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**Civil society preparations for the Seventh BWC Review Conference
("BWPP Online Discussions")**

How will technological developments influence the BWC?

This paper is based on the views expressed by Maria J. Espona, Ineke Malsch, Kathryn Nixdorff and Jonathan Tucker during the BWPP online discussion on the topic of "How will technological developments influence the BWC?", available at www.bwpp.org/revcon-techinfluence.html.

We have had the great privilege of working with Dr. Jonathan Tucker on this project and are deeply saddened by his untimely passing. His contributions have been invaluable to all in the biological weapons control community.

Developments in Science and Technology

Advances in science and technology (S&T) over the past few years have initiated new and improved approaches to countering disease and promoting health in general that are inordinately beneficial to society. At the same time, the possibilities for misuse that are inherent in the knowledge gained from developments in S&T pose potential biosecurity risks.

Progress in genomics is enabling ever more rapid and cost effective analysis of gene functions as well as facilitating the manipulation of even very complex microorganisms to meet designer specifications.¹ Synthetic biology is advancing beyond sophisticated engineering of microorganisms to outfit them with DNA-based biological circuits that allow them to perform unique tasks. Sub-fields of synthetic biology are now reaching into the realm of creating artificial life from chemical components.² Systems biology seeks to understand the working of complex physiological systems within and between cells.³ These studies are generating an immense amount of knowledge that pinpoints vital cellular targets and ways of manipulating them for both beneficial and non-peaceful purposes. The dramatic developments and expansion of information technologies have contributed significantly to advances in all the above S&T areas as well as to the dissemination of the knowledge gained.

Concerns about advances in S&T leading to the creation of novel and more effective biological warfare agents are compounded by the recognition that new and improved ways of delivering them are already at hand and will be developed further at a rapid pace. Great strides are being made in biological agent delivery techniques for use in vaccine therapy, cancer and immunotherapy. The production of defined nanoparticles combined with new methods for making substances absorbable through the nasal and respiratory tracts and across the blood-brain barrier creates a potential for greatly improved aerosol delivery of bioactive compounds.⁴ Improvements in aerosol delivery platforms as well as improvements in the targeting specificity and gene transfer efficacy of viral vectors for use in drug and vaccine therapy, cancer treatment and immunotherapy⁵ have at the same time made the use of these agents for biological warfare much more feasible.

But it is not only the rapidity with which these advances are occurring that is an outstanding feature of S&T developments, it is also the immensity and complexity of the knowledge that is accumulating from such studies. In our discussions, we identified additional factors that contribute to the complexity of dealing with biosecurity aspects of advances in S&T, including the convergence of biology and chemistry, technology dissemination dynamics and the distinctive nature of biological risks. There are thus clear indications that we have reached a critical point in being able to deal adequately with both the benefits offered and the potential risks posed by advances in S&T in relation to the Biological and Toxin Weapons Convention (BWC).

Science and Technology and the Seventh Review Conference of the BWC

The urgent need for a new process in reviewing S&T developments in relation to the BWC has been expressed by several voices since the Sixth Review Conference and the end of the second intersessional process meetings. Not only a need for more frequent reviews⁶ but also more meticulous assessments of S&T developments and their relevance for the BWC⁷ have been called for. The time to pick up on these suggestions is more than ripe, and we join others in offering the following points for consideration by the States Parties at the Seventh BWC Review Conference.

1. More frequent review of S&T developments and their relevance for the BWC. How often this review should be made is open to debate, but to wait every five years is just too long given the rapidity and above all the immensity and complexity of science and technology developments. This is all the more urgent considering the fact that access to technological developments is disseminating rapidly around the globe to more and more countries. We particularly support having annual meetings where the review of one particular area of advancement would be covered per year.

2. A more thorough scrutiny of developments by experts to assess the relevance of advances in different areas. Up to now the reviews of advances in science and technology have been carried out mainly by individual States Parties or the ISU and submitted as background papers. However, there has never been a formal assessment by the collective BWC body. To receive the attention that would be most useful, a body of policy makers and scientists representative of all States Parties as well as experts from civil society and industry (“Body of Experts”) could meet for an intensive exchange of views about the relevance of particular areas of advancement. In the assessment process, an intensive exchange amongst scientists and policy experts together would be most productive, so that each side can best understand the problems of the other in dealing with the developments.

