TANSEI

TANSEI aims at sharing worldwide the latest developments at UT with everyone interested in education and research.

Vol. 04

The University of Tokyo Magazine

March, 2004

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TANSEI-The school color of the University of Tokyo is light blue (tansei in Japanese). It was initially used at the first rowing regatta between the University of Tokyo and Kyoto University in 1920. The colors of the two universities were determined by drawing lots. Kyoto University drew dark blue and the University of Tokyo light blue. Since then, light blue has been the school color of the University of Tokyo.

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Greeting from the Editor

TANSEI Vol. 04 focuses on the research performed at the University of Tokyo. The theme of the feature article in this issue is the 21st Century COE Program. Due to limitations in space however, we could profile only nine of the 26 projects that have started under the program at the University of Tokyo prior to the end of the 2003 academic year.
The Charter of the University of Tokyo stipulates the principles of its academic activities as follows:

> The University of Tokyo shall promote academic freedom to pursue truth and knowledge, with the aim of maintaining and developing education and research at the world's highest level. Being well aware of the influence that research may exert on society, the University of Tokyo shall seek to ensure a broader connection with society in response to society's dynamism and to contribute to human development. The University of Tokyo shall return the academic competence and expertise accumulated since its establishment to society, as well as develop education and research internationally and interact with other parts of the world.

Our university is expected to promote research that will design the future. In this issue, we will present a part of the academic research activities promoted by the university in the hopes of meeting this expectation. Your frank opinions and suggestions would be much appreciated.

Ichiro SAKUMA, Ph.D.
Chairman of the Public Relations Committee

Feature article:

The University of Tokyo as a center of excellence in the 21st century

Reiko KURODA
Executive Advisor to the President for Research
Professor, Graduate School of Arts and Sciences

The 20th century has been termed the century of progress in scientific knowledge. The tremendous advances in knowledge and technology have brought affluence. However, the North-South divide, the expansion of poverty, global warming, exhaustion of resources/energy, and the population explosion are side effects with serious implications for man and his environment. To solve these problems, we must create new knowledge in the 21st century, and use it wisely. At the World Conference

21st Century COE Program

The world in the 21st century faces a variety of challenges ranging from intensified conflicts to serious poverty as well as global environmental issues.
The 21st Century COE Program has been initiated to serve as a center for promoting education and research at the world's highest level with the aim of helping Japan address these global issues.
This feature article will describe nine of the 26 COE programs centered at the University of Tokyo.

on Science held in Budapest in 1999, it was emphasized that 21st century sciences should contribute not only to the advancement of "knowledge", but also to "peace", "sustainable development" and "society".

Science itself is undergoing change. In my specialized field for example, at the Nobel Jubilee symposium held in Stockholm for the occasion of the 100th anniversary of the Nobel Prize, we discussed together with many Nobel laureates, the future of molecular sciences. We shared the view that future science will not be confined to individual disciplines, and that the new frontiers lie in interdisciplinary areas, e.g. in nano-medicine between nanoscience and medicine, in the mesoscopic domain between the micro- and macroscopic worlds, in complex biological systems including evolution with temporal/spatial factors, and in environmental systems. It was a very exciting discussion.

We are in an era when science itself and the relation between science and society are undergoing profound change. I believe that society very much expects the University of Tokyo to be fully engaged and responsive. We have a great responsibility regarding the inheritance and creation of knowledge, human resource development, and the return of knowledge to society.

The corporatization of the University of Tokyo will be achieved in April 2004. This will allow the evolution of world-class educational/research activities, having due regard to national and international needs in education and research for the 21st century. The 21st Century COE (Center of Excellence) Program, which was inaugurated in 2002 by the Ministry of Education, Culture, Sports, Science, and Technology, fosters a competitive environment and selectively supports the formation of world-leading research and educational centers for each disciplinary field in our country. With regard to the University of Tokyo, 26 projects have been selected, of which 9 are introduced here. Further details of each project shall be found on the relevant website. These challenging projects incorporate research in different fields with the objective of developing internationally competitive researchers, and quickly returning the results of research to society. Highly-motivated approaches are being made also from departments which were not selected in COE projects. We, the management of the University of Tokyo, with its many strengths in education and research, intend to promote these objectives in this new century to encompass our daily lives, from the past to the future, from the microscopic world to the end of space, and into the world of femto seconds and the ultra-high speed.

21st Century COE Program 2002

Categories	Program Title	The core courses to form the program	Program Director	URL
Life sciences	Multidisciplinary approach to the biological signaling mechanism	Graduate School of Medicine: Department of Functional Biology	Tomoyuki TAKAHASHI	http://www.iam.u-tokyo.ac.jp/coe/
	Promotion of basic biosciences for the understanding of organisms' uniqueness	Graduate School of Science: Department of Biological Sciences	Masayuki YAMAMOTO	-
	Strategic approach to drug discovery and development in pharmaceutical sciences	Graduate School of Pharmaceutical Sciences: Department of Molecular Pharmacokinetics	Yuichi SUGIYAMA	-
Chemistry, materials sciences	The frontier of fundamental chemistry on the basis of molecular dynamics	Graduate School of Science: Department of Chemistry	Yasuhiro IWASAWA	http://www.chem.s.u-tokyo.ac.jp/21coe/21coeindex.html
	Human-friendly materials based on chemistry	Graduate School of Engineering: Department of Applied Chemistry	Kimihiko HIRAO	http://www.chem.t.u-tokyo.ac.jp/coe/
Information sciences, electrical and electronic engineering	Information science and technology strategic core	Graduate School of Information Science and Technology: Department of Computer Science	Masato TAKEICHI	http://www.i.u.-tokyo.ac.jp/coe/
	Electrical engineering and electronics for the active and creative world	Graduate School of Engineering: Department of Electronic Engineering	Kazuo HOTATE	http://www.ee.t.u-tokyo.ac.jp/coe/
Humanities	Center for Philosophy	Graduate School of Arts and Sciences: Department of Interdisciplinary Cultural Studies	Yasuo KOBAYASHI	http://utcp.c.u-tokyo.ac.jp/
	Construction of death and life studies concerning culture and value of life	Graduate School of Humanities and Sociology: Department of General Culture	Susumu SHIMAZONO	http://www.l.u-tokyo.ac.jp/shiseigaku/
	System reform for the development of core academic competence	Graduate School of Education: Department of Integrated Educational Sciences	Motohisa KANEKO	http://www.p.u-tokyo.ac.jp/coe/
Interdisciplinary, combined fields, new disciplines	Research Center for Integrated Sciences	Graduate School of Arts and Sciences: Department of Multi-Disciplinary Sciences	Makoto ASASHIMA	http://rcis.c.u-tokyo.ac.jp/
Total	11 Programs	8 Graduate Schools		

21st Century COE Program 2003

Categories	Program Title	The core courses to form the program	Program Director	URL
Medical sciences	Center for Integrated Brain Medical Science	Graduate School of Medicine: Department of Neuroscience	Shoji TSUJI	http://neurocoe.umin.jp/
	Research on disease caused by the interaction between environmental and inherited genetic factors	Graduate School of Medicine: Department of Internal Medicine	Ryozo NAGAI	-
	Development of advanced clinical research with the application of genomic medicine	Institute of Medical Science	Yusuke NAKAMURA	-
Mathematics, physics, earth sciences	New mathematical deployment center to support scientific technology	Graduate School of Mathematical Sciences	Shigeo KUSUOKA	http://www.ms.u-tokyo.ac.jp/top/coe.html
	Quantum extreme systems and their symmetries	Graduate School of Science: Department of Physics	Katsuhiko SATO	http://bilbo.phys.s.u-tokyo.ac.jp/coe21/
	Predictability of the evolution and variation of the multi-scale earth system	Graduate School of Science: Department of Earth and Planetary Science	Toshio YAMAGATA	http://www.eps.s.u-tokyo.ac.jp/COE21/index.html
	Applied physics on strong correlation	Graduate School of Engineering: Department of Applied Physics	Yoshinori TOKURA	http://www.coe-ap.t.u-tokyo.ac.jp/
Mechanical, civil, architectural and other fields of engineering	Mechanical Systems Innovation	Graduate School of Engineering: Department of Mechanical Engineering	Nobuhide KASAGI	http://mechasys.jp
	Center for Sustainable Urban Regeneration	Graduate School of Engineering: Department of Urban Engineering	Shinichiro OHGAKI	http://csur.t.u-tokyo.ac.jp/
Social sciences	"Soft law" and the State-Market relationship : Forming a base for strategic research and education in business law	Graduate School of Law and Politics	Nobuhiro NAKAYAMA	http://www.j.u-tokyo.ac.jp/coelaw/
	Invention of policy systems in advanced countries	Graduate School of Law and Politics: History of International Politics	Susumu TAKAHASHI	http://www.j.u-tokyo.ac.jp/coeps/
	Center for Research of Market Economy and Nonmarket Organization	Graduate School of Economics: Department of Economic Theory	Hiroshi YOSHIKAWA	-
	MONOZUKURI (Manufacturing) Management Research Center	Graduate School of Economics: Department of Business and Marketing Studies	Takahiro FUJIMOTO	-
Interdisciplinary, combined fields, new disciplines	Biodiversity and ecosystem restoration	Graduate School of Agricultural and Life Sciences: Department of Ecosystem Studies	Izumi WASHITANI	http://www.ber.es.a.u-tokyo.ac.jp
	Center for evolutionary cognitive sciences	Graduate School of Arts and Sciences: Department of Language and Information Sciences	Toshikazu HASEGAWA	http://ecs.c.u-tokyo.ac.jp/
Total	15 Programs	8 Graduate Schools and 1 Research Institute		

Research on disease caused by the interaction between environmental and inherited genetic factors

