to measures *'designed to prevent unauthorised acquisition of pathogens, toxins or other bioactive substances of biological origin – to prevent their potential misuses inconsistent with the provisions of the BTWC'* whereas biosafety measures are those '*intended to prevent the unwanted or accidental release of biological material from a "controlled environment" that could lead to diseases in humans, animal or plants.'*

[91] Pearson G *Preparing for the First Meeting of the States Parties: II: Security and Oversight of Pathogenic Microorganisms and Toxins* University of Bradford, Department of Peace Studies, Briefing Paper No. 9 (Second Series), October 2003. Available at http://www.brad.ac.uk/acad/sbtwc/

biological agents or toxins has been a matter of disagreement in relation to the acceptability of activities undertaken as part of '*biodefence*' programmes.[92] [93] Today the renewed interest in the US, Russia, and elsewhere into '*non-lethal*' incapacitanting agents that span the bio-chemical spectrum likewise challenges the presumption that general statements condemning the use of biological and toxin agents for hostile purposes could provide a solid foundation for consistent practice.[94] As noted earlier, some NGOs have put forward suggestions as to what might be incorporated in a code of conduct for biodefence programmes. Achieving shared international agreement between States Parties on the criteria for determining the acceptability of biodefence programmes could be challenging.

45. Moreover, whatever is agreed by way of the content of codes, how they will be interpreted in practice is another matter. While ethical codes might purport to offer universal standards for evaluating appropriate action, their interpretation and enforcement cannot be divorced from questions of power and authority. As in past debates about the appropriateness of biodefence projects, what counts as a permissible activity is not simply a function of what takes place, but who is in a position to impose and resist assessments. Along these lines, as part of a critical analysis of the activities reported as part of the US biodefence programme, it has been noted that *'similar activities in other countries have led the United States to label them biological weapon proliferators. Yet no doubt those countries would ascribe their activities to benign "threat assessment" necessary to develop appropriate military defenses and medical treatments, just as the U.S. is now describing its activities.'*[95] The potential for some countries to dismiss concerns about its activities again raises the issue of whether a code setting out universal working standards could be internationally negotiated.

46. So far this sub-section has considered the universality of the provisions of codes in relation to issues about their coverage. This though is not the only issue that arises regarding whether one or many codes are appropriate. Another issue is whether a distinct and separate code addressing particular concerns relating to biological weapons is sought or whether standards relating to biological weapons should be integrated into existing industrial, organizational or professional codes. While the former approach would require (to some extent) a '*new*' code to be formulated, the latter would require existing codes to be modified. The two approaches would have different practical issues in respect of their promulgation. In addition, the two approaches may well reflect differences in the priority and responsibility for preventing the hostile use of biological and toxin agents. If, for instance, the topic is to be included within existing codes, then questions about the implementation and utility of provisions relating to biological weapons will depend on the overall implementation procedures and utility of the codes in which they are embedded which can vary considerably. Some might suggest that many of the existing provisions of such codes already call for standards of ethical and legal conduct that would rule out the development of biological weapons and so this topic need not be covered as explicitly. Such an appraisal is likely to be challenged by those that maintain the development of biological weapons is so grossly abhorrent or in need of attention today that special efforts must be taken.[96, 97, 98, 99] Although securing agreement on a separate code on its own may well bring greater attention to the

[92] Zilinskas R. ed. *The Microbiologist and Biological Defense Research* New York: New York Academy of Science; 1994. In terms of the BTWC, one point of concern has been what, if anything, distinguishes 'research' from 'development' as the former word is not explicitly addressed in the Convention.

[93] Leitenberg M. *Biological Weapons in the Twentieth Century: A Review and Analysis* 2002 see http://www.fas.org/bwc/papers/21centurybw.htm

[94] Wheelis M Dando M. Back to bioweapons? *Bull Atomic Scientists* 2003 59.

[95] Rosenberg B Leitenberg M. Who's afraid of a germ warfare treaty. *LA Times* 6 September 2001. See also Bolton J *Beyond the axis of evil: additional threats from weapons of mass destruction*. Heritage Lecture No. 743. Washington DC: Heritage Foundation; 2002.

topic of biological weapons and enable more in-depth treatment of the issues at hand, it may well be much harder to achieve consensus and take much longer.

Outcome or Process?

47. While much of the current discussion of codes to address biological weapons issues centre on their utility once they are drawn up, many of those social scientists that offer positive overall assessments of codes stress the process benefits associated with devising and revising codes. The phrase *'a code is nothing, coding is everything'* has been used to highlight the significance of procedural aspects. Particularly with regard to the educational aim of raising awareness, posing the issue of what constitutes appropriate conduct through a process of devising a code can have many benefits. Some existing professional codes make a positive virtue out of ambiguity and uncertainty by drawing attention to their limits as standard setting devices and thereby the importance of process considerations.[100]

48. Reflection on the process advantages of codes would suggest the speed by which they are finalized is not of vital importance nor is the status of any code as universal. What is needed instead is a process of formulating codes that is fairly explicit about its presumptions and that seeks to engage a wide range of participants over time. Initial disagreement might well prove productive in terms of achieving a more effective code in the long term and also suggesting alternative possibilities. With regard to the latter, in keeping with international differences found in relation to industrial codes of conduct, codes relating to biological weapons issues from different regions of the globe might alternatively stress the importance of transparency measures versus explicitly prescribing what counts as appropriate behavior.

49. These themes are particularly salient in considering biological weapons because, as indicated above, there is not uniform agreement about the acceptability of certain activities and probably relatively little knowledge of the salient issues among many of those engaged in the life sciences. Asking and re-asking what a code should entail is one way of fostering debate about what constitutes appropriate action and thereby encouraging cultures where concerns about the threats of biological weapons are more prevalent. Such a process-based approach though may not be regarded by some as adequate evidence that the scientific community is taking sufficient responsive action. Whatever the mix of process and product, it should be borne in mind that professional and organizational codes of conduct often change over time as a sense of the problem which they are meant to address and the necessary responsive measures develop.[101] So any international code or codes addressing biological weapons issues will need a mechanism for its review and revision.

