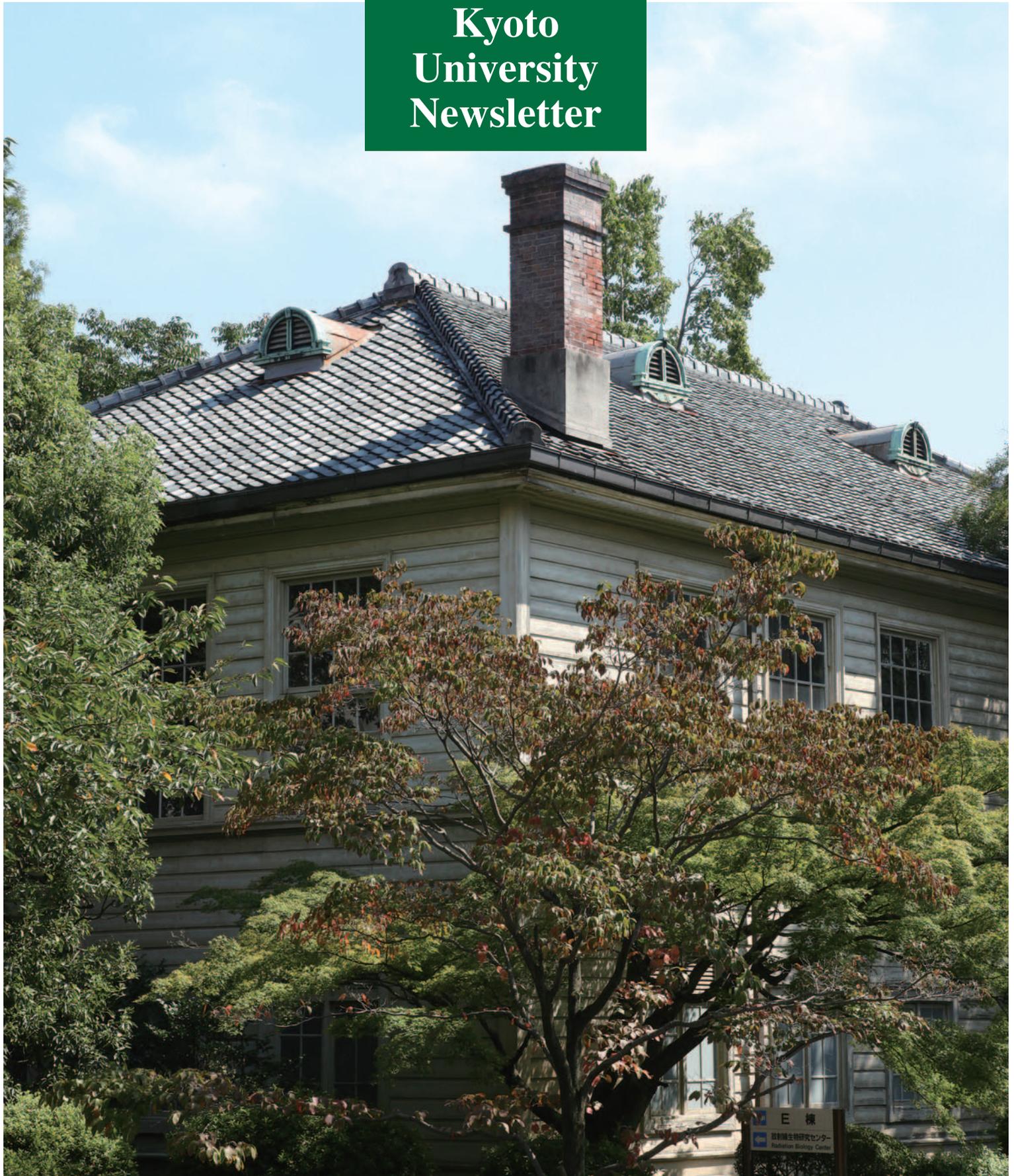


楽友
Raku-Yu

Kyoto
University
Newsletter



1 Kyoto University's strategic policy and activities for collaboration with industries and governmental agencies

Kohei SHIOTA, Executive Vice-President, Kyoto University

2 FEATURES

Kyoto University's European Representative Office in London now in full operation:

**An Honorary Doctor's degree is presented to Dr. Alan Kay
The 10th APRU Doctoral Students Conference was held**

6 Forefronts of Research at Kyoto University

First discovery of a transporter gene that facilitates the accumulation of nicotine in the tobacco plant

Kazufumi YAZAKI, Professor, Research Institute for Sustainable Humanosphere

Development of a Next-Generation Artificial Bone for Lumbar Spine Surgery

Takashi NAKAMURA, Director, Kyoto University Hospital

10 Essay

Global Transformation of Emergency and Critical Care Medicine in Kyoto University

Naoyuki MATSUDA, Associate Professor, Graduate School of Medicine

11 Interview

It is my goal to explore living space, community and systems for the support of senior citizens' lives with community involvement.

Lata SHAKYA, the third year doctoral student at the Graduate School of Engineering

12 What's Happening in International Relations

President Matsumoto urges a switch to SURVIVABILITY at the 2009 G8 University Summit in Italy

Discussions with Iraqi Minister of Foreign Affairs, Mr. Hoshyar Mahmoud Zebari

Kyoto University Programs for Future International Leaders: K.U. PROFILE

14 PROMENADE

Heian Jingu Shrine – A crystal dream to energize revitalization of the Imperial Capital

Editor's Notes

It is our great pleasure to present you, distinguished readers, the autumn issue of Raku-Yu, 2009. Autumn is one of the best seasons in Japan. The weather is cool and pleasant, and we can enjoy change in the color of the leaves on the mountains surrounding Kyoto (the prevalence of the red color is called 'momiji' in Japanese). As the first signs of autumn appeared you will probably have noticed that Japanese politics had also experienced some far-reaching changes.

And Kyoto University is also in the process of undergoing its own change. In this issue we discuss the growing collaboration between with industries and government agencies that Kyoto University has been promoting lately. Executive Vice-President Prof. Kohei Shiota explains the rationale and objectives behind this strategic push by Kyoto University. We also include a report on the activities of the newly-opened Kyoto University's European Representative Office in London, which are related to this expansion of our priorities.

We also feature on-going academic and cultural activities sponsored by or held in Kyoto University. Prof. Kazufumi Yazaki reports the discovery of the transporter gene for nicotine, while Prof. Takashi Nakamura explains the contributions that the next-generation artificial bone can make to health care. Finally, Dr. Naoyuki Matsuda explains his pathbreaking role in the development of emergency and critical care medicine in Kyoto University.

We look forward to seeing you again in the next issue which will be published in Spring, which, by the way, is also best seasons.

Front Picture: Former Auditorium for Anatomy

The College of Medicine, Kyoto Imperial University, which later became the Faculty of Medicine, Kyoto University, was founded with eight departments in 1899. Thereafter the number of departments increased to 18 by 1902 through devotion to the enhancement of equipment and facilities. On both sides of the road which runs from the front gate of the Faculty of Medicine on the south to the north inside the grounds, department facilities were added one after another; the Anatomy facilities and the Pathology facilities on the east side, the Physiology and Hygiene facilities and the Pharmacognosy and Medical Chemistry facilities on the west side.

The Auditorium for Anatomy seen in the cover photograph was completed in 1902, adjacent to the Anatomy building. It clearly represents the characteristics of European style wooden construction in the latter part of the Meiji Era, with its two chimneys made of brick projecting from the tiled roof. Although it appears to be two-storied at first glance, its interior is actually a lecture theater with a dissecting table on a platform. This auditorium and a part of the Anatomy facilities currently remain, though neither is presently used.

