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Through Engineering
Intellect and Knowledge

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Supporting Techno-Entrepreneurship

The Takeda Foundation
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Bulletin

Inside

New Foundation Is Established and Begins Full Slate of Activities

On April 1, 2001, the Takeda Foundation – a new nonprofit, operating foundation was formally established and quickly began operations. The objective of the Foundation's award and grant activity is to encourage the creation and application of new engineering knowledge that will generate substantial value for people in their daily lives. This knowledge should extend beyond the specialized fields, and should be related in some way to measurement technologies.

The foundation's activities focus on promoting and supporting new "Engineering Intellect and Knowledge" that meets key human needs. The Foundation has coined the term "Techno-Entrepreneurship" to define activities that challenge technological frontiers through the applications of engineering intellect and knowledge. The Foundation's three substantive areas of focus include *social/economic well-being* (information and electronics), *individual/*

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Takeda Award 2001 Announced

The Takeda Foundation announced the winners of the first Takeda Awards in early September. The Takeda Awards are presented annually to individuals who have made outstanding contributions in creating and applying new "Engineering Intellect and Knowledge" in three fields: Social/Economic Well-Being (information and electronics), Individual/Humanity Well-Being (life sciences), and World Environmental Well-Being (environment).

To select the recipients of the Takeda Awards 2001, the Foundation accepted nominations from an international group of 770 nominators. All nominations were reviewed, then screened in a formal selection process. After the winners were determined by the Selection Committee, they were approved by the Board of Directors on September 4, 2001.

One award was given in each of the Foundation's three fields. The monetary value for each award is 100 million yen. The award ceremony took place in Tokyo on December 4, 2001 in Tokyo, Japan. Listed in alphabetical order, the winners were:

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New Foundation is Established and Begins Full Slate of Activities (continued from page 1)

humanity well-being (life sciences), and *world environmental well-being*. The Takeda Foundation administers a number of programs to pursue its goals; each is described in other sections of this newsletter.

- The "flagship" activity is the presentation of a prestigious new, international award – **The Takeda Award**.
- In addition, the Foundation has commenced a competition for research and development grants under the **Takeda Techno-Entrepreneurship Award** program.
- The Foundation will also provide scholarships to Japanese engineering students.
- Finally, the Foundation will support a number of analytical and public outreach activities.

"Underpinning the Foundation's establishment is the belief that there is a complementary relationship between the development of new measurement technologies and the acquisition of new engineering intellect and knowledge," says Ikuo Takeda, the Foundation's Chairman and financial benefactor. Dr. Takeda began his career conducting basic research in the field of semiconductors. He eventually founded a company that is now known as Advantest Corporation, a leading international corporation specializing in electronic testing.

While based in Tokyo, the Takeda Foundation has a strong international orientation. All programs except the scholarship activity are open to international participation, and most of the Takeda Award 2001 winners are from North America and Europe. Leading Silicon Valley research institute SRI International is working with the Foundation to extend the worldwide reach of its programs.

Takeda Award 2001 Announced (continued from page 1)

Technical Achievement in Social/Economic Well-Being

The achievement honored in this area is "the origination and the advancement of open development models for system software – open architecture, free software, and open source software." The prize was awarded jointly to Ken Sakamura (for developing and promoting the TRON open architecture), Richard M. Stallman (for starting the free software movement and leading the development of the GNU operating system, and Linus Torvalds (for developing the Linux operating system kernal through the open source process for software development).

Technical Achievement in Individual/ Humanity Well-Being

The achievement honored is "the development of a large-scale genome sequencing system by establishing the 'whole genome shotgun strategy' that utilizes a modularized data acquisition system and high-throughput DNA sequencers." The prize was awarded jointly to Michael W. Hunkapiller (for his contribution to the development of the automated high-throughput DNA sequencers and the promotion of the foundation of Celera Genomics) and J. Craig Venter (for the foundation of Celera Genomics and the development of "the whole genome shotgun strategy.")

Technical Achievement in World Environmental Well-Being

The achievement honored is "the development and promotion of the Ecological Rucksacks and Material Input per Unit Service (MIPS) concepts as measures of the ecological stress of products and services." The prize is awarded jointly to Friedrich Schmidt-Bleek (for developing and promoting the Ecological Rucksacks and MIPS concepts) and Ernst Ulrich von Weizsaecker (for his contribution in refining and promoting the Ecological Rucksacks and MIPS concepts).

