JAPAN PRIZE NEWS

THE SCIENCE AND TECHNOLOGY
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U.K. and Japanese Scientists Named as Laureates of the 2006(22nd)Japan Prize

The Science and Technology Foundation of Japan (Chairman: Hiroyuki Yoshikawa) announced that British and Japanese scientists have been named as laureates of the 2006 (22nd) Japan Prize.

Sir John Houghton (74), Formerly Chief Executive, Hadley Centre for Climate Prediction and Research, Meteorological Office, U.K., will receive the Japan Prize in this year's category of "Global Change." He contributed to the Atmospheric structure and composition based on his satellite observation technology and for promotion of international assessments of climate change.

Dr. Akira Endo (72), Director, Biopharm Research Laboratories, Inc., Japan, will receive the Japan Prize in the category of "The Development of Novel Therapeutic Concepts and Technologies." He contributed to the Discovery of the Statins.

Global Change

Sir John Houghton CBE FRS

The Development of Novel Therapeutic Concepts and Technologies

Dr. Akira Endo

Japan Prize

The Japan Prize is awarded to world-class scientists and technologists who were credited with original and outstanding achievements and contributed to the advancement of science and technology, thereby furthering the cause of peace and the prosperity of mankind. In principle, original achievements in science and technology are given priority during the selection process.

No distinction is made as to nationality, occupation, race, or sex. Only living persons may be named.

Fields of study for the prize encompass all categories of science and technology, with two categories designated for the prize each year in consideration of developments in science and technology.

Each Japan Prize laureate receives a certificate of merit and a commemorative medal. A cash award of 50 million yen is also presented for each prize category. The award is intended for a single person, in principle, but small groups of researchers are also eligible.

Global Change

Achievement : For pioneering research on atmospheric structure and composition based on his satellite observation technology and for promotion of international assessments of climate change.

Sir John Houghton CBE FRS (U.K.)

Honorary Scientist, Hadley Centre for Climate Prediction and Research and Formerly Chief Executive, Meteorological Office, U.K.

<Summary>

Observations by weather satellites began in the 1970s, when Sir John Houghton developed a new means for making observations to measure the temperatures and composition of the upper atmosphere based on his independent theory. This opened the way to elucidating the three-dimensional temperature structure of, and distribution of micro-components such as ozone in the atmosphere across the entire globe. Then he established the Hadley Centre for Climate Prediction and Research to pursue this research and to study international climate change. He also has played a central role in compiling the First, Second and Third Assessment Reports under the auspices of the Intergovernmental Panel on Climate Change (IPCC).

Opening up the global observation satellite

These days, we regard images of clouds and weather data sent from weather satellites as completely ordinary. However, weather satellites have been with us for less than half a century. Most weather observations until the 1950s were mainly terrestrial, and limited to the developed world. Observations reached up to around 20 km above the earth, made by weather balloons and small rockets. The launch of the first weather satellite in 1960 made it possible to cover the entire globe – sea and land, and the Arctic and the Antarctic.

The first weather satellites had limited functions, merely capturing images of cloud distributions and measuring temperatures at the cloud tops. At that time, Sir John Houghton, who conducted research into atmospheric physics at Oxford University in England, developed a theory of infrared atmospheric radiation which made it possible to determine the temperature structure of the atmosphere from observations of extraterrestrial infrared rays. The Earth is warmed by heat (radiation) coming from the Sun, and heat (radiation) is emitted by the Earth's surface and the atmosphere. The wavelength of the solar radiation is principally in the visible light spectrum, but terrestrial radiation is long wavelength infrared radiation. By separating the observed wavelength spectrum into its components (diffraction) and looking for the characteristic wavelength for the absorption of infrared radiation by carbon dioxide (CO_2), it is possible to determine at what height in the Earth's atmosphere a signal is being emitted.

This was a breakthrough principle, but sufficient resolution is required in order to determine atmospheric temperatures to an accuracy of 1K (absolute temperatures). With the assistance of Professor Desmond Smith of the University of Reading, Sir John proposed a specific new diffraction technique. This was an infrared radiation gauge known as the Selective Chopper Radiometer; it was mounted in Nimbus 4 which was launched in 1970 by US National Aeronautical and Space Administration(NASA) and in subsequent satellites.

