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Editorial
EDITORIAL

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In memoriam : Frederick Sanger (1918- 2013)

FATHER OF GENOMICS WHO REVOLUTIONISED SCIENCE AND MEDICINE THROUGH DNA AND PROTEIN SEQUENCING

(Image obtained with permission from Wellcome Trust Sanger Institute, Cambridge, UK)

We are happy to present the 4th issue (Vol.1) of our journal. This editorial of "International Journal of Applied Sciences and Biotechnology" is dedicated to the memory of Fredric Sanger, who passed away on November 19th, 2013 at Addenbrooke's Hospital in Cambridge. Frederick Sanger, who revolutionized science and medicine through DNA and protein sequencing, was the only Briton twice to win the Nobel Prize. As of 2013, he is the only person to have been awarded the Nobel Prize in Chemistry twice, and was one of just four individuals to have been awarded two Nobel Prizes. The other three were Marie Curie (Physics, 1903 and Chemistry,

1911), Linus Pauling (Chemistry, 1954 and Peace, 1962) and John Bardeen (twice Physics, 1956 and 1972).

Frederick Sanger was born on Aug. 13, 1918, in Rendcomb, England, where his father was a physician. While he initially planned to study medicine like his father, he switched fields and earned a degree in natural sciences (Biochemistry) from Cambridge University in 1939. He became an atheist, saying he lacked hard proof to support his religious beliefs. “In science, you have to be so careful about truth,” he said. “You are studying truth and have to prove everything. I found that it was difficult to believe all the things associated with religion.”

Dr. Sanger decided to study insulin, a protein that was readily available in a purified form for the treatment of diabetes. His choice of insulin turned out to be a fortunate one: with 51 amino acid beads, insulin has a relatively simple structure. Still, it took him ten years to unlock its chemical sequence. His approach, which he called the “jigsaw puzzle method,” involved breaking insulin into manageable chunks for analysis and then using his information of chemical bonds to fit the pieces back together. Using this technique, scientists went on to determine the sequences of other proteins. Sanger first won the Nobel Prize in 1958 at the age of 40 for his work on the structure of proteins. He had determined the sequence of the amino acids in insulin and showed how they are linked together. The sequence of insulin was very key in terms of leading to understanding the link between DNA and proteins. But the discovery that changed the whole science field was the 1953 work by Watson and Crick with help from Maurice Wilkins and Rosalind Franklin showing that DNA was, in fact, a double helix which provided a clear explanation of how DNA could be self-replicated.

Sanger’s lab praises him as an "extremely modest and self-effacing man whose contributions have made an extraordinary impact on molecular biology." Unusual for someone of his stature, Dr. Sanger spent his entire career in a laboratory. Long after receiving his first Nobel, he continued to perform many experiments himself instead of passing on to junior researchers as is typical in modern science labs. Dr. Sanger said he was not particularly expert at coming up with experiments for others to do and had little aptitude for administration or teaching. “I was in a position to do more or less what I liked, and that was doing research,” he said.

In 1962, Dr. Sanger moved to the British Medical Research Council Laboratory of Molecular Biology, where he was enclosed by scientists studying deoxyribonucleic acid, or DNA, the hereditary material in humans and almost all other organisms. Dr. Sanger quickly discovered that his jigsaw method was too cumbersome for large pieces of DNA, which contain many thousands of letters. “For a while I didn’t see any hope of doing it, though I knew it was an important problem,” he said. But he persisted, developing a more efficient approach that allowed stretches of 500 to 800 letters to be read at a time. His technique, known as the Sanger method, increases by a thousand times the rate at which scientists could sequence DNA. In 1977, Dr. Sanger decoded the complete genome of a virus that had more than 5,000 letters. It was the first time

the DNA of an entire organism had been sequenced. He went on to decode the 16,000 letters of mitochondria, the energy factories in cells.

Developing the chain termination, or dideoxy, method of sequencing DNA (The Sanger Method of DNA Sequencing) led to Sanger's second Nobel Prize, awarded jointly in 1980 with Stanford University's Paul Berg and Harvard University's Walter Gilbert,: Paul Berg, who determined how to transfer genetic material from one organism to another, and Walter Gilbert, who, independently of Dr. Sanger, also developed a technique to sequence DNA. Because of its relative simplicity, the Sanger method became the dominant approach. In a 2001 interview, Dr. Sanger spoke about the challenge of winning two Nobel Prizes.

"**It's much more difficult to get the first prize than to get the second one," he said, "because if you've already got a prize, then you can get facilities for work, and you can get collaborators, and everything is much easier**."

In addition to the Nobel Prizes, Sanger was made a fellow of the Royal Society in 1954, Commander of the Order of the British Empire in 1963, Copley Medal in 1977 and the Order of Merit in 1986.

After his death; Venki Ramakrishnan, Nobel laureate and deputy director of the Laboratory of Molecular Biology, said: "Fred was one of the outstanding scientists of the last century and it is simply impossible to overestimate the impact he has had on modern genetics and molecular biology. Moreover, by his modest manner and his quiet and determined way of carrying out experiments himself right to the end of his career, he was a superb role model and inspiration for young scientists everywhere."

"He (Sanger) was really a hero of mine. He was the quiet scientist. He hated talking and he liked doing things. He was always involved in getting things done," said Sir John Edward Sulston, Nobel laureate (2002 in Physiology or Medicine) the first director of the Sanger Institute named after Sanger. In 1992 the Wellcome Trust and the Medical Research Council established the Sanger Centre, for furthering the knowledge of genomes. Located 10 miles outside Cambridge, it became one of the main sequencing centers of the Human Genome Sequencing Project. According to The Sanger Institute, when he was asked if he would mind an institute being named after him, Sanger agreed but said "It had better be good."

In word of Dr Craig Venter "He (Sanger) twice changed the direction of the scientific world, first with the sequencing of insulin, proving that proteins were linear strings of amino acids and second with his then new method of sequencing DNA, which led to the field of genomics. His contributions will always be remembered,"

Sanger got married to Margaret Joan Howe in 1940. They had two sons, Robin and Peter, born in 1943 and 1946, and a daughter, Sally Joan, born in 1960. Apart from his work Sanger main interests was gardening and what he best be described as "messing about in boats".

I finish with two of the quotes by Sanger, which inspires our scientific researcher to have a high regard for what they do and nurture commitment for their work

“Scientific research is one of the most exciting and rewarding of occupation"

" I believe that we have been doing this not primarily to achieve riches or even honour, but rather we are interested in the work, enjoyed doing it and felt very strongly that it was worthwhile"

Vivek Singh

Assistant Editor
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