A scene from about 1910, looking from the front gate of the College of Medicine to the north. The Auditorium for Anatomy can be seen in the center on the right. The lower left photograph is the current scene viewed from almost the same angle.



Kyoto University Archives collection

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A Note on Order of Names

As a general rule, names appearing in *Raku-Yu* are written in given name/family name order.



This name was taken from the assembly hall called "Raku-Yu Kaikan" that commemorated the 25th anniversary of the founding of Kyoto University.

Kohei SHIOTA Born in 1946, Dr. Kohei Shiota graduated from the School of Medicine, Kyoto University in 1971, and completed his studies in the Graduate School of Medicine and received a doctor's degree in 1976. He became a professor at the Faculty of Medicine, Kyoto University in 1990, and assumed the position as Dean of the Graduate School of Medicine and the Faculty of Medicine, Kyoto University in 2007. He has held his present position of Executive Vice-President since October, 2008.

Executive Vice-President Shiota was nominated by President Hiroshi Matsumoto in the fall of 2008, acting in the double capacity of Executive Vice-President for Finance and Industry-Government-Academia Collaboration for Innovation. He has stated that both of these duties are extremely important for Kyoto University to fulfill its social mission concerning education and research. To stabilize the fiscal base of the university and to improve the university quality of education, research, and medical care he emphasizes the necessity for strategic management. In addition, he is setting up a system that will enable Kyoto University researchers to apply their research output in the private sectors. Executive Vice-President Shiota has been involved in education and research in Teratology, Embryology, and Anatomy for about 40 years at Kyoto University. He solemnly says, "I would like to reciprocate some of the kindness Kyoto University has shown me during the past years since I was a student."



Kyoto University's strategic policy and activities for collaboration with industries and governmental agencies

Kyoto University has made significant contributions to higher education and research activities, and has produced world-class researchers in various scientific areas. In addition to pursuing the advancement of the basic sciences, another important role of the university is to make research results accessible to the public and enhance the utilization of intellectual properties resulting from the university's research activities. To this end, Kyoto University has established the Office of Society-Academia Collaboration for Innovation (SACI) to promote industry-government-academia collaboration. The threefold mission of the Office is (1) to promote collaborative research between academia, industry and government, (2) to support business start-up ventures by researchers and students, and (3) to manage and utilize the university's intellectual properties. To promote technology transfer to industries, we administer intellectual properties in collaboration with the Kansai Technology Licensing Organization (Kansai TLO) and other external organizations. Both domestic and foreign patent applications have been increasing, and over 2,900 patent applications have been submitted to date. Consequently, the royalty income for Kyoto University has increased steadily. The staff members of the three divisions of the SACI, i.e., the Medical and Bioscience Division (including the Intellectual Property for iPS Cells Section), the Science, Engineering and Agriculture Division, and the Software and Contents Division, assist researchers and students in collaborating with industries

and governmental agencies.

Collaboration with foreign universities and industries remains robust. A number of international research projects are ongoing, and the exchange of researchers and students is active. In order to facilitate collaboration with foreign universities and institutes, Kyoto University recently laid out its policy for international industry-government-academia collaboration. We are working to establish an effective network with universities, technology transfer organizations and private corporations outside of Japan. One recent development was the opening of Kyoto University's London Office in February 2009. We hope the London Office will facilitate interaction with leading universities and industries not only in Great Britain but also throughout Europe. We are likewise interested in expanding our collaborative networks in Asia, Africa and the Americas.

Collaboration with industries and governmental agencies is an important mission of the university through which the intellectual output of research activities is returned to society and utilized for its benefit. At the same time, the fruits of this technology transfer provide researchers with the appropriate incentives and thereby promote research activities within the university itself.

Kohei SHIOTA
Executive Vice-President, Kyoto University

塩田浩平

Kyoto University's European Representative Office in London now in full operation:

In February 2009, Kyoto University opened its European Representative Office in London as the first overseas operating base in Europe. Its main function is to act as the frontline base for information gathering and strategic planning of global alliance and collaboration with leading universities and research institutes in the UK and Europe.

In 2008, Kyoto University started the 5 year International Industry-Government-Academia Collaboration program under "the Strategic Program for the Promotion of Coordination among Industry, Academia and Government", funded by the Japanese Ministry of Education, Culture, Sports, Science and Technology. Its objective is to conduct joint research with overseas universities and industry, and to promote international technology trans-

fers.

One unique aspect of Kyoto University's international alliance activities is its attempt to go beyond binary collaboration between Kyoto (A: academy) and an overseas institution (A or I: industry), and to realize a trinary one between Kyoto (A), an overseas university (A) and its associated industry (I). The former type can be called an AA or an AI type, while the Kyoto approach is an AAI type where the industrial partner is part of the overseas academic partner. Furthermore, we intend to achieve an IAAI type where the first industrial partner comes from Kyoto's contact.

The reason behind these approaches is that we consider international collaboration and alliance as university activities that are based on our ongoing academic research with high quality

and existing networks of researcher members and students. In this way, we can identify and rely on trusted partners who are familiar with the local legal systems and business practices.

In the first stage, we have been seeking out global collaboration networks of AA or AI types with existing partners, who have research collaboration and exchanges at the university level, and establishing new ones in the US and Europe. For example, we are in discussions with leading UK universities such as Oxford and Bristol for joint research projects and with MRCT (the Medical Research Council Technology) for technology transfer. The next stage will focus on conducting more concrete actions like joint seminars, workshops, researcher exchanges, IP (intellectual property) evaluation and technology marketing among others, towards realizing our final target of AAI and IAAI partnerships.

For all this to succeed, the most important point is to build up trusting relationships with the parties concerned and maintain good, regular communications with them. We place great emphasis on face-to-face meetings; speedy responses and regular, direct contact.

We have selected Europe as the site of an overseas office which will take the lead in all these collaborations because of the close proximity between a large number of possible premier partners which have close similarities in higher education systems and business manners. We decided on London as it is considered to be one of the largest and the most strategic centers of



Devon House (center), the new home to KU's European Rep. Office is located in central London - 200m from the Tower Bridge.

science and technology world. There are other encouraging factors such as the UK Government's great efforts to further science and technology, and Kyoto University's already many existing partnerships with world-class UK universities.

The European Representative Office will serve as the frontline base for Kyoto University's international Industry-Government-Academia innovation activities in Europe. The office will carry out information gathering and analysis of universities, companies, and science and technology policies in Europe. It is also expected to become a center for building up human networks, cultivating and fostering relationships with key personnel in Europe, possibly acting as a gateway to Japanese

industry and research world in the future. Furthermore, the office will contribute to the globalisation program of Kyoto University especially its effort to promote its brand through joint research, alumni networks, and overseas internships.

Prof. Dr. Toshio Nomura was appointed on July 1, 2009 as director of the European Office in London. Dr. Nomura obtained his Doctor of Science degree at Tokyo Institute of Technology in 1980, and has wide experiences and expertise on international Industry-Academia collaborations. Most recently, he has been a director of a leading Japanese electronics company's research institute in Oxford.

