3

Education for the Life Sciences: Choices and Challenges

Brian Rappert

> *The web of prevention is expressly designed to foster synergy of action among all people in a position to limit the risk of poisoning and the deliberate spread of disease. The idea is that if individual actors in the life sciences are properly informed of the risk, rules and their responsibilities, they will make better decisions. (ICRC, 2004)*

> *Just to point out we are all thinking about education and we feel like that is the next stage, and at least our working group, and I am hearing the same thing from the others, feel like it is the next big thing we need to do. (Remark by Professor Paul Keim at the 30 March 2006 meeting of the US National Science Advisory Board for Biosecurity)*

The education of those associated with the life sciences has gained a prominent place in considerations of how to prevent bioattacks. In many respects, this is hardly surprising or contentious. An understanding of the basis for, and the potential of, such weapons is a prerequisite for sound practices and effective policies. For an organization such as the US National Science Advisory Board for Biosecurity that is tasked with proposing procedures for researchers to define, evaluate and communicate dual use research, education has an obvious relevance.

And, yet, whatever the widespread and readily appreciated significance of education, when the question is asked: 'What should count as individuals being properly informed of risks, rules and their responsibilities?', then quiet agreement can give way to vocal questioning. Who needs to be properly informed? What should education consist of? Who should determine this? Education can be a source of disagreement, at least in part, because any idea of what it properly consists of is inexorably bound with the exercise of authority.

This chapter treats the topic of education as a window for examining many

of the questions associated with determining what needs to be done in enacting a web. The next section begins by briefly reciting recent calls for professional education and awareness-raising – mainly those statements coming from Western countries. It notes that while such calls are frequently made, specifics about what that education should consist of are often absent. The third section examines some of the many choices and challenges associated with educational efforts; these relate to who should educate whom, and about what, how and why. The fourth section then briefly describes various activities currently under way. To illustrate some of the tensions in what gets done, the fifth section focuses on the possibilities and problems raised in seminars undertaken by Malcolm Dando and the author.

The pervasive call for education

The need for awareness-raising and education of one sort or another has long been recognized as part of efforts to prevent the development and use of biological weapons. For instance, the 1991 Final Declaration of the Third Review Conference and the 1996 Final Declaration of the Fourth Review Conference of the Biological Weapons Convention (BWC) appealed to the science community to adhere to the terms of the convention (see, as well, BMA, 1999). There is little doubt, though, that the urgency and extent of calls for education increased considerably after 11 September 2001 and the anthrax attacks in the US, in line with the overall boost in attention to biological weapons.

Such calls have taken a number of forms. The World Medical Association's (2002) *Declaration of Washington on Biological Weapons* underlined the responsibility of its national medical associations to educate the public and policy-makers, reinforce the norm against biological weapons, and instruct themselves about the health effects of biological weapons. With the passage into force of national legislation regarding the security of pathogens and laboratories (e.g. the US Public Health Security and Bioterrorism Preparedness and Response Act of 2002 and the 2001 UK Anti-terrorism, Crime and Security Act), researchers have been required to become familiar with their legal obligations.

Beyond these fairly traditional topics of concern, education has also been a strong theme in attempts by science and medical communities to establish systems of self-governance in response to heightened concerns about the 'dual use' potential of findings and techniques. As part of endorsing such an approach, the US National Academies report *Biotechnology Research in an Age of Terrorism* (NRC, 2003, p111) recommended that 'national and international professional societies and related organizations and institutions create programs to educate scientists about the nature of dual use dilemma in biotechnology and their responsibilities to mitigate its risks'. The US National Science Advisory Board for Biosecurity (NSABB), set up with the intention of taking forward many of the recommendations of *Biotechnology Research in an Age of Terrorism*, has a charge to develop recommendations for mandatory biosecurity education

programmes for those working at federally funded institutions. While the NSABB had not yet taken up this charge by early 2007, as indicated by the quote from Professor Keim, concerns about education have come to underpin a variety of the board's deliberations. A meeting of British scientists, policy-makers and others in 2004, sponsored by the Royal Society and the Wellcome Trust, called for enhanced education and awareness-raising training for scientists regarding their legal and ethical responsibilities. This was done to further a system of self-governance.

