Creating Life in the Lab

Written by Heather Zeiger

The J. Craig Venter Institute recently announced their successful synthesis of a complete bacteria genome to an unsurpassed level of accuracy. Researchers were able to replace the genome of the host cell with the synthesized one. Several web sites and commentators have dispelled any aura of the miraculous by pointing out what exactly Venter's group did and what they did not do. For just a sampling (bolded emphasis is mine):

"What Venter and his team did was to determine the sequence of the DNA in one of the world's simplest bacteria, use the sequence information to synthesize a copy of that DNA from subunits sold by a biological supply company, then put the synthetic copy of DNA into a living bacterial cell from which the natural DNA had been removed."{1}

From the original research article on the Venter group's discovery: "We refer to such a cell controlled by a genome assembled from chemically synthesized pieces of DNA as a 'synthetic cell,' even though **the cytoplasm of the recipient cell is not synthetic**."{2}

"The idea that this is 'playing God' is just daft. What he has done in genetic terms would be analogous to taking an Apple Mac programme and making it work on a PC—and then saying you have created a computer. It's not trivial, but it is utterly absurd the claims that are being made about it."{3}

"To clarify the facts, 'the team put chemically synthesized pieces of the M. mycoides DNA into yeast which assembled the bacteria's genome. Then, the M. mycoides genome was transplanted into Mycoplasma capricolum and "booted up" to create a new synthetic version of M. mycoides'…For this 'proof of principle' instance, they tried to 'synthesize' a bacterium

as close to the original genome as they could, with the major 'new' genetic material being watermark protein messages (e.g. spelling "CRAIGVENTER"). They didn't use the original DNA as a template, but just as a 'standard' for comparison. **Since this was a test of concept, the goal was to generate something that already exists**."{4}

Neat Trick or Cause for Concern?

I think one of the most laudable feats of this group that should please many biochemists is that they were able to perfect the DNA synthesizing technology to the point that they reconstructed an entire bacterial genome—a much longer sequence than what is typically done in the laboratory setting—and they were able to do it with such accuracy that the cell's translational machinery read it. Exciting for biochemists, but advancements in laboratory technique and technology are hardly the stuff of headlines. As a chemist, I think it's a neat trick; as a bioethicist, I am concerned. My concern is not about the technology itself, but about the underlying presuppositions that seem to go unquestioned, even unnoticed.

The media response has been that of excitement and fear. At the heart of the fear surrounding genetic engineering is power. Why would anyone care about bacteria{5} unless he or she thought it implied something about human beings? Unless they are in the field, most people do not pay particular attention to the musing of a scientist about his research project on some esoteric species identifiable only by its Latin name. We do not care, that is, until that little bacterium has the potential to bring great harm or great good (or both) to human beings.

The fear or excitement (depending on your view of technology and scientists) is spread by two fundamental assumptions:

1) Since every organism, including human beings, is made up

> of genes, if scientists can manipulate one gene, then they can manipulate any gene, including human genes, and;
>
> 2) by manipulating genes scientists are manipulating life itself and the very essence of an organism's identity. This philosophical assumption, known as *reductionism*, is what we often assume without thinking about it.

These philosophical assumptions are grounded in a worldview of *materialism* (a.k.a. *naturalism*; I will use the term materialism throughout this article). The materialistic worldview says that matter and energy are all there is, there is no supernatural and there is nothing beyond what is in the natural world. If that is the case, then by definition, human beings are defined by their physical parts. There is nothing nonphysical which we can call our identity. That also means that the difference between something being alive versus not being alive must be defined by physical parameters. Since all organisms have a genome, scientists assume that there is some combination of nucleotides (the individual molecules of the genome) or a certain minimal number of nucleotides that makes something alive.

The Venter Group's Reductionist Project

The Venter group, from the beginning of their project, was quite up front with the goals of their research. When asked about the implications of their project, Craig Venter responded in an interview posted in *SciWatch* in 1997:

> What is life? I don't think there are that many biologists trying to answer that one . . . . We're . . . working on a reductionist view of trying to take the smallest genome that we have…and see if we can't understand how those . . .[genes] work together to create life . . . .{6}

This is the same sentiment held by James Watson, Nobel Laureate and co–founder of the structure of DNA. In his book,

DNA, he states:

> Our discovery had put an end to a debate as old as the human species: Does life have some magical, mystical essence, or is it, like any chemical reaction carried out in a science class, the product of normal physical and chemical processes? Is there something divine at the heart of a cell that brings it to life? The double helix answered that question with a definitive No.{7}

According to scientists who hold to materialistic presuppositions, life is chemistry. Who we are boils down to our chemistry, which puts those that can manipulate our chemistry in a position of power.

Given these beliefs, it is no wonder that people automatically jumped from the genome of a bacterium to the implications for people. But one thing science has shown us is that the leap from bacteria to man is not simple or straightforward. Man's genome is not much larger than many other, simpler organisms, yet scientists have found that human DNA is much more complex. As it turns out, it is more than an issue of connecting nucleotides together like a chain of beads in the right order.