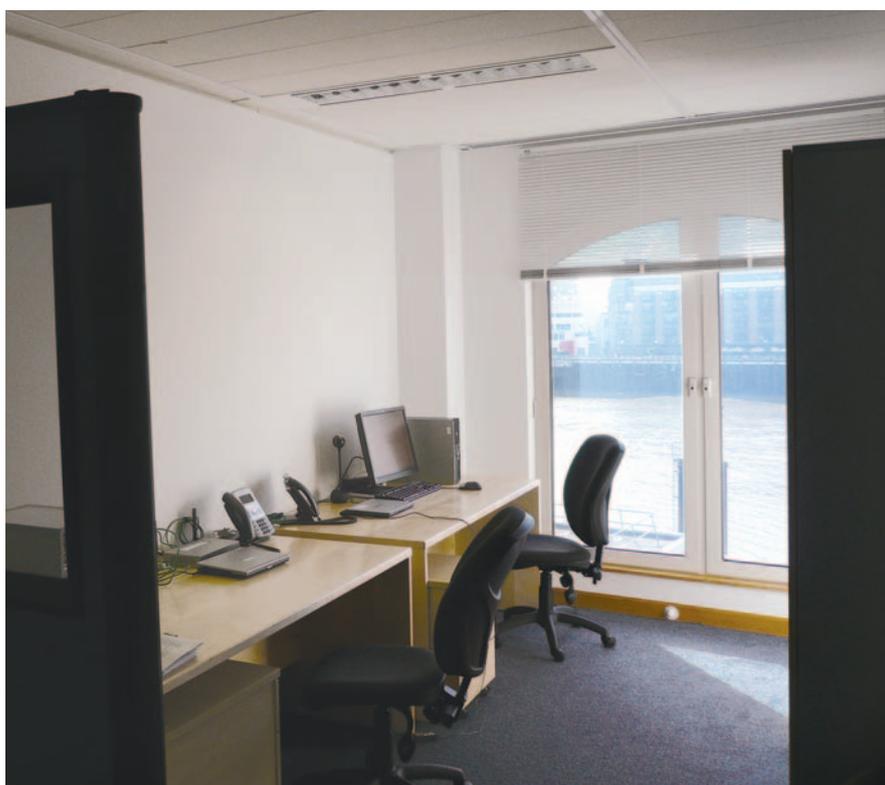
For further questions and comments, please contact the following address.



Dr. Toshio Nomura

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The 3rd floor office overlooking the south shore of the River Thames.

The IAAI-C was coined by Dr. Hiroshi Matsumoto, President of Kyoto University, and can be also called “I-U-U-I (Industry-University-University-Industry) collaboration.” “I-U” is pronounced as I and You in English and “U-I” is pronounced as 友愛, or friendship, in Japanese.

An Honorary Doctor's degree is presented to Dr. Alan Kay

The degree of Honorary Doctor of Kyoto University was conferred to Dr. Alan Kay at the Guest Room of Kyoto University Clock Tower Centennial Hall on January 20, 2009. In attendance were President Hiroshi Matsumoto, Executive Vice-President Shuzo Nishimura for Education and Student Affairs, Dean Shinji Tomita, Graduate School of Informatics and others. They displayed the portrait of the late Prof. Yahiko Kambayashi, who invited Dr. Kay to Kyoto University originally and worked together with him, at the presentation ceremony. Dr. Alan Kay (President of the Viewpoints Research Institute) is a pioneer of computer science in the United States who has also made a great contribution to educational research concerning informatics at this university.

Dr. Kay is the 12th person to be awarded this honorary degree. His is the fourth honorary doctorate conferred by Kyoto University since the revision of the rules in 2003 when the award criteria was expanded to include contributions to education and academia, in addition to contributions to academic research at Kyoto University. Furthermore, this is the first time the title has been conferred for contribution to educational research in this university.

After the presentation ceremony, Dr. Kay delivered a lecture entitled "Systems Thinking for Children and Adults: A Lecture in Memory of Yahiko Kambayashi-sensei." Dr. Kay, who has continued to study personal computing and how to utilize it for education, talked about systems thinking for children and adults, interspersed with anecdotal memories of Professor

Kambayashi, to an engrossed audience. At the beginning of the commemoration party, President Matsumoto and former President Makoto Nagao gave brief remarks, followed by a response by Dr. Kay. A toast was then proposed by Mr. Mitsuo Takakuwa, Superintendent of the Board of Education of Kyoto City. Thereafter Dr. Kay and other attendees enjoyed talking to each other.



*Dr. Alan Kay

Dr. Alan Kay was born in the Commonwealth of Massachusetts in the United States in 1940. He received his Bachelor's Degree in mathematics and molecular biology from the University of Colorado in 1966, and a Master's Degree in computer science and psychology from the University of Utah in 1968. He earned a Ph.D. in computer science at the University of Utah in 1969. During the 1970's and beyond he worked at the Palo Alto Research Center of Xerox (PARC), ATARI Inc., Apple Inc., among others, and also taught at UCLA and MIT.

In an age when only large-scale computers existed, Dr. Kay introduced the concept of a hand-held small computer he called "Dynabook" as an ideal personal computer in advance of the world trends. As a pioneer of personal computing he developed the programming language "Smalltalk", based on the innovative idea of an object-oriented language. He has had a great influence on programming languages and other aspects of computing which have become widespread at present. It can be said that

the concepts of personal computing and object-oriented languages are the most important inventions in computer science in the 20th century.

Besides these remarkable and distinguished accomplishments, Dr. Kay devotes much of his energy in childhood education, and has developed an object-oriented programming language "Squeak" for mathematics and science education for children. Now the practical activities of information education using this language in elementary schools and elsewhere are being promoted in many countries. Kyoto City, in cooperation with Kyoto University, implemented the "Alan Kay Project" to foster pupil creativity using Squeak, and promote the ability to keep up with the information age between 2002 and 2005.

Moreover, as a Visiting Professor of Information Education Environment at the Department of Social Informatics Graduate School of Informatics, Kyoto University, Dr. Kay has left vast and significant achievements on educational research, especially in these fields.

The 10th APRU Doctoral Students Conference was held

The APRU is an association of 42 universities from 16 countries and regions of the Pacific Rim, and hosts a variety of conferences and symposiums throughout the year. The Doctoral Students Conference is one of these, with an aim to broaden participants' insights and encourage cross-border interactions by providing participants the opportunity to learn about the research activities of many different fields of studies.

The momentous 10th annual conference was held from July 6 to 10, at the Kyoto University Clock Tower Centennial Hall, and had a turnout of approximately 100 graduate students from 26 universities.

After listening to the welcoming words of President Hiroshi Matsumoto and attending the lecture on “understanding the chimpanzee mind through both field and laboratory research,” by Prof. Tetsuro Matsuzawa, doctoral students engaged in group discussions around the conference theme; “Promoting Originality and Diversity in Research.” This discussion continued on throughout the duration of the conference, concluding with a presentation contest on the final day.

Oral presentations were made by participants on a wide array of research topics during the following three days. As a rare opportunity to exchange research information and intermingle with colleagues from various cultures, social backgrounds as well as fields of expertise – participants commended the conference as “a stimulating experience” and a place where “diversity can lead to the discovery of more ideas or ways of looking at things.”

After the presentation sessions, participants were invited to afternoon

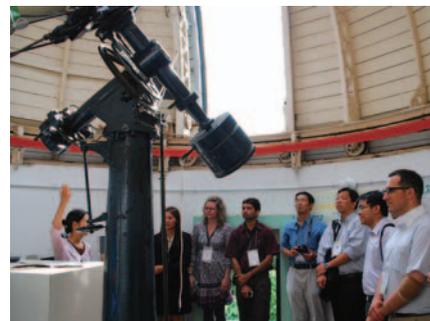
socials. On day 2, the activities included a chance to experience the Japanese tea ceremony at Seifuso, hosted by Kyoto University students and a Japanese calligraphy lesson by the shodo club. On day 4, participants visited the Kwasan Observatory, Disaster Prevention Research Institute or Research Institute for Sustainable Humanosphere. A reception was held on day 3, with a dance performance by the university Noh club – Kongohkai. The fusion of traditional Japanese culture and leading edge tech-

nologies will hopefully act as a catalyst for innovative research activities of the near future.