3. Collective scrutiny of the recommendations of this Body of Experts by the States Parties of the BWC. Proposals covering what needs to be done to ensure greater security could then be formulated and presented to the BWC States Parties in time for their next meeting.

4. Consideration of positive aspects of S&T developments for ensuring more effective biosecurity. The ways in which developments in S&T could contribute positively to enhancing biosecurity and strengthening the BWC should be a part of the assessment of their relevance by the Body of Experts. Areas to be assessed in particular include the emerging field of microbial forensics, which employs advanced genetic and physiochemical analyses to identify the source of the agent used in an attack. These technologies could support United Nations field investigations of alleged biological weapons use, as well as provide a powerful tool for monitoring compliance with the BWC, which lacks formal verification measures. In addition, developments in the area of computer science concerned with “designer biochemistry” should be assessed, including ways in which biohazardous properties of computer-designed molecules can be detected and possibly avoided⁸ early in the development process.

We can be certain that advances in S&T will continue to develop rapidly, and the knowledge gained will become more and more complex. Finding a new process to more adequately assess the relevance of these developments and their potential consequences for the BWC is urgent and in the interest of all States Parties.

Endnotes

¹ Petterson, E., J. Lundeberg and A. Ahmadian. 2009. Generations of sequencing technologies, *Genomics*. 93: 105-111.

² Schmidt, M. 2009. Do I understand what I can create? In *Synthetic biology. The technoscience and its societal consequences*, ed. M. Schmidt, A. Kelle, A. Ganguli-Mitra and H. de Vriend, 81-100. Dordrecht et al.: Springer.

³ Thiel, K. 2006. Systems biology, incorporated? *Nature Biotechnology* 24, 1055-1057; Rix, U. and G. Superti-Furga. 2009. Target profiling of small molecules by chemical proteomics. *Nature Chemical Biology* 5: 616-624.

⁴ Suri, S.S., H. Fenniri, and B. Singh. 2007. Nano-technology-based drug delivery systems. *Journal of Occupational Medicine and Technology* 2: 16-21.; see also Malsch, I. 2011. *Nanotechnology and the BTWC*. BWPP RevCon discussions, 18 January 2011. Available at <http://www.bwpp.org/revcon-techinfluence.html>.

⁵ Chalikonda, S., M.H. Kivlen, M.E. O'Malley, X.D.E. Dong, J.A. McCart, M.C. Gorry, X.-Y. Yin, C.K. Brown, H.J. Zeh, III., Z.S. Guo and D.L. Bartlett. 2008. Oncolytic virotherapy for ovarian carcinomatosis using a replication-selective vaccinia virus armed with a yeast cytosine deaminase gene. *Cancer Gene Therapy* 15: 115-125; Hwang, S.-K., J.-T. Kwon, S.-J. Park, S.-H. Chang, E.-S. Lee, Y.-S. Chung, G.R. Beck Jr., K.H. Lee and L. Piao. 2007. Lentivirus-mediated carboxyl-terminal modulator protein gene transfection via aerosol in lungs of K-ras null mice. *Gene Therapy* 14: 1721-1730.

⁶ UK, *Scientific and technological developments relevant to the Biological Weapons Convention*. Contribution to the background document on new developments in science and technology, Sixth Review Conference, Geneva, 2006. Available at <http://www.opbw.org>; See also a summary of a workshop by the National Research Council. *Trends in Science and Technology Relevant to the Biological and Toxin Weapons Convention*. National Academies Press, Washington, D.C. 2011. Available at <http://.nap.edu>.

⁷ Rhodes, C. and Dando, M.R. Options for a scientific advisory panel for the Biological and Toxin Weapons Convention. In *A web of prevention. Biological weapons, life sciences and the governance of research*, ed. B. Rappert and C. McLeish, 95-114. London: Earthscan, 2007; Dando, M.R. and Pearson, G.S., *The Provision of Scientific and Technological Advice to the Biological and Toxin Weapons Convention*. Review Conference Paper No. 27, University of Bradford, February 2011. Available at www.brad.ac.uk/acad/sbtwc; Pearson, G.S., *Special HSP Report from Montreux*, May 2011. Available at <http://www.sussex.ac.uk/Units/spru/hsp/>.

⁸ Van Noorden, R. 2011 How to design a safer chemical. *Nature*, online 29 July 2012, doi:10.1038/news.2011.448.