- Establishment of a research center for system disease life science -

Program Director: **Ryozo NAGAI**
Professor, Graduate School of Medicine

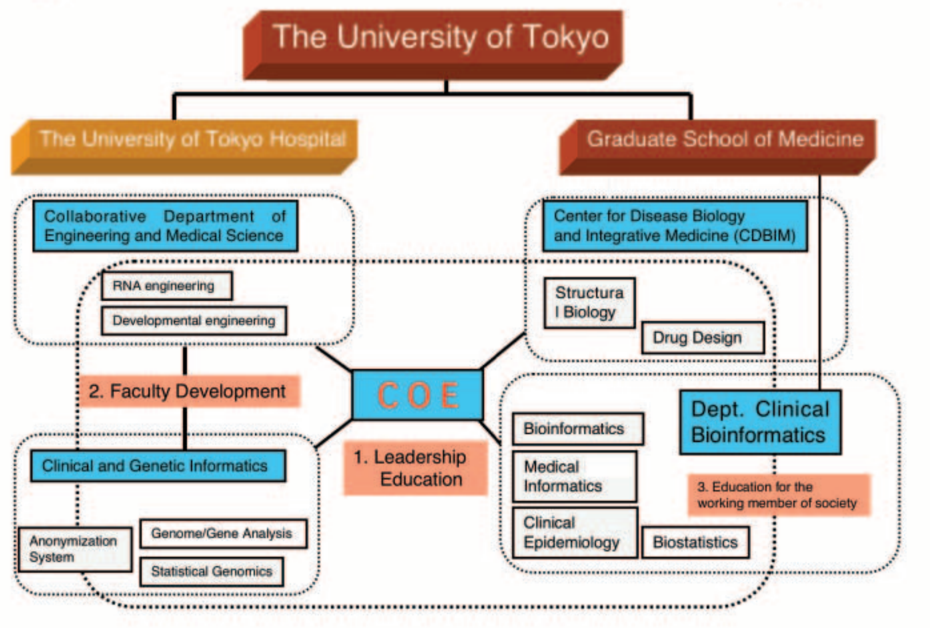
The life sciences have achieved great success in elucidating the life process mechanism during the latter half of the 20th century. Despite our high expectations, this success has not contributed to continuously producing innovative therapeutic drugs to overwhelm diseases. The public health is threatened more than ever as an increasing number of patients come to suffer from cardiovascular and lifestyle related diseases. One of the reasons for this current situation is that research in life sciences have merely focused separately on nanoscale, molecular, cellular, individual and group levels, but not comprehensively, to understand life.

Our mission in life science in the 21st century is to link the outcomes obtained during the last century directly to the improvement of public health. In the COE Program research on disease caused by the interaction between environmental and inherited genetic factors, we interpret "disease" comprehensively as the "destruction of a biosystem." In this context, we have created a "system disease life science." A new discipline where disease or the destruction of a biosystem will be remedied and/or treated in an interdisciplinary fashion by integrating molecular genetics, molecular biology, protein engineering, structural biology, RNA engineering, developmental engineering, bioinformatics and medical informatics.

We have already succeeded in isolating and identifying key molecules that are involved in the occurrence and development of cardiovascular diseases, lifestyle related diseases and hematologic neoplasms. These key molecules include the transcription factor KLF5, which plays an important role in developing cardiovascular disease, an adiponectin receptor, which is an adipocyte-derived antidiabetic and antiatherogenic hormone, and the transcription factor Evi-1, which interacts with genome instability to promote cancerous transformation of hematopoietic cells. In addition, we have begun developing drugs for radical therapies targeting key molecules of disease and their co-factors.

Organizations to promote an education for researchers in this field have also been established. The Department of Clinical and Genetic Informatics at the University of Tokyo Hospital has been working on explaining the mechanisms underlying the occurrence and development of disease by combining information on environmental factors and genetic factors. The Clinical Bioinformatics Specialists Training Unit has begun transorganizational activities to provide interdisciplinary leadership education on genetic statistics, biostatistics and medical informatics, aimed at training researchers who will lead the next generation of bioinformatics. Furthermore, the following two facilities have also been established: the Collaborative Department of Engineering and Medical Science at the University of Tokyo Hospital, jointly operated by the graduate schools of Medicine and Engineering, and the Center for Disease Biology and Integrative Medicine (CDBIM). Our Research Center aims to bridge these interdisciplinary organizations with the University of Tokyo Hospital, the largest-scale national university hospital in Japan, enabling the realization of research discoveries from bench to bedside to community, or from the full understanding of disease to the development of medication for radical therapies. We also seek to serve as the center in training experts with advanced knowledge in the life science field.

Organization Chart of the 21st Century COE Program



New mathematical deployment center to support scientific technology

Program Director: **Shigeo KUSUOKA**
Professor, Graduate School of Mathematical Sciences

Our objective is to form an international center for research and education with mathematics and mathematical application and to further develop the international research activities currently being conducted. To foster researchers who are able to examine from a broad perspective in mathematics / mathematical sciences from a long-term perspective is also an important target. These objectives comply with the principles of the Graduate School of Mathematical Sciences, which was inaugurated in 1992.

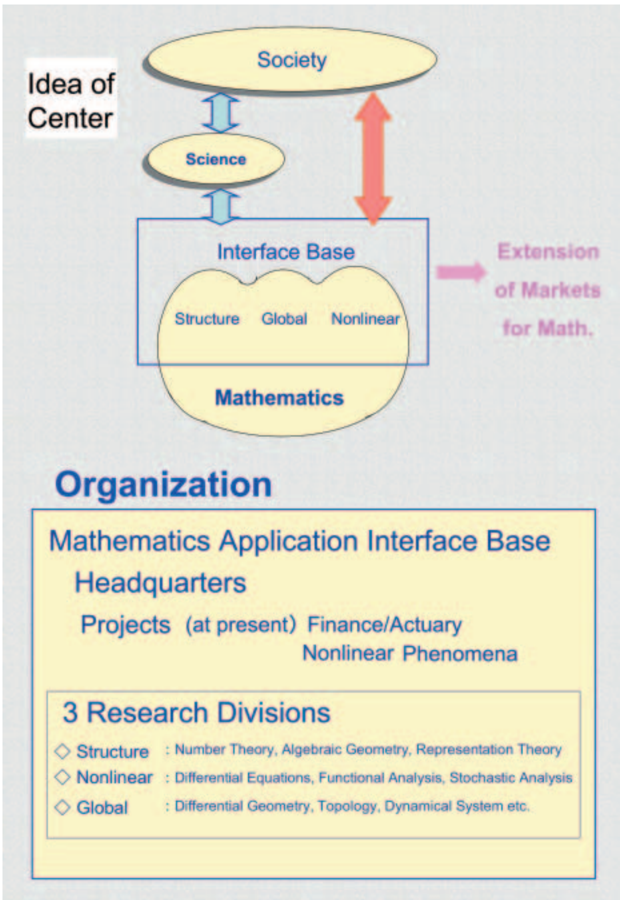
Mathematics is a basic discipline or infrastructure supporting science. Its contributions as a method to solve problems raised by science were presented indirectly to the real world. Now with the advance of the computer, new methods based on mathematical theories are being applied directly to practical technologies. Sophisticated mathematics also started to be used as tools to describe models. Even patents based on mathematical contents are now being approved, and the research of mathematical applications directly linked with applications in society has an increasing necessity.

However, it is not unusual for a lengthy time to pass, such as 50 or 100 years, before a newly created mathematical theory can reach the stage of application. There are also many cases where mathematical theories, whose application proved to be useful, were the results of pure thought in pursuit of concepts, without consideration to their application.

Mathematical research, regardless of its domain, requires studies to be conducted under a free atmosphere where the researchers do not need to consider whether the results will become at once useful or not. On the other hand, researchers will not be able to answer society's expectations of mathematics if they do not think at all about the application of their theories. As we already have a long-term accumulation of mathematical education research, the center's organizational structure will attach greater importance to mathematical applications.

The research center consists of a Mathematical Application Interface Base and three research divisions for mathematical research (Structure, Nonlinear, and Global). The Headquarters is organized to supervise the COE project as a whole and for planning. Several research groups for fields where mathematical science has yet to be established in Japan will be deployed under the Headquarters. Thus systematically connecting mathematics and application, with the objectives of searching for application possibilities for mathematics in society and to create new fields for mathematics from an application viewpoint. The Finance / Actuary Research Group and Nonlinear Phenomena Research Group are the groups which have already begun working.

The Graduate School of Mathematical Sciences is now responsible for basic mathematical education at the University of Tokyo, and will also have as its future objective to play a part in the educational research for mathematical application, and to become a worldwide base-station for application research.



Mechanical systems innovation

Program Director: **Nobuhide KASAGI**
Professor, Graduate School of Engineering
http://mechasys.jp

This new century has brought to light the increasing importance of rebuilding our world as a sustainable system symbiotic with the Earth and establishing a safe society where people, with differing values, can live a healthy and comfortable life with internal satisfaction. The school of engineering that creates machines and mechanical systems is also expected to contribute to the real enrichment of human life through the creation and application of new knowledge.

An international research and education center for innovation in mechanical systems will be organized in this program with the Department of Mechanical Engineering, School of Engineering, the University of Tokyo, as its core. The center will gather 19 researchers from the five related Departments and also from the Institute of Industrial Science, the University of Tokyo, and invite specially appointed researchers and assistants to be the organizing members of the center, as well as inviting the world's leading researchers from abroad.

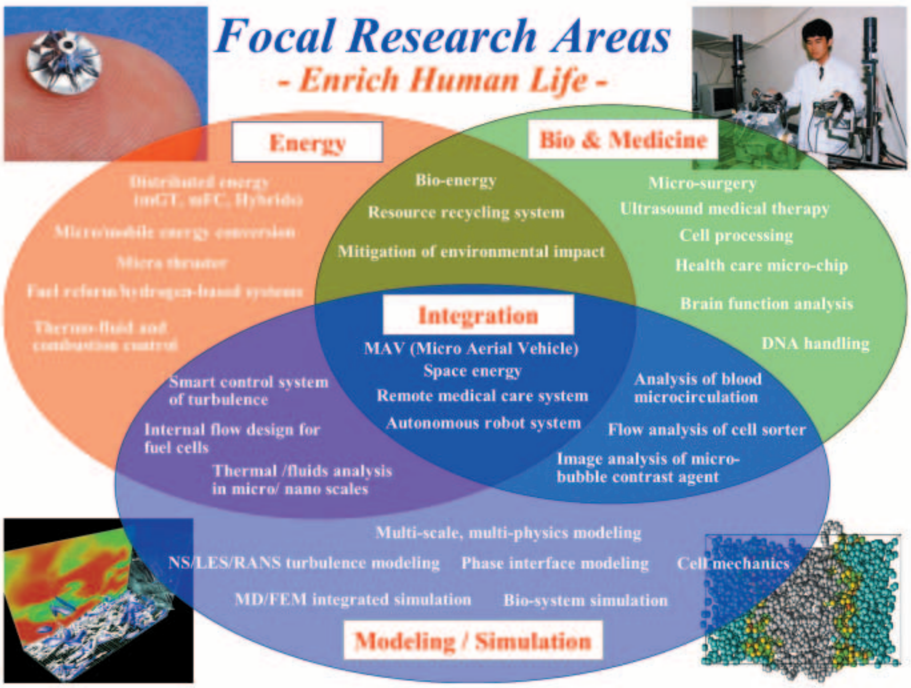
The center will promote creative research on original and advanced mechanical systems in fields such as energy, biotechnology and medicine, which form the basis of affluent human life. It will also aim at the academic innovation of mechanical engineering based on dynamics that describe the behavior of materials in micro- and macroscopic scales. The amalgamation with other fields of information, biotechnology and medicine, etc, and the integration of nano/microtechnology will be actively accelerated, and the creation and systematization of a new school of thought will be promoted. Development of highly specialized human resources capable of leading industry, government and education through this research will also be a target of the program.