The final day closed off on a high note, with participants applauding enthusiastically the presentation ‘Scarlet Medusa Chorus’ of Associate Professor, Shin Kubota of Seto Marine Biological Laboratory, Field Science Education and Research Center of Kyoto University. Promises were made among students to reunite at the next conference.



Student sessions encouraged much discussion



A tour of Kwasan Observatory



Experiencing the tea ceremony



Noh stage performance during the Reception Party



Group photo

First discovery of a transporter gene that facilitates the accumulation of nicotine in the tobacco plant

The results of research conducted by the team headed by Prof. Kazufumi Yazaki of the Research Institute for Sustainable Humanosphere were published electronically in "Proceedings of the National Academy of Sciences USA (PNAS)," a science magazine published in the United States on January 23, 2009.

Outline

Morphine from the poppy and Taxol, an important anticancer medicine, from a plant belonging to the yew family are well-known among the plant-origin alkaloids. It is also known that there exist in nature as many as 12,000 other natural plant alkaloids. Many of these have various bioactive substances, and some presently play an important role in the pharmaceutical industry and at clinical sites such as hospitals using "natural medicines." However, collec-

tively this group of natural compounds requires cautious use as they may also be harmful to the human body when applied in large doses. In fact, the natural toxicity, or "poisons of nature," which originate in plants has been well reported in the media. The most familiar of all these alkaloids is possibly the nicotine contained in tobacco. Though nicotine has gained worldwide reputation as bad for one's health, it used to be utilized as an insecticide in old times. It is interesting to note that nicotine is of the highest order among the more than 10,000 varieties of alkaloids with regard to its strength for physiological activity. It is thus treated as a poison when used as a chemical reagent.

Nicotine is a peculiar alkaloid found in the tobacco plant (same family as eggplant), and it accumulates (2-8% per dry weight) in the tobacco leaf which is the raw material of cigarettes. However,

nicotine is not actually produced in the leaf of the tobacco plant but rather in the roots before it is carried to the above-ground part where it finally accumulates in the leaf vacuoles. Though this mechanism has been common knowledge for a long while, the molecular mechanism involved in its accumulation inside the leaf remained unclear until we conduct our own experiment. Through our overall screening of genes using the technique known as cDNA-AFLP in this research, the transporter gene which associates accumulation of nicotine in the leaf was identified, and its function understood. As a vacuole-localized transporter related to accumulation of an alkaloid, this is the first discovery in the world. The contents of this research are described in detail as follows:

How does nicotine accumulate in the vacuoles of the tobacco leaf? We sought to explain this mystery by

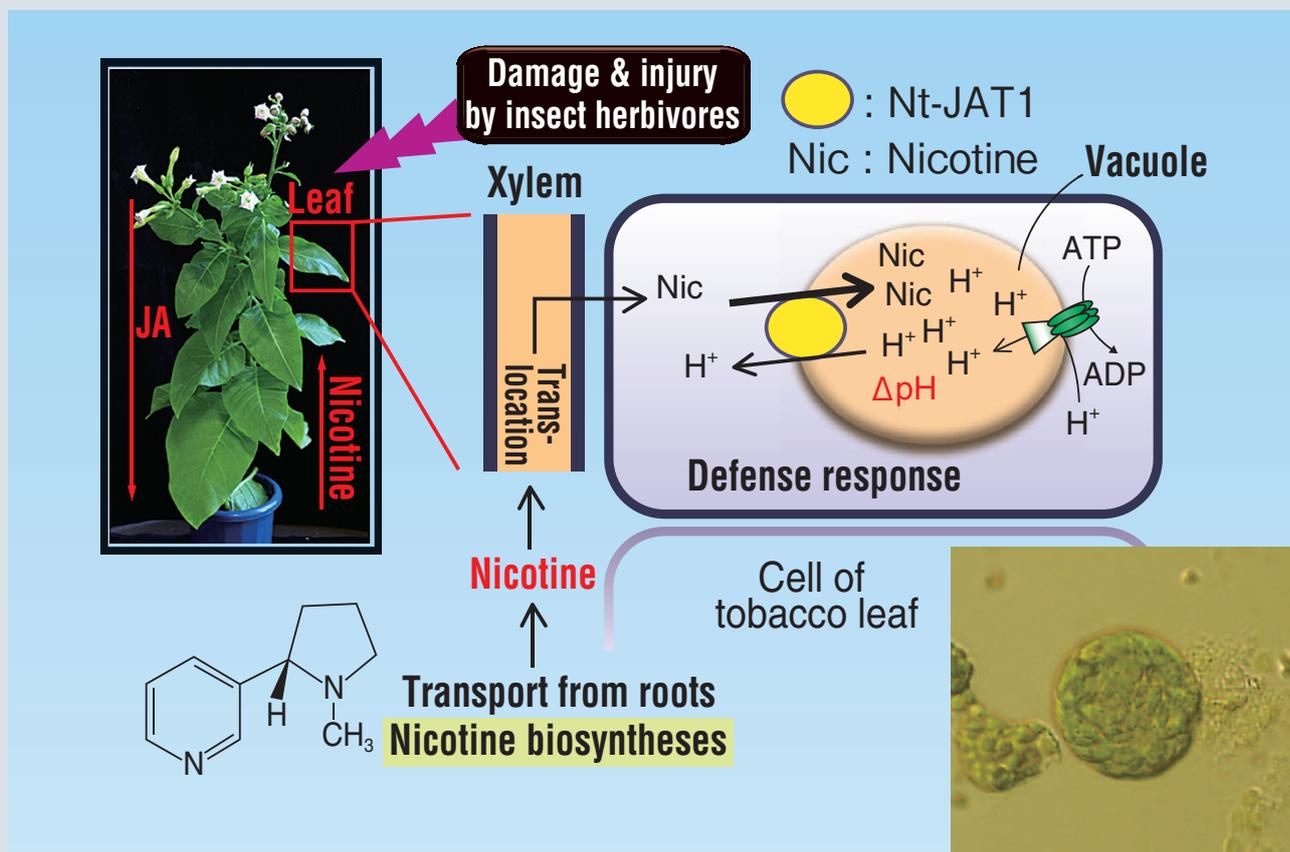


Figure. Function model of Nt-JAT1 in tobacco leaf

exploring at the gene level and setting up a joint research study in cooperation with Dr. A. Goossens et al. of Ghent University in Belgium. When we induced the production of nicotine in the tobacco cell, we conducted an overall analysis for a transporter gene which would appear in the same pattern as the genes that biosynthesize nicotine. As a result, we discovered the transporter gene Nt-JAT1, which demonstrated an expression pattern similar to that of the production pattern of nicotine. When this gene was expressed in yeast cells, we found out that the yeast was also able to transport nicotine. In addition, we produced this protein at high level using cultured insect cells, and further experimented after preparing small vesicles called proteoliposome jointly with Prof. Yoshinori Moriyama of Okayama University. Thus, Nt-JAT1 was found to have the ability to recognize the alkaloid and to cause it to accumulate in the proteoliposomes. Moreover, Nt-JAT1 was proven to have the ability to transport nicotine by exchanging it for the hydrogen ion (proton) in the vacuole.