This new means of observation, the radiometer, extends atmospheric observations from two to three dimensions and going up in height to the stratosphere, 10 km to 50 km up, allowing a clear view of the temperature structure of the atmosphere (Fig. 1). As the diagram below shows, in the troposphere approximately 10 km up the temperature of the air declines with increasing altitude, but in the stratosphere approximately 50 km up, the temperature of the air tends to rise. The air above the Equator and in the Southern Hemisphere, when it is experiencing winter, forms a low temperature zone.

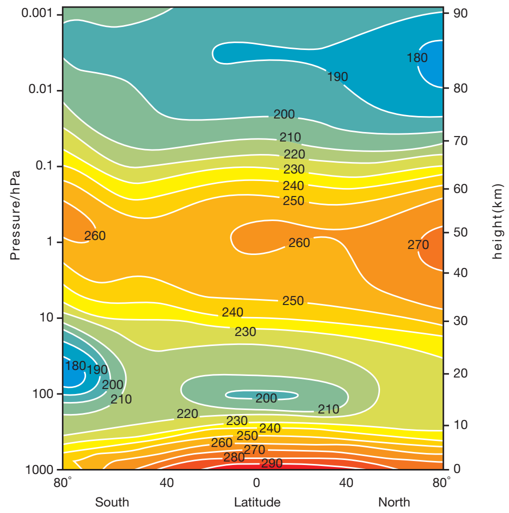


Fig. 1. Temperature profile of the Earth's atmosphere. Shows mean temperatures (K) for 4 August 1975, based on observation data from Nimbus 5 and 6. (0°C=273°K)
J.T. Houghton (1986): The Physics of Atmospheres, Second Edition, Cambridge University Press, 271 pp.

The weather satellites continuously observing the Earth capture the changes in temperature from hour to hour and day to day. These changes show us the movements in the atmosphere. These observations will contribute to research into changes in the atmosphere.

Measuring changes in the atmosphere on a global scale

Further advances in infrared radiometry in the second half of the 1970s led to the development of radiometers that detected anomalies in atmospheric pressure (Fig. 2). These radiometers enabled observations of the temperature structure of the mesosphere which is above the stratosphere. Sir John Houghton had also proposed such radiometers, and these principles are now used widely in modern satellites.

This expansion in the field of observations heightened the awareness amongst meteorologists of the need to observe change on a global scale, and plans were made to observe the micro components of the atmosphere by satellite and to capture changes in them. The principal components of the atmosphere are nitrogen and oxygen, but water vapour and ozone are important micro components. Water vapour forms clouds, which become rain and snow and return to the ground in a continuous cycle. Ozone forms the ozone layer, which is concentrated at a height of around 15 km to 30 km; the ozone layer absorbs the harmful ultraviolet radiation from the Sun, protecting life on Earth. Ozone (O_3) is formed by the Sun by photochemical reactions from oxygen (O_2) and is continuously being generated and decomposing, maintaining the balance of the atmosphere.

At his laboratory, Sir John developed a stratospheric and mesospheric sounder intended to measure the ozone, methane and water vapour components of the atmosphere. It operates on the same principles as the infrared radiometer, but over a broader spectrum of wavelengths, and can make observations from microwaves to infrared, visible light and the ultraviolet. The ultraviolet range that is absorbed by ozone is important in observations of ozone. The stratospheric and mesospheric sounder was mounted on Nimbus 7 which was launched in 1978, and made observations of the entire globe.

As a result, it was confirmed that ozone formation is most active in the equatorial region, where solar radiation is strongest, and that the ozone is carried to high latitudes by large-scale cyclic movements of the atmosphere. The Nimbus series of satellites are polar-orbiting satellites, passing around 14 times per day in a North-South direction along the longitude over the Artic and Antarctic landmass at a height of approximately 1,000 km. With the establishment by the stratospheric and mesospheric sounder of the spectrometer as a means of measuring the composition of the atmosphere, it should also soon be possible to measure changes in the ozone level in the Antarctic.