Some key words such as miniaturization, decentralization, mobilization, functionalization, process intensification, diversification, and personalization shall be implemented in this program as a common approach providing clues for future technology to enrich human life through creating safety, well-being, health, and convenience. The following three projects shall be promoted as focal research areas from FY2003 to FY2007:

(1) Energy Innovation Project
The objective of this project is to innovate technologies for efficient energy utilization, resource/environment monitoring and environmental impact mitigation through small distributed or mobile multi-modal energy conversion systems, super small satellites, and underwater autonomous robots.

(2) Biotechnology / Medical Care Innovation Project
The objective here is to build custom designed and/or home medical care systems where nano/micro-mechatronics, robotics, and biotechnology are integrated.

(3) Hyper Modeling/Simulation Project
This project is a school for the modeling and simulation of multi-physics/multi-scale phenomena taking place inside and outside mechanical systems. It is to show drastic development and systematization, making possible leading designs for the future mechanical systems mentioned above.



Concept of Mechanical System Innovation

MONOZUKURI (Manufacturing) Management Research Center

Program Director: **Takahiro FUJIMOTO**
Professor, Graduate School of Economics

This center is one of the 21st Century COE projects in the Graduate School of Economics, the University of Tokyo. The objective here is to conduct research on the Integrated MONOZUKURI (manufacturing) System, a manufacturing, development and purchasing system built by some Japanese companies after World War II. The system is well represented by Toyota's manufacturing system and total quality control (TQC), which makes up one of the more valuable intellectual properties that Japan could disseminate to the world. In the academic world also, achievements by Japanese researchers in this field have given it high value from abroad, and a substantial global researchers' network also exists.

However, as no systematic academic research in this field has been conducted by any Japanese institution, the capacity to disseminate to the world was weak. As a result, both industry and academia have had problems, including the recent stagnation in international research, or the strongly rooted gap in productivity among companies and among industries.

This center has been established to change the current situation. With an industry-academia alliance and international collaboration as the two primary policies, the following four themes have been set as the pillars of research.

(1) General Systematization Research to present the Integrated MONOZUKURI System as formalized knowledge through a trans-industrial analytic framework

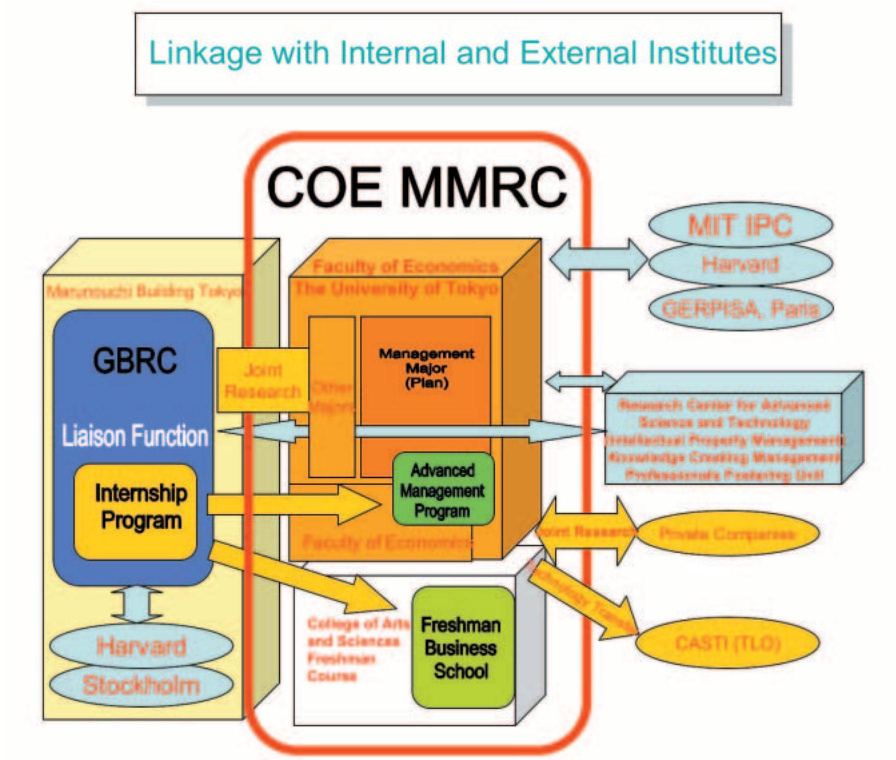
(2) Architectural Research to reconsider the existing industry classification from the viewpoint of the design concept and to expand competitiveness analysis

(3) International Comparison Research to enrich joint analysis on competitiveness with MIT (Massachusetts Institute of Technology), Harvard University, and French universities, and so on.

(4) Brand Strength/Sales Capability Research which connects competitiveness with profitability

In order to promote the collaboration between industry and academia, the office of the Management Research Center was newly placed in Hongo 3-chome, and a full-time research director was employed from a private company. Our aim is for this center to be an "Open Center." We plan to employ about 30 researchers with experience in MONOZUKURI as specially appointed researchers. They will form teams with young researchers and students to develop a system that will change their rich tacit knowledge into inheritable and formalized knowledge. Purely academic studies will also be conducted and all research activities will be carried out via project basis accomplishment correspondence. The GBRC (Global Business Research Center), a non-profit organization which manages the satellite office in the Marunouchi Bldg., will offer a Specific Training Course on Management. This course offers a consistent education over three years (the latter 2 years as an undergraduate course plus a first year in a master's course) to develop young researchers capable of carrying out research and disseminating their knowledge in this field to the world. Academia, in government collaboration with the Ministry of Economy, Trade and Industry, etc. will also assist (fig.).

Long-sustained studies are required in centers with this kind of objective, as shown in preceding cases like MIT. The reason it is named as a "center" is to show our indomitable resolve to continue as an intellectual dissemination-base to the world even after the COE Program has ended.



Center for evolutionary cognitive sciences at the University of Tokyo When, why and how did humans become unique among great apes?

Program Director: **Toshikazu HASEGAWA**
Professor, Graduate School of Arts and Sciences
http://ecs.c.u-tokyo.ac.jp/

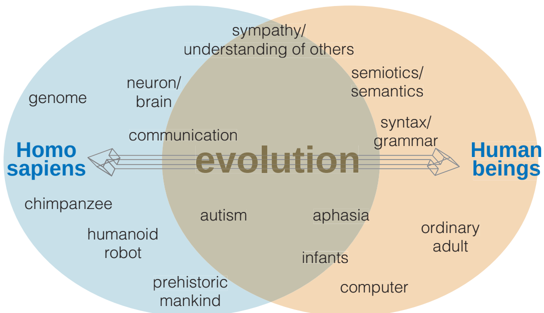
However contrary it may be to most people's convictions, the closest relative of a chimpanzee is not a gorilla. It is a human. This finding is one of the most spectacular outcomes in evolutionary anthropology in recent years. According to Prof. Jared Diamond, biologist, the University of California, Los Angeles, humans should be called "the third chimpanzee" along with the common chimpanzee and the bonobo. We can no longer talk about humans without recognizing the biological fact that we also belong to the great apes.

It is also obvious, however, that humans are unique, unlike other great apes such as chimpanzees and gorillas. While from a biological point of view, humans are merely another species of anthropoid they are unique from another perspective. We are a one of a kind great ape with a sophisticated mind, language and social structures. How can we explain this gap? When, why and how did humans become a unique great ape? This is one of the most thrilling issues in human science to be addressed in the 21st century as well as a main subject of our COE projects.

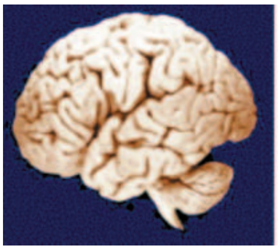
Current human sciences have shown a new development both in theory and method, providing us with a research strategy that was not available in the past. Genomic science and evolutionary biology are providing us the most basic theoretical framework and analytical tools to understand the life phenomena. Meanwhile, cognitive and linguistic sciences continue to develop, transcending the traditional framework of liberal arts, by applying scientific methods. All these new research methods combine evolutionary cognitive science or evolutionary psychology, and have made rapid progress during the last decade mainly in Europe and the US. Our COE projects are aimed at developing a research center in line with this global trend.

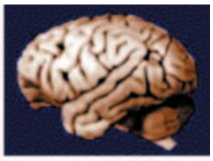
Some of our COE projects are outlined in the following; in a comparative genomic project, we will seek to elucidate the origin of qualities unique to humans by comparing humans and chimpanzees in their genomes and phenotypes to find commonalties and differences. In a developmental brain science project, we attempt to understand cognitive development in infants and children by adopting a cognitive brain scientific approach, shedding light on how mind and language are formed from the level of ontogeny. A linguistic research project will focus on the linguistic process inside the brain and linguistic-specific hereditary disease. Theoretical and empirical research on the origin of language will also be conducted.

Our program consists of the following five departments: human evolutionary studies, cognitive development science, psycholinguistics, integrated linguistic science and computational linguistic science. There are a total of 21 staff promoting research along with post-doctoral researchers and research assistants. Staff members from the divisions of cognitive and linguistic sciences at the Graduate School of Arts and Sciences play a main role in our COE projects. These core members are supported by staff from Hongo Campus, including the Graduate Schools of Science, Agriculture and Humanities and Sociology, the University Museum, the University of Tokyo Hospital and Information Technology Center. This interdisciplinary cooperative network will promote our programs. We are planning to hold lectures and symposiums inviting leading researchers from both Japan and abroad. Those concerned on campus will be informed of these events.