At the international level, a variety of organizations have called for educational initiatives. This includes the International Committee of the Red Cross in its 2002 *Biotechnology, Weapons and Humanity* appeal, the UN Policy Working Group on the United Nations and Terrorism (2003), and the InterAcademy Panel in its *Statement on Biosecurity* (IAP, 2005), as well as the report of a Royal Society–InterAcademy Panel–the International Council for Science international workshop on science and technology developments (see Chapter 5 in this volume).

Many of the calls have received impetus from, and given impetus to, attempts to develop and promulgate codes of conduct. In 2005, States Parties to the BWC met to discuss and promote common understanding and effective action regarding the 'content, promulgation and adoption of codes of conduct for scientists'. Education figured as central in many of the codes papers and presentation by states and NGOs. Countries as diverse as Germany, China, Australia, Pakistan and Japan spoke about the need for scientists to be knowledgeable about laboratory safety procedures and cognizant of the ethical implications of their work. In relation to research relevant to dual use concerns, for instance, Germany argued that: 'Governments should therefore encourage universities to make [risk management] training obligatory in their biomedical and bioscience curricula' (Brasack, 2005, p3). It went further to promote a licensing system for those working in genetic engineering and pathogenic micro-organisms. Herein, a licence 'should be contingent upon proper training on the content of the Biological and Toxin Weapons Convention and the obligations incumbent on scientists under this treaty, as well as training on ethical decision-making and risk assessment'. The final *Report of the Meeting of States Parties* in 2005 contained a number of education-related points (see UN, 2005).

The predicaments of education

Many of the aforementioned calls and statements are largely just that: general declarations identifying sources of concern meant to encourage (more or less well-defined) future action. While forms of legislation and regulation related to laboratory security, as well as the vetting of researchers, generally stipulate obligations that are enforced by public agencies, much of the recent policy attention to education relates to more wide ranging concerns about the potential for the malign application of the life science findings and techniques. With regard to the latter, the attention to education is especially significant given the repeatedly

expressed preference for research community self-governance mechanisms over the legislative approaches that often govern the transfer of materials and equipment (see Chapter 9).

In the initiatives mentioned so far, education is rarely portrayed as a problematic undertaking. Certainly, the extent of consensus regarding the inappropriateness of biological weapons suggests broad accord about the ultimate aim. The largely yet to be taken forward status of the educational calls mentioned in the previous section also contributes to the lack of explicit acknowledgement of knots and binds.

Even within the parameters of the general calls set out, though, it is possible to identify sources of likely tension. For instance, the IAP (2005) *Statement on Biosecurity* and the 2005 BWC final *Report of the Meeting of States Parties* (UN, 2005) suggest that scientists should consider the 'reasonably foreseeable consequences' of their work. But this poses the question of just what those consequences are, how far they extend into the future and who can foresee them. Related to this, general calls for those in the life sciences to consider the ethical implications of their work are likewise question begging about how those implications are to be determined.

This section examines some of the key questions about education in the web of prevention: what should that entail? How should it be done? Who should do it and for whom? Why is it necessary?

What?

The near universal denunciation of biological weapons provides the core component for educational messages seeking to foster a web of prevention. However, the consensus on this basic issue belies the potential for dispute elsewhere. While international agreements such as the BWC and the 1925 Geneva Protocol provide the cornerstone for the international legal prohibition of biological weapons, in certain key respects they leave standards of individual conduct ill defined. For instance, just what should count as justified for 'protective purposes' is not specified in the BWC. Since most, if not all, aspects of bio-defence activities have at least some offensive relevance, drawing lines about what can be done is often contentious. With the recent substantial expansion of bio-defence funding in the US, critical points have been made about the permissibility of certain activities and their effects on undermining international confidence in the convention (see Leitenberg et al, 2003; Rappert, 2006). While the ambiguity about central terms of the BWC was and probably remains essential in getting states to agree to it, this situation does make promulgating standards for individual conduct somewhat challenging.