Leading world climate research

Sir John Houghton left Oxford University in 1983 to take up a position as Director of the U.K. Meteorological Office. While he was Director in 1990 Sir John set up the Hadley Centre for Climate Prediction and Research, which is part of the Meteorological Office. The Centre was named after the Eighteenth Century British meteorologist John Hadley, who developed the notion of the Hadley Circulation, under which air ascends in the equatorial regions, moves towards the Poles, and descends in the high latitudes. As its name suggests, the Hadley Centre for Climate Prediction and Research is also intended to research atmospheric movements on a global level.

At this point, it is said that something about the change in our understanding of the word “climate” occurred in the second half of the Twentieth Century. Not long ago, climate fell into the realm of geography. In school textbooks, it was included amongst the social rather than physical sciences. It was described as a regional phenomenon, with terms such as “continental weather pattern” and “Mediterranean weather pattern” and so on. As means of observation advanced, research on theory-based mathematical models led to “climate” being regarded as a great dynamic cycle.

The British universities, and particularly Oxford University with Sir John, gave early impetus to research into the mathematical modelling of atmospheric cycles. With a tradition of theoretical research, the scholars collected data through satellite measurements, and called for the U.K. to take the lead in establishing a centre for the study of climate change. Sir John was at the forefront of this movement. The Hadley Centre for Climate Prediction and Research accepts research workers from overseas and actively collaborates with research bodies outside the U.K. becoming a model for international meteorological research centres.

Establishing international recognition of climate change

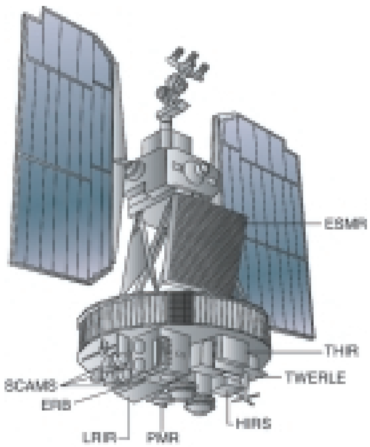
Concern for global environment issues, including the impact of human activities, rose to prominence in the second half of the 1980s. At that time, the British Prime Minister, Margaret Thatcher, took the lead by organizing a conference of scientists and government representatives from around the world. This led to the establishment of the Intergovernmental Panel on Climate Change (IPCC).

The IPCC has three working groups. Working Group 1 (WG I) collects the latest scientific knowledge on climate change, which is evaluated by scientists from many different fields. Sir John Houghton was elected to lead WG I and he addressed the scientists of the world. Then Sir John urged scientists to feel a sense of responsibility in regards to environmental issues, to analyse them correctly based on scientific evidence; and to make presentations to enable scientists and politicians to understand the issues.

While it is scientists who prepare the Assessment Reports, it is representatives of the various governments who form the plenary session that considers and approves them. Through the participation of the government representatives, the scientists who prepare the reports are able to play a part in deliberations on international policies and in advancing the domestic policies of individual countries. The first Assessment Report issued in 1990 supplied important information for the World Climate Conference that year and the 1992 Earth Summit.

Further work was done on the IPCC Assessment Report, and a Second Assessment Report was issued in 1995, and a Third Assessment Report in 2001. In each case, Sir John served as Chairman of WG I and established the international assessments of climate change. His work has been taken up by the compilers of the Fourth Assessment Report to be completed in 2007.

Fig. 2. Nimbus 6 weather satellite and observation instruments
Based on NASA, Nimbus 6 User's Guide



The Nimbus 6 satellite showing the location of the experiments:
SCAMS(scanning microwave spectrometer);
ERB(earth radiation budget experiment);
LRIR(limb radiance infrared radiometer);
PMR(pressure modulator radiometer);
HIRS(high resolution infrared sounder);
TWERLE(tropical wind energy conversion and reference level experiment);
THIR(temperature and humidity infrared radiometer);
ESMR(electrically scanning microwave radiometer)
(from NASA, Nimbus 6 User's Guide).