Codifiers or Clarifiers?

50. Another issue is whether codes should merely seek to reiterate the existing provisions of national and international agreements and conventions, or whether they attempt to further a

[96] Atlas R. ASM Testimony: Conducting Research During the War on Terrorism: Balancing Openness and Security House Committee on Science "Conducting Research During the War on Terrorism: Balancing Openness and Security." October 10, 2002. See http://www.asm.org/Policy/index.asp?bid=9595

[97] House of Commons – Science and Technology Committee. *The Scientific Response to Terrorism* 6 November London: HMSO; 2003

[98] Stimson Center. *Compliance through Science: US Pharmaceutical Industry Experts on a Strengthened Bioweapons Nonproliferation Regime* September 2002.

[99] Petro J Plasse T McNulty J. Biotechnology: impact on biological warfare and biodefense. *Bioterrorism & Biosecurity* 2003 1: 161-168.

[100] Gotterbarn D. Not all codes are created equal. *J Business Ethics* 1999 22: 81-89.

[101] Backof J Martin C. Historical perspectives. *J Business Ethics* 1991 10: 99-110.

shared understanding of their meaning. As part of its April 2004 statement on *The Individual and Collective Roles of Scientists*, the Royal Society called on the scientific community to *'comply with requirements of both national legislation and international treaties and conventions.'*[102] One difficulty in achieving this is whether those in the life sciences are knowledgeable of the provisions of such legislation, treaties and conventions. More importantly though is the underlying issue as to what these agreements mean in the first place. Much has been achieved by the States Parties through their reaffirmations at successive Review Conferences. Although biodefence and non-lethal weapons have been noted above as contentious issues, they have not yet been the subject of reaffirmations at the Review Conferences although proposals were made[103] that would have been a step forward at the Fifth Review Conference in 2001/2002, had that succeeded in agreeing a Final Declaration. Even outside of such fairly high profile disputed topics, international agreements typically entail a high degree of abstraction and generalization; this is often a result of the competing agendas at play in international negotiations. The BTWC is a convention written for State Parties and not a text which is meant to guide the actions of individuals.

51. In such a situation, a key issue is where responsibility rests for determining what ought to be done.[104] Of course, in the end it is important to ensure individuals make appropriate ethical decisions. Yet, just whether the responsibility for determining what counts as the prudent course of action should *solely* rest with individuals is another matter.[105] If a scientist or a team of them are left to their own devices to interpret highly contentious and complex issues because a code suggests it is their responsibility to do so, its ultimate utility is likely to be limited. There can be advantage in a tiered approach involving appropriate national and possibly international bodies to consider and advise on particularly difficult issues.

52. While it is illusionary to imagine a formal written code of conduct can resolve all ethical dilemmas or uncertainties under their domain, they can aid in setting out how dilemmas are approached and how responsibility should be distributed between individuals and organizations. Professional associations offering codes or other measures can also aid individual decision making by providing a sense of the wider context in which scientists should situate their individual efforts such as the future possibilities that might become possible from scientific advances. Through the adoption of codes, organizations or professional bodies can either forward a sense of what conventions should mean or restate the terms of existing agreements. Attempts to clarify the meaning of existing conventions need not only take the form of statements about the rights and wrongs of particular topics, but instead could include the agreement of guiding principles. For instance, in a discussion of professional codes of conduct for anthropologists, Sluka suggested the discipline should be directed by: an overriding responsibility to those studied, the censuring of covert research, the

[102] Royal Society *The Individual and Collective Roles of Scientists* April 2004: 3.
[103] Dando, M & Whitby S,, *Article I – Scope,* in Pearson, G, Dando, M & Sims, N (eds), *Key Points for the Fifth Review Conference,* University of Bradford, Department of Peace Studies, November 2001. Available at http://www.brad.ac.uk/acad/sbtwc
[104] For a related discussion of rules and responsibility see Rappert B. The Distribution and the Resolution of the Ambiguities of Technology; or Why Bobby can't Spray. *Social Studies of Science* August 2001: 557-592.
[105] For instance, the Royal Society has commented that: *'[A]pplying a vetting process across the spectrum of basic research proposals, would be difficult and impose a burdensome layer of bureaucracy on the research enterprise. For example, how would such a process have applied to the fundamental nuclear physics research proposals in the 1920's and 30's that provides the foundations for the development of nuclear weapons?'* See Royal Society *The Individual and Collective Roles of Scientists* April 2004: 3. Yet, had such a system been in place, whatever its likely limitations, it may well have facilitated international scientific agreement regarding the real possibility of developing an atomic bomb and in what situations their use (as opposed to testing) would be appropriate. Such agreements might have had significant implications for the decision to use such bombs on Japan at the close of the World War II.

importance of accountability for ethical violations, and the prioritization of public duty over private interests.[106]

Extenders or Consolidators?

53. Another set of issues related to whether codes reiterate or further understanding is whether they attempt to build on existing practices and controls or whether they pursue a more restrictive line of bringing together what already exists.

54. Some of the attention to codes today is to address the need to ensure strict controls are in place for the physical and biological containment of pathogens and toxins. Should codes be limited to this topic though, they are unlikely to result in significant changes to current practices in many countries. The raft of biosecurity measures introduced across the globe post 9-11 means that codes in this regard may be considered as nothing more than a consolidation of existing regulations. In contrast, a key area of contention is the issue of how far policy concerns about biological threats should extend in the United States beyond traditional select agents to impact a wide range of activities currently not affected by biosecurity regulations.[107] Another issue is whether codes challenge existing practice about who should take part in setting standards. Conceding a role for a code of ethics or conduct may well necessitate engaging in debates about the social responsibilities of those undertaking work relevant to the life sciences; a matter where 'society' and well as 'science' has a legitimate voice.[108]