Reductionism and the Human Genome Today: What Is New

Dr. Richard Sternberg of the Biologic Institute conducts research based on several findings that seem to indicate that the blueprint for an organism's overall body plan is not found by reading the genome on a nucleotide-by-nucleotide basis. There seems to be a more complex interaction between the genome and other cellular functions and between different parts of the genome in different ways that was once thought. His research seeks to identify those interactions and how they translate into an organism's blueprint.{8}

What scientists are finding is that the genome is not read as

a letter–by–letter array (one–dimensional), as was once thought, but that there are spatial and translational (three–dimensional) factors that help determine how our genome is interpreted. *No longer is it a simple issue of what letters code for what. Now it is what letters, located where, and interacting how, code for what. This flies in the face of reductionism because now we cannot assume that the chemistry codes for life. Apparently there is more to it than that.*

Reductionism and the Human Genome Yesterday: What Is Not New

Even before scientists discovered that there are layers of complexity to the genome, many researchers found that their experiments did not work as expected from a reductionist perspective because the step from bacteria to man is not a direct correlation. By looking back to the beginning of genetic engineering technology, we find that many people held reductionist presuppositions that fueled fear and concern. We also find that reductionism failed to account for the setbacks in going from simple organisms to man. Many people reacted to the discovery of recombinant DNA (rDNA) in the 1970's and 1980's with fear, concern, and anticipation.

RDNA involves building DNA strands and inserting them into organisms using something called vectors. Today this technology is frequently used in the lab, and it was used by the Venter group for their procedure. In the 1970's and 80's much of the ethical debate centered on the implications of using rDNA in human beings, even though the procedure was only being used in bacteria. We call the use of rDNA technology in humans, human genetic engineering. Ironically, after all of the hype surrounding this new technology, 30 years of using rDNA has not resulted in success in human genetic engineering.

Reductionists would say that because every organism is composed of genes and life must be defined by its physical

parts, if we can engineer and replace DNA in simple organisms, we can do the same in humans. However, in reality we still cannot replace portions of human DNA with synthesized DNA because there is a level of complexity in mammalian cells, and human cells in particular, that scientists still do not understand.

Conclusion: The Meaning of Life Is Not Found under a Microscope

The further down you go, even to the level of atoms, subatomic particles and quarks, you will never find the essence of life; at most you can understand structure. Those are two very different things that are confused when you have a commitment to a materialistic perspective. From a materialistic perspective, the essence is in the structure. Man is the sum of his parts. Contrast this to a theistic perspective. Man is made from similar elements as other organisms, connecting him with part of creation, but he is also beyond creation because of his relationship with or access to God. In a Christian theistic view, in particular, the essence of man is not in his parts but in how those parts combined with his spiritual component make him more than a creature. He is something, someone, made in the image of God. Part of that image is our creativity and ability to communicate original ideas, as well as our self–awareness, including our place in time and our mortality. These are all attributes that describe God. Yet these traits don't seem to be shared by animals, even animals that are genetically similar to human beings.

In a *Science* article from 1999, several ethicists considered the implications of Venter's group's goal to create a minimal genome. Prophetically, the authors caution against reductionist implications: "…a reductionist understanding of life, especially human life, is not satisfying to those who believe that dimensions of the human experience cannot be explained by an exclusively physiological analysis… **There is a**

serious danger that the identification and synthesis of minimal genomes will be presented by scientists, depicted in the press [ref removed], or perceived by the public as proving that life is reducible to or nothing more than DNA…"{9}

Now, eleven years later, one of the authors of that same article responded to the Venter group's recent announcement by saying:

> Venter and his colleagues have shown that the material world can be manipulated to produce what we recognize as life… Their achievement undermines a fundamental belief about the nature of life that is likely to prove as momentous to our view of ourselves and our place in the Universe as the discoveries of Galileo, Copernicus, Darwin, and Einstein.{10}

The author perpetuates the very assumption that the original ethics article cautions against! We should be careful to not assume so much. There is no reason to believe that the ultimate nature of life is locked away in our genes, and many reasons to believe that it is not. The Venter group did not create life; they studied and mimicked the structure of Someone else's creation.

Notes

1. Jonathan Wells, "Has Craig Venter Produced Artificial Life?" posted on May 24, 2010 on Discover Institute blog, *Evolution News & Views*, www.evolutionnews.org/2010/05/has_craig_venter_produced_arti035081.html.
2. Original research article published in Science Express online: www.sciencemag.org/cgi/content/abstract/science.1190719
3. Steve Jones, geneticist, quoted by Jonathan Sarfati in "Was life really created in a test tube? And does it disprove biblical creation?" May 25, 2010, creation.com/synthetic-life-

by-venter

4. Science Integrity, "Notes on 'Creation of a Bacterial Cell Controlled by a Chemically Synthesized Genome'," (link to cited article found here), scienceintegrity.net/SynthesizedGenome.aspx

5. The particular bacteria, M. mycoides, was selected because it has one of the simplest known genomes.

6. Quoted in Science vol 286, December 1999, p. 2087. Original quote from Anonymous, Sci Watch (September/October), 3 (1997).

7. Watson, James D., *DNA: The Secret of Life*, Random House, Inc. New York, 2003.

8. Richard Sternberg, "Current Research," www.richardsternberg.org/research.php. See also: www.biologicinstitute.org.

9. Science, vol. 286, December 1999, pg. 2087, emphasis added.

10. "Sizing up the 'synthetic cell'," online version of commentary in Nature, www.nature.com/news/2010/100520/full/news.2010.255.html.

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