Nt-JAT1 is a member of the MATE transporter gene family, and in point of fact, it is known that there is a MATE gene in the human genome similar to Nt-JAT1 in tobacco, and that it is also able to transport nicotine. Though nicotine is a defensive substance produced to protect the tobacco plant from invasion by harmful herbivores, it is, in fact, also potentially poisonous for the tobacco plant itself, and nicotine plays a role as the “paradoxical magic ingredient” which keeps away the plants’ enemies while building a poison within. It is believed that this is an extremely elaborate biodefense mechanism developed in the course of the evolution of plants’ efforts to defend themselves from enemy attacks. Alkaloids accumulate chiefly in the vacuoles of the plant cell, and we have, for the first time ever, demonstrated with Nt-JAT1 how many

existing alkaloids are accumulated in the vacuoles of the plant cell at the genetic level. This research could potentially have a huge impact on the pharmaceutical and the agricultural sectors, as well as the tobacco industry.

Prospects

Since Nt-JAT1 has been identified, the development of a tobacco variety that does not accumulate nicotine in the leaf is becoming more possible. This might have far-reaching effects even to the habitual smoker to work toward becoming a non-smoker while continuing to smoke, that is, without using anti-smoking products. Moreover, for those who dislike cigarette smoke, the absence of nicotine in cigarettes will be less disturbing.

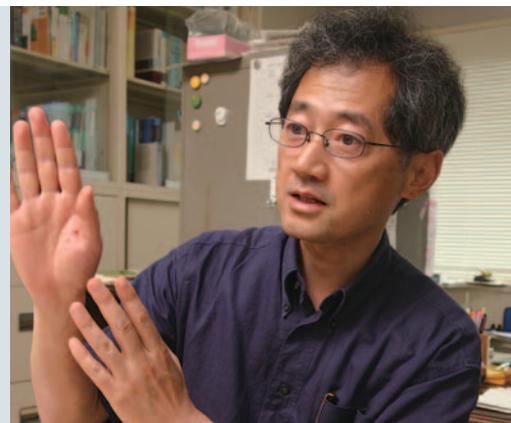
Additionally, Nt-JAT1 can transport a variety of plant alkaloids besides nicotine. This means that it is possible to apply this research to the high accumulation and the high production of anti-cancerous plant alkaloids (for instance, Taxol and vincristine, etc.) which are used in large quantities during cancer therapy. In this sense, it is expected that there will be remarkable progress in drug therapy with alkaloids and applied research which provides advantages for health maintenance.

Notes

- This research was a joint project of Kyoto University with Okayama University in Japan, Ghent University in Belgium, and VTT Technical Research Center in Finland.

- This research was made possible by Grants-in-Aid for Scientific Research of Priority Areas from the Japanese Ministry of Education, Sports, Culture, Science and Technology on ‘Organelle Differentiation.’

- The main experiments were conducted by Mr. Masahiko Morita and Dr. Nobukazu Shitan, a graduate student and Assistant Professor in Professor Yazaki’s laboratory, respectively.



Kazufumi YAZAKI

- Born in 1959
- Field of specialization : Plant Molecular Biology
- Completed doctoral program, Graduate School of Pharmaceutical Sciences, Kyoto University
- Ph.D., Kyoto University
- Professor, Research Institute for Sustainable Humanosphere, Kyoto University

Although it might be a fantasy, I am expecting that the recent discovery has the potential to contribute to issues with energy, food, and the environment when applied.

Professor Yazaki, who now specializes in molecular biology with work centering on plant gene research, originally began as a researcher of pharmaceuticals. Furthermore, the roots of this life can be traced back to the TV animation “Sasuke” which he watched in his elementary school days. When he saw the scenes in which the hero ninja defended himself by using medical herbs, or the ninja attacked his enemies using herbs, he was completely fascinated and thought, “Studying medical herbs is all there is for me!” Other children were usually attracted by unique ninja techniques and played at mimicking them, but the young Yazaki was different, already demonstrating his originality by pursuing this unique goal. In his junior high school days, he took to regularly climbing mountains to collect medical herbs, and trying to drink them himself, often encountering various terrible experiences.

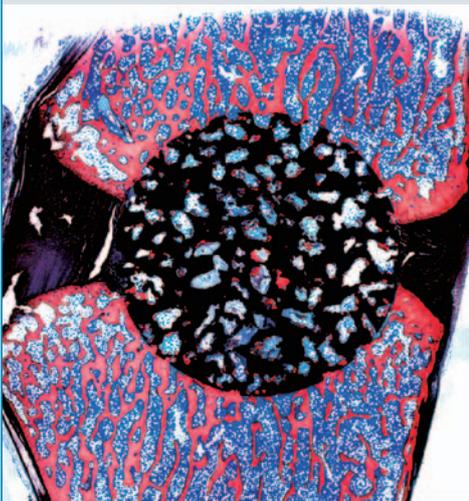
He entered the department of pharmacy at the university, starting with a study on the structure determination of natural substances. But he was not content with this specialization, and increasingly developed his interest in how the medicinal properties are produced, carried, and stored in a plant, and thus entering the world of genetic research through his research in enzymology. Though this new discovery has attracted the media given its potential to contribute to a ‘non smoking’ world, Professor Yazaki said with a slightly dissatisfied face, “I just happened to use tobacco as my research material. I had no thoughts about a no-smoking campaign.” He explained the mechanism for how alkaloids are stored in plant vacuoles at the gene level, and which can be utilized for medicines and insecticides. As a result, it is natural to entertain high expectations about the application of this research to a wide range of fields in agriculture, medicine and pharmacology.

Professor Yazaki has many hobbies. He enjoys hang gliding, scuba diving, underwater photography, skiing among other things. What he would give his very life for is “to eat the most delicious things,” showing curiosity that is ever-growing.

Development of a Next-Generation Artificial Bone for Lumbar Spine Surgery

Kyoto University Hospital has developed a new artificial bone to be used for surgical treatment of low back pain. Clinical trials began in November, 2008.

This new artificial bone made of titanium has pores of 100-500 microns in diameter each which are connected under the surface to each other with a tunnel-like structure. It has properties such as bioactivity which allow it to connect to bone directly, and osteoinduction in which the material itself stimulates the beginnings of new bone growth in pores after implanted in the muscle. This is a unique artificial bone, thus far non-existent, that was developed by joint research conducted by the Department of Orthopaedic Surgery, Kyoto University Hospital, and the Department of Biomedical Sciences at the College of Life and Health Sciences of Chubu University. Permeated from the surface to the center with its interconnected network of pores, this structure is highly suitable for fusing with surrounding bone. Moreover, unlike currently used ceramics and other materials, the porous structure with its extraordinary strength as metal cannot be damaged even if employed in areas of the body which experience heavy stress such as the spine.



Utilizing this artificial bone for spinal fusion surgery for disorders such as degenerative disc disease and spondylolisthesis, provides lessened surgical invasion and a shortened operation time. An additional operation to harvest bone graft from the pelvis is also omissible. Titanium is a metal already widely used in orthopaedics, and because this artificial bone is one which is processed with the same surface as that of artificial joints made of titanium, there are essentially no new safety concerns. In this clinical trial, we hope to confirm the safety and effectiveness of this newly introduced artificial bone with its porous structural technology.

This examination is a joint project advanced by the Department of Orthopaedic Surgery, and the Translational Research Center of Kyoto University Hospital. The development of a device for medical treatment and the conducting of clinical trials for that device with doctors at the core and related professionals from other disciplines are remarkable as characteristics of research which has not been conducted previously.

