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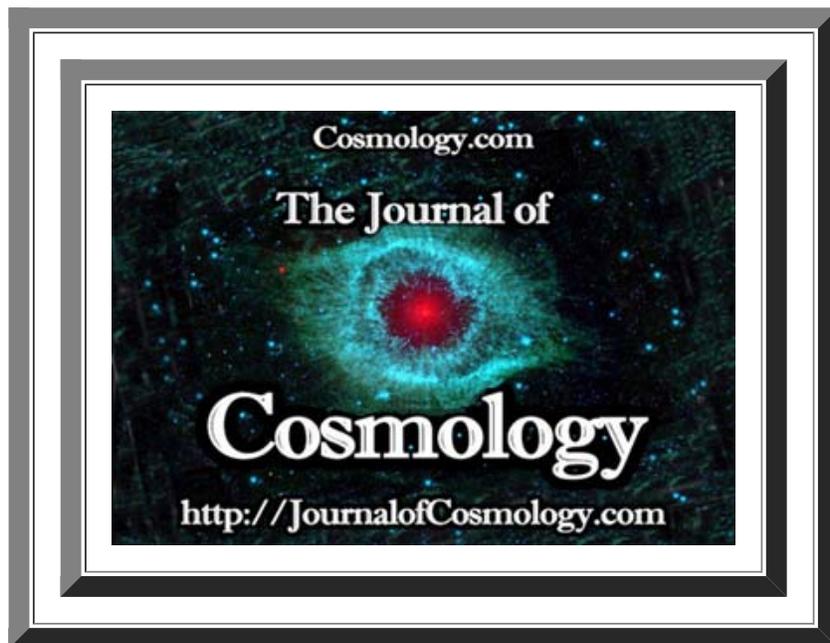
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Commentaries: Artificial Life

Abstract

On May 20, 2010, famed geneticist Craig Venter and colleagues published a landmark study in the emerging field of 'synthetic biology', the creation of an artificial bacterium genome (copied from DNA sequences of *Mycoplasma mycoides*) which was transferred into a closely related microbe which began to successfully reproduce, making over a billion copies of itself.

Venter's achievement has drawn mostly enthusiastic praise, with some likening it to the 'splitting the atom' and deserving of the Nobel Prize. Yet others warn of a 'Frankenstein monster' and 'genetic pollution'; fearing that artificial genes and artificial life may take over the world, and end life as we know it.

Scientists and bioethicists from around the world have been asked to comment and to explain. What is the real significance of this achievement, and is there any reason to feel fear?

Is Craig Venter Playing God with Genetics and DNA?

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Has genomic Titan Craig Venter stolen fire from the sun? Along with his research team, Venter has announced the "Creation of a Bacterial Cell Controlled by a Chemically Synthesized Genome" (Gibson et al., 2010). From the

bottom up, so to speak, the Venter team assembled the chemicals to make up the genome of a bacterium, *Mycoplasma mycoides*. Then the lab team transplanted the nucleus into a *Mycoplasma capricolum* recipient. The result is the creation of a new life form, *Mycoplasma mycoides* JCVI-syn1.0, a bacterium controlled solely by the synthesized genome. From now on we can expect the new cell line to replicate continuously. This is a major achievement in genetic technology.

What motivated Venter and his lab team of twenty-five to work fifteen years to make this happen? Venter's purpose has been to "understand the basic components of life," he told Charlie Rose in a May 21, 2010 television interview. Venter said he is trying to "get control over nature." According to Venter, this proof of concept will provide the resources for future inventions of synthetic life forms, forms that could provide the human race with more effective vaccines, food, and fuel.

What are we hearing in the hallways of the ethicists and the corridors of the moralists? Do we hear whispers of "hubris"? "Prometheus"? "Frankenstein"? "Playing God"? Has Venter crossed the line between non-life and life? Has he provoked the ire of the gods who alone claim province over life's origin? Will nature respond to this invasion with a counter attack, letting loose genomic chaos?