The Development of Novel Therapeutic Concepts and Technologies

Achievement : The Discovery of the Statins and their Development

Dr. Akira Endo (Japan)
Director, Biopharm Research Laboratories, Inc., Tokyo, Japan

<Summary>

In 1973 Dr. Akira Endo isolated from *penicillium* a ground-breaking substance called ML-236B (currently known as compactin) that lowers blood cholesterol levels, and confirmed that it was also effective in humans. This discovery triggered world-wide research into the compactin group and resulted in the birth of several hypercholesteremia drugs from amongst that group. These drugs, known collectively as statins, are presently used by approximately thirty million people around the world and help to prevent cardiac disease and strokes and so on.

The leading therapeutic drug for high blood cholesterol

Blood contains lipids such as cholesterol and triglycerides. Excessive concentration of blood cholesterol is a condition known as hypercholesteremia. This illness affects more than twenty million people in Japan alone. Excess cholesterol gradually adheres to the interior of blood vessels leading to hardening of the arteries which in turn causes blood vessels to become clogged and increases the risk of diseases such as myocardial infarction and cerebral infarction.

Dr. Endo discovered the ground-breaking substance “ML-236B” (often called compactin) that lowers blood cholesterol levels, and directed his energies into making it into a medication. This research garnered much attention resulting in research commencing worldwide. Subsequently several breakthrough drugs for hypercholesteremia appeared from amongst this compactin group. These are known collectively as statins and are currently used by approximately thirty million people around the world and help to prevent cardiac disease and strokes and so on.

Developing a new-acting medication

Dr. Endo had been interested in mold and fungi since boyhood. During his time at university he read the autobiography of Dr. Alexander Fleming who had discovered penicillin from *penicillium*, and he conceived a desire to personally undertake research that would make use of mold. After graduation he joined Sankyo Co., Ltd. and was involved in research to find substances from mold and fungi that would be useful in food processing. While studying in the United States from 1966 to 1968, however, he learned that a very large number of people develop myocardial infarction from hypercholesteremia and determined to produce a therapeutic drug for it.

Around that time there were three main medications used in the treatment of hypercholesteremia. One was a special type of fine resin powder called negative ion exchange resin. Cholesterol converts bile acid in the liver and is used in fat absorption. This powder binds bile acid in the intestines and forms faeces that are eliminated from the body. As bile acid thus decreases, the body tries to compensate for that lost portion by converting cholesterol to bile acid with a resulting drop blood cholesterol level. This however had very little effect in preventing myocardial infarction and difficulties in ingesting this medication made it onerous for patients.

The remaining two medications included a nicotinic acid derivative and something called a fibrate-type drug. Neither of these acted on cholesterol and their cholesterol-lowering action was also limited. Fibrate-type drugs in particular demonstrated a variety of side affects including liver damage, vomiting and diarrhoea, while muscular impairment (striated muscle myolysis) sometimes occurred as a serious side effect.

While these drugs were gradually improved and are presently used by some patients Dr. Endo was aiming for a drug that acted differently to these. He knew that cholesterol is produced within the body more often than it is ingested as food. He therefore thought he would try and produce a drug that reduced the amount of cholesterol produced in the body.

The human body contains a multiplicity of enzymes that work to change substances. Cholesterol is formed when approximately thirty types of enzymes successively act on the substance that makes up its raw material. Dr. Endo hypothesized that if the action of one of these enzymes could be inhibited, this would impede cholesterol production and therefore the cholesterol level would likely drop. He set about searching for a drug that would inhibit the action of an enzyme called hydroxymethyl-glutaryl coA reductase.

Persistence leads to discovery in mold

Upon his return to Japan, Dr. Endo confirmed a method enabling the efficient investigation of whether a mold or fungus culture medium contained a substance with the desired action, and proceeded to investigate 6,000 strains. In 1973, when trying to taper off research that had remained fruitless for two years, he finally found compactin, a substance that exerts a powerful inhibiting action on enzymes, from *penicillium* formed on rice produced in Kyoto (Fig. 1).

This was the beginning of all statins. However, as blood cholesterol levels did not decrease when compactin was administered to rats its development as a drug was not commenced. Dr. Endo did not give up though, and after two years further persistence, identified that blood cholesterol in chickens decreased by close to 50%. Further trials with dogs and monkeys confirmed a dramatic lowering in blood cholesterol levels.