The BWC not only entails elements of built-in ambiguity, but also of deferral. It is for States Parties to the convention to translate its general provisions into specific national measures and legislation. Nevertheless, the extent and nature of national implementation varies significantly, with a not inconsequential number of signatories having no implementation legislation (Pearson and Sims, 2006). Variation in how the convention is interpreted is particularly pronounced

because of the lack of any verification and enforcement agency, as well as the absence of a negotiating mandate during recent years that might have facilitated more uniform practice. While variation in interpretation and implementation allows for individual nations to undertake actions in light of their respective resources and circumstances, it does mean that the make-up, emphasis and prioritization of any education activities are likely to differ in significant respects. The matter of how international agreements translate into national acts is not only an issue for formal arms control conventions. Just how (and whether) statements made by international groupings of national associations, such as those by the World Medical Association or the InterAcademy Panel, will translate into practical actions is far from clear. No doubt, determinations of the adequacy of an inconsistent approach depend upon assessments about the source of biological threat and just who is likely to be the target of it.

Such national variation is likely to affect what should be included in educational efforts. The aforementioned distinction between the safety and security of pathogens and the fairly novel emphasis on the dual use potential of research findings is relevant here. Undoubtedly, the latter receives greatest attention in the US. To the extent that questions about what gets done and how it is communicated are broached beyond its borders, contention related to national differences is likely to arise. Within the context of the BWC, for instance, many of those nations that make up the Non-Aligned Movement are likely to express fears that dual use responsive measures could restrict access to science and thus undermine Article X of the convention. This states that the BWC 'shall be implemented in a manner designed to avoid hampering the economic or technological development of States Parties to the Convention or international cooperation in the field of peaceful bacteriological (biological) activities'.

How?

The previous subsection pointed to likely differences in national appraisals of concerns that might well lead to significant dissimilarities in assessments of proper risks, rules and responsibilities. Noting such large-scale comparative variations raises the question of just how differences in assessments about the nature of threats and what should be done in response are to be handled through educational programmes. Is there an authoritative voice that can adjudicate between alternative assessments? Are there some ways of thinking that must be challenged? Who would do this on the international stage?

These issues, however, do not just pertain to what education should be *about*. Rather, the process *of* educating itself can entail a negotiation of what counts as authoritative knowledge. A key issue in this regard is whether the intention of education is to impart a particular authoritative understanding to an audience, or whether it is to elicit an understanding from individuals based on what they believe. The former is typically associated with traditional teacher-centred forms of education, the latter with more modern, progressive student-centred forms. The former is also perhaps much more prevalent in science education, whereas the latter is more so in ethics education. In relation to the topics under consid-

eration in this chapter, this 'how' issue can be stated somewhat differently: is it the purpose of educational activities to confront certain (misconceived, poorly considered, etc.) ways of understanding the intersection of the life sciences and bioweapons, or is it to enable individuals (e.g. scientists, administrators, etc.) to make sense of these issues for themselves? The first would be consistent with a strategy of confrontation and conformity, the second with a strategy of dialogue and difference. The first would also be more appropriate to questions of laboratory safety and security, the second more appropriate to concerns about dual use knowledge.

As Billig et al (1989) argued, however, efforts to 'implant' and 'elicit' are not starkly opposed options; instead, the two often mix in complex ways, in practice. Consider this point in relation to one topic in current discussions. In the March 2006 meeting of the NSABB, attention was given to what procedures should be in place to communicate dual use research methodologies and results. This followed on from a previous agreement by a group of science journal editors to review manuscripts for their dual use potential. As noted in these deliberations, of the 16,000 manuscripts submitted to the journals of the American Society for Microbiology over a certain time period, only three were subjected to additional biosecurity peer review. Of those three, only one was modified.

What should these figures be taken to indicate? They might point out that the dual use problem – as it relates to the publication of scientific manuscripts – is 'largely one of perception' and therefore that any responses should be tempered (Casadevall, 2006). With this assessment there is a definite danger that policy responses may needlessly hamper research. Others, though, could contend that such low figures should be taken with caution because of the likelihood that there will be many more submissions of concern in the future and that past ones were missed (Osterholm, 2006). Here the potential lack of consistency in the way in which manuscripts are assessed is a major source of concern.