Research fields of the 21st Century COE Program "Center for evolutionary cognitive sciences" (upper column) and research subjects (lower column)





To elucidate the origin of human qualities by comparing genomes, brains, behavior and cognitive abilities between species and conducting research on development.
(left) Brains of a human and chimpanzee
(right) A infant and his/her mother participating in cognitive developmental experiments

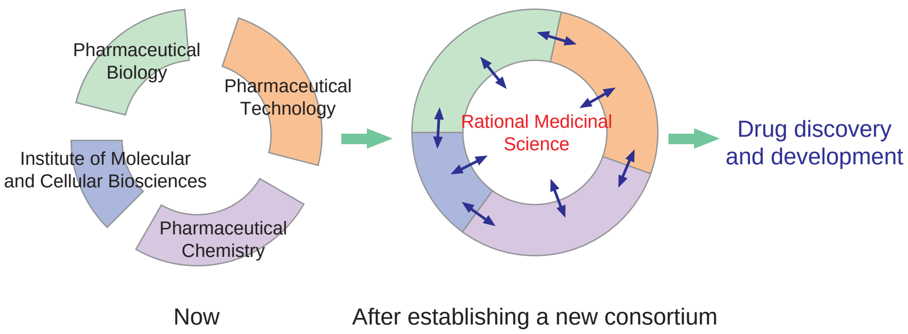
Strategic approach to drug discovery and development in pharmaceutical sciences

Program Director: **Yuichi SUGIYAMA**
Professor, Graduate School of Pharmaceutical Sciences

Most drugs that we take contain small organic molecules, which are designed to treat or prevent disease by modulating bodily functions and keeping our body in a healthier state. While the development of biological treatment such as gene therapy and regenerative medicine have continued to proceed in recent years, medication therapy using effective small organic molecules should continue to play a main role in treating various kinds of acute as well as chronic diseases.
The explosive progress of modern biology has elucidated that a drug becomes effective by interacting with a specific in-vivo molecule, especially a protein, and modulating (activating or inactivating) the function of that molecule. Furthermore, the recent elucidation of all human genes has allowed a dramatic progress in our understanding of organisms in physical terms, enabling us to perform drug discovery and development research using proteins in the body specific to a certain disease. The advancement of technology has thus provided us with opportunities to discover drugs as a result of a rational process from discovery of a target molecule playing a critical role in the development of a disease; to the search for small organic molecules acting on another molecule; to a study on the validation of pharmacological effects in-vivo.
Our research organization has stationed research teams from almost all fields required for drug discovery and development, each of which has been engaged in advanced research in its own specialized field. In order to ride the new wave of drug discovery and development and survive in an ever more intensely competitive global situation, our immediate and essential challenge is to create a new research area that transcends the conventional academic framework. Such an interdisciplinary approach will allow us to apply new findings, such as newly discovered proteins and new synthetic methods, to our drug discovery and development efforts in a timely manner. The major objective of our COE is to establish the "science of drug discovery and development" as an academic field where the biology of diseases, structural biology, synthetic organic chemistry, pharmacology and pharmacokinetics / pharmacodynamics, which are essential to drug discovery and development, are dynamically combined so as to give a more concrete and strategic form to the concept of "development of small organic molecules that modulate human bodily functions," an idea unique to pharmaceutical science (fig.). We believe a successful fulfillment of this objective will contribute to developing the seeds of new innovative drugs. Some of the COE that have been assigned to conduct research in the life science field have also chosen drug discovery and development as one of their research subjects. We are the only center, however, that aims at developing a prototype of drug discovery and development in Japan. This strategic drug discovery and development project, first proposed by the University of Tokyo, will be carried out in the many research divisions of the Graduate School of Pharmaceutical Sciences, and part of the Institute of Molecular and Cellular Biosciences at the university. The diseases of primary focus will be Alzheimer's and serious lifestyle-related diseases such as diabetes and atherosclerosis. We hope to find the most viable candidate compounds to treat these diseases during the five-year period of the COE project.
The research will be strategically performed by the following four groups, each of which will pursue its own objective while closely communicating with each other:

(1) A biology group engaged in the discovery of target molecules (genes, proteins) that cause the disease or play a key role in advancing the disease. This group will also evaluate the efficacy of the drugs designed.
(2) An organic synthesis group engaged in designing small organic molecules targeted at proteins that cause the disease and developing new synthesizing methods.
(3) A structural analysis group engaged in three-dimensional analysis of target proteins and an analysis of interaction between a new drug and its target sites.
(4) A pharmacology group including the researcy area of biochemical pahramcology and pharmacokinetics / pharmacodynamic engaged in the optimization of lead compounds.

For those compounds whose efficacy that have been confirmed, we will seek practical application at an industrial level through cooperative activities between pharmaceutical companies and relevant courses of our graduate school. In putting such compounds to practical use, we will also seek to design tailor-made drugs based on a genome-wide evaluation of patients' genetic characteristics in relation to the efficacy, side effects and pharmacokinetics / pharmacodynamics of the drugs. At the center, we will also emphasize providing opportunities for graduate school students and young researchers to interact with each other in the hopes that they will be able to learn the importance of acquiring interdisciplinary knowledge and views, as well as being able to contribute to developing pharmaceutical sciences for the next generation.



Establishment of an international center for research and education

- The frontier of fundamental chemistry focusing on moleculas dynamism -

Program Director: **Yasuhiro IWASAWA**
Professor, Graduate School of Science
http://www.chem.s.u-tokyo.ac.jp/21coe/21coeindex.html

Objectives of establishing a new consortium:

The Department of Chemistry, Graduate School of Science, The University of Tokyo was selected for the 21st Century COE Program in 2003 by the Ministry of Education, Culture, Sports, Science, and Technology. This COE program aims to develop and establish new frontiers in chemistry with molecular dynamism as a yardstick and to develop internationally competitive researchers who will motivate the development of natural sciences in the 21st century. In order to achieve these objectives, new educational measures and policies and research shall be selectively applied and promoted not only by the Department of Chemistry, but also in collaboration with the Laboratory for Earthquake Chemistry and the Research Center for Spectrochemistry, the Graduate School of Science, and partly with the Graduate School of Engineering, the Graduate School of Frontier Sciences and the Graduate School of Arts and Sciences.

COE education and resource development measures and policies:

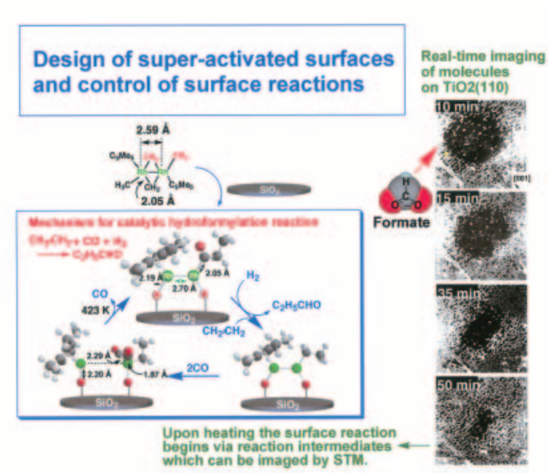
(1) Employment of students from graduate school (doctorate courses) and post-doctoral researchers from Japan and other countries.
(2) Begin a full-scale English language education program in order to become internationally competitive. Such a course would be the first one in Japan for doctoral students.
The key to "international competitiveness" is English language ability. Subjects of the program shall be students in the first year of a doctoral course. The goal shall be the development of talented researchers with sufficient ability in logical technical writing (research reports), presentation, and debate in English.
(3) Sending doctoral students for short term study abroad program.
(4) Establishment of graduate school education: An educational curriculum across departments by project promoting members and an international educational curriculum by visiting professors from abroad.

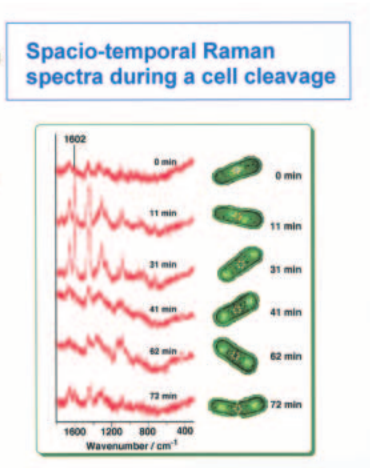
COE priority research themes:

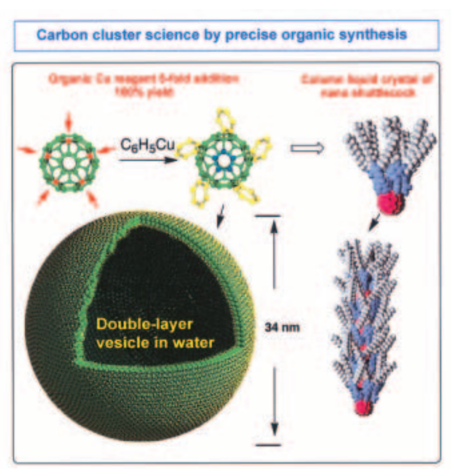
(1) Establishment of new fundamental notions about chemical reaction on the basis of molecular dynamics.
(2) Construction of super-activated surfaces and control of reactions on solid surfaces.
(3) Development of new methods for molecular transformation as well as the synthesis of new chemical compounds by controlling molecular dynamism.
(4) Spatio-temporal analysis of molecular dynamism in a biological cell.

Future plans

(1) Establish an ideal education system for doctoral courses in chemistry in Japan and promote human resources development with international competitiveness.
(2) Establishment of an international center of research and education on fundamental chemistry (Consortium for Research and Education in Fundamental Chemistry) beyond the barriers separating the current departments.







Information science and technology strategic core

Program Director: **Masato TAKEICHI**
Professor, Graduate School of Information Science and Technology
http://www.kc.t.u-tokyo.ac.jp/COE/index-j.html

Information technology of the 20th century, whose main role was played by the Internet and information equipment represented by PC, is undergoing drastic changes in the 21st century, an era of symbiotic paradigms of information systems and human beings. The objective of this COE program is to amalgamate research over a broad area covering information science to mechanical engineering, thus establishing information science and technology for the 21st century in close contact with the real world. In order to achieve this objective, we have developed an organization (Information science and technology strategic core) which strategically manages the research. The education covers a broad area towards a new information science system, and three field amalgamating projects which are now in progress, the Real World Information System Project, the Global Dependable Information Infrastructure Project, and the Super Robust Computation Project.
In the Real World Information System Project, research and development is currently underway to include an integrated environment where information agents are able to recognize daily motion to track the movement of people, a virtual reality system capable of natural conversation, humanoid robots able to perform complicated tasks, and various ubiquitous appliances. The information appliances of the future recognize the people holding out their hands, and provide support according to their needs (fig.1).
The Global Dependable Information Infrastructure Project intends to realize a global and individual information infrastructure which society can really depend upon. Various technologies are under development including, a dependability technology which satisfies open access/ permeability/ automatic adaptation, and element technologies from chip architecture to applications. This will be provided in combination with dependability integration as a whole, and large-scale data processing technology aimed at the integrated use of network information, and application technologies with wide-use dependability.
The Super robust Computation Project is engaged in a task to systemize a robust computation, which even when its components are imperfect, is capable of operation as a whole by complementing each other. Thus eliminating problems such as software freeze up during operation or malfunction due to disturbances including calculation error, measurement error, physical noise, human error or probabilistic uncertainty (fig.2).
We have established a program headquarters to supervise these three integrated projects, to elaborate long and mid term research plans as a COE, and return the research results to society and flow back to education. The headquarters is now strategically developing research and education.