Background

When low back pain due to instability and disc degeneration of the lumbar spine is a diagnosed condition and symptoms of degenerative lumbar disc disease do not improve sufficiently through conservative medical treatment, lumbar interbody fusion is performed. A technical procedure by which bone graft is harvested from the pelvis or other areas is generally performed in the case of lumbar vertebrae fusion procedures, the harvest of autogenous bone is accompanied by such problems as:

- 1) causing invasion to a non-diseased part of the body
- 2) extension of operation time and bleeding during surgery in addition to post-operative pain in the donor site

- 3) problems with the quality and quantity of grafted bone in geriatric patients

Though attempts which utilize artificial bone made of ceramics have been made thus far for heightened load areas such as the spine, there are several problems that occur when using non-porous ceramics. Among other things, they do not bond with bone except on the surface, and an extended time period is required for the osseous tissue to unite. Furthermore, although an early osseous union can be expected, it is not advisable to use porous-body ceramics because they may be damaged under heavy load conditions.

By using this bioactive porous titanium as artificial bone, it is possible to evade operations for bone harvest and thus avoid various medical complications. In this clinical trial, our aim is to utilize the bioactive porous titanium for intervertebral fusion, and to examine the clinical effectiveness and the safety of the new device.

Outline of Artificial Bone

The bioactive porous titanium is formed by consecutive pores in a tunnel-like structure of pure titanium. In this internal continuous-pore structure, more than 99% of the pores are connected to the surface, and 80% or more of these pores have interconnections with a diameter with 50 μm or more. The implant used in this clinical trial is constructed with a non-porous frame in order to improve handling, safety, and strength when surgery is performed. Due to its processing, compressive strength and yield strength are more than 80 MPa and the implant withstands loads of 10,000N, which means it is capable of bearing the load of spinal vertebra. When the material undergoes the process of bioactivation, a uniformly thin bioactive layer of about 1 μm is formed throughout the inside of the implant. However this layer does

not create any significant change in the main structure. This layer is what makes it possible to bond with bone.

Clinical Trial

Our clinical trial is a first attempt by the associated surgeons for applying the associated use of the bioactive porous titanium developed by joint research of the Department of Orthopaedic Surgery, Kyoto University, and the Department of Biomedical Sciences, College of Life and Health Sciences of Chubu University. Though the development of medical equipment is usually furthered by corporate initiation, it is difficult for the achievements of basic research to be clinically applied effectively due to the great amount of time and funds required. Assistant Professors Shunsuke Fujibayashi, and Mitsuru Takemoto played a major role in this effort by creating a plan for conducting the clinical trial with the cooperation of the Translational Research Center of Kyoto University Hospital. We then obtained approval of the Ethics Committee of the Graduate School of Medicine and Faculty of Medicine, Kyoto University. We anticipate that excellent new medical equipment can be applied to patient treatment at an earlier stage and research on the domestic development of medical equipment such as biomaterials will be activated through this research effort.

The present clinical trial was performed for five patients, and follow-up surveys were conducted for one year since their surgery.

Surgical Procedure

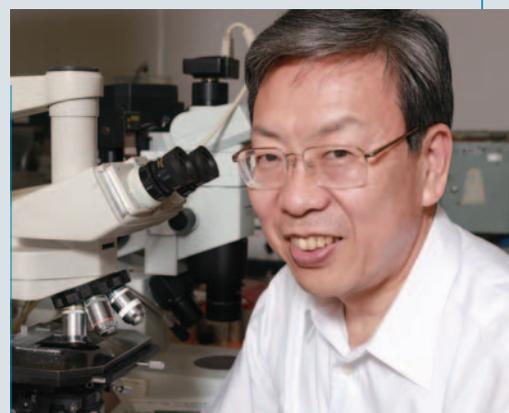
The targets of the surgical procedure are those patients who do not improve with conservative medical treatment (physical therapy or drug therapy) after three months or more and have also progressed to a morbid state in a single intervertebral disc space with diseases such as degenerative disc

disease, spondylolisthesis, or isthmic spondylolisthesis. The operative procedure is unilateral TLIF (Transforaminal Lumbar Interbody Fusion). This technique is a minimally invasive surgical procedure for lumbar spine fusion. Pedicular screws are placed from a posterior approach, the facet joint on one side is excised, and the intervertebral disc is approached through the intervertebral foramen. The bioactive porous titanium implant is then inserted into the disc space to replace the discal tissue. Attaching the screws and rods completes the lumbar interbody fusion. Walking exercises will begin from the day following the operation and the patient can be discharged from the hospital in about two weeks after the operation. Use of a postoperative corset is prescribed for six weeks after the operation, and evaluation of bone union etc. with clinical performance and X-rays is conducted for one year after the operation by regular outpatient care.



View to the Future

After we confirm the result of this experimental research is good, the shift to multi-center clinical trial or advanced medical treatment is expected to be the next phase.



Takashi NAKAMURA

- Born in 1948
- Field of specialization : Orthopaedic Surgery and Biomaterial
- Completed doctoral program, Graduate School of Medicine, Kyoto University
- M.D., Ph.D., Kyoto University
- Director, Kyoto University Hospital

We have extended the area in the role that we orthopaedists take to make a vital and long-lived society. It has become a challenging and interesting age.

It is said that about 80% of Japanese suffer from lumbago at least once in their lives. The team of orthopaedists at the Kyoto University Hospital which is led by Director Nakamura has brought good news to patients of discopathy and other problems for whom spinal fusion is especially necessary.

Director Nakamura graduated from the Faculty of Medicine at Kyoto University in 1974. After working for hospitals in the *Keihanshin* District, and studying in Canada, he assumed the position of Associate Professor at the Biomedical Engineering Center, Kyoto University (now called the Institute for Frontier Medical Sciences, Kyoto University) in 1991. Since that time, he has earnestly devoted himself to the research and development of artificial bone and joints in cooperation with the Institute for Chemical Research, Kyoto University. The next generation titanium artificial bone has shown that titanium not only bonds quickly with the surrounding bone but that bone grows inside of titanium implants. As a result, it can be expected that patients will be liberated from various risks. In the future, new research will be mainly conducted by doctors to pursue this development, and clinical trials will open the way for new medical treatment that can be offered to patients more promptly, and consequently. These are expected to create a stir in medical treatment administration in Japan.

Though he was once attracted to mathematics in his high school days, Director Nakamura finally entered medicine because he felt it was a "good work which pleases people." He says that the world of orthopaedics is undergoing change. At present with increased number of senior citizens living alone, many aspects of their medical treatment have become more important, such as preventing them from becoming totally bedridden, and how to maintain their physical condition and mobility. Therefore, it is increasingly necessary to provide medical treatment as a team including physical therapists and care workers with the orthopedist at the core. This field in which Director Nakamura and others play an important role is sure to expand further.



Naoyuki MATSUDA

- Born in 1962
- Field of specialization : Emergency medicine, Critical care medicine, Anesthesiology, and Pharmacology
- Completed doctoral program, Graduate School of Medicine, Hokkaido University
- M.D., Ph.D., Hokkaido University
- Associate Professor, Graduate School of Medicine, Kyoto University

I believe that the university hospital should construct a network with the health community of medical practitioners, and should become a citadel for emergency medicine.

Dr. Matsuda, is the grandson of a surgeon and the son of a pediatrician, first wanted to become a physician himself. However, after entering Hokkaido University, his interests broadened and he chose to specialize in anesthesiology from which he could view a wide variety of specialties, and then leapfrogged into the world of emergency medicine. When emergency medical treatment became a specialty on a nationwide scale he took an active part in its establishment as a member of the emergency department ward in Hokkaido University Hospital. He moved to Kyoto University in 2007, and he has been working tirelessly to cultivate emergency medical specialists and to ascertain an emergency health care system both for the University Hospital and the local communities. Initially those around him worried that Kyoto was behind the times as it was slower to establish emergency medical systems than other prefectures, but he now states brightly, "The academic research environment of Kyoto University is preeminent and the potential of doctors and individual students is also excellent. I'm very glad I came here because it was, above all, a pleasure to construct things from scratch."

