

CRISIS – DISARMAMENT COMMITTEE

Background Information

There is no agreed definition of synthetic biology, but it is best understood as the deliberate design of biological systems and living organisms using engineering principles.

The technological manipulation of life was first advocated at the turn of the last century and was instrumental in shaping the rise of molecular biology. However, the widespread use of the term has only occurred since the mid-2000s, as the field has emerged owing to the falling cost of gene sequencing and synthesis. The aims of synthetic biology include: 1) the production of minimal living genomes; 2) the design of interchangeable parts that can be assembled into pathways for the fabrication of novel components; 3) the construction of entirely artificial cells; and 4) the creation of synthetic biomolecules.

One of the main aims of synthetic biology is the creation of novel genetically modified organisms (GMOs), which may have utility in the production of energy and bioremediation. However, such a prospect raises concerns about their accidental release into the environment, as by their very nature such biological machines could evolve, proliferate and produce unexpected interactions that might alter the ecosystem. A number of measures are being proposed or adopted to ensure adequate biological control, including: engineering bacteria to be dependent on nutrients with limited availability; and integration of self-destruct mechanisms that are triggered should the population density become too great.

The ability of synthetic biology to produce known, modified or new microorganisms designed to be hostile to humans is a major concern, and has been demonstrated by the synthesis of the polio virus and the pandemic Spanish Flu virus of 1918. A major issue in this respect is the ready availability and poor control over commercial DNA synthesis. Furthermore, in the future, 'garage biology' (synthetic biology at home) may be established as a hobby. However, most concerns arise from state-level biological warfare programs. A number of proposals have been made by both scientific groups and government agencies to address the dual use (military/civilian) nature of synthetic genomics, including: controls over commercial DNA synthesis and public research; and considering the impact of synthetic biology on international bio-weapons conventions. As yet there is no policy consensus on these issues. Furthermore, there is an ongoing debate about whether improved bio-security measures should be achieved through professional self-regulation or formal statutory oversight.

The development of biological weapons has a long history, with military programs using advances in basic biology, including recombinant DNA techniques, to try to create new forms of offensive weapons. In this context, it is notable that a CIA Report from 2003 painted a dark picture of the bio-weapons future suggesting that some "engineered biological agents could be worse than any disease known to man" and that the genomic revolution had made such rapid progress that the traditional methods of monitoring weapons of mass destruction could prove inadequate. To ensure that the intelligence services remained knowledgeable on the potential applications of bioengineering the report suggests a closer working relationship with the biological science community. In the UK similar concerns have

Source: Andrew Balmer & Paul Martin, *Synthetic Biology, Social and Ethical Challenges*, Institute of Science and Society, University of Nottingham, May 2008

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arisen about synthetic biology with the Ministry of Defense highlighting the field as one that may impact future military capabilities and in 2006 the Defense Science Advisory Council agreed to examine the military opportunities and threats arising from the field.

Researchers funded by DARPA at Stonybrook University successfully synthesized polio virus from scratch. The lead scientist, Dr. E. Wimmer, under criticism from the media and fellow scientists defended the research suggesting that it would not fuel bioterrorism since they created the virus from readily available components and that it underscored the need to continue vaccination against the disease. Three years later another team of scientists published a paper in *Science* announcing they had sequenced and built the pandemic Spanish Flu virus of 1918, which killed an estimated 20-50 million people worldwide. This research was undertaken to understand the virus in more depth, since much that was known about it was largely speculative. It was also hoped that the research would help scientists understand virulent flu viruses more generally. An editorial of the same issue of the journal *Science* defends its production and publication

A major issue raised by the critics of this technology is that by their very nature biological machines are evolutionary machines; they are subject to natural selection and potentially gene flow. This means that mutations in the genome of the synthetic organisms could produce unexpected interactions with the environment and other living, natural organisms. Considering the myriad unusual functions enabled by that could be integrated in synthetic genomes, a concern is that functions upon which nature has never operated may provide advantages over natural organisms leading to unexpected proliferation of a synthetic biology product, thereby radically altering the ecosystem. Microorganisms intended for cleanup of one particular chemical may interact with others, potentially passing synthetic genes to natural species thereby “contaminating” the gene pool. It’s also claimed that even without such evolutionary intervention the released species may interact with naturally existing substances and cause unexpected side-effects.

Crisis Scenario

The worst case scenario has indeed taken place: a week ago, a lethal airborne microorganism has escaped from its secure research facility in Malta. Was it an involuntary accident or a deliberate act of terror? The question became irrelevant in the face of mounting havoc. While the authorities of Malta, of Europe, and of the rest of the world, were struggling to circumscribe the epidemic, more farsighted voices were heard, which called for the establishment of international “rules of procedures” which will make such worst case scenarios nearly impossible. It has become clear that the issue was not only military facilities and production, which had been targeted by the Ban on Chemical and Bacteriological weapons, but also civilian research installation.

In an atmosphere of crisis and impending doom, conscious of the gravity of the situation and of its responsibility, the Disarmament Committee of the United Nations convenes to draw the first draft of international guidelines to meet the new challenges of Synthetic Biology.

Source: Andrew Balmer & Paul Martin, *Synthetic Biology, Social and Ethical Challenges, Institute of Science and Society, University of Nottingham, May 2008*