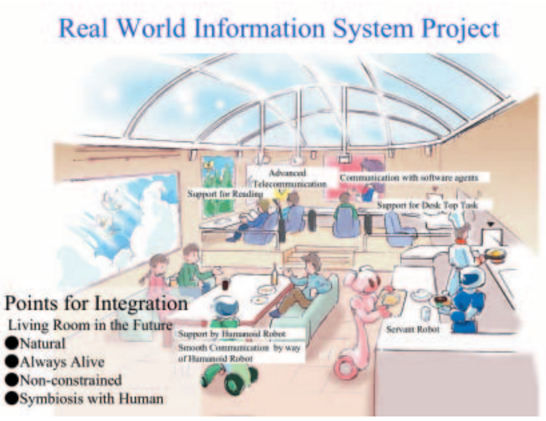


fig.1: Real-World Information System Project: Research and development of an information system which allows humanoids, agents, and ubiquitous devices which are unevenly distributed around people to persistently cohabit with and support people.

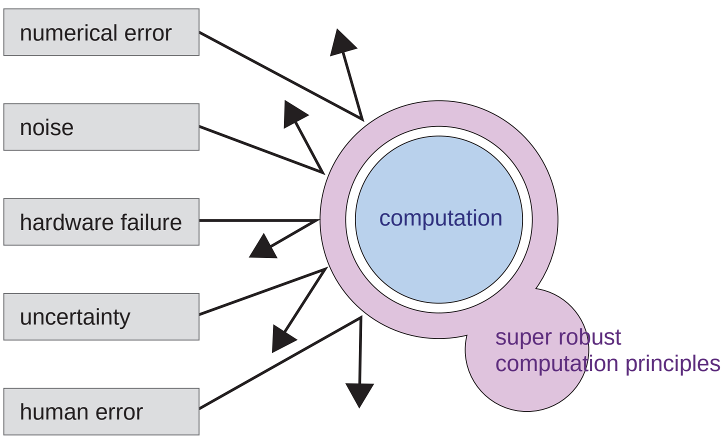


fig.2: Super robust Computation Project: R&D of a computation which enables robust systems to be set up from intrinsically unstable elements in the real world and precise simulation of the real world.

System reform for the development of core academic competence

Program Director: **Motohisa KANEKO**
Professor, Graduate School of Education
http://www.p.u-tokyo.ac.jp/coe/

What core academic competence should children in Japan possess? What must schools do in order to provide education to fulfill this requirement? How should the society support them? The aim of our COE is to seek answers to these questions by performing empirical, theoretical and systematical investigations and then to propose and encourage those concerned to establish a new system to develop basic academic competence.

Objectives:

In a globalized, knowledge based society, basic knowledge and skills have become critical factors for individuals to succeed and the society to develop.
Current realities are however that students have lower motivation for learning and schools and classes, places where academic abilities are traditionally developed, have been faltering as society changes. It has become very difficult to merely maintain the academic level as it used to be. To make matters worse, consensus has not been wholly obtained on what kind of academic competence is required to cope with our new society. This is not a concern unique to Japan but has become common to all OECD nations. An entire society must have a certain unified image of the required academic competence and participate in forming a system to develop such competence. In order to do so, we need to sort out issues to be addressed, and conduct basic research, survey and analyses.
In response to the needs stated above, our center has been established to create a basic and theoretical study on core academic competence. We mean to shed light on actual situations by conducting a large-scale survey, as well as to analyze these situations from a broad perspective through action research and international comparisons. With these combined activities, we seek to contribute to a system reform for the development of core academic competence.

Organization

In order to achieve these objectives, the establishment of a network among researchers, teachers and school administrators, and national and local officials in charge of educational administration is paramount. From this point of view, the center has formed its organization based on the concept shown in the figure.

(1) The center is divided into the following three units: A *Cognitive Research Unit*, a *School Research Unit* and an *Alternative Systems Unit*. These units consist mainly of teaching staff from the faculty of the Graduate School of Education at the University of Tokyo (center members), junior center researchers, external collaborative researchers and researchers invited from overseas. Ten research projects are currently ongoing under this organization.

(2) In addition, the center seeks cooperation and advice from the schools and municipalities liaison board and external liaison researchers consisting of those who are actively addressing issues related to academic competence at schools and municipalities in Japan. The center also asks prefectural boards of education nationwide to assign prefectural liaison members who are to give advice on the centers activities and serve as contact persons when the center conducts surveys.

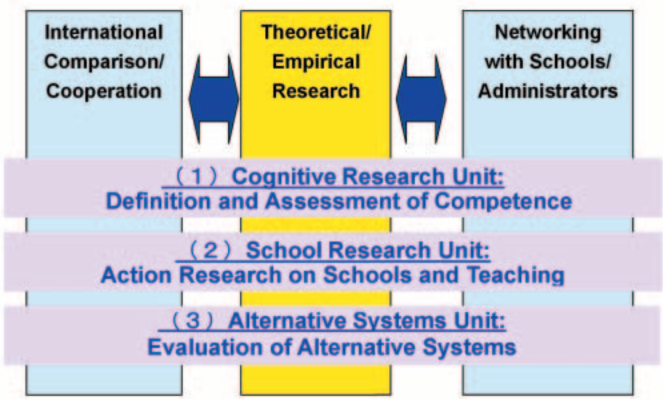
What to achieve

The center aims at achieving the following three goals during the five-year research period:

(1) To establish the foundation for research and development and education concerning core academic competence
This is stated as the primary objective. More specifically, we will aim at accumulating knowledge about academic competence and establishing a core theoretical framework and analytical methodology. We hope to form a large-scale database on academic competence that will be obtained from a large-scale survey and other follow-up surveys. In addition, we hope to train researchers to be engaged in basic and theoretical research concerning the development of academic competence.

(2) To play a core role in multifactor and participative reform to build core academic competence
Any issue concerning basic education involves fundamental issues surrounding what modern knowledge and society should be. We therefore consider it necessary to establish a flexible multi-factor system in developing basic academic competence. This begins with diversified efforts to develop basic academic competence based on individual philosophy which leads to the formation of basic academic competence that will be required by a new society as a whole. From this point of view, we seek, from the early phase of the process of our research, participation from various entities involved in the development of basic academic competence so that the center and all these participants will cooperate as a whole in promoting a single action research project.

(3) To build an international cooperative research consortium on basic academic competence and play a role as the center in promoting its activities
Since issues surrounding basic academic competence involve various factors, we need a research organization that transcends the traditional pedagogical framework. It is required therefore, to form an international cooperative research organization to deal with issues on basic academic competence. At least up until now, outcomes from various types of international comparisons have shown that the standard of Japanese education is significantly higher, a result in which many countries have expressed a keen interest. From this standpoint, the COE of the University of Tokyo on basic academic competence will invite major universities and research institutes from the OECD nations to form an international cooperative research consortium on basic academic competence. We would also like to establish a close and cooperative relationship with researchers in Eastern Asian nations.



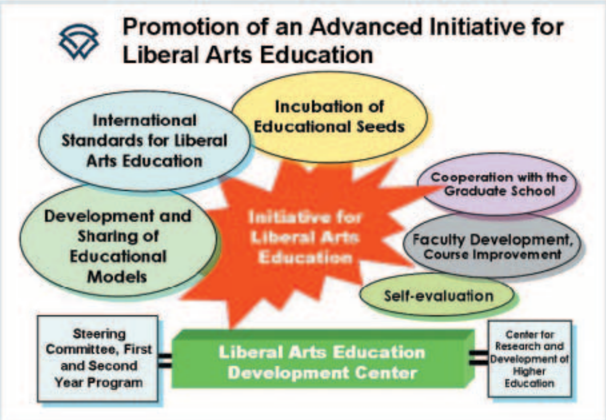
Initiatives in support of distinctive university education program

The Initiatives in Support of Distinctive University Education Program were initiated in the current academic year by the Ministry of Education, Culture, Sports, Science and Technology. Under this program, the ministry selects universities with outstanding and distinctive programs in various fields among national, municipal, prefectural and private universities (including junior colleges) nationwide, which would benefit from national efforts to improve higher education in the future. The University of Tokyo applied for support under the theme of "subjects mainly concerned with comprehensive efforts". This was one of five fields designated under the ministry's program. The title of the program at the University of Tokyo is "the promotion of creative integration between the liberal arts and sciences education and advanced graduate research". Our application was one of those selected from a total of 139 that were filed for this designated field.

Liberal arts education and advanced graduate education

Makoto ASASHIMA
Dean of the Graduate School of Arts and Sciences

In recent years, many national universities have abolished their liberal arts departments or colleges. In the midst of this trend, it is significant and important to note that, despite having shifted its main emphasis from undergraduate to graduate school education, the University of Tokyo has maintained its College of Arts and Sciences. We aim to provide all undergraduate students with an education based on the spirit of the liberal arts in order to form the students' personalities and to help them to develop a truly comprehensive range of knowledge. The national curriculum for elementary and secondary education has been revised, and, consequently, the quality of students entering university has changed. We believe that liberal arts education has become all the more necessary.
While the College of Arts and Sciences is primarily responsible for liberal arts education at the University of Tokyo, the entire university is assisting and cooperating in this effort. Our program, with its theme of promoting the creative integration of liberal arts education and advanced graduate research, has been selected by the Ministry of Education, Culture, Sports, Science and Technology as a distinctive university educational program.
The aim of the program is to incorporate outcomes obtained from advanced graduate research into the undergraduate curriculum so as to foster academic curiosity and to promote an intellectually adventurous spirit among undergraduate students. More specifically, students will be given opportunities to discover new subjects, to study those subjects, and to present and discuss the results of their study. Throughout this learning process, they will be encouraged both to think independently and to express themselves actively so that they can acquire comprehensive knowledge of a kind which has been lacking in conventional education, and which can only be developed in the context of an emphasis on the liberal arts.
We will require students to understand and apply the intellectual systems generated by interdisciplinary and integrated research in order to address issues that cannot be dealt with within existing disciplinary frameworks. To achieve this goal, the Komaba Educational Development Office will be set up in June of this year to promote leading-edge liberal arts education initiatives. The Office will be mainly engaged in the development of a new curriculum, in the improvement of syllabi, and in faculty development (FD) (fig.). Through this initiative, the University of Tokyo seeks to develop a new model of liberal arts education and hopes to present the model on and off campus as well as to the world.
With the concerted efforts of the entire university -- and taking into account the requirements of the university after the incorporation of national universities has been completed -- the University of Tokyo will continue to redefine the meaning of the liberal arts and to provide a distinctive education aimed at helping to fulfill the important responsibilities that universities are expected to bear.



