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STUDENT VOICES

Ethics in Synthetic Biology: Exacerbated Misconceptions of the Nature of Man and Cosmology

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Modern science has been the leading spirit of Western civilisation, breaking the boundaries of cultural values and dominating the globe. From genetic technologies to biomedical applications, emergent projects are now focusing on synthetic biology (SB). SB is defined as the *deliberate design* of novel biological systems and organisms based on principles elucidated by biologists, chemists, physicists and engineers. In essence, it is about *redesigning life*.[1] SB approaches can be grouped into three: DNA-based device production whereby DNA synthesis is used to deliberately engineer biological systems; genome-driven cell manufacture whereby genomes are reduced to only those essential to "sustain" life before being transferred into host cells for functional investigation; and the creation of proto-cells which aims to build minimal cells used for developing "artificial" cellular systems including tissues and organs.[2]

Scientists claim that SB aids industrial applications such as bioremediation, biofuel production and healthcare. Furthermore, SB is seen as a solution to diseases affecting wildlife, a way to manage food shortage by creating a "sustainable" model, as well as a means to minimise production costs of the anti-malarial drug artemisinin (Jay Kiesling and team). While mentioning the benefits of SB research, ethical issues must not be overlooked. The ethical concerns can be classified into two groups: (i) physical dangers involving biosafety and biosecurity

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and (ii) non-physical desecrations that potentially endanger the well-being of individuals and communities.

With the rapid advance in technology, researchers have come to rely heavily on devices such as DNA synthesisers, which they deem necessary to expand their current "biological knowledge" and gather as much "biological data"[3] as possible. This is unlike the past whereby scientists proceeded from facts and understanding to technology—in contrast to the current technology-to-understanding trend in scientific research.

The approach generally used in most physical (or natural) sciences education, in particular biology, is reductionism. Not just organisms but the concept of life too is reduced to purely biological compounds, genes or algorithms. Such a simple "subtraction and addition" approach is not the way to gain an understanding of life as there are unconsidered factors that escape one's sight. For example, functionality of a single polypeptide depends not only on the genetic code but requires assistance from ribosomes, tRNAs and other co-factors. A system's efficiency is reliant on a series of pathways, each with its own set of critical factors.

Another example is the digestive system, which depends on enzyme activation, nutrient absorption and metabolism, i.e. physical-chemical breakdown and material substances formation. Formation of enzymes prior to their activation necessitates the transcription-translation of the genetic code in the presence of a stimulus. This illustrates how the system is a myriad of interconnected networks where knowledge of each pathway is based on a complete comprehension of the system as a whole. If, in their study of the production of a functional protein and the digestive system, researchers conduct investigations on individual pathways and molecular interactions, then the conception of life—which is of a spiritual nature and therefore more complex—ought to be studied comprehensively, not simply in a physical-empirical aspect.

When analysing an object of knowledge, it is important to match the method of study to its specific nature in order to arrive at a true understanding of the subject matter. How can a spiritual entity be quantified and studied through empirical means? No doubt, reductionism, which views human life as just DNA codes, is clearly an improper method to understand the concept of life. It might help in forming hypotheses and research questions, as well as obtaining data, but if used solely in a non-holistic approach, then alternative accounts of life might be veiled.

SB research should observe acceptable guidelines to avoid any form of transgression. But what is meant by "acceptable"? True freedom is to *act as our real*

and true nature demands and a true choice inclines towards what is good (Al-Attas 2014). This shows how fundamental the conception of human nature or the reality of man, the i.e. human-ness factor, is. Since human beings share the same nature, they too must share the same inclinations, conforming to the demands of their true nature and heading in the same direction. Thus, what is considered good and bad is indeed absolute and universal.

Modern science is built upon a framework that narrows knowledge and truth to only that which can be experienced by the external senses. Hence scientists may form theories or determine the direction of scientific research that could involve unethical scientific activities. For example, physics is utilised in nuclear weapon construction while biology has played a questionable moral role in the rise of DNA-exchange technology in the 1970s. Great "advances" in traditional biology have been consistently raising ethical concerns, and SB is no exception.

Physical Concerns

Scientists may affirm that they are working in safe and closed laboratories, but there have been cases of laboratory accidents, unintentional releases of modified organisms and horizontal gene exchange between modified-unmodified organisms, not to mention the uncertain and unexpected manner in which such organisms adapt to the environment. These biosafety issues are a real cause for concern. One such case took place in May 2004, when a Russian scientist handling Ebola virus research died after pricking her finger with a virus-contaminated syringe (Stone 2004).

Apart from biosafety issues, there are biosecurity concerns including state-based biowarfare and non-state sponsored bioterrorism. The post-9/11 delivery of anthrax spores via letters to addressees, causing at least five deaths and widespread panic, is an example (Cohen et al. 2004; Wallin et al. 2007). Another example is the Bush administration's controversial smallpox vaccination programme, which coincided with its involvement in the Iraq war. Since there had been no smallpox cases in the past 20 years, the World Health Organization (WHO), the Centres for Disease Control and Prevention (CDC) and related public health executives were initially opposed to this programme, citing the high risks of mass vaccination. However, following Bush's statement of his planned mass vaccination, only the WHO disagreed whereas the rest remained silent (Cohen et al. 2004). History has proven that pathogen threats are real and recent publications have reported scientists' efforts in synthesising deadly viruses.

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Non-Physical Concerns

A non-physical desecration that should not go unnoticed is the shift in the conception of what is a human being and the impact of this shift on the environment when "new" biological entities are lab-synthesised (Newson 2011). A slight distortion in the conception of something affects how one makes a judgement and the value one attributes to something, motivating actions in line with the perceived priority. Major yet subtle shifts in the relationship between human beings and nature, especially where SB is involved, should come under close scrutiny as early as possible, given the potential consequences on conservation and biodiversity maintenance.