Given the widely expressed preference for self-governance by life science communities, in general, as well as self- and peer-vetting of manuscripts, whether one accepts the 3 in 16,000 figure is vital in justifying what needs doing. Should scientists and editors, for instance, be shaken out of their complacent mindset, or have the experts who have undertaken the reviews of manuscripts, to date, sufficiently taken everything into account? As an organization tasked with raising the existing profile of the dual use dilemma through devising mandatory educational activities, it would seem unavoidable that the NSABB will have to steer a complicated course between eliciting thinking by scientists, while seeking to influence that in some way.

Who?

These considerations regarding whether there is a proper understanding or not to be realized beg the question of just who is involved: who is the educator and who is the learner if, indeed, such a distinction is to be made. While much of the national regulations and legislation regarding the physical security of pathogens set down some parameters regarding just who needs to fulfil their obligations, in

relation to concerns about the destructive use of results the issues at hand are much more complicated. Assessments of just who needs to be educated in relation to the latter could vary between those working with dangerous agents to a wider range of those (however peripherally) associated with the life sciences (e.g. including certain mathematicians, engineers and funders).

Determining who should be the audience and at what point in time depends upon assessments about where the problems lie. Are any likely dangers going to be associated with dangerous pathogens and toxins, or are there threats from areas of research, such as neuroscience and bioregulation (see Dando, 2003)? If one maintains the latter position, a considerable amount of research and development in large pharmaceutical companies and small biotech firms might merit scrutiny.

But making determinations of audience will also depend upon the desired end state of education. Is education merely to raise awareness of specific concerns or to bring about a particular collective understanding? Is the goal to get those with benign intent to recognize a potential or to compel particular forms of behaviour? If the audience is broadly conceived, then the first options would seem much easier.

As well, working with a relatively narrow pathogen-centred audience has the advantage of engaging with those much more likely to be aware of dual use concerns. The further that outreach goes from those familiar with the issues at hand, then the more likely any educator might need to be a proselytiser. In relation to the geographic breadth of an audience, for instance, there is now a considerable problem for those in the US most actively concerned about dual use knowledge: how can international attention to this topic be fostered without it appearing that it is an unacceptable expression of geopolitics?

Finally, the need for education is related to where threats are seen to come from: whether, for instance, they stem from those countries with the most active biotechnology activities, the most lax controls or the most frequent outbreaks of pathogenic diseases.

The matter of 'who' in certain education policy deliberation is not just an issue of 'who' in the science community. The rather wide ranging attention garnered by experiments, such as the artificial synthesis of polio virus, by the accidental release of pathogens from certain labs and by the recreation of the 1918 Spanish flu virus have led to concerns about 'the public's' reaction to past and future scientific pursuits. The spectre of further government legislation spurred on by public outcry haunts many policy debates (see, for example, Albright, 2003).

As a result, the education of *the public* has become a prominent matter for some (as in the deliberations of NSABB – see Keim, 2006). Such discussions have a rather distinctive flavour. Whereas earlier this chapter maintained that varying appraisals are given of what education *for* scientists should mean in terms of instilling and eliciting knowledge, education in relation to the public is routinely discussed in terms of educating the public *by* experts. The approach is one of transmitting knowledge in order to avoid misunderstanding. It is difficult to find any positive insights identified in policy discussions regarding what

knowledge and insights members of the general public might bring to bear in responding to the destructive application of life science research.

Why?

As a final key area, the matter of why education is being pursued is highly germane. As an abstract call, the case for further education about bioweapons-related issues is rather uncontroversial. Once one becomes more hands on, however, the importance of education has to be weighed against other educational priorities. The question of why this particular topic is in need of greater attention then looms large. In the context of those countries with severe and chronic public heath problems, the reasoning for this question becomes all the more plain. In the context of dispute about where any bio-threats might stem from, this question becomes all the more complicated.

Education itself, furthermore, is often seen as way of spreading particular priorities and concerns. In its extreme formulation, education can be regarded as a type of propaganda. Why it is being done, then, is an important issue. In relation to bioweapons, this consideration can be perceived in different ways. The fact that significant attention is devoted to what gets funded, published and communicated might be interpreted by some as an imperious agenda. Education in the absence of other significant regulatory initiatives, however, might be seen by others as a cover to mask the absence of substantial action.

