

Is synthetic biology the original 'syn'?

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Date: 09.07.2010

Category: Emerging Technologies

Heralded as having the potential of starting a new industrial revolution and criticised as overstating the potential benefits arising from it, the news that Dr. Craig Venter and his team have successfully developed the first living cell to be controlled entirely by synthetic DNA has understandably caught the headlines of news bulletins around the world.

But what exactly has been achieved? Has artificial life really been created? What is synthetic biology and what, if any, are the ethical implications?

This revolutionary advance, published in the widely respected journal Science, centres around the synthesising of genetic material. Only last August Dr. Craig Venter, biologist and entrepreneur probably best known for his role in sequencing one of the first human genomes, predicted that "artificial life is only months away". Eight months on and he is reporting the completion of a crucial step in the journey of reaching this goal.

What is synthetic biology?

Synthetic biology - also referred to by the media as "extreme engineering" and "biotechnology on steroids," - represents a shift from merely seeking to understand biological systems to actually creating new ones.

In this recent breakthrough, Venter and his team have been able to construct a bacterium's genetic software by way of synthesising genetic materials from basic chemicals. This "software" was then transplanted into a host cell which went on to replicate - a sign of life.

Not quite synthetic life?

Without doubt this is quite an achievement but it is not quite synthetic life in its truest sense. It is synthetic in so far as the DNA has been synthesised, but not that a new synthetic or artificial life form has been created, as Jim Collins, Professor of Biomedical Engineering at Boston University has noted in the Nature commentary.

Venter has taken a copy of the DNA of a relatively simple and primitive organism that already exists in nature, carried out a number of tweaks on the DNA and then tested it to see if it still works. It does. This is no mean feat but the fact remains that the organism whose DNA was copied and synthesised is one of the simplest organisms on the earth and lacks many of the structures found in more complex organisms.

Nevertheless, the team were able to synthesise the genome perfectly which is not to be dismissed. Particularly so, given that on the first attempt the team got one letter wrong resulting in the bacterium failing to function.

Where to next?

Therefore, full blown artificial life may yet to be achieved but it does not take that much imagination to see that based on the results of this breakthrough the creation of brand new organisms may not be that far around the corner.

Being able to scale up the process, thereby creating more complex organisms will be the next challenge in order to realise the fulfilment of eco-friendly biofuels (designer microbes which can feed off carbon dioxide and excrete biofuels), bio-medical interventions and computing technology. It will

be even more of a challenge should calls for a moratorium on synthetic biology be upheld; a position which looks set to be strongly challenged given the rate of progress shown by Venter's team.

Consequently, what does remain crucial is engagement with the nexus of ethical, legal and social implications (ELSI) which are presented by such a breakthrough and the developing field of synthetic biology.

The "original syn"?

As some have noted the homonym 'syn (or sin) bio' may well become an appendage to the synthetic biology industry in just the same way as 'Frankenstein foods' became notoriously associated with GM foods. Such is the possible reaction to horror stories of artificial life running amuck and out of control. In order to avoid a repeat of the GM debacle lessons must be learned. As with other emerging technologies, 'upstream', early stage public engagement with synthetic biology must take place in order to allow the public, informed by all the relevant stakeholders, to fully grasp the scale and magnitude of the issues involved. This is something that the UK's Royal Society's recent survey on synthetic biology highlighted as crucial to policy development in this area.

One of the prime concerns that has been expressed and which has been the fuel behind many of the media headlines has been that this groundbreaking development constitutes humans 'playing god' in terms of creating life.

At the heart of the Christian faith is the belief that humans were created 'in the image of God'. Christians believe that every human being is made in the image of God. Humans reflect God's image in what they do (capabilities and attributes) and what they are (their humanity). Therefore each human life has a unique dignity and unique value because of the divine image. If God is Creator God then one facet of the divine image humans bear is creativity. Yet that creative expression has limits to it. We cannot 'improve' upon human nature as this would involve altering the image which we bear.

Moreover, by its very nature synthetic biology treats biological organisms as nothing more than sophisticated machines, thereby causing life to be considered solely from a reductionist perspective, prevalent in contemporary science not least biology and specifically genetics. In brief, a reductionalist perspective seeks to take the complexity of any given system and understand it from the bottom up. The outcome is that a reductionalist methodology results in a reductionalist ontology; the system is explained wholly by the properties of its component parts. Therefore life is life, regardless of the means by which it has been created and whether or not one believes some special or divine force has been involved in its creation.

The significance of this latest advance therefore is not necessarily what it demonstrates here and now but where it points to in terms of the future and where it may take us. Should further developments occur in synthetic biology which allow us to modify natural life forms into something radically different, then this would pose serious ethical questions. How would we begin to value different forms of 'life'? To what extent would the application of synthetic biology result in new manipulative possibilities for the human project in terms of the design and creation of life?

Bioerror

Making alterations to natural life involves a certain degree of risk. At this time scientists do not yet understand how to synthesize organisms with predictable replication and mutation properties. However versatile microbes are in adapted to the alterations carried out by human interventions, if mistakes are made, then they will be replicated and may quickly become uncontrollable and unmanageable. What happens if redesigned bacteria and viruses are loosed into the environment? What would be the impact on the environment?

Bioterror

Likewise, there is the obvious attraction to terrorists of being able to radically alter and modify viruses and bacteria given the fact that it is relatively inexpensive to do. Coupled with this is the fact that as synthetic biology develops calls are being made to make synthetic biology 'open source'. This would effectively mean that instructions for creating synthetics would be available via the Internet. In turn this makes the potential for synthetic biology-enabled bioterrorism far more likely. This appears to be more than just hype, particularly when one considers the recent response by the Federal Bureau of Investigation (FBI). The bureau has launched its Biological Sciences Outreach Program, with the aim of starting to bridge build and discuss with biologists the potential biosecurity risks from their science.

Distributive Justice

Advances in synthetic biology also challenge the understanding of distributive justice and presents the possibility of widening the gap between rich and poor. Artemisinin is a precursor for anti-malarial drugs and is naturally produced from wormwood in China and south east Asia. Synthetic biology could produce artemisinin quite easily and see production shift from developing countries to developed countries thus having a profound and disastrous effect on local economies. Furthermore, with developing countries lacking the likely knowledge base and finance to invest in synthetic biology techniques it would effectively bar developing countries from even attempting to engage in this new field of technology and production.

The future

Therefore one can see that the landmark development Craig Venter and his team have been able to perform is one to be embraced with caution and with a pressing need to be aware of where it could take us into the future. For it is in what it promises as opposed to what it currently offers which is of most interest. Clearly the need for effective regulation and control is necessary in order to manage the risks involved but perhaps even more important than that is first determining the direction of where advances in this field will take us and whether we are ready to fully embrace and understand the consequences of such a decision.