What the Takeda Award Aims to Achieve

The Takeda Award is given to individuals who have made significant contributions to scientific and technological achievements that enhance the value of human life and lead to an increase in wealth, richness, and happiness of life for humanity.

In the-so-called "second industrial revolution," local economic systems developed into national economic systems. Now, in the "third industrial revolution," national economic systems are transforming into an international economic system. In this process, the way in which markets respond to the needs of people will be the key to prosperous development. The creation and application of engineering intellect and knowledge, as well as growth in techno-entrepreneurial spirit, are indispensable for its realization.

The Takeda Award will be given to exceptional individuals who have made significant contributions to the creation of engineering intellect and knowledge. Engineering intellect and knowledge can be generated through combinations of various types of knowledge, including the establishment of new scientific knowledge, the formation of new algorithms, the use of new ideas, the proper management of organizations, and the capture of market needs.

For example, the 2001 Takeda Awardees in the field of Social and Economic Well-Being have created new engineering intellect and knowledge in the form of open development models for system software. Their achievement enabled a free and open method for development of software, resulting in an expanded and improved market.

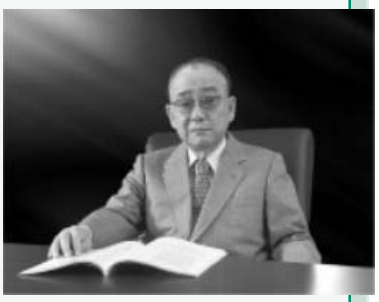
Wealth and richness in this context do not refer solely to money. In the 20th Century, the world experienced vicious cycles of over-investment that created economic bubbles and resulted in long-lasting economic recessions. The world has seen many economic bubbles and recessions, such as the recession in the United States in the late 1970s, the bubble in Japan experienced in the late 1980s, and the information technology related bubble and new recession that occurred worldwide at the turn of the century.

It turns out that mere money games never produce real wealth and richness for people. Wealth and richness in this context means a happy life itself that people can lead and can be obtained through technological innovations created by engineering intellect and knowledge. However, wealth and richness cannot be achieved automatically by the creation of engineering intellect and knowledge alone. Ultimately, it is techno-entrepreneurship that brings wealth and richness to people. For this reason, the Foundation focuses on techno-entrepreneurship.

Engineering intellect and knowledge needs first to be provided in a form that is usable in the market, then to be tested in the market, and finally to produce wealth and richness through transactions in the market. In this way, techno-entrepreneurship forms a bridge between engineering intellect and knowledge and the market. In other words, techno-entrepreneurship is the driving force behind engineering intellect and knowledge, the challenging spirit to overcome risks.

In the first half of the 20th Century, the world witnessed many wars, including two World Wars that destroyed many lives and an enormous amount of wealth. However, through deep reflection and sincere search for peace, people throughout the world strived to develop their countries, and as a result, growing prosperity can be seen in many countries and places.

During the process of post-war recovery, the world saw a long lasting conflict between two economic systems – capitalism and socialism. Through this conflict, people have learned that the latter does not produce wealth for people. In the era of a global society, people, money, and information can and must transfer freely from country to country despite the existence of geographical borders. In addition, true wealth and richness can be produced only in nations that possess a mature market.



Techno-entrepreneurship is shared by those who provide social bases for technological innovations without making a profit for themselves, as well as by those engaged in profit-making enterprises. Examples of the former include the Takeda Award recipients in the Environment Well-Being field, who have provided practical ways to resolve environmental problems by creating the concept of an eco-rucksack. Examples of the latter include the Takeda Award recipients in the Individual and Humanity Well-Being field, who created both engineering intellect and knowledge and a venture company.

The Takeda Foundation has decided to create awards in fields which people find especially important - information technology, life sciences, and the world environment. Our view is that the wealth to be built in these markets in the 21st Century will be several times greater than that existing in the 20th Century.

The Foundation hopes that the Takeda Award will promote the creation of engineering intellect and knowledge and techno-entrepreneurship, thus creating new markets. Through this process, the Foundation hopes that the award will contribute to an increase in wealth and richness for people. In summary, the Foundation seeks to contribute to the happiness of humankind in the 21st Century by sending a message that promotes engineering intellect and knowledge and techno-entrepreneurship.

This is my sincere wish and prayer for the remainder of my life.