55. As noted above, those critical of codes have argued their adoption often serves as a *'soft touch'* measure that avoids of other forms of regulation while giving the appearance that responsive action has been taken.[109] If confined to existing regulatory provisions, codes for those engaged in the life sciences in regard to biological weapons issues may well be regarded in the same light. The general enthusiasm for codes in policy discussions coupled with a lack of attention to what the codes will be might be taken as indicating some are seeking them in lieu of other controls. There is at least some explicit recognition that codes might be thought of a means of avoiding forms of more stringent or external regulation. In relation to the dual-use implications of biological research, the American Society for Microbiology has argued '*that a self-imposed code of responsible conduct and oversight is preferable to a mandated regime*.'[110] The biomedical charity the Wellcome Trust has given

[106] Sluka J Comments on Pels. *Current Anthropology* 124-6.
[107] Petro J Plasse T McNulty J. Biotechnology: impact on biological warfare and biodefense. *Bioterrorism & Biosecurity* 2003 1: 161-168.
[108] As well, determinations of the scope for concern in no small part will depend on assessments of the nature of security threats; a topic on which the scientific community cannot be asked to developed its own assessments. As such the potential for codes for those in the life sciences to determine or even set out what would be relevant to determine the advisability of certain activities is limited.
[109] With regard to this point, it is interesting to note that industrial representatives in both the UK and US have supported some form of greater formal regulation over voluntary codes by citing the likely ineffectiveness of the latter. It could be argued that the existing degree of the regulation of pharmaceutical and biotech industries means that precise forms of regulation are a more preferable option for them because they do not entail the open-ended ethical commitments and additional efforts that might be implied by codes of conduct. Whatever the reasons for particular positions, whether codes are and are likely to be seen as burdensome or trivial is a matter on which commentators should remain open minded. See House of Commons – Science and Technology Committee. *The Scientific Response to Terrorism* 6 November London: HMSO; 2003 and Stimson Center. *Compliance through Science: US Pharmaceutical Industry Experts on a Strengthened Bioweapons Nonproliferation Regime* September 2002. Available at http://www.stimson.org/pubs.cfm?ID=66
[110] Atlas R. ASM Testimony: Conducting Research During the War on Terrorism: Balancing Openness and Security House Committee on Science "Conducting Research During the War on Terrorism: Balancing Openness and Security." October 10, 2002. See http://www.asm.org/Policy/index.asp?bid=9595

initial endorsement to the idea of a code, but squarely as part of a system of self-governance by the scientific community.

Codes under the BTWC

56. The topics of potential disagreement about the purpose and place of codes discussed above are further compounded by contrasting assessments regarding the proper vehicle by which they might be adopted. While the multilateral Meetings of Experts and of State Parties in 2005 under the BTWC provide a forum for discussing international codes, it could be argued that the current US administration does not regard this venue highly. Many security analysts have interpreted the decisions of US officials during and since the Fifth Review Conference as an indication of a lack of desire to see substantive progress under the Convention in the next few years.[111] The US imposed limits on the annual multilateral meetings – their status as non-negotiations, the necessary stand alone quality of each year's topic, and the constraints on their duration – likewise have been taken as a clear indication of the desire to marginalize the BTWC. The US orientation contrasts with that of other countries who have actively sought to strengthen the BTWC. For supporters, a failure, as happened in the 2003 meetings, to promote significant *'common understanding and effective action'* in the 2005 meetings would be another significant and regrettable set back to the BTWC as a viable and relevant agreement. It could be argued that radically divergent expectations exist for the 2005 meetings on codes of conduct deriving from different political assessments regarding the proper direction of arms control.

Issues for a Code of Conduct for those engaged in the life sciences in regard to biological weapons aspects.

57. The analysis given in the last two main sections suggests a number of issues need to be considered as part of the establishment of codes of conduct for those engaged in the life sciences. These issues are listed below, although the list is not exhaustive nor does the order indicate their relative importance:

* Which is the relevant community to make decisions about what codes should be adopted? Should *'the'* scientific community alone determine the composition of codes intended for them? In what ways is the *'prevention against biowarfare and bioterrorism…too important to leave to the scientists and politicians'*[112]?
* How will any future codes combine both individual and collective responsibilities?
* Will codes consist of standards that go beyond existing regulatory provisions in terms of their rigor or specificity?
* What is the question to which codes are being sought as an answer? As part of this, what is the potential for codes to keep abreast of current scientific developments that might facilitate the development of biological weapons?
* Does a long term and widespread commitment exist among the relevant organizations to implement codes effectively?
* By what criteria might a code be deemed effective? Is *'keeping the conversation going'* about the potential security problems of the life sciences sufficient?
* To what extent are differences in the implementing countries in the adoption of codes and well as other regulatory measures acceptable?

[111] Sims N. *The New Multilateral Process for the BTWC: Ambiguities and Opportunities,* University of Bradford, Department of Peace Studies, Briefing Paper No.2 (Second Series), January 2003. Available at http://www.brad.ac.uk/acad/sbtwc

[112] Pax Christi International, *Pax Christi International Calls for Ethical Approach to Biological Weapons* Ref.: SD.08.E.04 Brussels, June 2004 see http://www.paxchristi.net/PDF/SD08E04.doc

* Should codes seek to elaborate and clarify existing international conventions? Should discussions undertaken as part of such conventions elaborate and clarify the meaning of codes? Related to this, is the purpose of codes to resolve international disagreements about the advisability of some actions?
* In what way is the fate of any code implicated in other areas of policy?
* Who are codes for: workers on the bench, professional organizations, government negotiators, those in industry, the public, etc.?
* Are codes being brought in to stave off other controls?
* Is it realistic to expect that common standards in practice for *'the'* life science community across sub-disciplines and nations?
* Can guiding principles be agreed for setting and interpreting codes?
* What positive commitments exist for scientists to consider the social and ethical implications of their work?
* Is calling for *'compliance'* to existing national legislation and international agreements sufficient? To what extent is it possible?
* How can the effectiveness of codes be gauged? Is it realistic or helpful to assume common criteria should apply across disciplines and countries?
* Are governments, professional organizations, funders, NGOs and others willing to take a stance on the proper interpretation of international weapons agreements?
* Could new code(s) alleviate or exacerbate the deficiencies of existing codes?
* Irrespective of questions about scientists' knowledge of international prohibitions, is there sufficient recognition of the dual-use possibilities stemming from work in the life sciences? Is there a significant problem to be recognized at all?
* Is the discussion of a code a way of engaging with potentially contentious political questions or a way of avoiding them?