Teachers in UT

The University of Tokyo has a faculty of approximately 2,800 professors, associate professors, and lecturers, all of whom devote their energies both to world-class research in their particular fields and to providing students with a solid education.

UT faculty members have received numerous awards for outstanding achievements in their fields.

Here we introduce a selection of two UT scholars who received prestigious awards in 2003 and 2002, and who represent the rich variety and high level of scholarship at this university. Among the awards are the Shijuhosho (Medal with Purple Ribbon), given to a scholar who has made a great invention or carried out important research in a field of science or technology; and the Saruhashisho, which is granted to a female scholar who has achieved outstanding scholarship in a field of natural science.

By introducing these award-winning scholars, we hope to give you a taste of the wonderful research and education being carried out at UT. Of course, there are also many other faculty members engaged in similarly worthy activities.

Catalyst surfaces as magic mediator

– Design, Characterization, and Understanding

Yasuhiro IWASAWA

Shijuhosho (Medal with Purple Ribbon) 2003
Professor, Graduate School of Science

The catalyst has long been named the "magic mediator" that realizes many types of chemical reactions creating important materials and solving environmental and energy problems in human life. The catalyst has been placed in a "black box" into which we can hardly see and hence, there is very little that is understood of the process of catalysis at a molecular level.

Ultimately controlling surface reactions of solid catalysts at a molecular level will guide the development of highly performed catalysts, which may solve the critical issues of extremely selective chemical processes, global and local environments, energy and material resources, and medicinal exploitation. To achieve this goal, we have been integrating modern surface science, organometallic chemistry and materials science into surface chemistry and catalysis leading to the creation of a new field of surface catalytic science on designed surfaces and oxide single crystal surfaces by in-situ and ex-situ spectroscopies and other physical techniques. The approach based on chemically designed surfaces and single crystal surfaces signals a marked advance beyond the traditional strategy of heterogeneous catalysis research.

To achieve this purpose, we have developed several methods and applied modern physical techniques to characterize and monitor surface structures and catalytic reactions under working conditions. Real-time imaging of migration of adsorbed molecules on oxide surfaces has been performed by in-situ scanning tunneling microscopy (STM) (fig.1). Surface catalytic reactions on $TiO_2(110)$ have also been imaged by in-situ STM. To observe dynamic changes of active structures on catalyst surfaces, a time-resolved energy dispersive x-ray absorption fine structure (DXAFS) technique has been developed (fig.2). We are the first to succeed in monitoring the structural change every 100 ms.

We have also established the surface chemistry of attached metal complexes and clusters and molecular imprinting metals on oxide surfaces. We have succeeded in preparing Nb monomer, Nb dimer, and Nb monolayer on SiO_2 surfaces which show entirely different catalysis from each other. We have discovered a novel phenomenon on the role of metal-metal bonding in selective metal catalysis. Molecular imprinting is a promising approach in preparing artificial enzymatic catalysts. A size and shape selective Rh-dimer catalyst was first successfully designed by combining a metal-complex attaching method and a molecular imprinting method (fig.3).

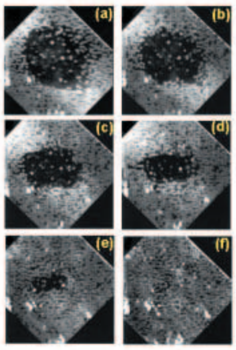


fig. 1
Real time STM images (30 x 30 nm^2) for the formate migration on $TiO_2(110)$.

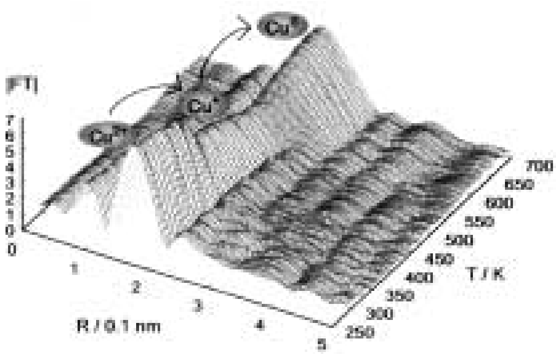


fig. 2
Time-resolved XAFS spectra for dynamic structure change in Cu of ZSM5 zeolite.

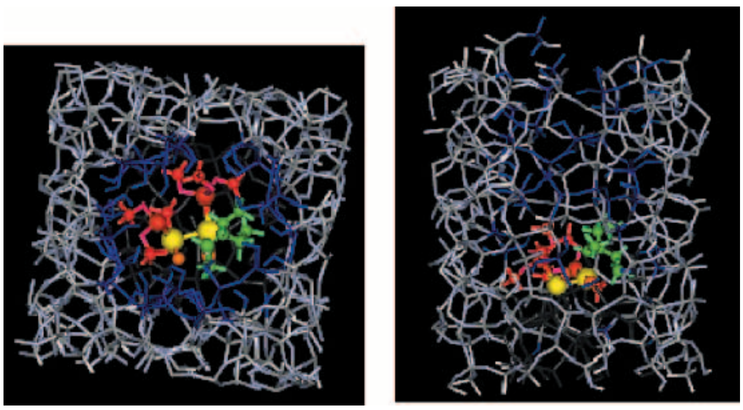
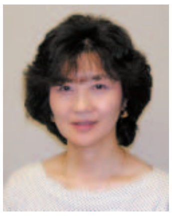


fig. 3
Modeling of molecular imprinting Rh-dimer catalyst toward an artificial metal-enzyme (top view & side view).

Life's molecular motors

– Pursuing the motile mechanism of spermatozoa



Chikako SHINGYOJI
Saruhashisho 2002
Associate Professor,
Graduate School of Science

Active movement is a sign of life in all plants and animals. It is found at all levels of their organization, that is, from the cells and tissues that make up their bodies to the whole organism. Although the movements of the organisms and their parts differ vastly in speed, force and other properties, most of them are driven by a few kinds of what are called "motor proteins" of the cell. There are three major kinds of motor proteins: myosin, kinesin and dynein. Among these, dynein is responsible for the movement of sperm cells, or spermatozoa, which propel themselves by moving their tails or flagella. In flagella as well as in other parts of the cell, the function of dynein is to move along a microtubule, one of the cytoskeletal components of the cell, by using energy obtained through the hydrolysis of ATP.

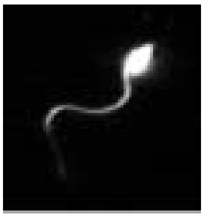
Sperm cells swim towards the egg by "beating" their flagella. In sea urchin sperm, for example, rhythmic bending waves are formed at the base of the flagellum at about 40-50 cycles/sec and propagated towards the tip. Sperm can change their direction and swimming speed by changing their waveform.

The internal structure of the flagella responsible for the movement is the axoneme. It consists of microtubules and other components arranged in the so-called "9+2" pattern, in which nine 'doublet' microtubules surround the 'central-pair' microtubules. Dynein arms occur in two regular rows along each of the nine doublet microtubules. They cause sliding movement of adjoining doublet microtubules past one another. The flagellar bending waves are produced by regulated activity of the dynein arms.

What causes the flagella to oscillate? This is one of the questions that have not been answered for a long time. Recently, we measured the force generated by dynein with 'optical trap nanometry', and found that a single dynein arm in its natural position on the doublet microtubule generated a force of about 6 pN. More significantly, the force developed by a single dynein molecule showed oscillation (Nature, 393: 711-714, 1998). The oscillatory properties of individual dynein molecules may be important for flagellar oscillation as well as the control mechanism in which the higher level '9+2' structure of the axoneme are generally implicated.

How does the '9+2' structure regulate microtubule sliding to produce oscillatory flagellar bending? Our recent study with elastase-treated sea urchin sperm flagella (J. Cell Sci., 116: 1627-1636, 2003) has shown that the dynein arms on one side of the axoneme and those on the opposite side are alternately activated to induce the reciprocal sliding necessary for oscillatory bending. The switching of the activity of dynein is regulated by the central-pair of microtubules. This is the basis for the regulation of both the direction and the speed of swimming sperm.

Recent studies made in many laboratories, including ours, have elucidated much of the basic mechanisms underlying sperm motility. There are, however, still many unsolved problems regarding the regulation of dynein in flagellar motility. One of the remaining questions is how the oscillation of dynein is related to the flagellar oscillation. Further studies of the dynamic properties of both dynein and the doublet microtubules will give us a clue to solving these problems.



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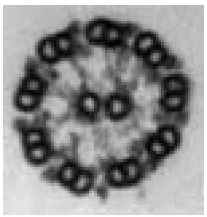

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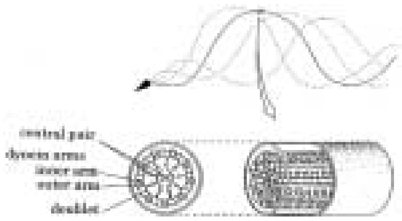

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fig.
(a) A sea urchin sperm; (b) electron micrograph of a cross-section of its flagellum (the membrane has been removed to expose the axoneme); (c) schematic drawing of the flagellar axoneme showing the 9+2 structure within membrane.

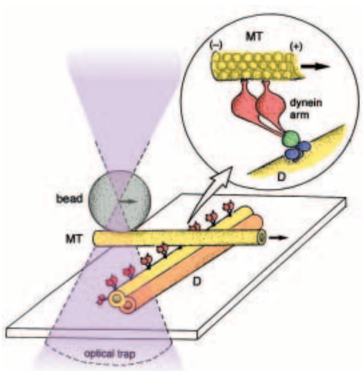

fig.
Drawing showing the principle of optical-trap nanometry used to measure the force of a single dynein arm.

