Honorary Doctor of Science

Professor Susumu TONEGAWA

Citation written and delivered by Professor Paul LAM Kwan-sing

Pro-Chancellor:

There are few more important areas in modern science than the study of human genes, research which carries with it the very real prospect of diminishing human suffering. Research in the range of associated disciplines attracts some of the sharpest international minds, and it is from this highly competitive environment that Professor Susumu Tonegawa has emerged as a visionary and pioneer who has unified comprehensive knowledge of a number of disciplines to solve some of the fundamental problems facing his contemporaries.

Professor Tonegawa was admitted to the Department of Chemistry at the Kyoto University in 1959. In his senior year at Kyoto University, Professor Tonegawa read scientific papers on the operon theory by Francois Jacob and Jacques Monod and was so inspired by this work that he changed his major to molecular biology and decided to study this area as a graduate student. He was accepted into Professor Itaru Watanabe's laboratory at the Institute for Virus Research at Kyoto University and was encouraged to complete his graduate studies in the United States, which had more sophisticated graduate training programmes than the ones available in Japan.

With Professor Watanabe's help, Professor Tonegawa was awarded a Fulbright travel grant to attend graduate school in the Department of Biology at the University of California in San Diego. He earned his PhD in molecular biology in 1968 and remained in San Diego as a postgraduate fellow at the Salk Institute where he was impressed with the excitement of the scientific research in eucaryotic molecular biology and inspired by the stimulating atmosphere. In the latter half of 1970, Professor Tonegawa was required to leave the country for at least two years before re-applying for a visa. Just before he had to leave, he was told the new Basel Institute for Immunology in Switzerland had opened and was encouraged to apply for membership of the institute. He subsequently stayed there for ten years from 1971.

Between 1974 and 1981, Professor Tonegawa thrived at Basel in an atmosphere of freedom and cooperation. He investigated the "germline" vs "somatic" theory of antibody diversity, the central problem in the immune system. Professor Tonegawa published an influential paper in 1976 that proved the validity of somatic theory. This not only settled the major controversy in immunology but also laid the groundwork for future research on immunological disorders like autoimmune diseases and immunodeficiency diseases, as well as the causes of cancer, specifically blood cancers such as leukemia and lymphoma.

By the early 1980s, Professor Tonegawa had made his major contribution to immunological research and was ready to launch a new scientific project and wanted to return to the United States. Selecting from numerous offers, he accepted a position as Professor of Biology in the Centre for Cancer Research at the Massachusetts Institute of Technology (MIT) in Cambridge. One important development he made was identifying a gene that led to the discovery of a new T cell receptor (gamma delta) that could be involved in a new type of immunity.

Professor Tonegawa received a surprise when a reporter called him for comments on being named 1987's sole winner of the Nobel Prize in Physiology/Medicine. The committee had realised that his key to unlocking the way the immune system functions was the basis for all future research into fighting infectious disease. The bulk of this Nobel Prize-winning work was done in Switzerland, when he discovered how only 10,000 genes in the human body could produce millions of diverse antibodies that fought off disease caused by viruses and bacteria. Professor Tonegawa had used mouse cells to determine that when antibodies are produced, different segments of the gene are combined at random, resulting in a huge number of varying combinations. His findings had shattered the prevailing belief that genes could not change.

Professor Tonegawa himself credited his successful career to mentors and colleagues he met along the way: "When I look back on my scientific career, I am amazed at my good fortune. At every major turn, I met scientists who were not only at the very top in their own fields, but who also gave me insightful advice and generous help."

In 1988, Professor Tonegawa was named an investigator at the Howard Hughes Medical Institute at MIT, where he researched learning and memory. Using genetically engineered mice, he studied neural development and the molecular,

cellular, and neuronal circuitry used in memory. In 1994, he became Picower Professor of Biology and Neuroscience and director of the Picower Centre for Learning and Memory at MIT. In 2004 Professor Tonegawa and his research team made a new discovery regarding memory. They discovered a mechanism in the brain that controls, as quoted from *Biotech Week*, "the formation of lasting memories."

Throughout his research career, Professor Tonegawa, Japan's only winner of a Nobel Prize in Medicine, conducted research outside of his native country. However, earlier this year, after 46 years of living overseas, Professor Tonegawa accepted the directorship of Japan's most prestigious brain research institute, the RIKEN Brain Science Institute (BSI), while retaining a very active laboratory at MIT. His presence will undoubtedly attract more scientists to the north Asian nation. Professor Tonegawa has always been a pioneer in research but his long-held views in relation to education have also been very influential in higher education. He recognised the value of interdisciplinary work and a broad knowledge base much earlier than many of his contemporaries. Whilst he began studying molecular biology in the 1960s when the field was just emerging, he has followed this up with decades of cutting-edge research in a number of other fields, including immunology and neuroscience. Recognising that science was becoming very specialised, with scientists from many fields not talking with one another, he identified what he termed "a goldmine" in interdisciplinary areas. In so doing he identified himself as the visionary scientist and educator we are proud to honour today because of the outstanding contributions he has made to humanity.

Mr Pro-Chancellor, in recognition of his visionary contributions to physiology, medicine, and education, it is my great privilege to present Professor Susumu Tonegawa to you, for the award of the degree of Doctor of Science, *honoris causa*.