The year 2001 falls on the centennial year of the Nobel Prize, which was born in 1901. The date is therefore very meaningful to me. As a last word, I would like to express my heartfelt gratitude to those who participated in the processes of nominating and selecting the achievements and recipients, and I would like to ask our friends and colleagues to foster this new award in the era ahead.

Ikuo Takeda, Chairman

Social/Economic Award Honors Open Development Models for Systems Software

The Takeda Award 2001 for social/economic well-being was awarded to Ken Sakamura of the University of Tokyo, Richard M. Stallman of the Free Software Foundation, and Linus Torvalds of Transmeta Corporation. The award is for the technical achievement of originating and advancing open development models for system software – open architecture, free software and open source software. This achievement has brought about significant impacts through freely open methods for the development of computer operating system and related software.

Ken Sakamura

Ken Sakamura proposed the based concept of TRON (The Real-time Operating system Nucleus), the operating system kernel for real-time embedded systems, in 1980. Based on his proposal, the TRON project began in 1984. The distinctive features of the TRON concept are that:

- Only the application programming interface specifications are defined;
- These specifications support real-time operations and a wide range of processors; and
- The resulting specifications are available to everyone as "open architecture."

In each step during the product cycle, the development process is open in order to gather useful inputs from many users. Resulting TRON specifications have been widely adopted and implemented in various kinds of embedded systems installed in personal computers, cellular telephones, automobiles and other products.

In 1984, Stallman began to write Unix-compatible system software as free software, thus starting the GNU system. GNU is a recursive acronym for "GNU's Not Unix." The free software concept includes the freedom to access the source code, redistribute copies, and use the modified program. This has allowed many programmers to contribute improvements to programs. As a result, GNU software such as a high performance editor, a compiler and a graphical user interface, has gained a strong reputation for free software because of excellent functionality and high stability. GNU is the forerunner of the recent open source movement.

Richard M. Stallman

Linus Torvalds

Torvalds released on the Internet his first version source code of Linux, the computer operating system kernel, in 1991. The Linux project has been conducted in a unique manner to improve this original version. Many volunteers from around the globe have joined the project to improve and debug the opened version of Linux source code. Their improvements have been filtered often by Torvalds to be adopted into subsequent versions of Linux. This process has led to voluntary, enthusiastic and rapid improvements to Linux, and consequently, a high performance and highly reliable operating system kernel has been produced.

These projects – TRON, GNU and Linux – used new methods to develop computer system software which is the key component of information technology. The free and open development styles and utilization schemes utilized have gathered valuable inputs from many people, and led to new computer applications and high-grade programs. These innovative models have had an important influence on the computer software market.

Awardees' Comments

Sakamura: *"With PCs, the Japanese computing industry had to follow existing standards. Now with embedded computing, Japanese young people can create original products."*

Stallman: *"I realized that I had an opportunity to fight for freedom and cooperation by writing free software. An operating system developer was needed, and that's me. That's how it started."*

Torvalds: *"The concept of Open Source brings the real meaning of science to programming. It encourages the open exchange of ideas, and continuous progress through incremental improvements."*

Individual/Humanity Award Given for Genome Sequencing System

The Takeda Award 2001 for Life Sciences was bestowed to Michael W. Hunkapiller of Applied Biosystems and J. Craig Venter of Celera Genomics. They were selected for their contributions to "the development of a large-scale genome sequencing system by establishing 'the whole genome shotgun strategy' that utilized modularized data acquisition systems and high-throughput DNA sequencers."

Hunkapillar recognized the importance of automated and high throughput analytical instruments in the then-emerging era of large-scale genome sequencing, and produced a fully automated, high throughput DNA sequencer, the PRISM3700. He combined the technologies of high throughput multi-capillary electrophoresis with fluorescent dye chemistry, an automated sample exchange system, and the sheath flow detection method, to create the PRISM3700, which has a 10-fold higher productivity than conventional slab-gel DNA sequencers. Later, the PRISM3700 became a powerful tool for human genome sequencing, and was used by both the Human Genome Project and Celera Genomics.

Michael W. Hunkapiller

Venter recognized the labor and time-saving possibilities of the whole genome shotgun method, in which the whole genome DNA of an organism is randomly broken into millions of fragments and then sequenced. The resulting short sequences are aligned through overlapping regions using a computer algorithm. The major players of genome analysis relied upon sequencing fragments of genome DNA after their locations were confirmed in the original DNA. Venter developed an assembly algorithm that could handle large volumes of sequencing data produced by the shotgun sequencing of large-scale genomes such as the human genome.