A Code Matrix

58. The previous sections considered various issues related to the establishment and promulgation of a life sciences code in relation to biological weapons aspects. While increasing attention is being given to this policy option by a wide range of organizations, the utility of codes should not be taken for granted. Codes should perhaps be better thought of as means, rather than as ends in themselves. A code that specifies enforceable standards based on existing regulations risks being redundant whereas one aiming to be aspirational risks being irrelevant.

59. Such an analysis makes it easy to outline some elements of a single code that could prove of limited relevance. A code that merely stated vague provisions such *as 'Just do the right thing', 'Don't build a germ bomb'*, and that had no provisions in place for future re-evaluation, or that was not owned and supported by the relevant organizations could mean a code that is simply a shiny document that quickly gathers dust.

60. Specifying a useful and effective code or codes is more difficult. Codes that set out standards in novel areas, that contextualize and make connections, that provide detailed expectations for behavior, and that act as a device for '*keeping the conversation going*' about what should be done are more likely to prove beneficial. Exactly what sort of code is appropriate and by what measure its effectiveness should be judged though depends on why codes are sought and who is their expected audience. In relation to matters of audience, this analysis has focused on those engaged in the life sciences, as almost all of the present policy discussion takes this group as the pertinent one for focus. However, it needs to be recognized that there is a wide range of expertise that is involved in the life sciences such as policy-

makers, regulators, investors and others who equally have responsibilities to prevent the hostile misuse of the life sciences.[113] In regard to purpose, this analysis has argued that codes *can* have more varied functions than solely proscribing action. Based on the previous analysis, a variety of **laudable aims for codes in the life sciences** in respect of biological weapons can be identified:

1. Raise awareness of the potential for the hostile use of biological agents among relevant professionals and organizations;
2. Reinforce or otherwise take forward standards for the biological and physical containment of pathogens and toxins;
3. Enable individuals to re-examine their actions by establishing a sense of the social and ethical context in which science takes place;
4. Facilitate a process of long term discussion about the possible implications of the life sciences and what sorts of controls might be prudent;
5. Clarify individual and collective professional responsibilities;
6. Provide modest impediment to the involvement of individuals in inappropriate programmes of work, whether that be explicitly offensive programmes or otherwise questionable projects;
7. Encourage scientists to be aware of and comply with the requirements of international conventions while at the same time working towards the clarification of their meaning.

Even for this limited set of aims no one type of code is likely to serve them all adequately.

61. If codes are assumed to be worth pursuing and a commitment is made to their promulgation, one possible way forward is to develop and adopt an integrated *'matrix of codes'*[114] that would consist of different types fulfilling a range of aims for varied audiences. Although single code initiatives on their own might have limited utility, taken together they could provide one element of a more comprehensive response to biological weapon threats which has been referred to as a *'web of prevention'*[115] or *'web of deterrence'*[116]. Such a matrix could build on current and planned code related activities while identifying useful additional measures and points of integration. This section outlines the shape of such a possible matrix. It does not seek to resolve all the issues but indicates the significance and general outline of a matrix approach. For simplicity, it does so by reference to the state of codes and other forms of regulation in the UK. Proposals are made as to how existing provisions might be modified.

Matrix Element 1 -- Enforceable Codes: Developing Existing Regulations

62. It was argued earlier that monitoring and enforcement mechanisms are essential for ensuring codes fulfil their intended function. In relation to the issues discussed so far, controls on the physical and biological containment of pathogens and toxins are most amenable to this sort of formalized enforcement regime. In the UK, a code of practice could

[113] See Robinson JPP. Codes of conduct and individual responsibility. 31 May 2004 http://www.ex.ac.uk/codesofconduct/Publications/JPP.htm
[114] A term originally proposed by Vivienne Nathanson of the British Medical Association.
[115] As proposed by the ICRC see http://www.icrc.org/Web/eng/siteeng0.nsf/html/5VDJLW?OpenDocument
[116] Pearson G. Prospects for Chemical and Biological Arms Control *The Washington Quarterly* Spring 1993: 16, 145-62. A 'web of deterrence' would also consist of such elements as international arms controls, export and monitoring procedures, defensive and protective measures, and determined responses to the use of biological weapons.

be based on regulations such as the 2001 UK Anti-terrorism, Crime and Security Act[117], the Genetically Modified Organisms (Contained Use) Regulations 2000[118] or more general documents such as the UK Medical Research Council's Policy and Procedure for Inquiring into Allegations of Scientific Misconduct.[119]

63. A code of good practice bringing together and reiterating the provisions of existing codes and regulations might provide a limited added value in complying and clarifying controls. The introduction of such a code might also bring greater attention to the issues at hand. Yet, as argued above, it is important to find ways of taking further existing code of practice-related initiatives as well. Pearson has offered one such proposal for incorporating BW concerns within the existing routine procedures for evaluating scientific and medical work.[120] He takes as his starting points both the need to reaffirm the core tenet of the BTWC that microbial or other biological agents should only be used in types and quantities that can be justified for prophylactic, protective or other peaceful purposes as well as the limited prospects for achieving agreement on an international code in the 2005 BTWC discussions. The proposal is to build on existing national and international health and safety regulations[121] by establishing a code of practice requiring that current hazard assessments of scientific activities also consider their legality under obligations deriving from prohibition agreements which in the UK are those in the Biological Weapons Act 1974[122] and the Chemical Weapons Act 1996[123]. In this manner, considerations about the control of biological weapons would be integrated into everyday practices of varied communities engaged in the life sciences with little additional regulatory burden. Since not all countries have taken the necessary measures to bring into force the national implementation measures set out in the BTWC,[124] this approach could have the added benefit of drawing attention to the need for such national implementation action.

