Emerging issues

Members of the Network of Global Agenda Councils discuss the issues that will shape our future.

Synthetic biology:
Designing our existence?

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The latest scientific advances will soon enable us to take charge of evolution itself. Synthetic biology is a new form of engineering that involves the creation of complex, new biological systems. It is the result of the confluence of knowledge in life sciences, engineering, and bio-informatics, and the most promising innovations in this new field – genetic design, protein manufacture and natural product synthesis – could have a revolutionary impact on our lives, particularly with regards to the production of energy and medicine. It brings with it gigantic opportunities and risks.

Early innovations may include personalized, genome-specific medications for the treatment of cancer and degenerative diseases such as Parkinson's and Alzheimer's, and pro-environmental bacteria designed to counter the effects of pollution; picture a microbe that 'eats' the toxicants in a contaminated body of water. As an alternative to existing, limited energy sources, we could also engineer the mass production of cellulosic ethanol – a renewable plant-based biofuel that produces very low carbon emissions.

On the other hand, synthetic biology could also prove to be extremely hazardous. Even among enlightened citizens and scientists, there's a great deal of concern surrounding the field – and rightly so. These innovations have tremendous possibilities for good, but they could be devastating without proper regulation. Certain DNA products have huge capacity for virulence or pathogenicity: Mad Cow Disease is no more than a prion – a tiny little protein, smaller than a virus – but its effects are potentially devastating.

These new DNA products are quite consequential in terms of health and global security, but it wouldn't require much for a rogue state or scientist to duplicate the technologies involved. The core knowledge isn't difficult to acquire, and if an entity with an understanding beyond amateurish were intent on using or misusing it, they wouldn't find it hard to do so. Even among engineers with positive intentions, working with nanomaterials is extremely risky: if you create tiny

Chromosomes range in size
from
50 million
to
250 million
bases* each

*Bases are the building blocks of DNA

Source: Ensembl genome browser release 68, July 2012

A scientist prepares protein samples for analysis at the Institute of Cancer Research in Sutton, UK
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Forecast future value of DNA sequencing market

$3.5 billion
value of DNA sequencing market in 2012

$11.7 billion
estimated value of DNA sequencing market by 2018

Source: BCC Research, DNA Sequencing: Emerging Technologies and Applications, February 2014

particles without the necessary oversight, sometimes the results are small enough to integrate into normal DNA sequences when they come into contact with them, producing unforeseen mutations.

In addition to these security threats, the rise of synthetic biology poses a series of ethical considerations. On a philosophical level, I believe that man is an emotional, amoral egoist. Our moral compass is steered by the frameworks in which we find ourselves, and we are governed primarily by self-interest and emotional motivations. These motivations, combined with biological innovations are now leading us towards personal enhancements, both physical and cognitive.

The cognitive enhancements are far more problematic, not least because the mind defines who we are. Within a decade or so we will have the ability to enhance our mental dexterity, not only in terms of mental ability, but also our emotionality (or lack thereof). While we might like to pretend otherwise, emotions are physical, cellular and subcellular neurochemical events; once we understand this better – we know quite a bit already – we should be able to influence mood.

The very concept of biological and cognitive enhancements poses significant questions. Who will be enhanced, and will this create a dangerous societal divide between the enhanced and the non-enhanced? With the chronic gap between rich and poor citizens now the top trend in this year's Outlook, could synthetic biology result in even more dangerous inequalities both within and across societies? Do parents have the ethical and legal right to design their babies the way they want to, or should there be bio-ethical oversight approval mechanisms? These are serious concerns, and they operate at the state level in addition to affecting individuals.

The protective response required is not easy, but necessary. We must aim at creating oversight mechanisms that mitigate risks without stifling innovation. Because of the diverse national and commercial interests involved, oversight can only be provided by a powerful multistakeholder organization – one that can hold states to account, as well as non-state actors, from biotechnology companies to individual scientists.

Above all, we should remember that human nature is an uncertain variable. The idea that we have innate morality competes with the brutality, inequality, and everything else that fills the history of our species. We must never be complacent about the virtues of human nature – thus the need for very stringent governance paradigms for these extremely powerful new tools ■