While drug development commenced in this way, toxicity tests in rats revealed a toxic effect on the liver and development once more halted. Then, in collaboration with Dr. Akira Yamamoto a lecturer at Osaka University at the time, using compactin in patients with critically high levels of blood cholesterol enabled confirmation of a conspicuous decrease in blood cholesterol and also its outstanding safety.

Development was recommenced and in 1979, when Dr. Endo considered that clinical trials were on track, he left Sankyo and joined Tokyo University of Agriculture and Technology. In the following summer, development was once more suspended due to flaws in toxicity tests on dogs.

Separate to these developments, at the end of 1978, Merck & Co., Inc. in the United States discovered a second statin, "lovastatin", that was very similar to compactin. (Actually, Dr. Endo had also discovered a substance the same as this at Tokyo University of Agriculture and Technology). Merck commenced clinical trials in 1980, obtained Federal Drug Administration approval in the U.S. in 1987 and started marketing the drug.

Meanwhile, Sankyo developed Plavastatin which was a partially modified compactin and this went on sale in 1989. As its appearance coincided with the emergence of high blood cholesterol as a major health problem in Japan, it was widely used.

Statins continue to evolve

Numerous companies apart from Sankyo and Merck then took up statin development. Lovastatin and pravastatin were followed in the market by simvastatin and fulvastatin, and recent years have seen the emergence of atorvastatin, pitavastatin and rosuvastatin (Fig. 2). The last three of these are particularly effective in cholesterol-lowering capability and currently constitute a triumvirate of drugs to combat high cholesterol.

The origin of all these drugs was "compactin", the first statin discovered by Dr. Endo. In fact, the same substance had been discovered at the British company Beecham (now Glaxo, Smith, Klein). Beecham, however, did not direct much attention to this substance because of its weak antibiotic effect. Later, despite administering it to rats, as it still did not lower blood cholesterol the company gave up on developing it as a cholesterol-lowering drug.

Dr. Endo had a clear vision for making a drug that inhibited the production of cholesterol and he overcame numerous obstacles to realize this aim. The substance that he discovered became the forerunner of outstanding drugs which are helping society to this very day.

Compactin also proved extremely useful in research into mechanisms controlling the amount of intracellular cholesterol when cells incorporate and produce cholesterol. Dr. Michael S. Brown and Dr. Joseph L. Goldstein, U.S. researchers who accepted Dr. Endo's offer to use compactin in collaborative research with him were awarded the Nobel Prize for Physiology or Medicine in 1985.

Thus, Dr. Endo's discovery of statin, has not only saved countless people from the burden of illness but has made a significant contribution to advances in learning.

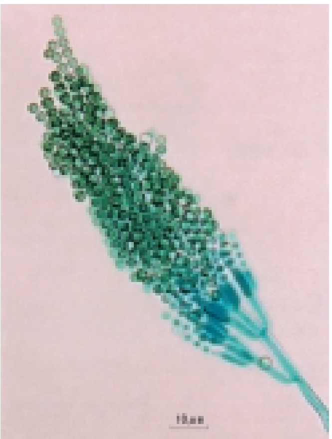


Fig. 1. Microphotograph of *Penicillium citrinum* in which Dr. Endo discovered the first statin (compactin).

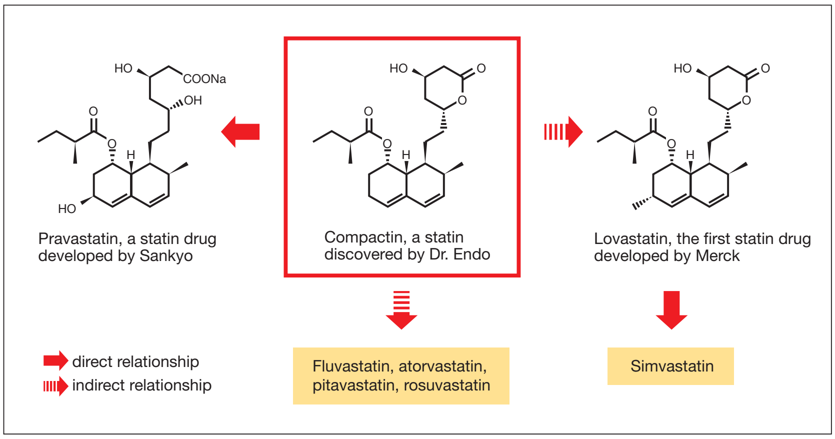


Fig. 2. The various statin-type prescription drugs developed on the basis of the statin discovered by Dr. Endo.