J. Craig Venter

Hunkapiller and Venter developed a modular sequencing system that enabled the systematic and concentrated production and treatment of genome information with the operation of 300 PRISM3700 sequencers in one place, representing a novel engineering intellect and knowledge application to biological measurement. They founded a private company, Celera Genomics, and succeeded in sequencing the human genome in a short period of time.

Hunkapiller and Venter also demonstrated that a commercial enterprise can carry out multi-centered basic research such as genome sequencing in a faster and more economical fashion than publicly funded research facilities, thus representing a major achievement in techno-entrepreneurship. The Celera effort stimulated and accelerated the publicly funded Human Genome Project, and as a result, opened the way to industrial applications of sequence information and contributed significantly to the development of genomic science. The achievement of Hunkapiller and Venter is generating a major impact on medicine, agriculture, pharmaceuticals, and bioinformatics, and is expected to make far-reaching and profound contributions to individual and human well-being.

Awardees' Comments

Hunkapiller: *"People who understand science and technology make the best leaders and managers in technology enterprises. You need a vision of what is possible, and that requires more than just experience in business. It requires an understanding of what technology can do and what science is needed."*

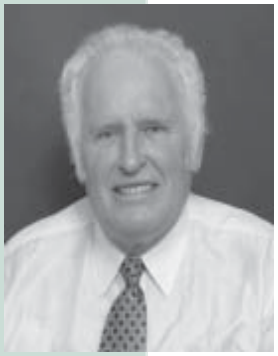
Venter: *"Integrating scientific breakthroughs with advanced information technology and super computing power allowed us to attain this achievement. Applying an entrepreneurial approach permitted me to assemble a diverse team and do better science. We need to rethink science infrastructure and research models."*

Environmental Award Recognizes Measurement of Ecological Stress

Mankind has benefited enormously from nature, but growing material wealth has been achieved at the expense of great ecological destruction as a result of obtaining and using natural resources. Friedrich Schmidt-Bleek presented the Ecological Rucksacks and MIPS concepts in 1993 as broad measures of environmental stress.

Schmidt-Bleek proposed that the dislocation of natural materials – from excavating, extracting natural resources, channeling water for irrigation, etc. – is a fundamental cause of environmental damage. Therefore, all products and services used by people carry a "rucksack" of all the materials displaced or processed during the life cycle of that product or service. This creative concept was termed the "Ecological Rucksack," which is associated with each product. It is calculated to indicate the weight of all materials displaced in the production and use of the goods or services.

Friedrich Bio Schmidt-Bleek



Schmidt-Bleek developed a second indicator, known as Material Input per Unit Service, or MIPS, which reflects the "real" value of the goods and services, and attempts to place these in the economic product function. MIPS is the ratio of the Ecological Rucksack value per unit of service. By associating a MIPS value with each product, companies, governments and individuals can take into account the environmental stress created by the production of various goods and services.

Ernst Ulrich von Weizsaecker, president of the Wuppertal Institute for Climate, Environment and Energy over the period 1991-2000, invited Schmidt-Bleek to the Institute to develop these concepts further. Collaboration between Schmidt-Bleek and von Weizsaecker led to the refinement of the Ecological Rucksacks and MIPS concepts, connecting resource productivity with energy efficiency and making clear the relationship between these concepts and toxicity and environmental hazards.

Ernst Ulrich von Weizsaecker

Von Weizsaecker wrote the book, Factor 4, which introduced these important concepts on a global basis. The Wuppertal Institute continues to undertake great efforts to disseminate these concepts and promote the collection of basic data for the calculation of MIPS in collaboration with Schmidt-Bleek.

The values of Ecological Rucksacks and MIPS are simple measures indicated by weight, and therefore have practical uses in industrial fields. For example, adverse environmental stresses can be reduced by fashioning products in such a way to yield lower Ecological Rucksack and MIPS values, or to generate larger service values.

Although MIPS is an approximate value, it makes it possible to understand complex environmental stresses comprehensively. The use of MIPS will increase awareness of the environmental stress caused by different products and services; this awareness could eventually integrate environmental stress into the marketability of different products. This will influence economic activities by reflecting the true cost of goods and services, including the cost of environmental stress.