Educational initiatives

Against such considerations about what might be done, this section briefly mentions some of the educational activities being undertaken today. The purpose is not to provide a comprehensive account of all such efforts worldwide, but to illustrate something of the range of choices available. During recent years, educational activities in the area of biological weapons and the life sciences have included initiatives such as:

- Good laboratory practice. Under the World Health Organization's Biosafety Programme, various activities are being undertaken to reduce the accidental or inadvertent spread of disease from the handling of pathogens. This includes the provision of technical assistance and information, as well as the development of standards. In 2006, the WHO launched a laboratory guidance for biosecurity entitled Biorisk Management. US Sandia National Laboratories has an International Biological Threat Reduction programme centred on minimizing bio-risks from research. It undertakes workshops, lab consultations and conferences on such matters as assessing the risks with agents, laboratory biosecurity/biosafety procedures, transportation of agents, methods of pathogen and disease surveillance, means for reducing outbreaks, and export-control compliance.[1]
- Online education and training modules. The Southeast Regional Centre of

Excellence for Biodefense and Emerging Infections has established an online module intended for those engaged in biological research.[2] Its main focus is with the dual use potential of modern life sciences and the measures that scientists, technicians and others might undertake to minimize concerns stemming from their work. The Federation of American Scientists has produced a series of online educational modules designed to increase awareness of biosecurity and to promote enhanced self-regulation by scientists.[3] The Center for Arms Control and Non-Proliferation has also produced an online educational programme that includes information about the threat of biological weapons, the history of their use, the dual capability of modern biology, and national and international efforts to reduce bio-threats.[4]

- Summer courses. The Institute on Global Conflict and Cooperation within the University of California runs a two-week summer course for graduate students and junior professionals that examines the threat of bioterrorism and public policy responses.[5]
- Curriculum development. The Nuclear Threat Initiative compiled a listing of university and institute courses taught relevant to the area of biological weapons.[6] Middlebury College in Vermont, US, has convened a number of annual curriculum development workshops for those studying nuclear, chemical and biological weapons.[7]

With each of these activities, important questions can be posed about the what, how, who and why of education. Such a comprehensive analysis, however, is beyond the scope of this chapter. The remainder of it will, instead, examine one educational initiative in detail in order to suggest the choices and challenges at stake.

The life sciences, biosecurity and dual use research seminars

The dual use research seminars developed by Malcolm Dando at the University of Bradford, UK, and Brian Rappert (this author), from the Department of Sociology and Philosophy at the University of Exeter, UK, in 2004, comprise an interactive dual use seminar format, and are supported by grants funded by the UK Economic and Social Research Council as well as the Alfred P. Sloan Foundation. Originally, the seminars were undertaken with a view to informing policy deliberations in the UK in the build-up to the 2005 BWC codes of conduct meetings.

When we began thinking about what kind of educational activity to undertake, we thought it was vital to promote interaction *between* practising scientists. Because of the personally and professionally threatening nature of dual use concerns, we judged it essential to get peers to deliberate upon these issues with one another (rather than with us). In addition, the overall lack of professional attention to dual use issues in the past suggested that some researchers would not have well-thought out views about the issues posed. Encouraging interaction

was one means of exploring how scientists and students defined the issues at stake. To this end, in a manner analogous to 'focus groups', we sought ways of bringing groups together and guiding them through questions in order to probe their reasoning and to encourage reflection.

Initial efforts to do so were made in the UK. The original plan was to convey seminars through the regional branch meetings of the Institute of Biology, a professional body for British biologists. However, due to a lack of interest in this topic and practical difficulties, this plan was abandoned. Instead, existing university faculty departmental seminar series were used. Rather than giving traditional presentations, where we would lecture for most of the time and then leave a few minutes for questions at the end, the seminars were designed as a question-and-answer session. We planned to talk about specific dual use cases and policies and then pose questions for group discussion.

As such, just what questions we asked and how became key concerns. At the start, it was difficult to know how to schedule the questions or what topics among the large range of possible relevant ones might be most appropriate. Three general issues were identified as central to current dual use knowledge debates: are there experiments or lines of work that should not be done? Are some results better left unpublished or otherwise restricted in their dissemination? Are the envisioned proposals for the oversight of research sensible? What we then did was to experiment with different orderings, contents and emphases to find ways of probing our emerging sense of participants' likely evaluations. For instance, prominent cases of dual use research in biosecurity discussions were introduced and the initial questions were posed about whether they should have been published or conducted. It was clear from the start that audience members were overwhelmingly in favour of publishing and conducting such experiments. The main arguments offered for this could be generalized as 'we need to know'. It was important to undertake research and disseminate its findings because this would provide beneficial health applications and also aid in devising defensive measures.

