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EDITORIAL

"Dual Use" and "Intentionality": Seeking to Prevent the Manifestation of Deliberately Harmful Objectives

A Summary and Some Reflections on 'The Advancement of Science and the Dilemma of Dual Use: Why We Can't Afford to Fail'

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The iconic destruction of the World Trade Towers in New York on the 11th September, 2001 marks a watershed in human affairs. The present dangers faced collectively by many societies take various guises including scenarios in which bombs with or without added radioactive isotopes, poison gas and pathogenic microorganisms could be employed. How can disasters planned by individuals and groups who seek to harm societies be prevented? How can the provision of such groups with the tools of destruction be prevented? And how can the unwitting creation of means whereby those skilled in the art may fabricate agents of even greater destructive power be prevented?

Such questions have led to the notion that the research effected in the areas of nuclear energy, toxic gases and disease-causing microbes may not only be used for the benefit of all societies but also their harm. From this arises the concept of the dual-use of both the knowledge examined by the application of the scientific method and the products made by the engineers. While it is clear there is a simple dichotomy between the beneficial and a harmful uses of either knowledge (science) or a physical tool, it should also be made clear that all elements of knowledge and all tools have many applications—so multiple uses—each of which may be further categorised under the dual-use dichotomy. The generality of this situation may be illustrated by the efforts of A. Chamberlain (Davidson et al. 2007) and her colleagues who wish to question all the researchers on the Duke University Campus

The majority of papers in this special issue were presented at a conference, 'The Advancement of Science and the Dilemma of Dual Use: Why We Can't Afford to Fail' held on 9–10 November 2007. The conference chairman was Andrzej Górski and its patrons were UNESCO and the President of the Polish Academy of Sciences. Three additional papers on the subject of Dual Use have been included in this issue; the authors are T. A. Cavanaugh (2009), J. Forge (2009) and D. Koepsall (2009).

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engaged in microbiological work and ask them to imagine and write down possible harmful applications of the knowledge or materials that they are seeking to generate.

Many presentations at this conference dealt with the question of whether it is possible to so categorise research projects in these sensitive areas such that we should take specific actions either to prevent that research progressing or to restrict the dissemination of the results to only those who have a "need to know"? To do this it is clearly necessary to define the sensitive areas. It seems to be clear that when dealing with pathogenic organisms there should be regulations dealing with the modification of their pathogenicity and the vaccines or antimicrobials that could be used to prevent or cure disease caused by such organisms. Such regulations might cover the nature of the changes that could be made, the people who may engage in such experiments, the way in which information derived from these studies would be disseminated, the involvement of special representatives of the public who may vet such projects and the implementation of disciplinary (as opposed to aspirational) codes of conduct that are backed up by procedures akin to those that operate in the criminal courts.[1] The possible need for such strictures was illustrated by S. Miller who reported on the work in Australia where a mouse pox virus (Ectromelia) was unintentionally made more virulent following the introduction of an interleukin gene (IL-4) (Jackson Ronald et al. 2001). While many expert groups have looked into this problem as discussed by R. Flower (Royal Society 2006) and D. Franz (National Academy 2007), the group assembled in Warsaw was able to examine some issues that were not covered in the published literature.

Of course it is possible to make lists of topics whose misapplication could lead to the development of information or materials that may be useful in an attempt to effect significant social damage. The reports referred to above do this in extenso. Yet this does not really touch the problem. To date those who have actually assembled bombs or devices to cause social damage have used materials that are readily available in over-the-counter shops or can be stolen from military stores, demolition companies or mining operations. Pasta flour, hydrogen peroxide, dynamite, cooking gas cylinders, Ricin made from beans, Cyanide rat poisons, Weed killer, fertilizer, Semtex, Chlorine and the simple chemical derivatives of phosphorous, halides and methanol that may be converted to Sarin are all available to those who have a mind to acquire them. Of course it is also possible to collect pathogenic microbes from humans or animals who become infected, the most outstanding of which are Anthrax, Plague, Francissella, Foot-and-Mouth Disease virus and Influenza. The transfer of current research ideas or materials does not seem to be involved in any of the known incidents of social damage that have been inflicted to date. So, there is a question as to whether the vigilance and exacting scrutiny with which such research projects at the cutting-edge of a nominated (for its proximity to the generation of a dangerous agent) subject area are actually the best use of such resources. Indeed, it is the simple robust techniques that have been in use for many decades that are likely to be used to assemble weapons for societal destruction.

[1] As reported verbally at the conference by V. Nathanson of the British Medical Association.

Notwithstanding this analysis, academies and institutions in many countries have made it their business to take a position with regard to the possible perverse use of the research that emanates from the laboratories under their influence. Each such country faces the same problems as set out above. But it has to be noted that there exists in the present literature and in trained biotechnologists sufficient information and capability to enable a determined person or small group of people to build highly destructive weapons. It is clearly unnecessary for such knowledge and skill sets to be at the cutting edge of the subject; from the weapon makers point of view, the tried and tested methods that are robust, simple and proven are more attractive than the sophisticated state-of-the-art capabilities that are at the limits of practicality and are not yet consolidated by the application of the research and development process that is needed to transfer a potential product from the laboratory bench into the manufacturing plant. This is a procedure that costs 10 times more than the research and takes 10 times the amount of time: an effort that is only expended on less than 1% of the possible products of the research process.

As was noted by D. Franz (National Academy 2007) and expressed by S. Pustovit (2009) and this author, there is a second arm to the emergence of a destructive weapon, and that is the will, desire or intentionality of the weapon maker. Of course, such considerations are normally dealt with by psychologists, sociologists and philosophers rather than by biotechnologists or nuclear engineers. Nevertheless, it is necessary to examine these issues here as they are crucial to the determination of any approach to the situation faced.