Members of the 2006 (22nd) Japan Prize Selection Committee

	Name	Post
Chairman	Nobuaki Kumagai	President of University of Hyogo, Professor Emeritus of Osaka University

Selection Panel for Global Change

	Name	Post
Panel Chairman	Isamu Hirota	Professor Emeritus of Kyoto University, President of Meteorological Society of Japan
Acting Chairman	Ryuji Kimura	Professor, University of the Air
Members	Yutaka Kondo	Professor, Research Center for Advanced Science and Technology, The University of Tokyo
〃	Yasuhiro Sasano	Director, Atmospheric Environment Division, National Institute for Environmental Studies
〃	Takakiyo Nakazawa	Professor, Graduate School of Science, Tohoku University
〃	Teruyuki Nakajima	Director, Center for Climate System Research, The University of Tokyo
〃	Fujio Masuda	Professor, Graduate School of Science, Kyoto University

Selection Panel for The Development of Novel Therapeutic Concepts and Technologies

	Name	Post
Panel Chairman	Shigehiko Kamoshita	Director of San-ikukai Hospital, Professor Emeritus of the University of Tokyo
Acting Chairman	Tsuguya Fukui	President of St.Luke's International Hospital, Professor Emeritus of Kyoto University
Members	Masato Kasuga	Professor, Graduate School of Medicine, Kobe University
〃	Masaki Kitajima	Dean, Keio University School of Medicine
〃	Shoji Tsuji	Professor, Graduate School of Medicine and Faculty of Medicine, The University of Tokyo
〃	Tatsutoshi Nakahata	Professor, Graduate School of Medicine, Kyoto University
〃	Shingo Fujii	Professor, Graduate School of Medicine, Kyoto University

(as of July 7, 2005)

Categories Selected for the 2007 (23rd) Japan Prize

The Science and Technology Foundation of Japan announced the two categories for the 2007(23rd)Japan Prize, and determined their definition as follows.

Letters have been sent to numerous scholars and rescarchers throughout the world, requesting nominations in the fields the award is being made. The selection committee will then recommend candidates to the Board of Directors of the Foandation, and make their decisions.

Field I: Production

"Innovative Devices Inspired by Basic Research"

Basic research in science is playing an important role as a cornerstone of our modern society. Breakthroughs in physics, chemistry and other fields of basic research often come to fruition in the form of the new materials or devices, eventually leading to the development of a new industry.

The award for 2007 will be focused on accomplishment in developing original findings in basic research into the invention of an innovative device which will likely create a new industry.

Field II: Life Conservation Technology • Life Environment

"Science and Technology of Harmonious Co-Existence"

Life is expressed in each entity at every level of the biological hierarchy such as cells, individuals and eco-systems. All of them show a particular set of features of life. It is also expressed in the network of complex overlapping relationships, direct or indirect and competitive or cooperative, between such systems. Breakage of a network of stable relations between biological systems causes a disruption, and may eventually result in the destruction of the biosphere as well as the physicochemical conditions of our mother planet, the Earth. It has been suspected that the network of biological relationships is ripping apart as a result of human activities. It is thus of urgent necessity to understand the mechanisms underlying--and also to develop technologies for reasonable management of--the harmonious co-existence of various biological systems. The harmonious co-existence is a much broader concept than *symbiosis* and includes any relationship, which fosters living harmoniously together with others, between biological systems at any level of the hierarchy of life.

The Japan Prize for 2007 in this field will be awarded for significant accomplishment in the science of disruption and stabilization and the technology of protection and restoration of harmonious co-existence in biological systems in a very broad sense. This includes studies on the effects of degradation in the atmosphere, hydrosphere or soilsphere, and of emerging infectious diseases on the co-existence of these entities, and conversely on those changes caused by disruption of co-existence.