Awardees' Comments

Schmidt-Bleek: *"If we cannot control the output side (due to high costs), why not try to control the input side? Industrialized nations must increase their resource productivity at least tenfold. To do this, we need to apply systems approaches."*

von Weizsaecker: *"We have neglected long-term survival conditions. We need to develop market mechanisms that lead us in the right direction. Many technological solutions are available, but these must be supplemented by new technologies and entrepreneurial talents."*

Takeda Techno-Entrepreneurship Award Promotes Leading-Edge R&D

In another area of Foundation activity, the Takeda Techno-Entrepreneurship Award will be presented annually to recognize research themes that can be expected to contribute to the creation and application of engineering intellect and knowledge in the Foundation's three application fields. These awards will emphasize research and development aimed at "realizing value for all mankind, based on the creation and application of engineering intellect and knowledge," consistent with the philosophy of the Takeda Foundation.

Two Takeda Techno-Entrepreneurship Awards will be presented in each of the three application fields, with a maximum assistance period of three years. In terms of research themes, the awards will mainly target R&D activities that focus on ideas that will lead to the creation of new businesses. Payments will be up to a maximum of 10 million yen (approximately US$80,000) per year. Based on ongoing evaluations, the term for receipt of this incentive award may be extended beyond one year. Applications, which are open to the public, will be accepted directly from the applicants. There are no restrictions regarding nationality or affiliation. The Foundation is employing the innovative approach of "Cyber Workshops" to identify and refine research themes. A distinguished panel of experts chairs the workshops, which are open to participation by applicants, outside specialists, and potential sources of complementary or future funding (venture capital firms, "angels," etc.). This year's Cyber Workshops are focusing on the following themes:

Cyber Workshops on Social/Economic Well-Being	Cyber Workshops on Individual/ Humanity Well-Being	Cyber Workshops on World Environmental Well-Being
A. Ultra-Low Power Consumption Devices, Circuits, Architecture and Systems	C. Extremophilic Biomes (Extremophiles)	E. Evaluation and Management of Environmental Risks
B. Design and Development of Hardware Having Flexibility and Expandability of Functionality and Performance	D. Systems Aiming at Tissue Engineering	F. Novel Technologies for Chemical Measurement Used for Environmental Monitoring

An investigation group will analyze and verify the nominated themes in each field, after which winners will be determined by a selection committee and further approved by the Board of Directors of the Foundation, to ensure strict and impartial selection. Our ceremony 2002 will take place on November 20-21. Award winners in 2001 were:

Workshop A. Yasuo Nagazumi (GDS Inc.), "A Programmable Low-Power Matched Filter Using Charge-Domain Signal Processing"

Workshop B(1). Tsutomu Sasao (Kyushu Institute of Technology), "On a New Type of Programmable Logic Devices and Their Logic Synthesis"

Workshop B(2). Tetsuo Hironaka (Hiroshima City University), "Reconfigurable Computer with Cycle-by-Cycle Reconfiguration and Execution Aimed to be a General-purpose Computer"

Workshop C. Shinsuke Fujiwara (Osaka University), "Application of Hyperthermophilic Enzymes in Hydrophobic and Supercritical Fluid Environments"

Workshop D. Katsuto Tamai (Hirosaki University), "Development of In Vivo Tissue Engineering System Based on Non-Invasive and High-Affinity in Vivo Delivery Technique"

Workshop E(1). Joaquim I. Goes (Bigelow Laboratory for Ocean Sciences), "Assessing the Influence of Enhanced Solar Ultraviolet Radiation on Marine Phytoplankton and Its Consequences for Ecosystem Structure and Function"

Workshop E(2). Akira Naganuma (Tohoku University), "Studies on the Genes Determining Individual Sensitivity for Methylmercury Toxicity"

Workshop F. Toyohide Takeuchi (Gifu University), "Development of Environment-Friendly High-Efficiency Capillary Separation Analytical System"

Takeda Award Selection Committee Members

Ken-ichi Arai, University of Tokyo
Kunihiro Asada, University of Tokyo
Hiroki Haraguchi, Nagoya University
Hiroshi Ishiwara, Tokyo Institute of Technology
Keiji Kainuma, Bio-oriented Technology Research Advancement Institution
Toshihiko Kanayama, Advanced Semiconductor Research Center
Akio Kokubu, New Media Development Association
Kiyoshi Kurokawa, Tokai University
Ken-ichi Matsubara, Nara Institute of Science and Technology
Mitsuru Miyata, Nikkei Business Publications, Inc.
Junko Nakanishi, Yokohama National University
Yoshio Nishimura, Nikkei Business Publications, Inc.
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