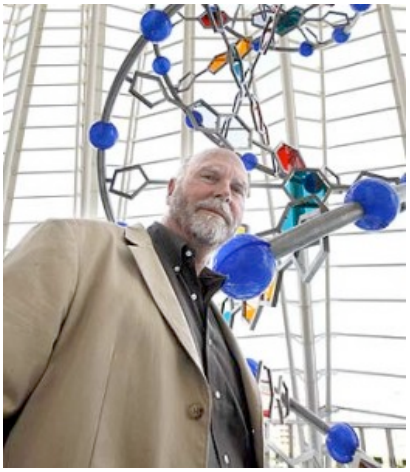

J. Craig Venter – *Genomic Explorer*

"To live, to err, to fall, to triumph, to recreate life out of life." ~ James Joyce

Many are referring to the 21st century as the century of the life sciences. Recent advances achieved since the millennium have opened new doors that are leading us to important new discoveries and achievements. Pivotal to genomic exploration is the scientist, J. Craig Venter.

On May 20th, 2010, Venter said, *"We're here today to announce the first synthetic cell. This is the first self-replicating cell we've had on the planet whose parent is a computer."* This breakthrough is the culmination of a 15-year quest.

Venter is best known for his work in mapping the human genome a decade ago through the use of advanced algorithms and computing techniques. In 2007, his team mapped the complete diploid human genome of a single individual. This allows scientists to view both sets of an individual's chromosomes (one inherited from each parent), as well as the analysis and assembly of the 2.9 billion base pairs of human DNA. Scientists now know that there are five to

seven times greater human-to-human genetic variation than previously thought. It is this kind of genome sequencing and analysis that has the potential for highly individualized medicine and disease prevention.

Armed with this newfound knowledge, the team replicated an existing genome of the bacterium *Mycoplasma mycoides* in a computer. *They digitally replicated the complete genome*. Venter refers to this process as 'digital biology.' Once digitized, they had to figure out a way to chemically replicate the genome using, Adenine, Thymine, Guanine, and Cytosine, which make up the DNA in living organisms. Then, they would transplant this newly created chromosome into an existing cell (*Mycolplasma capricolum*), have it remove the existing chromosome, transform the living cell according to the newly implanted chromosome, and then replicate itself.

Although this may sound simple in theory, it had never been done before. This is different from the process of genetic engineering. Genetic engineering has to do with modifying a small number of genes in an existing genome. Venter's process has to do with the recreation of an *entire genome – digitally*, and its transplantation into a living cell. The process is both ingenious and complicated; therefore, it will be discussed in greater depth at the lecture.

According to Venter, *"Genome transplantation was the first essential enabling step in the field of synthetic genomics as it is a key mechanism by which chemically synthesized chromosomes can be activated into viable living cells."*

According to team member Dr. Hutchinson, *"To me the most remarkable thing about our synthetic cell is that its genome was designed in the computer and brought to life through chemical*

synthesis, without using any pieces of natural DNA. This involved developing many new and useful methods along the way."

Of course, many questions have arisen now that we have discovered this new biological power. What could it be used for? Is it safe? What are the potential dangers?

Some of the key uses for this new biology have to do with the creation of vaccines, pharmaceuticals, fuels, foods, environmental remediation, and new materials. The population of the planet is expected to grow to 9 billion people by the year 2050 – nearly a 50% increase from today's population. Venter argues that it will take scientific assistance to safely deal with the needs and problems of the growing population.

Several studies have been done regarding the ethics of the new science, and these studies are ongoing.

II. The Voyage of the Sorcerer II

"To strive, to seek, to find, and not to yield." ~ Alfred Lord Tennyson

In addition to the work already completed on mapping the complete diploid human genome and the creation of the first successful synthetic cell, Venter is now mapping the genome of the ocean and the atmosphere of our planet – a newly burgeoning field called *Metagenomics*. He is sailing around the world and taking water samples every 200 miles. Using shotgun sequencing, he is collecting microbe samples and mapping their genomes. The team has already discovered millions of new genes. Of particular interest are the genes they discovered in microbes that can convert

sunlight directly into a kind of electrical energy, which is different from photosynthesis.

They discovered that the ocean is not a giant homogeneous pond. In fact, the genomes of the microbes that they sampled differ by 85% every 200 miles. Apparently, every area of the ocean is distinctive and different from all other areas.

Investigations of the atmosphere and the earth are revealing an equally surprising depth and diversity of organisms and new genes. *More about Venter, genomics, synthetic cells, the voyage of the Sorcerer II - its discoveries and possible applications will be discussed during the lecture at the Institute on November 13th @ 4:00 p.m. Onward!*

Russ Lewin
IWC Member, November 2010