There are a number of different approaches to the issue of intentionality. The first is to determine whether or not a person has a state of mind that is consonant with the construction and deployment of a weapon designated to destroy a body of people. Secondly, we might ask how such a state of intentionality came into being. Thirdly, it is necessary to decide on how to deal with the people who express such states once they are detected. Fourthly, it would be desirable to discover ways of intervening such that these states of mind do not occur.

At this point one might identify two approaches to these problems. The "Social" option requires the "professionalisation" of all those who have access to the materials or knowledge necessary for the production of a dangerous device. Such individuals will be answerable to the body of their peers for their ability to acquire and use the knowledge base of the subject area and to be educated in the ethics of the use of that knowledge. They will have signed up to a code of conduct for their profession and will be held to follow that code by the rest of the membership of the profession, one of whose coded obligations is the requirement that they monitor the behaviour of their fellows so as to prevent the development of practices that might bring the profession into disrepute. The Institutions that serve the profession hold the membership book and the committees that define the membership through their ability to apply disciplinary measures to those who stray. While this is generally in place for Doctors, Dentists, Architects, Surveyors, Lawyers, Engineers, Technicians, certain Artisans, branches of the Military and other professions, this is not, in many countries, the case for Biochemists, Biotechnologists, Physicists, Chemists and Biologists. It is to be noted that the establishment of the "professional" is a means whereby society may be brought into a more accepting working relationship

with those whose knowledge and abilities transcend the general understandings and knowledge-base of the people in society. The establishment of this "trust" is essential in enabling the professionals to practice without the fear that they are exploiting the ignorance of the people to their own selfish ends and to the disadvantage of the society. The provision in the code of conduct of the edict to "do no harm" is a safety net that society requires in allowing the professional to practice within a particular society.

A second approach may be termed the "Mental" approach. But dealing with the mind is unlike any other topic. There are those who opine that mind is something special whose workings cannot be fully explained by the interaction of energetic entities, atoms, molecules and cells alone (referred to by this author as an Energy Plus or EP approach), while others are content to seek explanations for the working of the mind as the emergent property of the interaction of energetic or material entities (referred to by this author as the Energy Only or EO position) (Spier 2001). For the former, EP group, it is difficult to see how it is possible to advance our thinking or our ability to intervene as we may be dealing with one or more entities whose properties lie outside the properties of energetic or material entities. Such properties defy tangibility and may work in manners that are contrary to the cause and effect relationship we hold to exist for all rational actions and events. We might say that when an individual intends to do serious harm to others that such an urge just welled up inside their mind without identifiable stimulation or preconditions. This clearly presents problems in detection, anticipation or correction. This being the case, the only possible response is to set aside any hope of intervention and place all one's efforts in the prevention of the acquisition of the physical means to make and deploy a weapon.

Alternatively, a mind that is based on the properties of material entities only, the EO situation, is tangible, logical and comprehensible by the application of observation, reason and the scientific method. Here it is becoming possible to hope to learn the series of events that leads up to a mind that has the intention of doing harm. There is also the prospect of being able to change the intentionality profile away from such destructive urges. And the detection of a harmful intentionality (a *mens rea*), should be practicable before any harm is done.

For such reasons, it becomes useful to examine the case histories of those who have expressed an intent to inflict harm and have survived its damaging effects. It may also be possible to gain information from people who know others who are expressing the symptoms of seeking a way to be harmful. It should also be feasible to seek out people who have been trained and are fully conversant with the production of harmful agents so as to attempt to understand how they see the world and their position in it. But let us go further. Modern techniques of non-invasive body scanning by Magnetic Resonance Imaging (MRI) and Positron Emission Tomography (PET) have produced images of the mind as it thinks particular classes of thoughts. What this teaches is that particular thinking processes occur in definable positions in the brain. In the event that a person seeks to deceive a questioner by providing a false answer, it is possible to detect an activity that betokens the falseness of the answer in a position of the brain that correlates with the attempted deception. This does not mean that each person in the society has to

be subject to brain scans while asking them questions about their harmful intentions. But it does show that it is possible to detect certain states of mind and this leaves open the possibility of research to make such states more readily apparent. Indeed, at some future time it will be normal to be provided with skull caps that enable mentally active people to control images on a computer screen (Pell et al. 2007). This could provide an entry point leading to the discovery of the deeper states of mind that govern our intentionality. It then becomes a short step to imagine Radio Frequency Identification (RFID) tags that, on excitation, beam to an observer the state of a person's brain so that the mental formulation of a falsehood by that individual would be readily observable for all to see.

As neuroscience and engineering progress, it will be necessary to take a careful and considered position on the amount of information that may be taken from us either knowingly or surreptitiously, in exchange for a sense of security of our persons in public places. How might we build into this situation the safeguards that can provide us with the notion that if the individuals of a society deal fairly with all the other people with whom they associate, will those associates deal fairly with them? Multi-tiered control systems based on the application of ethics, laws and power could be engineered along with the corresponding education and training systems.

It seems that the problem of dual-use can lead to areas of social engineering. Because all that is produced, whether it is knowledge or widgets, is capable of causing benefit or harm, so, it is necessary to recognise this situation and seek to obtain the maximum benefit from it. One problem is that it is not always certain as to where the benefit lies. Should one take the simple objective function, "that all we seek is to enhance the chances of the survival of humans both as individuals and groups", then there is an operating principle from which it is possible to learn and grow. There is not a single answer to how this quest should be pursued, but what is clear, is that natural selection will exert its effects on the diverse approaches we adopt to achieve the objective function. From this will arise new species of humans and new ways of living—the future will indeed be as exciting as the past and just as difficult to fathom.

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