64. The proposal by the US National Research Council in its report *Biotechnology Research in an Age of Terrorism*[125] to expand the existing NIH rDNA review procedures for seven categories of 'experiments of concern' might inform an enforceable code. The NRC suggested that proposals falling under these categories should be submitted to Local Institutional Biosafety Committees for 'assessment' regarding their security, rather than just biosafety, implications. An expanded national board could then be convened to examine the

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[117] Her Majesty's Stationery Office. *Anti-terrorism, Crime and Security Act 2001* ISBN 0 10 542401 3. Available at http://www.hmso.gov.uk/acts/acts2001/20010024.htm

[118] Her Majesty's Stationery Office, *The Genetically Modified Organisms(Contained Use) Regulations 2000* Statutory Instrument 2000 No. 2831 ISBN 0 11 018676 1. Available at http://www.hmso.gov.uk/si/si2000/20002831.htm

[119] Medical Research Council. 1997. *MRC Policy and Procedure for Inquiring into Allegations of Scientific Misconduct* London: MRC. Available at http://www.mrc.ac.uk/pdf-mis_con.pdf

[120] Pearson G Some Additional Considerations Regarding a Possible Biological and Toxin Weapons Convention (BTWC) Code of Conduct 12 February 2004. Available at: http://www.brad.ac.uk/acad/sbtwc.

[121] In the UK including the Health and Safety Act 1974 and Control of Substances Hazardous to Health Regulation 2002. See http://www.ex.ac.uk/codesofconduct/Examples/index.htm See as well Pearson, Graham. 2003. National Measures to Establish and maintain the Security and Oversight of Pathogenic Microorganisms and Toxins Bradford Briefing Paper April 2003.

[122] Her Majesty's Stationery Office, *Biological Weapons Act 1974.* Available at http://www.opbw.org/nat_imp/leg_reg/uk/BIOLOGICAL%20WEAPONS%20ACT%201974.pdf

[123] Her Majesty's Stationery Office, *Chemical Weapons Act 1996* , ISBN 0 10 540696 1 Available at http://www.hmso.gov.uk/acts/acts1996/1996006.htm

[124] Sims, N *Towards the BTWC Sixth Review Conference: Making Best Use of the 26 March 2005 Anniversary,* University of Bradford, Department of Peace Studies, Briefing Paper No. 10 (Second Series), December 2003. Available at http://www.brad.ac.uk/acad/sbtwc

[125] National Research Council. *Biotechnology Research in an Age of Terrorism* Committee on Research Standards and Practice to Prevent the Destructive Application of Biotechnology Washington, DC: National Academies Press; 2004. Available at http://books.nap.edu/catalog/10827.html

most difficult proposals, a role now to be fulfilled in the US by the newly created National Science Advisory Board for Biosecurity.

65. It is not yet clear what criteria will be used to judge individual projects against or how this oversight system will function. A survey[126] of institutional biosafety committees in the US has identified a number of biosafety shortcomings in regard to the assessment of work involving dangerous pathogens. The value of such pre-experiment assessments depends, in part, on the extent to which the results and implications of these activities are foreseeable. Leaving it up to individuals or groups in biosafety committees to anticipate issues of concern is a questionable strategy to the extent that experiments yield unpredictable results. However, a parallel approach has long been taken in regard to ethical committees considering experiments involving human subjects. Specifying procedures for reporting significant 'dual use' findings might be another line to pursue as part of enacting an enforceable code.

66. In international terms, while the enforceable measures discussed above might not pose a significant burden on some countries, the approach to globalisation in world trade means that increasingly all countries are adopting similar standards. Although current procedures and infrastructures for monitoring and evaluating scientific and medical work vary considerably around the world, efforts are increasingly being made to harmonise such procedures and infrastructures.

Matrix Element 2 -- Aspirational Codes: Raising the Awareness of Biological Weapons

67. Section 3 noted a number of critical issues about the possible contribution of aspirational codes. As argued, such codes often conceal more than they clarify and past experience in industry and elsewhere would suggest that their effect on behavior is modest at best. In relation to offensive biological weapons development, past experience with programmes in the Soviet Union, South Africa, and Iraq would suggest the array of oaths, conventions and public condemnations relevant to biological weapons did little to dissuade the participation of physicians and scientists.[127] [128] However, international standards and positions are constantly changing and what might have been true in the second half of the 20th century need not be true in the 21st century.

68. Aspirational codes on their own are quite limited options. However, as part of an integrated matrix, the adoption of such codes might raise the profile of biological weapons, particularly for policy makers within funding bodies, professional societies, and similar organizations, and facilitate future action. Whatever the indeterminacy of the American Society for Microbiologists code of ethics, for instance, it has provided a platform for members concerned about biological weapons to link their concerns to an official statement of the Society. In the UK, few industrial or scientific organizations make any explicit reference to biological weapons as part of their codes or standards. Merely agreeing the relevancy of biological weapons as a topic of concern would have the potential advantage of facilitating subsequent action, even if it did not lead to action today. Existing examples of such codes include The American Phytopathological Societies Position on Biological

[126] Sunshine Project *Biosafety Bites,* June 2004 onwards. Available at http://sunshine-project.org/biodefense/bb.html

[127] Gould C. How science was compromised. *Track Two* 2001 10(3): 14-19.

[128] Alibeck K Handelman S. *BIOHAZARD: The Chilling True Story of the Largest Covert Biological Weapons Program in the World* New York: Random House; 1999.

Weapons[129], Australian Society for Microbiology Code of Ethics[130], EuropaBio Code of Conduct[131] and the ethical principles of BIOTECanada.[132]

Matrix Element 3 -- Educational/Advisory Codes: Provoking Debate about the Place of Science in Society

69. While enforceable codes of practice could help to impose agreed standards and procedures and aspirational codes could provide a basis for furthering awareness of biological weapons within organizations, educational or advisory codes could promote dialogue about the problem of the hostile use of the life sciences and the wisdom of any responsive measures. This Briefing Paper has suggested 'codes of conduct' are at their best when they seek to encourage and enable individuals to reinterpret their actions. Since the issues associated with BW codes today are going to be far more complex than simply forbidding participation in offensive weapons programmes, there is ample scope for useful discussion. The 'lack of teeth' of such codes is only a major problem if they are conceived as a means of ensuring certain forms of behavior. Instead of performing this function, such codes can seek to encourage individuals and groups to assume a position of responsibility as moral agents, though the ultimate ability of codes to do this is highly dependent on the process of their adoption and revision. Codes agreed by one group can also signal to others what should be treated as a topic of concern.