As for the present conditions of emergency medicine, Dr. Matsuda strongly feels the necessity of cultivating the ability to diagnose the condition of the individual patient first and foremost, even going so far as to consider his or her life background. "Nowadays, because of overspecialization of each department, patients are provided a diagnosis and a standardized medical treatment is prescribed. However, even with the same disease, symptoms are manifested differently depending on the individual." After saying this, he continued with this interesting statement, "One of the merits of medical treatment in Japan is that it originally intended to seek 'medical care with hospitality (Omotenashi-no-Iryo),' which means that each patient should be carefully diagnosed and the best treatment should be found for patients respectively." Dr. Matsuda's logical and intelligible words delivered with a smile as he continues to listen carefully to others, resounds with a significant persuasive power.

Global Transformation of Emergency and Critical Care Medicine in Kyoto University

Kyoto was previously known as the most underdeveloped region when it comes to emergency medicine in Japan. The Department of Primary Care & Emergency Medicine was established at Kyoto University in April 2006. These days, however, specialists in emergency and intensive care medicine all over Japan have begun to gather in Kyoto, and to steadily improve the clinical outcome of emergency care. Our department is dedicated to providing sufficient acute disease treatment to university staff, our students, and neighboring communities, and is projected to improve the quality of emergency and intensive care medicine not only in Kyoto but throughout Japan.

All faculty members and students of Kyoto University share the mentality to aspire to be "the best" and to lead the world in their specialties. Aside from being encouraged by words such as "Boys, be ambitious,"* each person has a unique academic goal and wishes to contribute to the world through his achievements. Despite such an environment, emergency and intensive care medicine continues to lag behind as a field of science, failing to show the world sufficient academic accomplishments. This situation derives from the lack of philosophy or a simplified hypothesis concerning the aims of emergency and intensive care medicine. Emergency medicine requires a system that appropriately assesses the urgency of the condition and promptly initiates treatment on the one hand, and to assiduously analyzes acute disorder conditions on the other.

Presently, I am conducting research on the pathophysiology and therapeutics of systemic inflammatory response syndrome. Vascular endothelial cell injury associated with this syndrome is the pathological condition to which emergency and critical care medicine attaches the greatest importance. In addition, a medical system that can completely cure conditions including multiple traumas, multiple organ failure, and post-resuscitation encephalopathy is necessary.

For example, even pulmonary contusion after a traffic accident is not serious if it heals quickly, as in the case of children. Influenza is also of low-level concern if it takes a mild course by immunological enhancement. The promotion of injury healing and enhancement of immunological competence are the other aims of emergency medicine. I look forward to the establishment of a discipline that enables physicians to avoid panicking and remain composed during medical emergencies.

The breeze blows gently in Kyoto. The Kamo River flowing like a kimono emanates the sounds of running water and musical instruments. One reason for the sophisticated atmosphere here is that the Kyoto dialect has softer voiced consonants. I always emphasize four things to young doctors and young researchers: (1) Never say "No", (2) Step lively, (3) Remember to smile, (4) Greet all in a loud, clear voice. The adoption of these measures creates a revitalized atmosphere in our university and laboratory. Their performance must not become introverted, inactive, and sullen-faced. Science begins by simplifying individual, habitual concepts, and then embracing a wide range of aspects. We wish to revere the quiet atmosphere of Kyoto, always seek a complexity-free emergency care system, and enrich the science of acute period pathophysiology through our academic accomplishments. I hope to disseminate this new discipline of emergency and intensive care medicine from Kyoto to the rest of world.

* The famous phrase attributed to William Smith Clarke, the first vice president of Sapporo Agricultural College, which later became part of Hokkaido University in Japan.



It is my goal to explore living space, community and systems for the support of senior citizens' lives with community involvement

It has been almost ten years since Miss Lata SHAKYA came to Japan from Nepal. She says that while researching on the living environment of senior citizens of her home country, the theme of her research "has been extended naturally" from the concept of a house as a building, to that of a part of society and a town. Her present research is on housing design and community or town management (*Machizukuri*). She is also actively involved in a volunteer activity which sends wheelchairs to her country. Making the best use of her learning in Japan, it is her dream to create a model living environment for senior citizens, making better use of historical urban environment in Nepal.

■ **First of all, please tell us how and why you came to Japan.**

While I was attending a Japanese language school in Nepal, I found that Mimasaka University in Okayama Prefecture was recruiting international students, so I decided to apply. My study in Japan began at the Department of Environmental Design for Special Needs in 2002. I chose this department because I wanted to study the architecture and environment for the differently-abled people, and also because we do not have such a department at the universities in Nepal.

■ **What is your motivation behind your present research?**

My grandparents contracted Hemiplegia one after another due to illness, and I saw first hand how difficult it was for my family to nurse them. In Nepal, people tend to think you are abandoning your parents when you put them in a nursing facility, and, also there are no excellent nursing facilities in terms of living environment to accommodate them. Therefore, I wanted to be involved in the construction of support system to senior citizens and their family.

■ **Why have you remained in Japan after graduating from the University?**

I examined traditional Nepalese houses and dwellings for my undergraduate research. But, there are increasingly many other things to be further investigated along those lines. My

faculty advisor suggested me to join graduate school. So I joined the Graduate School of Kyoto Prefectural University for three years, researching on how living space should be designed from the standpoint of the people in socially vulnerable position. In Nepal, most of the traditional dwellings are of four stories. It might be difficult for senior citizens to live comfortable in these dwelling, however, I discovered the advantages that type of housing.

■ **In what respect did you notice advantages?**

Traditional dwellings have usually been built enclosing a courtyard. The courtyard has become the communication space in a sense where children play and peddlers come. However, the construction of isolated dwellings in recently developed residential areas has caused the reduction in communication between neighbors. Some of the senior citizens from these areas expressed dissatisfaction when I conducted my research interviews. Thus, I think that those senior citizens could lead good lives by making the best use of the merits of a traditional building. To deepen my knowledge, I started research under the supervision of Professor Takada of Kyoto University, who is a specialist in urban housing technology (such as Skeleton-Infill Method), and also community management (*machizukuri*). Now I am conducting research from the view of how a traditional town would look like from the view of the senior citizens.

■ **It is city planning more architectural question?**

Yes, it is a sort of town planning. Or it is a town management using traditional town's own unique space and community. Healthy senior citizens can enjoy open spaces of traditional area. But when they become dependent, their life become limited to a bedroom and it leads mental depression for both senior citizens and his/her family. There is a women's association in each neighborhood (*Tole*) in traditional residential area. They are actively involved in promoting the



Lata SHAKYA

- Born in 1979
- Currently a third year doctoral student at the Graduate School of Engineering, Kyoto University

welfare of society such as cleaning, renovating roads etc. I am thinking mobilizing these women's associations to improve traditional social spaces, particularly Buddhist monasteries (*Bahi*) into a kind of daycare service facility.

■ **By the way, I have heard that you are involved in a volunteer activity which sends wheelchairs to Nepal, Miss Shakya.**

I and a staff of Hiroshima Komyogakuen (an old age home) who is my good friend, collected some used wheelchairs from the International Youth Exchange Organization of Oita, Japan and requested the students in Automotive service Department, Hiroshima Municipal Technical High School to repair them. Our purpose is not to send wheelchairs to the individuals but to the women's association. We recommend a system of renting wheelchairs to need senior citizens for certain period. We believe that it motivates senior citizens. Eventually this system will lead fostering and utilizing manpower of members of the women's association, naturally playing a role as helpers.