Members of the 2007 (23rd) Japan Prize Fields Selection Committee

	Name	Post
Chairman	Kiyoshi Kurokawa	President, Science Council of Japan

FieldⅠ Production

	Name	Post
Panel Chairman	Kazuhito Hashimoto	Director, Research Center for Advanced Science and Technology, The University of Tokyo
Members	Kohei Uosaki	Professor, Division of Chemistry, Graduate School of Science, Hokkaido University
〃	Atsuhiro Osuka	Professor, Department of Chemistry, Graduate School of Science, Kyoto University
〃	Hidenori Takagi	Professor, Department of Advanced Materials Science Graduate School of Frontier Sciences, The University of Tokyo
〃	Hideaki Takayanagi	NTT R&D Fellow, Director, NTT Basic Research Laboratories, Nippon Telegraph and Telephone Corporation

FieldⅡ Life Conservation Technology･Life Environment

	Name	Post
Panel Chairman	Motonori Hoshi	Professor of Keio University Faculty of Science and Technology, Professor Emeritus of Tokyo Institute of Technology
Members	Fuyuki Ishikawa	Professor, Graduate School of Biostudies, Kyoto University
〃	Kunio Iwatsuki	Director, The Museum of Nature and Human Activities, Hyogo
〃	Itaru Yasui	Vice-Rector, United Nations University
〃	Okitsugu Yamashita	President, Chubu University

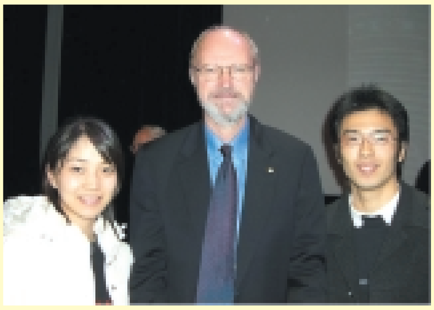
(as of July 4, 2005)

Japanese Students Attend the Nobel Prize Award Ceremony

In 1987, the Science and Technology Foundation of Japan (JSTF) instituted a program which began sending two Japanese students to the annual Stockholm International Youth Science Seminar (SIYSS). The event is held during Nobel Prize Week as a means of promoting the international exchange of young scientists, and is conducted under the auspices of the Swedish Federation of Young Scientists and with the support of the Nobel Foundation.

This year, it sent Mr. Daisuke Akai, of Kyoto Kyoto University and Ms. Kyoko Kumagai of Sophia University to the 30th SIYSS. Their report follows;

We served as delegates to the 30th Stockholm International Youth Science Seminar (SIYSS), held on December 4-10, 2005, as the representatives of Japan designated by the Science and Technology Foundation of Japan (JSTF). We had a valuable week with altogether 25 students from 16 countries, all of us aiming to be scientists--and 8 coordinators from Sweden.



With Prof. Robert H. Grubbs after his Nobel Lecture in Chemistry

We participated in many events related to the Nobel Prize, including the Award Ceremony. We were granted opportunities to talk with Nobel Prize laureates directly. Thus, we heard from them how they felt when they got the news of winning the Nobel Prize and we conversed with them about such varied subjects as Japanese food, the laureates' motivations as researchers, and more. We recognized how much pride they took in their research projects--as we struggled to communicate with them in English.

The Nobel Prize Award Ceremony was held in a solemn, bright atmosphere. We participated in the ceremony in traditional Japanese garb, wearing kimono and haori hakama, and we met the Minister of Education, Culture, Sports, Science and Technology. It gave us pause to realize that people around the world pay so much attention to the Nobel Prize. Some 500 students in Stockholm were given the opportunity to take part in the ceremony--and so we could know how much importance people attach to science over there and how highly the scientific environment is developed in Sweden.

Making presentations about my work

To sum up, we really appreciated all the efforts of those who gave us such a great opportunity. We'll do our best to further our own research, and to use well in our daily lives the knowledge, sensitivity and broad view of the world that we've got from this program.

Introducing characteristic of Japan "Origami" to the other participants

We all are ready for theNobel Prize Award Ceremony