Happiness is a fundamental objective for human beings. It is because human beings aspire to happiness that they will never stop improving their quality of life just to experience happiness. To improve life and attain happiness, people try to perfect their lives. Unfortunately, many tend to focus on the external form and become engrossed with cosmetic surgery in an attempt to perfect their appearance, becoming caught up in a vicious circle of continuous perfection, without giving much thought to its impact on their own happiness and well-being.

Now scientists are trying to improve the internal components as well, going so far as to alter genetic sequences in order to redesign them to possess perfect and desired traits. One has to hold on to the principle that scientific advancements should not be achieved in isolation, without regard to the ethical issues. It is therefore crucial that research studies in the field of sciences be constantly accompanied by critical analysis so that these ethical issues can be identified, examined and addressed.

SB proponents assert that the engineering or construction of biological components will steer us towards a better understanding of what life is, claiming that lab-synthesised minimal cells might provide answers for the factor that sparks off life. In short, they are attempting to study the origin of life. This exposes their assumption that life is just a matter of organic and inorganic atoms and molecules that come together to interact with each other, bringing forth life.

Human Beings as Speaking Living Beings

SB is concerned with human life because among all subjects of interest, human beings are the top priority when it comes to scientific research. Human beings use language to communicate and form conceptions about their physical

surroundings as well as those which are immaterial and non-physical, posing questions about subjects such as existence, life and death. Human beings must be distinguished from other species; this specific difference is extremely important. Only when one is able to answer key questions such as "What is man? What is the definition of a human being?", will we have understood the role of a human being and are able to recognise human beings for what they really are. This definition must be permanently established with certainty and knowledge for man to reach a higher level of certainty.

Man is a "rational animal". "Rational" should not be restricted to reasoning power and thinking abilities, which are considered by modern science and Western philosophy and civilisation as neither material nor spiritual; it should also encompass the ability to articulate and formulate words into meaningful patterns, implicating the intellectual and spiritual entity. Rationality involves the use of language to understand the correct meaning and conception of every created thing such as our self.[4] Modern science places human beings on the same plane as primates because experimental results show a very high percentage of relatedness in terms of conserved genetic sequences. The ranking of primates or other animal species with human beings is akin to equating a fertile land with a barren one. Corn, wheat and various kinds of legumes can be cultivated on fertile land; barren land, on the other hand, cannot produce any crops. Likewise, while human beings and animals do share similarities, there is an undeniable differentiating factor that distinguishes these two creations, and we must recognise ontologically the proper place and hierarchy of human beings and animals.

Conception of Nature

Created things are like the words of a book, symbolising something other than visible letters and words. If we understand words merely and individually as separate units, we will not be able to comprehend the book as a whole "system"; one has to know what these words mean and how they relate to the system. Similarly, in the study of a created object, one has to understand it "as it really is", not as standing on its own and self-subsistent; otherwise such a study is devoid of real purpose and the knowledge gained invalid. Man is a vicegerent of God on earth and he must not only rule socio-politically and control nature, but must also govern himself. Man is a microcosmic representation of the macrocosmos, therefore he must establish "the just order in his self, being and existence" (Al-Attas 1993).

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Human genes and the ecosystem are similar in that they comprise parts that influence other parts. Perturbing a part of a system, for example by mutation, i.e. replacing a single gene with another, has side effects and unpredictable implications (Fukuyama 2012). Michael Sandel equates the ambition of synthetic biologists to the Promethean aspiration to reshape nature, including human nature, to serve their purposes and desires. There should be an awareness of human limitations, specifically our ignorance and imperfect mastery of nature. An understanding that human beings ought not damage the natural world or reduce it to its commercial value, which is manifested in an insensitive attitude towards nature, should be inculcated in human beings (Lauritzen 2011). Verily, one's conception of human beings and of nature determines the attitude, behaviour and actions toward nature and other human beings.

Conclusion

Our priorities and how we harness technological advancements are deeply rooted in our conception of the nature of man, in other words, questions such as "Who am I? What is a human being? What is the definition of man and what is the precise human-ness factor that distinguishes human beings from other creations?" It is distressing to know that this fundamental conception has been distorted, leading to much confusion. Moreover, the meaning of nature, as understood by scientists, has been similarly altered. These are non-physical desecrations of SB that exist along with biosafety and biosecurity concerns. In this paper, I have mentioned that the human-ness factor is the "ability to form words in meaningful patterns". The establishment of permanent conceptions of human beings and nature are keys for researchers to reach higher levels of certainty. Man is a speaking, living being. Nature is a symbol, not a tool for manipulation. Definitions set limits, which are not shortcomings but provide a sense of direction and purpose, leading to improved life and happiness.

This paper is a summarised version of the student's final year project completed while an undergraduate in Nanyang Technological University, 2014.

Notes

1. "New Genetic Recipes: Are We Cooking Up Trouble with Synthetic Biology?", video lecture delivered by Prof. Thomas Murray, then CEO and president of The Hastings Centre, during the Nuffield Council on Bioethics Annual Lecture, 29 April 2009. Available at http://www.youtube.com/watch?v=XR7Oe4IjK_A.

2. Compare with Deplazes-Zemp (2012) who identifies five approaches.
3. DNA synthesisers are used to obtain "biological data" through the keying in of DNA sequences into a desktop and its instantaneous synthesis.
4. Prof. Syed Muhammad Naquib Al-Attas distinguished between the Western concept of rationality and the true and real concept of it during his Saturday Night Lecture Series at the Centre for Advanced Studies on Islam, Science and Civilisation (CASIS), UTM Kuala Lumpur, 19 April 2014.

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