70. Although enforceable or aspirational biological weapons related stipulations could be incorporated within existing codes, it can be argued that a distinct document is needed in the case of an educational code to elaborate in some detail an appreciation of the possible issues at stake. An example of such a code for those that conduct, fund, administer, and regulate work in the biosciences and biomedicine is provided below. It has been assembled, in part, by directly drawing on varied agreed declarations, codes and conventions (see Annex A). It includes a wide range of stipulations, some which might be classified as 'advisory' and others as 'enforceable'.

> ***Preventing the Hostile Use of the Life Sciences***
>
> *Every major technology - metallurgy, explosives, internal combustion, aviation, electronics, nuclear energy - has been intensively exploited, not only for peaceful purposes but also for hostile ones. The rapid developments across the life sciences*
>
> *This risk is not confined to traditional pathogens and toxins of concern; in addition, the fields of molecular biology, neuroscience, biological control and many others are*

[129] The American Phytopathological Society, APS net, *The American Phytopathological Societies Position on Biological Weapons.* Available at http://www.apsnet.org/media/ps/bioweapons.asp

[130] The Australian Society for Microbiology, *Ethics.* Available at: http://www.theasm.com.au/docs/ethics/default.asp

[131] EuropaBio, The European Association for Bioindustries, *Europabio's Core Ethical Values,* October 1998. Available at http://www.europabio.org/documents/ev_en.pdf

[132] BIOTECanada, *Biotechnology Industry Statement of Ethical Principles.* Available at http://www.biotech.ca/EN/ethics.html

[134] Alibeck K Handelman S. *BIOHAZARD: The Chilling True Story of the Largest Covert Biological Weapons Program in the World* New York: Random House; 1999.

[135] http://www.wma.net/e/policy/b1.htm

offering novel ways of manipulating basic life processes. For instance, through deliberate or inadvertent means, genetic modification of microorganisms could create organisms that are more virulent, are antibiotic-resistant, or have greater stability in the environment. Advances in gene therapy may allow modification of the immune response system of the target population to increase or decrease susceptibility to a pathogen or disrupt the functioning of normal host genes.

Those that conduct, fund, administer, and regulate work in the biosciences and biomedicine have an ethical and social responsibility to honour international agreements that they will use their knowledge and skill for the advancement of human, animal, and plant welfare and will not conduct activities in support of the use of micro-organisms, toxins or other biological agents for hostile purpose. In addition, as individuals, collectively as members of professions, and in discussions with other segments of society, these all have an obligation to actively deliberate what measures are necessary to minimize the risk that their work could be employed for hostile ends.

Today and in the future, an effective response to the threats from biological weapons will come from concerted international action by those in governments, the medical and scientific communities, non-governmental and professional organizations, the biotechnology and pharmaceutical industries and others. The history of life science research contains many instances – laboratory biosafety and vivisection to name but two – where standards have been developed and controls have been negotiated out of widespread social concern.

This Code is intended to provoke reflection, dialogue, and action regarding the desirability of response measures. The list of points included is not exhaustive. An understanding of the threats posed from the hostile use of biological weapons from states, groups or individuals will evolve over time and thus so will the necessary responses. The provisions included should not be regarded as separating the acceptable from the unacceptable in all practical situations. This Code is not a simple algorithm that generates definitive answers about what needs to be done. In some situations, standards may be in tension with each other or with standards from other sources. Such situations require those engaged in the life sciences to consider for themselves and discuss with others what constitutes appropriate action. The provisions of this Code should influence those associated with the life sciences to consider broadly who is affected by their work; to examine if they and their colleagues are acting with due regard; to consider how the public, if reasonably well informed, would view their actions; to analyze how the least empowered will be affected by their actions; and to consider whether their acts would be judged worthy of the ideal of those working in the life sciences.

In keeping with this, those that work in the life sciences should:

> ** acknowledge that minimizing risks from the hostile use of advances in the life sciences is of concern to them and part of their responsibility as professionals;*
> ** recognize their personal benign intent is an insufficient justification for setting aside such concerns;*
> ** strive to become aware of the 'dual-use' applications of their work;*
> ** consider the direct and indirect benefits and harms of their work to colleagues, their profession, their communities, and society at large;*

** be aware of the work of associates;*
** ensure they are knowledgeable and comply with respective national and international regulations regarding the physical and biological containment of agents. Where existing measure are considered to be inadequate such concerns should be raised with relevant policy officials and professional organizations;*
** take actions within their own sphere of influence that will contribute to risk reduction;*
** ensure that their actions are known amongst and complement the actions of others;*
** acknowledge they have a responsibility to consider the interests and ideas of all segments of society in assessing what needs to be done.*

Responsibility for minimizing the risk that life sciences will be used for hostile purposes is not just a matter for individuals, but one for the scientific and medical communities operating as a whole. Collective activities should be undertaken to monitor the threat of biological weapons and to identify actions likely to prevent biological weapons proliferation. As part of this, acting in concert, those representing and funding work in the biosciences and biomedicine should:

** recognize that their expertise means they have a responsibility to contribute to efforts to reduce the risks associated with biological weapons;*
** set up procedures whereby those concerned about possible dual-use applications can seek guidance and report any concerns, including whistleblowing on suspicious activities;*
** educate their members and the public about the potential for and responses to biological weapons, including through increasing awareness of this Code;*
** establish the expectation that where there is disagreement about the implications of experiments and findings, then these should be debated openly;*
** institute measures to scrutinize all work with potentially dangerous consequences and to ensure it is submitted to rigorous and independent peer review;*
** put in place procedures to survey overall developments in life science research to identity emerging areas of concern;*
** call for funding to be further directed at the alleviating the causes of insecurity and poverty worldwide (e.g., the spread of infectious disease);*
** reinforce existing international commitments on States to achieve effective progress towards general and complete disarmament, including the prohibition and elimination of all types of weapons of mass destruction;*
** recognize that international agreements are sometimes written in a comprehensive and abstract manner that can leave standards of appropriate conduct ill-defined. Efforts should be made to actively engage governments to clarify the understanding and meaning of prohibitions;*
** call for States to pursue in good faith disarmament negotiations leading to strict and effective international control that reflect the multiple concerns in the international community.*