With an emerging sense of this initial prevalent evaluation, we transformed subsequent information and questions in order to encourage participants to elaborate upon the reasoning behind it (see Rappert, 2006). For instance, in response the prevalence of the contention that 'we need to know', Dando and I devised a follow-on slide that detailed how, in one particular case, the researchers involved did not just publish their results in a standard scientific journal, but communicated its possible dual use implications through the semi-popular magazine *New Scientist*. Here, then, was an attempt to flag concerns in an accessible way to a much wider audience. In contrast to the near unanimity regarding the publishing of experimental results in the scientific press, responders have almost always been sharply divided on the merits of 'popularly publishing'. This disagreement could then serve as a basis for generating discussion about more detailed questions, such as: who is the 'we' who needs to know? Is popular attention to an issue necessary to generate political action? Would raising attention to potential threats make biological weapons more attractive options because of heightened public anxiety? Would the failure to draw atten-

tion to concerns one day lead to allegations of the paternalistic attitude of scientists? Through such discussion, different models for thinking about the place of science in society could become topics for debate *between* seminar participants. As such, in facilitating the discussion, Dando and I not only had to attend to the current topic, but also to think about what should come next by way of intervention in order to encourage participants to elaborate upon their underlying and often unstated reasoning.

This transformative approach to questioning that began in late 2004 was extended beyond the UK to a number of other countries. By the beginning of 2007, 51 non-pilot seminars had been conducted in six countries: 23 in the UK; 1 in Germany; 4 in The Netherlands; 2 in Finland; 14 in the US; and 7 in South Africa. Detailed analysis of the content of the seminars has been given elsewhere (see Dando and Rappert, 2005; Rappert et al, 2006; Rappert, 2007) and has led to the production of interactive educational materials.[8]

Rather than reiterating the main conclusions of such analyses, the remainder of this section considers some of the choices and challenges associated with trying to conduct this specific form of outreach in relation to previous points in the chapter.

The brief account earlier of the transformative dynamics indicates the basic mechanism for generating discussion: based on our sense of likely responses, we were able to give additional information and ask follow-on questions that further probed individuals' thinking. Such an approach provided a way of confronting participants' thinking, but in an indirect manner. Thus, the seminars mixed both the 'implanting' and 'eliciting' goals of education insomuch as they challenged certain ways of thinking – while getting individuals to articulate their own (contrasting) reasoning to each other.

Relying on participants' responses in this manner was tension ridden – it provided the basis for discussion and also its limits. With regard to the latter, for instance, if no participant brought up what we might consider to be a pertinent perspective, then we, as facilitators, were left with an awkward choice. We could offer that perspective in the form of a question during the discussion ('What about the view that X?'). However, doing so (even in a way that was not directly backing such a position) may well make us appear to be advocating a certain way of thinking. This was especially the case because, as indicated previously, participants tended to respond to the central issues of the seminars in consistent ways ('We need to know'), and this meant that we would also be querying them in a consistent fashion. So, while the seminar design enabled us as facilitators to steer the basic course of the discussion, this was in a fairly coarse manner.

Following on from these points, in designing and conducting the seminars, there were important concerns regarding the extent to which we as presenters explicitly advanced our positions. While we attempted to gauge their thinking about certain issues, there were many possible options regarding how our own thinking entered that process. Instead of simply posing certain questions, we could have probed participants by explicitly challenging what they said in order to generate a response and then further discussion. While it was possible to design the seminar along the lines of a 'debate' rather than a 'question-and-

answer session', it would have been more difficult interactively. For instance, an early attempt in the UK seminars to add a slide at the end that gave our assessment of participants' responses was abandoned because it repeatedly led to the closing down of discussion. Based on our experience in conducting the sessions, we decided to refrain from offering explicit positions on any of the questions unless asked.