First, let us ask: has Dr. Venter created life from non-life? No. Rather, he has assembled nucleotides—much as previous experimenters with recombinant DNA have done—into a new configuration to produce an entire genome, a genome that operates the cell's machinery. One might observe that this is what nature has been doing throughout our evolutionary history. As Charles Darwin theorized, nature is constantly generating new species through the interaction of variation in inheritance with natural selection. Assembling mutations over deep time leads to new species. Venter has done in the laboratory what Mother Nature has been doing for nearly four billion years. New life builds upon previous life.

A Berkeley bioethicist colleague, Gaymon Bennett, emphasizes that Venter has synthesized a genome; he has not created synthetic life. Or, to put it another way, no ontological or metaphysical change in our understanding of life or the origin of life has occurred here.

Nevertheless, secondly, Venter's achievement still looks a bit like that of Victor Frankenstein in Mary Shelly's 1818 novel, *Frankenstein: A Modern Prometheus*. Shelly wrote her novel after hearing the wild speculations of Erasmus Darwin, Charles Darwin's grandfather, regarding galvanism—that is, returning dead body parts to life. The fictional Dr. Frankenstein sewed together body parts from a number of corpses and, with a spike of electricity, enlivened the assemblage into a new living person. Dr. Frankenstein, overcome with feelings of scientific grandeur then announced to stunned onlookers: "Now I know what it feels like to be god." The new person got out of control, as we all know, letting loose chaos and death. Shelly condemns the hubris of Dr. Frankenstein because it mocks "the stupendous mechanism of the Creator of the world." Hence, our contemporary phrase for a scientist who crosses the line, "playing God," reminds us of Dr. Frankenstein and his unconscious ego ideal, Prometheus.

The reason the Olympian god Zeus punished Prometheus was that the Titan—when stealing fire from the sun—had crossed the line and invaded the sacred realm of the immortals. The problem with Prometheus as well as with Frankenstein was *hubris*, too much pride. This led to a backlash. This led to punishment of Prometheus by the gods and revenge by nature for Frankenstein. In our modern world, nature has banished the gods for setting moral limits on the height that human ambition will be allowed to rise.

Does Craig Venter exhibit hubris? Relevant to answering this question, one might note that two decades ago he hired his own biographer to chronicle the achievements which would eventually place him in the annals of history. He has donned the demeanor of the maverick, the entrepreneur, the rascal, the soldier of fortune. Yet, even this image has self-imposed limits. "I don't mind being *Bad Boy*," Venter told his wife over lunch; but "I just don't want to be *Evil Boy*" (Shreeve 2004). So, we must ask: is Venter just a bad boy or an evil boy? Will Mother Nature strike back with genomic chaos, punishing the mad scientist and perhaps the rest of us as well?

Actually, to my reading, the degree of Venter's own personal hubris is not at issue here. This is not an *ad*

hominem matter pertaining to this scientist as a person. Rather, the question has to do with whether or not nature has placed a “No Trespassing” sign in front of the genome. Does our DNA have a “Do Not Touch” sign on it? There is no philosophical or theological reason for keeping our scientific hands off DNA, at least as far as I can tell. Even though we can marvel at the wondrous elegance of genetic activity, neither animal genomes nor human genomes are intrinsically sacred. If a scientific researcher is going to risk playing God, I do not think that it is likely to occur at the point of genetic redesign.

If a laboratory team wishes to synthesize a genome, I see no ethical issues arising from genetic technology as such. Ethical issues might arise, however, when we consider the purpose (motive) or consequences. Should such experimentation be pursued for the purpose of biological warfare, then moral discernment would be called upon. However, bio-weapon construction is not Venter’s purpose. Or, in light of the precautionary principle, we might want to ask about the likelihood of collateral damage, the likelihood of un-anticipated negative consequences. It is too early to make such a judgment on Venter’s work. Yet, ethicists should remain on alert, watching what will happen in light of this breakthrough. Although Frankenstein is not yet here, we just might remain on the look out.

References

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Shreeve, J. (2004). *The Genome War*, Ballantine, p. 238.

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