In undertaking these measures, individuals and collective bodies should further recognize that concerns about biological weapons are not limited to activities directly contributing to the development, production or stockpiling of agents as part of

manifestly offensive programmes. For instance, the recurring interest in some quarters for so-called incapacitating agents threatens to undermine international efforts to prohibit the development, production, and retention of biological agents of types and in quantities that serve no prophylactic, protective or other peaceful purpose. In addition, however inadvertently, activities undertaken as part of biodefence programmes to elucidate the mechanism of virulence or assess biological threats can undermine international confidence in and in themselves violate prohibition regimes. To prevent this, efforts should be made to strengthen the confidence between peoples and the general improvement of the international atmosphere. The presumption should be that the details of biodefence programmes should be open for public scrutiny.

71. This code is intended as a 'modest' contribution in a few important respects. First, the proposing of such content is not intended to make the process of debating what any code should be superfluous. Rather it is intended to serve as an example of what could be done in order to promote discussion. The adoption of such a code should be viewed as an occasion for asking questions about the place of science in society at a given time, and how that might change. A second related point is that the stipulations seek to evoke deliberation rather than provide definitive answers. This approach is taken on the basis that, in these relatively early days of widespread concerted action to define and address the security risks stemming from work in the life sciences and elsewhere, the emphasis should be placed on provoking dialogue about what needs to be done rather than closing it down. Such discussion should include assessments of the criteria by which codes are judged to be 'useful' or 'ineffective', noting that such criteria are themselves likely to change over time. Certainly a further

don'ts. The purpose here is not to provide answers, but to raise issues as topics that need to be addressed in future discussions. The working through of what particular terms entail could be treated as part of the process related benefits of any code. Third, it is also pitched in a largely negative tone regarding their possible detrimental consequences rather than their role in reducing threats from biological weapons. While this or other deficiencies may well need correcting, the rationale in proposing such a code has been to flag possible issues to be addressed rather than resolving its final content.

72. In its terms, this code recognizes the importance and limitations of trying to establish rules specifying proper conduct. Rather than setting out certain standards and expectations, it seeks to initiate a process of critical reflection and dialogue. The provisions deliberately seek to challenge narrow focuses on biological and physical containment, the responsibilities of individuals, offensive programmes, or non-proliferation agendas. The disarmament focus could link with initiatives other areas to reinforce efforts against nuclear, chemical and other proscribed weapons.

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[136] Models of this as provided by National Research Council. *Biotechnology Research in an Age of Terrorism* Committee on Research Standards and Practice to Prevent the Destructive Application of Biotechnology Washington, DC: National Academies Press; 2004 and Steinbruner J and Harris E. Controlling dangerous pathogens. *Issues in Science and Technology* 19, 3, Spring 2003.

[131133] Models of this are provided by National Research Council. *Biotechnology Research in an Age of Terrorism* Committee on Research Standards and Practice to Prevent the Destructive Application of Biotechnology Washington, DC: National Academies Press; 2004 Available at http://books.nap.edu/catalog/10827.html and Steinbruner J and Harris E. Controlling dangerous pathogens. *Issues in Science and Technology* 19, 3, Spring 2003.

[137] See, e.g., *note* 27.

See, e.g., *note* 27.

Conclusions

73. Overall, the previous subsection and the Briefing Paper as a whole have suggested how a ‘matrix of codes’ might be taken forward and the possible aims and audiences involved. Table 1 provides a different appreciation of these issues by suggesting how the codes will function and who will be the main agents for taking the codes forward.

Table 1: A Proposed Matrix of Codes: Functions and Implementers

Type of Code	Primary Functions	Principal Implementers
Code of Ethics	Establish an organizational basis for future action by initially affirming the prohibition against the development of biological weapons	Policy makers in funding and professional organizations
Code of Conduct	Provide elaboration of individual and collective responsibilities of those associated life science work Set a basis for long term discussion about what needs to be done, in part by challenging existing agenda and framing of issues	Life science professionals
Code of Practice	Incorporate BW and biosecurity concerns within of day to day work procedures	Administrators, regulators, funders, and practitioners associated with scientific and medical practice

74. This section has provided the basic outline of a possible 'matrix of codes' that could take forward many of the analytical points made in previous section. Ultimately though it should be stressed that whether a code (or even a matrix of them) will be more than a piece of paper in a drawer depends on the practical commitments made by organizations in promoting and implementing them. The long term interest in codes in the sciences and the relatively little progress that has been made to date should serve to caution against the idea that codes might prove a relatively straightforward policy option. Likewise their utility should not be assumed. Rather, careful questions need to be addressed about their aims and audience; questions which themselves raise issues about consequences of work, the potential for ethical standards to affect behavior, the place of science in society, and the future of arms control.

Annex A: The proposed Code of Conduct was developed from ideas taken from the following sources.