With members of women's association (*Anand Mahila Samuha*) to whom she sent the wheelchairs. Miss Shakya is the sixth person from the right.

President Matsumoto urges a switch to SURVIVABILITY at the 2009 G8 University Summit in Italy

The G8 University Summit convened in the Italian historical city of Torino, on May 18-19 2009. This Summit began last year, with the gathering of heads of

major universities from both G8 countries and non-G8 countries, joined by the United Nations University and other university associations, in Sapporo, Hokkaido. Its purpose is to provide a platform for universities to address the critical issues facing humanity today, and to seek the path to global sustainable development.



The dramatic welcome through the entrance court of 17th century Valentino Castle in Turin.



Reception to the day's main event.



Opening session underway in the Salone d'Onore (Salon of Honour)



President Matsumoto presents in the Stanza della Caccia (Room of Hunting/Investigation).

At the second G8 University Summit, sessions were held on economics, ethics, energy policies and ecology, and presentations were made, discussed and refined by the leaders of each university.

Kyoto University was represented by President Matsumoto, who spoke as at the panel on energy policies. He stressed the urgent situation we face, and the need for a dramatic change our attitudes, from “sustainable development” to that of “survivability”. Other

panelists suggested that the transfer of technologies from advanced nations to the developing nations would make it possible to build a system of sustainable development.

The final consensus among participants was that the university will continue to be an important central force in creating a balanced and harmonious society.

The 2009 G8 University Summit in Torino came to a close on May 19, with the signing of a final declaration. Here, it was affirmed that the 4 ‘E’s – economics, ethics, energy policy and ecology are key for humanity to successfully face the crisis at hand. Also included in the declaration were sections encouraging the involvement of students – our future – in policy making procedures.



Final group photo with the university representatives together with members of the local support staff.

Discussions with Iraqi Minister of Foreign Affairs, Mr. Hoshyar Mahmoud Zebari

Mr. Hoshyar Mahmoud Zebari, Minister of Foreign Affairs for the Republic of Iraq visited Kyoto University on June 22, 2009. This visit was organized through the foreign ministry of



Exchanging gifts between Foreign Minister Zebari & Exec.Vice-President Yoshikawa.

Japan. During his meeting with Executive Vice-President Kiyoshi Yoshikawa, and Dean Nobuo Hayashi of the Graduate School of Law, Mr. Zebari expressed his conviction that his visit to Japan and

Kyoto University has been one of great significance, and will lead to future developments in academic and student exchanges between Iraq and Japan. After the meeting, Mr. Zebari spoke at a seminar



Discussing future possibilities in academic exchange.

open to the faculty at the Graduate School of Law and to graduate students specializing in International Law. He spoke on present day Iraq and its future, engaged in straight exchanges of opinion, and enjoyed the direct interaction with students at the university.

Kyoto University Programs for Future International Leaders: K.U. PROFILE

In 2009, the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) launched its Global 30 (G30) Program. K.U. PROFILE is Kyoto University's educational initiative under that program.

The G30 Program is a government initiative aiming to provide high quality education by taking advantage of the unique strengths of individual institutions, and thereby provide an educational environment more easily accessible to students from overseas. Through establishing a new system which offers classes entirely in English, the program facilitates the acceptance of overseas students to Japanese universities, promotes strategic international collaboration, and supports the formation of centers for the internationalization of Japan. All these will provide an ideal environment in which to foster young individuals who

will excel on the international stage.

By gathering together talented students from around the world and providing them with the education, research experience and global perspective needed for their future roles as international leaders, K.U. PROFILE hopes to educate the next generation of specialists who will provide solutions to current world problems, such as energy and environmental issues, poverty, and issues related to urbanization.

By 2011, in addition to our undergraduate Global Engineering Course, which addresses urban development and social infrastructure issues, this program will include eleven master's, doctoral, and professional courses, conducted entirely in English, in the fields of environmental studies, energy science, disaster prevention, life science, agriculture, informatics, primate research and busi-

ness management.

Kyoto University is also planning to establish an office in Hanoi to facilitate the recruitment of Vietnamese students by Japanese universities. The office is expected to open in 2010, and will be used to publicize information about Japanese universities as well as for student recruitment and orientation.

Through the K.U. PROFILE initiative, Kyoto University plans to increase the number of incoming international students from last year's figure of 1,335 to 3,200, and double the percentage of its international faculty members from 5% to 10%, by the year 2020. We hope that the success of this program will enhance the international standing of both Kyoto University and Japan as a whole, and will also contribute to the establishment of an international knowledge base which will benefit the whole world.



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P R O M E N A D E
京都逍遙

平安神宮

Heian Jingu Shrine — A crystal dream to energize revitalization of the Imperial Capital

Heian Jingu Shrine is located about 1 km south of the Yoshida Campus of Kyoto University and attracts more than 1.5 million visitors from home and abroad every year. It was constructed in 1895, and then has a rather short history of only 115 years when compared to the other major Kyoto shrines. Moreover, it was originally planned not as a Shinto shrine but as a memorial structure to provide space for events.

Kyoto prospered as the capital of Japan for nearly 1,100 years beginning with the reign of Emperor Kammu who had the capital built in Kyoto in 794. However, Kyoto's city center was ruined in the upheavals at the end of the Edo Era (1603-1867), and the subsequent transfer of the capital to Tokyo during the Meiji Restoration is as a tremendous shock for the people of Kyoto. It was in these circumstances that the large-scale National Industrial Exhibition was held in Kyoto as part of efforts by Kyoto citizens to attract people to Kyoto, hoping to revitalize the city.

That year happened to be the 1,100th anniversary of the establishment of Kyoto as Japan's capital, and monetary support and contributions were sent not only from Kyoto but from all over the nation for this commemorative event. A grand sanctuary to imitate the **Daigoku-den* of the Heian Era (794-1185) was built on a scale of 5/8. With a view to giving this building a long life, it was decided to make it a Shinto shrine.

Because it was not originally constructed as a shrine, Heian Jingu Shrine had no *torii*, or shrine gate. On the occasion of the commemorative ceremony for the coronation of Emperor Hirohito in Kyoto Imperial Palace in 1928, the Grand Shrine Gate was constructed with ferro-concrete, the largest of such gate in Japan with a height of more than 24 meters and a distance between the pillars of more than 18 meters. Associate Prof. Shizuo Ban of Kyoto University, who was famous for his study of ferro-concrete, designed the structure of the *torii*-gate and Prof. Goichi Takeda, also of Kyoto University was involved as adviser. This great Grand Shrine Gate is one of the ways that Kyoto University has contributed to the history of the Old Capital.

**Daigoku-den*: Main central palace of the Ancient Court. Important, national ceremonies were held here.



Shin'en (gardens), designated as a national scenic spot, surround the shrine buildings and sanctuaries. The area of the gardens is approximately 33,000m². Actually consisting of four smaller gardens, it is a representative stroll-style landscape garden, manifesting the beauty and elegance of the four seasons, changing in each.



Outen-mon Gate.
Front gate leading to the *Daigoku-den* (Outer Sanctuary).



Jidai-Matsuri, or "Festival of Ages" began in the same year Heian Shrine was founded. Each year about 2,000 people participate in the procession wearing costumes depicting the various periods of the approximately 1,000 years Kyoto served as the capital. The procession is about 2 kilometers long.



This is the vermilion Grand Shrine Gate that has become a landmark of Okazaki Park where cultural edifices such as Heian Jingu Shrine, museums, halls can be found. This gate is designated as a Registered Tangible Cultural Property.

[Right Photograph]

Grand Shrine Gate under construction.