Renewal of Agreement between the University of Tokyo and the European Organization for Nuclear Research (CERN)

Tomio KOBAYASHI
Professor, International Center for Elementary Particle Physics
http://www.icepp.s.u-tokyo.ac.jp/
http://public.web.cern.ch/public/

The University of Tokyo and CERN first reached a scholarly research exchange agreement in 1988, and interchange has continued since, most notably in the field of particle physics. This agreement is renewed every five years with this year marking the third renewal. When President Sasaki of the University of Tokyo visited CERN on July 29, a memorandum concerning the renewal of the agreement was signed and its extension was determined for five more years.

CERN is the European particle physics laboratory and for many years has had fierce competition with American laboratories in the research on particles using the world's largest energy accelerator. Especially after CERN's discovery of carriers of weak nuclear force (W-bosons and Z-bosons) about 20 years ago, CERN has been leading the world in this field until now. The International Center for Elementary Particle Physics (ICEPP), University of Tokyo participates in the Omni Purpose Apparatus for LEP (OPAL) experiment. This is an international undertaking that employs CERN's large electron positron (LEP), the world's largest energy electron-positron collider. The University of Tokyo has been taking the initiative in experiment proposals, construction and operation of the main parts of the measuring instruments and physical analysis. The LEP began operation in 1989 and continued until 2000 when it was closed. During this period, the LEP produced various results approaching the fountainhead of particle physics, including the definition that particles have three generations, the search for the Higgs particle, detailed verification of the unified-gauge theories, calculation of the top quark mass, and the suggestion of supersymmetrical grand unification theory among others.
CERN has now begun construction on the large proton-proton collider "Large Haron Collider" (LHC) as a project following the LEP. In comparison with the LEP, the LHC is expected to immediately expand the search area for new phenomena and new particles in the particle physics field tenfold. Discoveries of the Higgs particle, the key for the origin of mass, or supersymmetrical particles suggested in the experiments with the LEP are anticipated to take place. Besides the OPAL experiments, the ICEPP has carried out research and development of measuring instruments and investigations on the data analysis system for ATLAS, an international joint experiment using the LHC. From now until the start of experiments in 2007, the ICEPP will function as the LHC experiment local data analysis center and is planning to speed up the preparation of facilities to promote the physical analysis of experiments with the LHC. They will thus continue to play a central role among relevant researchers throughout the country.

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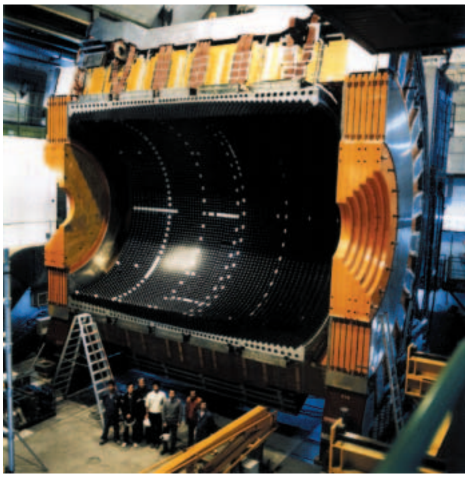
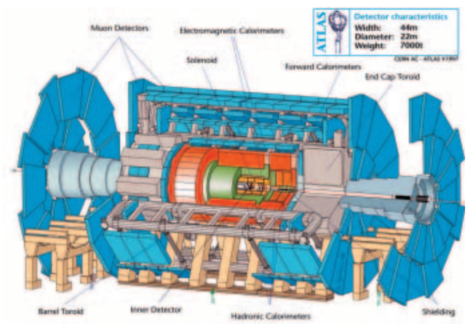
Photo 1: President Sasaki, the University of Tokyo, and Dr. Roger Cashmore, CERN Research Director.
Photo 2: President Sasaki listens to explanations from an ATLAS experiment spokesperson.



Lead glass shower calorimeter constructed by ICEPP in the OPAL experiment.



Completion drawing of the detector for ATLAS experiment in which a Japanese group including the University of Tokyo is participating.

TRON (The Real-time Operating system Nucleus) Project: An Industry-Academia Alliance

Ken SAKAMURA
Professor, Interfaculty Initiative in Information Studies
http://www.t-engine.org/

I have been conducting research for 20 years aimed at the realization of “everything computing”, which is the concept of having computer chips embedded in all the objects in our living environment. This research field is now called Ubiquitous Computing or Pervasive Computing, and is being recognized as the most important research domain in computer science.

For this operating system (OS), which will be the basis for this field, a real time response or a response without delay, shall be important in coping with the real environment. ITRON, a real time OS specification developed mainly by our laboratory, is currently the most popular OS specification for embedded microcomputers, and has been embedded in the control of car engines and mobile phones, etc.

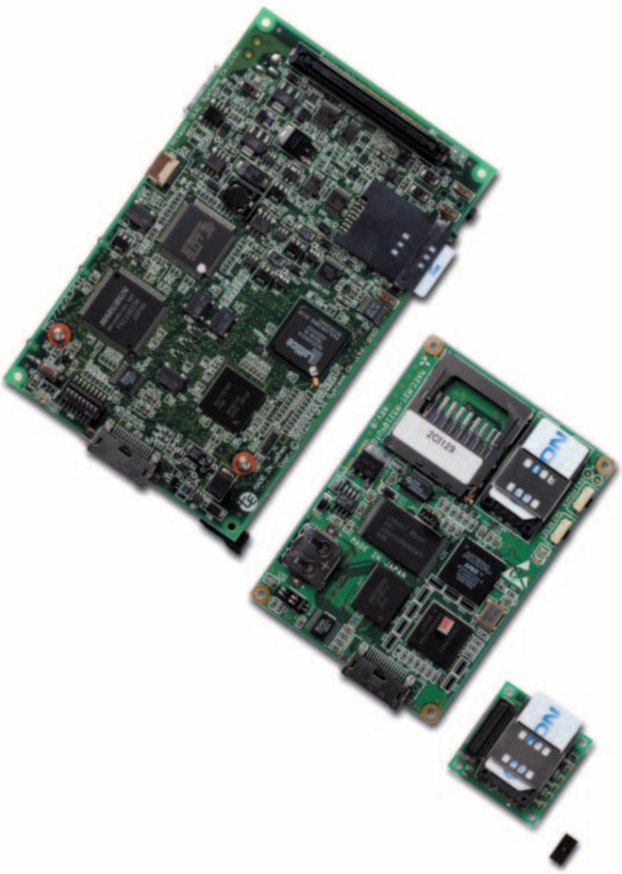
Now that realization of ubiquitous computing is slowly coming into focus, we established the T-Engine Forum in June 2002, a non-profit organization that promotes standardization activities to prepare our infrastructure for this new computing system. As of March 2004, this organization counted 330 companies as members. Most notably, we garnered some headlines when Microsoft, the world’s largest software company, applied for membership as well.

Upon hearing the word “computer,” people usually think of personal computers. But in actuality only 2% of the total number of microprocessors manufactured each year are used in personal computers. The majority of them are embedded in products such as electric appliances, cars and mobile phones.

Microchips are being used not only for home information appliances but also for various objects such as food and drugs. Such microchips exchange information between themselves and can recognize their surrounding environment. This constitutes an important element technology, which can lead to the realization of a context-aware environment, thus makes our life more affluent.

I am happy that fruits of the many years of research carried out by our laboratory aimed at the realization of ubiquitous computing will make a contribution to the world.

“Ubiquitous communicator” developed based on the T-Engine architecture by the Ubiquitous Networking Laboratory, where the author of this article, Ken Sakamura, Professor of The University of Tokyo, is the chair. Ubiquitous communicator is a terminal designed for individual communication and supports several communication methods. It works as a communicator with physical objects and a reader/writer of RFID and smart IC card.



T-Engine is a standardized development platform for embedded systems. For distribution of middleware, a standardized platform is necessary. The photos are standard T-Engine, micro T-Engine, nano T-Engine, and pico T-Engine from the bigger size, respectively. Standard and micro T-Engines have been already released. Nano T-Engine is being built using all-in-one-chip microcomputer and pico T-Engine is being developed for smart RFID application.

Newly Discovered Oldest Modern Human Fossil from Ethiopia

Gen SUWA
Associate Professor, University Museum
http://www.biol.s.u-tokyo.ac.jp/users/jinruikeitai/lab.html

With the rise of comparative analysis of modern human DNA sequences and development of better methods for estimating the age of fossils, since the 1980's, we have seen an accelerated interest in the study of modern human origins.

Outcomes of these studies have given strong support to what is now known widely as the Out of Africa model for the origin of modern humans: that an ancestral population that gave rise to all modern humans existed in Africa some 100,000 to 200,000 years ago. On the African continent, however, no potentially ancestral fossils of this age have hitherto been established in unambiguous support of this hypothesis.

The oldest modern human fossils introduced here were found in Ethiopia in an area where geological layers of around 200,000 years old are widely exposed on the present landscape. It was only several tens of kilometers away from where, in 1992, we discovered the ancient hominid *Ardipithecus ramidus*, which lived approximately 4.4 million years ago (Nature, September 22, 1994). Near the site were pastoralists grazing camels and forming temporary cluster of huts, such as the village of Herto. Here, I shall call the discovered human fossils the Herto fossils, after the name of the abandoned village. The discovery was made by a research team, with a background of over 15 years of joint research, that includes Dr. Berhane Asfaw, Ethiopian anthropologist, Dr. Yonas Beyene, Ethiopian prehistorian, Dr. Tim D. White, paleoanthropologist, University of California, Berkeley, and myself. While I was not directly involved in the discovery and excavation of the Herto fossils, I was involved in the evaluation of the anatomy of the fossilized crania as part of the joint research. In addition, geological research in Ethiopia conducted by my fellow Japanese collaborators had greatly contributed to the dating of the fossils at approximately 160,000 years before present.

The primary Herto fossils consist of two crania, one adult and one child. Both have a high and rounded neurocranium with the facial skeleton located in an anteroinferior position. In further detail, the fossils show a divided supraorbital ridge characteristic of modern humans. The adult Herto fossil had a large brain, with a cranial capacity of 1450 cc. Our statistical analysis of a series of cranial measurements also confirmed the modern-human-like dome-shaped neurocranium. These features are unique to modern humans and are not seen in Neanderthals and other archaic Homo sapiens. However, we must take into consideration the fact that there are substantial individual and group differences within modern humans. Referring to W. W. Howells' craniometric data taken from several thousand modern human skulls, we concluded that the Herto people had a larger face and stronger supraorbital ridge, indicating that they were more primitive than the modern human populations. Such features and the estimated antiquity of the Herto fossils serve as the rationale for regarding them as representing the earliest known stage of modern humans.