* *"The resolution of bioethical issues requires broad public discourse. We acknowledge our responsibility to consider the interest and ideas of all segments of society."*

-- *Ethical Principles of BIOTECanada* http://www.biotech.ca/EN/ethics.html

* *"Every major technology—metallurgy, explosives, internal combustion, aviation, electronics, nuclear energy—has been extensively exploited, not only for peaceful purposes, but also for hostile ones. Any major turn to the use of biotechnology for hostile purposes could have consequences qualitatively very different from those that have followed from the hostile exploitation of earlier technologies. Unlike … conventional or even nuclear weapons, biotechnology has the potential to place mass destructive capability in a multitude of hands."*

-- Statement by Matthew Meselson http://www.hir.harvard.edu/articles/?id=919&page=4

* *"It is not intended that the individual parts of the Code be used in isolation to justify errors of omission or commission. The list of Principles and Clauses is not exhaustive. The Clauses should not be read as separating the acceptable from the unacceptable in professional conduct in all practical situations. The Code is not a simple ethical algorithm that generates ethical decisions. In some situations, standards may be in tension with each other or with standards from other sources. These situations require the software engineer to use ethical judgment to act in a manner which is most consistent with the spirit of the Code of Ethics and Professional Practice, given the circumstances.*

Ethical tensions can best be addressed by thoughtful consideration of fundamental principles, rather than blind reliance on detailed regulations. These Principles should influence software engineers to consider broadly who is affected by their work; to examine if they and their colleagues are treating other human beings with due respect; to consider how the public, if reasonably well informed, would view their decisions; to analyze how the least empowered will be affected by their decisions; and to consider whether their acts would be judged worthy of the ideal professional working as a software engineer. In all these judgments concern for the health, safety and welfare of the public is primary; that is, the "Public Interest" is central to this Code.

The dynamic and demanding context of software engineering requires a code that is adaptable and relevant to new situations as they occur. However, even in this generality, the Code provides support for software engineers and managers of software engineers who need to take positive action in a specific case by documenting the ethical stance of the profession. The Code provides an ethical foundation to which individuals within teams and the team as a whole can appeal. The Code helps to define those actions that are ethically improper to request of a software engineer or teams of software engineers."

-- *SOFTWARE ENGINEERING CODE OF ETHICS AND PROFESSIONAL PRACTICE*
IEEE-CS/ACM Joint Task Force on Software Engineering Ethics and Professional

* *"11. Rapid advances in microbiology, molecular biology, and genetic engineering have created extraordinary opportunities for biomedical research and hold great promise for improving human health and the quality of life. Better and more rapid diagnostic tools, novel vaccines, and therapeutic drugs can be foreseen. At the same time, there is concern about the*

possible misuse of research for the development of more potent biological weapons and the spread of new infectious diseases. It may be difficult to distinguish legitimate biomedical research from research by unscrupulous scientists with the malign purpose of producing more effective biological weapons…

16. That the World Medical Association, National Medical Associations and healthcare workers worldwide promote, with the World Health Organization, the United Nations, and other appropriate entities, the establishment of an international consortium of medical and public health leaders to monitor the threat of biological weapons, to identify actions likely to prevent biological weapons proliferation, and to develop a coordinated plan for monitoring the worldwide emergence of infectious diseases. This plan should address: (a) international monitoring and reporting systems so as to enhance the surveillance and control of infectious disease outbreaks throughout the world; (b) the development of an effective verification protocol under the UN Biological and Toxin Weapons Convention; (c) education of physicians and public health workers about emerging infectious diseases and potential biological weapons; (d) laboratory capacity to identify biological pathogens; (e) availability of appropriate vaccines and pharmaceuticals; and (f) financial, technical, and research needs to reduce the risk of use of biological weapons and other major infectious disease threats."

-- 2002 *The WMA Declaration of Washington* (http://www.wma.net/e/policy/b1.htm)

** "The States Parties to this Convention,*

Determined to act with a view to achieving effective progress towards general and complete disarmament, including the prohibition and elimination of all types of weapons of mass destruction, and convinced that the prohibition of the development, production and stockpiling of chemical and bacteriological(biological) weapons and their elimination, through effective measures, will facilitate the achievement of general and complete disarmament under strict and effective international control,

Recognizing the important significance of the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare, signed at Geneva on June 17, 1925, and conscious also of the contribution which the said Protocol has already made, and continues to make, to mitigating the horrors of war,

Reaffirming their adherence to the principles and objectives of that Protocol and calling upon all States to comply strictly with them,

Recalling that the General Assembly of the United Nations has repeatedly condemned all actions contrary to the principles and objectives of the Geneva Protocol of June 17, 1925,

Desiring to contribute to the strengthening of confidence between peoples and the general improvement of the international atmosphere,

Desiring also to contribute to the realization of the purposes and principles of the United Nations,

Convinced of the importance and urgency of eliminating from the arsenals of States, through effective measures, such dangerous weapons of mass destruction as those using chemical or bacteriological (biological) agents,

Recognizing that an agreement on the prohibition of bacteriological (biological)and toxin weapons represents a first possible step towards the achievement of agreement on effective measures also for the prohibition of the development, production and stockpiling of chemical weapons, and determined to continue negotiations to that end,

Determined for the sake of all mankind, to exclude completely the possibility of bacteriological (biological) agents and toxins being used as weapons,

Convinced that such use would be repugnant to the conscience of mankind and that no effort should be spared to minimize this risk,

Have agreed as follows:"

-- Preamble to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction. Available at http://www.opbw.org

* *"The ICRC's message to actors in the life sciences can be summarized as follows:*

- *Be aware of the risks, rules and responsibilities as outlined in the ICRC appeal.*
- *Take action in your own domain to minimize the risk.*
- *Be aware of the work and interests of others and work with them.*

Some examples of the types of practical action the ICRC proposes to actors in the life science through the 'Biotechnology, Weapons and Humanity' appeal include:

- *Scrutinizing all research with potentially dangerous consequences and ensuring it is submitted to rigorous and independent peer review.*
- *Adoption of professional and industrial codes of conduct aimed at preventing the abuse of biological agents.*
- *Ensuring effective regulation of research programmes, facilities and biological agents that may lend themselves to misuse, and supervising individuals with access to sensitive technologies.*
- *Supporting enhanced national and international programmes to prevent and respond to the spread of infectious disease.*
- *Ensuring that awareness of risks, rules and responsibilities to prevent poison and the deliberate spread of disease are part of laboratory or other training for all personnel."*

-- ICRC *Responsibilities of Actors in the Life Sciences to Prevent Hostile Use* http://www.icrc.org/Web/eng/siteeng0.nsf/html/5VDJLW?OpenDocument