However, it was exceptionally rare that we were asked for our thinking. While what would count as an instance of being asked is open to some interpretation, in all the seminars in the UK, I suggest that we were only directly asked about our evaluation of specific issues in the order of several times. More generally, except for South Africa, it was likewise exceptional that anyone queried our agendas in conducting the seminars beyond the explanation we provided. Such a lack of questioning had the advantage of helping to move the discussion along according to our design and concerns. It did, however, limit the types of exchanges and presumably in doing so led the participants to make incorrect attributions about why we were saying what we did. This is especially likely to be the case in our work in The Netherlands, Finland and South Africa, where the seminars were arranged with the cooperation of national organizations (the Finnish Ministry of Foreign Affairs, the Royal Netherlands Academy of Arts and Sciences, and the Institute for Security Studies (Africa) with Chandré Gould).

Our decision not to directly confront participants with our own thinking was somewhat necessitated by the division of expertise. With the exception of some of the US seminars, very few participants displayed knowledge of dual use policy discussions. Therefore, it was certainly more the exception than the rule that any participant at any time during a session would bring up biological weapons-specific considerations beyond what we as moderators presented. This meant that the points we raised by and large formed the basis for subsequent deliberation about biological weapons issues. It also meant that if we as moderators chose, we could have marshalled ever more information on policy discussions in order to advance our own evaluations. For instance, to suggestions that proposed initiatives that were infeasible or ill advised, we could have said: 'Perhaps, but what about … ?' Thus, we had to find ways of conducting ourselves in order to initiate and to perpetuate discussion.

It should also be noted that some participants were experts in the specialized scientific field of most concern (unlike us). They could have used this knowledge to dispute our ability to adequately comprehend the topics posed or to turn the sessions into narrow, highly specialized, debates that severely limit who can legitimately speak. However, such moves were exceptional. Thus, both they and we refrained from giving certain types of expert-based arguments as part of having a joint conversation.

Despite the overall limited display of knowledge of dual use policy deliberations, some participants were obviously highly knowledgeable about both the scientific and policy issues raised. Such individuals posed interactive questions. It would have been possible, for instance, to turn the seminars into detailed exchanges between them and us in order to achieve a robust treatment of the topics covered. It would also have been possible for us as moderators to let these

individuals dominate the contributions from participants. However, we resisted both possibilities in order to achieve greater inclusiveness. We were able do this because our role as moderators posing questions gave us considerable control over the course of interactions, such as in determining who spoke next and for how long.

Conclusions

The account of the dual use seminars in the previous section illustrated some of the tensions that arise as part of educational efforts. Attempts to educate raise many difficult questions about who has claim to what expertise and how that is forwarded. In posing various challenges to realizing a web of prevention, the aim of this chapter has not been to issue a council of despair. Rather, it has sought to consider the many choices that demand measured attention. As argued, these choices are not matters that can simply be determined once and for all or that lend themselves to exclusive options and clear-cut answers because any educational initiatives require a negotiation of longstanding tensions.

As part of undertaking educational efforts, key questions include: is it expected that initiatives will lead individuals to act differently? Must researchers rethink the basic way in which they conceive their work? How likely is the potential for disagreement about the issues at stake and what needs to be built into the process of education? How are the aims of eliciting comprehension and providing knowledge balanced? Is education valuable in itself, or is it part of a process designed to aid some outcome?

Such questions and the general focus on the choices and challenges of education are of vital importance given current debates about the proper governance of dual use research. As noted in other chapters, many of the prevailing statements made on this topic stress the need for research community self-governance. Yet a basic prerequisite for the viability of such an approach is a knowledgeable community. There is a clear role for research into the effects of any educational initiatives, as well as the current knowledge base of those who self-govern; this is especially so in light of past experience of the difference between exceptions and practice in the governance of research (Sunshine Project, 2004). To the extent that the recommendations deriving from bodies such as the NSABB support systems are indebted to bureaucratic regulations, these matters are important in ensuring that the terms of regulations do not preclude necessary social and ethical reflection (see Rollin, 2006).

Acknowledgements

The author was aided in producing this chapter by a grant from the Alfred P. Sloan Foundation and a two-day workshop at Nuclear Threat Initiative (NTI) entitled Educating and Training the International Life Sciences Community on Dual Use Dangers, 25–26 July 2006.