In comparison with Neanderthals, however, the facial skeleton of the Herto people did not protrude forwards as much. While the Herto people had a large face, the structural relationship of the facial skeleton with the cranial base, i.e. the bottom-side of the skull, appears to be similar to that of modern humans suggesting that their faces were developed more downwards than forwards. It is difficult to interpret, however, the biological significance of such structural differences. Is the so-called modern-human-like shape of the cranium simply the result of a larger brain and smaller facial size? Or could the modern morphology have been associated with changes in pattern formation and growth of some specific parts of the cranial and facial complex? Evaluating and understanding these possibilities may provide us with a better idea as to the meaning of being "modern" from a biological point of view. The evolutionary history of humans cannot be entirely understood from experimental studies. Our continuing empirical studies will increase our understanding on aspects of our biological history that are yet to be elucidated, although it is not necessarily easy to obtain satisfactory results from the limited fossils.

The fossil evidence, by nature, is always insufficient both in quantity and quality. The challenge that lies in front of us, then, is to enlighten as much as possible the actualities of evolution with the limited available evidence. While the new fossils discovered in Ethiopia supports the so-called Out of Africa hypothesis, there still remain many unanswered questions; was the oldest modern human populations distributed only within Africa, or in a larger area including Asia? And how much of admixture might have occurred between the ancestral modern and the other more archaic groups of humans? These questions remain unanswered by the Herto fossils.

Excavation site of the Herto fossils. A semi-desert region approximately 230 kilometers northeast from Addis Ababa, the capital of Ethiopia.
Photo©2001 Tim D. White / Brill Atlanta

Adult cranium of the Herto fossils.
Photo©2000 David L. Brill / Brill Atlanta

Successful Launch of the University of Tokyo's Super-Small Satellite CubeSat

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A super-small satellite named the CubeSat "XI ([sai])" (10 cm x 10 cm x 10 cm, 1 kg weight) (fig.1), made by the students of the Nakasuka Laboratory, Department of Aeronautics & Astronautics, School of Engineering, the University of Tokyo, was launched at 23:15 (Japan time) June 30, 2003 from Plesetsk (Russia) by a 3 stage "ROCKOT" rocket (fig.2).

It entered into an 824 km circular, sun-synchronous orbit at 0:48 AM July 1st. The satellite was operating satisfactorily and passed over Japan at 4:34 AM, transmitting radio waves to the ground station in Building No.7 of the School of Engineering, the University of Tokyo, to confirm its normal operation. Initial steps have been completed and the satellite is now on regular operation, carrying out communication experiments, obtaining and downlinking images of the Earth, and making estimates on the attitude/movement of the satellite. XI is the smallest and lightest functioning satellite in the world and it shows that a satellite of such size can still fulfill its mission and capture images of the Earth, images that are consequently being highly praised throughout the world.

CubeSat is a project, first suggested by Professor Twiggs of Stanford University, to produce a standard satellite in a super-small size (10 cm x 10 cm x 10 cm and weighing less than 1 kg). The project provides practical education in space engineering to students by giving them the opportunity to experience the entire process of developing a satellite, launching it and learning about its behavior in the real world. It is also attracting attention as a very effective educational method for project management. The possibility of pioneering a new field in space development is also anticipated. As the satellites can be developed in an extremely short period of 1 – 1.5 years at low costs, new technologies in space engineering can be quickly verified leading to potential growth for space businesses. More than 50 universities throughout the world and space agencies such as NASA, are currently proceeding with their own CubeSat projects. We, the University of Tokyo project team, completed the development of a CubeSat earlier than the others, and were the first to launch it into space. Four other CubeSat satellites, including one from the Tokyo Institute of Technology group, were launched at the same time. However, among the CubeSat satellites, only the two Japanese orbiters are working normally, showing the high technological level in Japan in the field of super-small satellites.

It was a great challenge to manufacture a satellite weighing only 1 kg, considering that a satellite usually weighs from 100 kg to several tons and costs more than 10 billion yen, but various ingenious ideas from the students of the University of Tokyo opened up new doors. As the University of Tokyo had not been equipped with the necessary facilities for space environment tests such as radiation environmental tests or thermal vacuum tests, we had to transport the satellite to the Japan Atomic Energy Research Institute (JAERI), National Space Development Agency of Japan (NASDA), and the Institute of Space and Astronautical Science (ISAS) for testing. The radiation environmental test at JAERI alone would cost more than 5 million yen if conducted separately, however we were able to conduct our test free of charge by placing our materials alongside circuit boards that were undergoing radiation tests at JAERI, effectively conducting two test at the same time. As we are unable to use Japanese domestic rockets for the launch of our satellite, we also faced difficulties in placing our satellite into orbit. We had an unfortunate event with an American launching company but were finally able to secure space aboard a Russian rocket. With the help of many amateur radio operators, we were also able to obtain a radio station license on the amateur frequency band just prior to the launch. This fulfilled our need for a communication band. Throughout the development of this satellite, we came to realize that though it is advanced in the aspect of technology, Japan lacks the infrastructure for small satellite development.

The development of super-small satellites are not only an excellent subject for space engineering education, but also an effective method to provide easy access to people who are willing to accomplish something in the space. We fully intend to continue its development. This type of satellite is able to provide continuous images of the Earth at low costs and is applicable for satellite surveillance for disaster mitigation, for a remote sensing satellite for search of natural resources, for education and entertainment. In the current mission, the actual status of the satellite and downlinked images will be distributed free of charge to mobile phones and personal computers to those who have registered. More than 1,500 participants are currently enjoying the service. We hope that this will serve as a test case for such future applications and as a part of the activities to appeal to more people about space development. Details can be found at the Nakasuka lab website: http://www.space.t.u-tokyo.ac.jp.

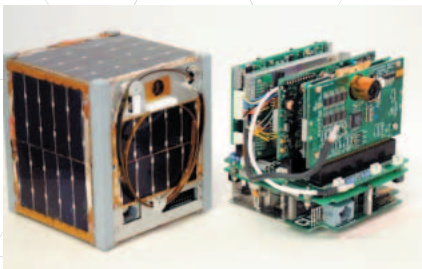

fig.1 External and internal view of CubeSat "XI"

fig.2 ROCKOT launch (June 30, 2003 Plesetsk base)

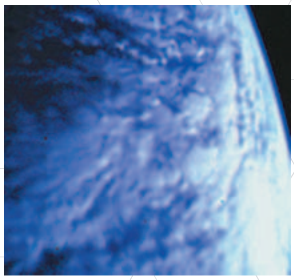

fig.3 Image of the Earth taken by "XI" (the Southern hemisphere, taken on September 17, 2003)

News in Brief January to December, 2003

January

A special lecture was given by Nobel Prize laureate, Professor Emeritus Masatoshi Koshiba.

"Neutrino" exhibition was held in commemoration of Professor Emeritus Masatoshi Koshiba's Nobel Prize.

February

The first entrance examination for undergraduate students was held. 8,441 candidates who had already passed an initial examination competed for admission. Only 2,921 passed.

March

The second entrance examination for undergraduate students was held. Out of 1,581 candidates, 349 were successful.

Commencement for the 2002 academic year was held for 3,380 undergraduate students, and 3,643 graduate students had their degree conferred. Charles M. Vest, President of Massachusetts Institute of Technology and Dr. Shiro Ishii, Professor Emeritus of the University of Tokyo, attended the ceremony as guests of honor and gave congratulatory speeches.

April

The University's matriculation ceremony was held. 3,336 freshmen started life in the University of Tokyo. 2,766 students were admitted to graduate school courses at master's level and 1,467 entered doctoral courses.

Professor Emeritus Noboru Murofushi, Professor Hidetoshi Fukuyama, Professor Naotake Mouri, Professor Masakatsu Shibasaki, and Professor Ken Sakamura received the Medal with Purple Ribbon in Spring.

Professor Emeritus Masatoshi Koshiba received the Grand Cordon of the Order of the Rising Sun.

May

"Exchange Session on Cooperation between the University of Tokyo and Industries" was held in Osaka.

The 76th Students' May Festival was held at Hongo Campus. About 46,000 people attended.

June

A collection of basic historical records of Japan (750 volumes) was presented to St. Petersburg State University of Russia.

July

"Open Campus 2003" was held at the Hongo Campus and Komaba Campus, and 1,123 senior high school students, selected on a first-come-first-served basis, took part in this event.

The 5th Open Academic Lecture was held at the main auditorium. About 460 people attended the lectures given by Associate Professor Chikako Shingyoji, recipient of the Saruhasisho, and Professor Hidetoshi Fukuyama, recipient of the Medal with Purple Ribbon in Spring 2003.

August

Prime Minister Mr. Koizumi inspected the Kamioka Observatory of the Institute for Cosmic Ray Research (ICRR), at Kamioka in Gifu prefecture.

September

The University of Tokyo - the University of British Columbia student exchange program 2003 was held.

October

Sweden-Japan University Presidents' Joint Seminar was held.

November

Professor Emeritus Kanji Ishii, Professor Emeritus Takeshi Mikami, Professor Emeritus Akira Fujishima, Professor Yoshiyuki Sakaki, Professor Yasuhiro Iwasawa, and Professor Yoshinori Tokura received the Medal with Purple Ribbon in Autumn.

Special lecture for the University of Tokyo was given by Mr. Carlos Ghosn, the President and Chief Executive Officer of Nissan Motor Company.

Komaba Festival was held at Komaba Campus.

December

The 6th Open Academic Lecture was held at the main auditorium. About 330 people turned up and listened to the lectures given by Professor Yasuhiro Iwasawa and Professor Emeritus Akira Hujishima, the recipients of the Medal with Purple Ribbon in Autumn.

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Cover:
The Akamon (Red Gate) was originally built in 1827, when the daughter of the 11th Tokugawa Shogun, Princess Yo, was married to the head of the Kaga-han (Kaga fief). Though its formal name is the Kaga-han Kamiyashiki Goshudenmon, the gate is more familiarly known as the Akamon due to its rich red lacquer finish. One of the finest remaining examples of an Edo-period feudal manor gate, the Akamon was designated a National Treasure in 1931 and remains today an Important Cultural Property.
Photo by Yuji OZEKI

Backcover:
Wood Block print of the opening ceremony for Kaisei-Gakko, the precursor of the University of Tokyo (1873)

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