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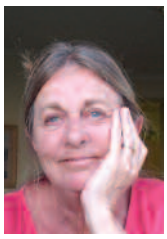

Synthesising a DNA Genome is a Major Feat - but is it creating new life?

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Craig Venter and colleagues recently published their work on a synthesised life form[1]. Once again scientists are charged with playing God and the associated hype and scaremongering promise cures and treatments for all sorts of human and planetary ailments, threaten a future of unknown dangers from genetically manipulated life forms, and demand a re-analysis of the meaning of life and God.

The scientists first carefully determined the sequence of the total genomic DNA (deoxyribonucleic acid) (around one million base pairs) of a simple bacterium called *Mycoplasma mycoides.* Overlapping segments of the complete sequence were then copied (synthesised) in the lab by the ordered stitching together of the four DNA bases. They then cloned and assembled the segments of the copied sequence in yeast cells, and transplanted the complete copy of the *mycoides* genome into a closely related bacterium, *Mycoplasma capricolum*, whose own genome had been previously removed. The recipient *Mycoplasma* 'shell' thus provided the necessary cellular environment for the synthesised genome (the *mycoides* copy) to direct cell growth and cell division and perpetuate the bacterial culture as *Mycoplasma mycoides*. The copied genome directing bacterial cell growth and division could be identified and distinguished from the original *mycoides* genome by a few sequence differences incorporated during the synthesis.

This is a considerable technical feat and is to be admired. But it is not a new life form. It is a copied genome using synthesised building blocks and it required the yeast intermediary step and components of a pre-existing *Mycoides* carrier cell to set growth and cell division in motion. It would be really impressive if science could create life from scratch - from something equivalent to the primaeval 'ooze'. In this respect, life as we know it originally only happened once and is encapsulated in the central dogma - DNA makes RNA (ribonucleic acid) makes protein - though what really came first is not clear. The wonder of the discovery of the structure of DNA was that, in one eureka moment, we could see in the double helix the essence of life itself. The implicit code in the order of the four bases directed the synthesis of the proteins of function and cell structure; the unwinding of the double helix and exact copying of the strands to be inherited by daughter cells ('like begets like') ensured life would go on in perpetuity; and the occasional variation or copying error explained the mutation and variation that underlies selection and evolution of new life forms.

Today all living species derive from one common DNA ancestor originating on this planet (or maybe, as some think, on some other planet in outer space with DNA arriving on Earth via meteorite). All known life - from viruses, bacteria and moulds, to plants and trees, to insects, animals and us - is all based on the same the same DNA to RNA to protein model. How else could life happen? It is difficult to conjure up a different form of life. From *Star Wars* to *Avatar*, science fiction still imagines so-called new life forms based on our own original plan. In terms of science synthesising new life, readers might be interested in a flight of fancy (currently) step-by-step instruction for the re-creation of life in 'Let's make a mammoth' by Henry Nichols[2].

Back to Venter's synthesised microbial genomes. Big claims are being made for the possible future uses and benefits of genomes synthesised to order to perform special tasks - from mopping up excess carbon dioxide, dealing with oil spills, aiding in new drug and environmentally-friendly fuel design, and so on. But it is hard to believe that inventing genes from scratch would be more efficient than using the efforts of billions of years of evolution honing and perfecting performance of different genes and their proteins for different purposes for different organisms in different situations. We already have the technology to recombine and splice different genes together, and to introduce them into carrier hosts. Synthetic biology of the future will probably combine man-made and evolution-made segments of DNA for specific purposes.

The new addition of synthetic genomes to the tool kit fuels the horror of some environmentalists who are terrified of what new combinations of genes designed or modified by the genetic engineers could get up to if they were to escape. What is this fear of scientists playing God? It is fear of the unknown and a lack of trust in those in power in a troubled world. With all new discoveries there is fear of unforeseen accident or misuse of knowledge. But regulations for containment and careful surveillance already operate in science and technology. All research proposals and grant proposals must pass the local ethical committees of the host research institute as well as national ethical committees. Scientists themselves are responsible for their discoveries and their consequences and, with peer review, keep an eye on each other. All knowledge can be used for good or evil.

However, fear of misuse must not hinder basic academic research. Many, if not most, major breakthroughs in science and medicine in the past have happened as a consequence of an anomaly, or an unexpected discovery, in the course of basic research. The alarming shift from basic research to applied research (projected useful outcome has been part of grant writing for the last three decades) has been accompanied by a dearth of exciting new discoveries. While the synthesis of a copy of an existing genome capable of directing the growth and division of a cell is not the creation of life, it is nevertheless a very exciting development in academic research of this kind. We do not know yet how it will be to our benefit and the extent of its potential.

Finally, what does the chemical synthesis of a genome say about God and religion? Nothing. Whatever one's understanding of God, it certainly does not make God redundant. Man, as scientist, has been re-organising and rearranging the elements of life and existence forever. Existence itself is a wonderful play of energy and matter coming in and out of form of increasing complexity in an interconnected oneness in space and time. Maybe God is not separate from his creation.

1 Venter *et al,* 'Creation of a bacterial cell controlled by a chemically synthesized genome,' *Science* 20 May 2010, http://www. sciencemag.org/cgi/content/abstract/science.1190719

2 Henry Nicholls, 'Let's make a mammoth,' *Nature* 20 November 2008 (http://www.nature.com/news/2008/081119/pdf/456 310a.pdf).