Notes

1 See www.lanl.gov/orgs/chs/cbtr.shtml.
2 See www.serceb.org/modules/serceb_cores/index.php?id=3.
3 See www.fas.org/main/content.jsp?formAction=325&projectId=4.
4 See www.armscontrolcenter.org/resources/biosecurity_course/.
5 See www-igcc.ucsd.edu/cprograms/PPBT/PPBT.php.
6 See www.nti.org/h_learnmore/h5_teachtoolkit.html.
7 See https://segue.middlebury.edu/index.php?&site=nonproliferaton&section=12161&page=50403&action=site.
8 See www.projects.ex.ac.uk/codesofconduct/BiosecuritySeminar/Education/index.htm.

References

Albright, P. (2003) ' "Sensitive" information in the life sciences', presented at the Meeting on National Security and Research in the Life Sciences National Academies and the Center for Strategic and International Studies, Washington, DC, 9 January

Billig, M., Condo, S., Edwards, D., Gane, M., Middleton, D. and Radley, A. (1989) *Ideological Dilemmas,* London, Sage

BMA (British Medical Association) (1999) *Biotechnology, Weapons and Humanity,* London, Harwood Academic Publishers

Brasack, B. (2005) *German Statement to Meeting of States Parties to the Biological Weapons Convention,* Geneva, 5 December

Casadevall, A. (2006) Comments made at National Science Advisory Board for Biosecurity, 20 March, Bethesda

Dando, M. (2003) 'Future incapacitating chemical weapons', in Lewer, N. (ed) *The Future of Non-lethal Weapons,* London, Frank Cass

Dando, M. and Rappert, B. (2005) 'Codes of Conduct for the Life Sciences', Bradford Briefing Paper no 16, 2nd series, www.brad.ac.uk/acad/sbtwc/briefing/BP_16_2ndseries.pdf

IAP (InterAcademy Panel on International Issues) (2005) *Statement on Biosecurity,* Trieste, IAP

ICRC (International Committee of the Red Cross) (2004) *Responsibilities of Actors in the Life Sciences to Prevent Hostile Use*, Geneva, ICRC

Keim, P. (2006) Comments made at National Science Advisory Board for Biosecurity, 20 March, Bethesda

Leitenberg, M., Leonard, J., and Spertzel, R. (2003) 'Biodefense crossing the line', *Politics Life Sciences*, vol 22, pp1–2

NRC (National Research Council) (2003) *Biotechnology Research in an Age of Terrorism,* Washington, DC, National Research Council

Osterholm, M. (2006) Comments made at National Science Advisory Board for Biosecurity, 20 March, Bethesda

Pearson, G. and Sims, N. (2006) 'Successful Outcomes for the BTWC Sixth Review Conference', Review Conference Paper no 16, March, Bradford

Rappert, B. (2006) 'The life sciences, biosecurity and dual-use research', in Conference Proceedings of the 10th PIIC Beijing Seminar on International Security, 25–28 September, Beijing

Rappert, B. (2007) *Biotechnology, Security and the Search for Limits: An Inquiry into*

Research and Methods, London, Palgrave
Rappert, B. Dando, M. and Chevrier, M. (2006) 'In-depth Implementation of the BTWC: Education and Outreach', November, Bradford, Bradford Review Conference Paper no 18, www.brad.ac.uk/acad/sbtwc/
Rollin, B. (2006) *Science and Ethics*, Cambridge, Cambridge University Press
Sunshine Project (2004) *Mandate for Failure,* Austin, TX, Sunshine Project
UN (United Nations) (2003) *Annex Report of the Policy Working Group on the United Nations and Terrorism,* A/57/273-S/2002/875, Geneva, UN, 6 August
UN (2005) *Report of the Meeting of 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/MSP/2005/3, 14 November, Geneva, UN, www.opbw.org
WHO (World Health Organization) (2006) *Biorisk Management: Laboratory Biosecurity Guidelines*, Geneva, WHO
World Medical Association (2002) *Declaration of Washington on Biological Weapons,* 17.400 WMA, Ferney-Voltaire, www.wma.net/e/policy/b1.htm