Professor Hitoshi Murayama

Yukawa Commemoration Prize, 2002

Introduction to Cosmology

Where did we come from? Why are we here? Where are we going? These age-long questions are now subjects of modern science. I introduce basic concepts in this area of rapid progress. We are literally stardust, born in old stars. Yet stars did not form without mysterious dark matter which dominates the matter content of the Universe. The fate of the Universe is governed by even more mysterious dark energy, that comprises about 70% of the Universe. And the study of the Universe, the biggest thing we can think of, is intimately connected to the study of the tiniest things, elementary particles.

Professor Yuan Tseh Lee

Nobel Laureate in Chemistry 1986

Sustainable Transformation of Human Society

Yuan T. Lee

During the long history of mankind, planet Earth seemed to be an infinitely large place. The earth was so immense that the impact of human activities to the biosphere seemed quite negligible. But after the industrial revolution and especially in the twentieth century things have changed dramatically. World population increased from 1.5 billion to 6 billion in the twentieth century and has reached 7.2 billion this year. And with the advancement of communication and transportation, the earth has shrunk in relative terms. This sudden transition from "unlimited" to "limited" earth holds grave consequences – from climate change and mass extinctions to extreme weather. Yet human societies, having assumed an infinite earth for such a long time, have not been able to adapt. On the "limited earth", perhaps the most important challenges for scientists are problems related to the climate change and environmental degradation, together with unsustainable production and consumption. Without immediate action and transformation, the survival of human society will be seriously threatened.

This is the first time in human history that all human beings on Earth have been faced with learning to work together and live together as one family in a global village – the time for finally realizing that the planet Earth on which we live is only finite in space, capacity and natural resources. Our future depends entirely on how effectively the entire world would function as a community. This is a necessary awakening – vital for the survival and sustainable development of mankind. I believe that if we make the correct choice at this crossroads, then the 21st century is likely to be marked as the great turning point, or great transition – the beginning of a new era in the history of mankind.

Professor Harald zur Hausen

Nobel Laureate in Physiology or Medicine, 2008

The Search for Infectious Factors in Colon and Breast Cancers and in a Specific Neurological Disorder

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Red meat consumption has been considered in a large number of prospective epidemiological studies as a major risk for colon cancer. Only recently attempts have been published to identify specific types and factors in red meat contributing to this risk (1, 2). The available data point to a specific risk after long-time consumption of meat from Eurasian dairy cattle, particularly based on data from India, Mongolia, Japan and Korea. In the first three of these countries the colon cancer risk is very low, in India almost no beef is being consumed (Hindu population), in Mongolia red meat consumption is very high, but as far as beef is concerned, it mainly originates from Zebu-derived cattle and yaks. In Japan and Koreas beef consumption increased dramatically after World War II and after the Korean War. A substantial increase in colon cancer incidence occurred ~15-20 years after these wars.

Breast cancer incidence is high in most countries with high incidence of colon cancer. Yet in some regions remarkable differences exist: in Japan and Korea breast cancer occurs less frequently than colon cancer, in India breast cancer exceeds the rate of colon cancer. In additional countries (China and Bolivia) breast cancer incidence is low, corresponding to a low consumption of cow milk. There appears to exist a correlation between dairy cattle milk consumption and breast cancer incidence (2).

Our laboratory isolated a larger number of small novel single-stranded circular DNA molecules, presumably of viral origin. In cattle sera we found 10 specific DNAs, belonging into three different groups. From cow milk six different isolates have been obtained, all belonging into one of these groups. Human sera were negative for these agents. Autopsy material from two patients with multiple sclerosis, however, contained milk-related isolates.
The available data do not provide definite evidence for a role of these agents in human diseases, although transfection of their DNAs into human cells leads to active transcription of messenger RNA from these genomes.

References:

1. zur Hausen H. Red meat consumption and cancer: reasons to suspect involvement of bovine infectious factors in colorectal cancer. Int J Cancer. 2012; 130: 2475-83.

2. zur Hausen, H. and de Villiers, E.M. Dairy cattle serum and milk factors contributing to the risk of colon and breast cancers. Int J Cancer. 2015 Feb 3. doi: 10.1002/ijc.29466.

