Founding Editor's Viewpoint

Sailing the Sea of Synthetic Biology: Dr. Venter and the *Sorcerer II*

Just when I thought we could sit back and savor the discoveries (not to mention what we might do with them) of an era in which we've learned to read a genome and explain how it instructs the formation of proteins,[1] made real progress in deciphering the complexities of epigenetics, and found that thousands of genes are expressed differently in tissue as a function of whether we are male or female, another stunning achievement is announced.[2] It's worth mentioning that discoveries like this latest one, in which Craig Venter's group created a cell controlled by a chemically synthesized genome, do not make the front page or even the first few pages of *The New York Times* or *The Wall Street Journal*. What seems to capture the public imagination (or at least that of the press) is war, politics, stock markets around the world, and various other observations that are apparently more relevant (to my increasing amazement) than this newest step in a revolution that will soon transform what we mean by "life," how we create it, and how we use the unfathomably powerful discoveries we are amassing. True enough, Nicholas Wade did cover Dr. Venter's achievement in a "Health Section" article in the *Times* on the same day the science paper was published, but it was listed sixth, nestled among 9 other papers on subjects like why cyclists need helmets and what happens when patients don't fill their prescriptions.[3] I wondered if the Wright Brothers' brief launch of what was essentially a rudimentary biplane at Kitty Hawk had made the papers at all. It might be said of Venter's discovery that, like the Wright Brothers' first flight, it is only a beginning or, more accurately, one small albeit significant step in realizing the enormous potential of a qualitatively new era in human achievement.

Notwithstanding the apparent lack of public interest, the scope of the possible implications of this latest feat of synthetic biology did, I admit, impress the White House—President Obama asked his newly formed Presidential Commission for the Study of Bioethical Issues to examine the implications of Venter's findings. Obama's letter to Dr. Amy Gutmann, the Commission's chairman and president of the University of Pennsylvania, put it as well as anyone could: "As you know, scientists have announced a milestone in the emerging field of cellular and genetic research known as synthetic biology. While scientists have used DNA to develop genetically modified cells for many years, for the first time, all of the natural genetic material in a bacterial cell has been replaced with a synthetic set of genes. This development raises the prospect of important benefits....At the same time, it raises genuine concerns, and so we must consider carefully the implications of this research."[4]

I was glad someone besides Harvard's George Church was thinking about the potential and pitfalls of synthetic biology (which he's been doing thoroughly and frequently), and I hope Dr. Church is talking to the Presidential Commission about all that he's been doing on the subject. I was sorry he wasn't listed as a member of the Commission, but as the announcement from the Office of Science and Technology Policy stated, the group is heterogeneous and reflects what the Office called a "growing society-wide recognition that many of today's most difficult decisions at the boundaries of science and society are not just about biology and medicine but involve hardware, software and related technologies such as robotics."[5]

The editors of *Nature* understood the significance of what had just been published and immediately polled 8 experts (most, but not all, synthetic biologists themselves) for their thoughts on what Dr. Venter's group had accomplished. Some, like Mark Bedau, professor of philosophy at Reed College, expressed unreserved enthusiasm: "Tomorrow's synthetic cell could be radically unlike anything encountered in the history of life."[6] Others, like Dr. Church, had a different take and sounded a note of restraint: "This milestone and many like it should be celebrated. But has the JCVI [J. Craig Venter Institute] created 'new life' and tested vitalism? Not really. The semi-synthetic mycobacterium is not changed from the wild state in

any fundamental sense. Printing out a copy of an ancient text isn't the same as understanding the language…. The grand challenge remains understanding the parts of cells that help the DNA to function."[6]

Dr. Arthur Caplan of the University of Pennsylvania (who, by the way, is not a synthetic biologist but a bioethicist) had different concerns, and it almost seemed that Venter's accomplishment had turned Caplan's world upside down. He remarked: "Venter and his colleagues have shown that the material world can be manipulated to produce what we recognize as life. In doing so they bring to an end a debate about the nature of life that has lasted thousands of years."[6] In Dr. Caplan's mind, "Venter's achievement would seem to extinguish the argument that life requires a special force or power to exist." Oxford University's Richard Dawkins would no doubt point out that he's been saying that for years. Dr. David Deamer of the University of California at Santa Cruz put it much the same way, saying that as a result of Venter's discovery, "It may be possible to answer one of the great remaining questions of biology: how did life begin?.... If a synthetic RNA can be designed to catalyze its own reproduction within an artificial membrane, we really will have created life in the laboratory, perhaps resembling the first forms of life on Earth nearly four billion years ago."[6]

As for my own thoughts on reading Venter's report—what an original, daring, and entrepreneurial fellow Dr. Venter seems to be, and I picture him on his sloop, the *Sorcerer II*, leading what he calls the "Global Ocean Sampling Expedition" on which he sails the world's seas, surveying the genetic properties of their microbial communities. I am reminded of a character in one of my favorite books about the adventures of a mouse called Amos, who set out to sea in a boat of his own making to explore the world. The book's author, William Steig, writes of Amos' thoughts while he is contemplating the night sky from the deck of his little ship: "One night, in a phosphorescent sea, he marveled at the sight of some whales spouting luminous water; and later, lying on the deck of his boat gazing at the immense starry sky, the tiny mouse Amos, a little speck of a living thing in the vast living universe, felt thoroughly akin to it all."[7]

I think most scientists, both great and small, and constantly amazed at the beauty and complexity of the world around them, have had similar moments. Undoubtedly, Craig Venter is one of them.

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