Professor Robert Huber

Nobel Laureate in Chemistry, 1988

Protease control in Health and Disease and my Experience with its Translation into Practice and Business

Robert Huber

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As a student in the early nineteen sixties, I had the privilege to attend winter seminars organized by my mentor, W. Hoppe, and by M. Perutz, which took place in a small guesthouse in the Bavarian-Austrian Alps. The entire community of a handful of protein crystallographers assembled in a room which served as living and dining room and as auditorium for the lectures.

Today structural biologists organize large congresses with thousands of attendants and there exist many hundreds of laboratories specialized in this field. It appears to dominate biology and biochemistry very visibly if we count covers in scientific journals displaying macromolecular structures.

Structural biology was successful, because it was recognized that understanding biological phenomena at the molecular and atomic level requires to see those molecules.

Structural biology revealed the structure of genes and their basic mechanism of regulation, the mechanism of enzymes' function, the structural basis of immune diversity, the mechanisms of energy production in cells by photosynthesis and its conversion into energy-rich chemical compounds and organic material, the mechanism that makes muscle work, the architecture of viruses and multi-enzyme complexes, and many more.

New methods had an essential impact on the development of structural biology. Methods seemed to become available in cadence with the growing complexity of the problems and newly discovered methods brought biological problems within reach for researchers, a co-evolutionary process of the development of methods and answerable problems.

An important additional incentive for structural biology came from its potential application for drug design and development by the use of knowledge of drug receptors at the atomic level. The commercial interest in application spurred this direction of research enormously.

My lecture will start out with a very brief review of the history of protein crystallography and continue with our studies since 1970 on proteolytic enzymes and their control. Proteolytic enzymes catalyse a very simple chemical reaction, the hydrolytic cleavage of a peptide bond. Nevertheless they constitute a most diverse and numerous lineage of proteins. The reason lies in their role as components of many regulatory physiological cascades in all organisms. To serve this purpose and to avoid unwanted destructive action, proteolytic activity must be strictly controlled.

Control is based on different mechanisms which I will discuss and illustrate with examples of systems and structures determined in my laboratory:

a) by specific inhibition with natural and synthetic inhibitors
b) by enzymatic specificity
c) by activation from inactive precursors accompanied or not by allosteric changes
d) by co-localization of enzyme and substrate
e) by cofactor binding accompanied or not by allosteric changes
f) by controlled access to the proteolytic site.

The regulatory principles offer new opportunities of intervention for therapeutic purposes and use in crop science.

I then will let you share my experience with the foundation and development of two biotech companies with different business models, but both based on basic academic research in

structural biology:

Proteros (**www.Proteros.com**) offers enabling technology services for Pharma- and Crop science companies imbedding all steps of the workflow molecular and structural biology can provide and commands and uses its platform for the generation of leads from identified targets to in vivo Proof of Concept (PoC).

Suppremol (**www.Suppremol.com**) specializes in the development of novel immunoregulatory therapeutics for the treatment of autoimmune diseases on the basis a recombinant, soluble, non-glycosylated version of the human Fcγ receptor IIB. Suppremol was recently acquired by Baxter International Inc. (NYSE:BAX) offering an ideal setting for its therapeutic projects.

Professor Vladimir Voevodsky

Fields Medalist, 2002

How I became interested in foundations of mathematics

In my first years at the University I was interested only in mathematics where new exciting and fashionable things were happening. At that time it was algebraic topology and algebraic geometry. We had classes in the history and foundations of mathematics but I found them boring and irrelevant for my future.

Today I am working full time on the Univalent Foundations of mathematics - new foundations of mathematics which I and my colleagues are developing. In my lecture I will tell how I started to work on the Univalent Foundations and why I believe that this is the most important thing happening in mathematics today.

Professor Yongyuth Yuthavong

Nikkei Asia Prize, 2004

Is Science Everything?

Yongyuth Yuthavong
Deputy Prime Minister
Thailand

As science concerns all aspects of nature, the question comes up whether science is indeed everything. We note that three aspects concerning science, imagination, investigation and invention cover very large areas of human activities, not only concerning the physical world, but also the realms of the mind. The realm of science spans from subatomic structures to the universe. Yet, human engagement in areas like poetry, drama, literature and music, although interacting with science, occupies separate domains from science, not to mention other human activities including living and earning a living. Science is therefore not everything, but – for us here – very many things important, although we should not forget other things so as to make our lives complete.