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Contents

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On the cover
A *yakusha-é* (kabuki actor portrait woodblock print) design, featuring themes from the profile pieces on RISH's Asia Research Node, pages 3–11. How many of the project's research areas can you see depicted? (Trais/Fujiwara)

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Earth, sky, space, and everything in between

A comprehensive science connecting the spheres

RISH is steeped in the culture of interdisciplinary collaboration that defines Kyoto University. Since its start on the Uji campus in 2004, the "Research Institute for Sustainable Humanosphere" has fostered many collaborative opportunities worldwide, expanding *humanosphere science*. The newest of these, the Humanosphere Asia Research Node or ARN, founded in 2016, strengthens hub functions for collaborative research to find solutions to environmental problems facing all of humanity. We spoke with RISH director Takashi Watanabe and top ARN-affiliated researchers to hear their perspectives and hopes for the program.

Takashi Watanabe
Director, Research Institute for Sustainable Humanosphere
Professor, Laboratory of Biomass Conversion

Hiroyuki Hashiguchi
Associate Professor, Laboratory of Radar Atmospheric Science

Akihisa Kitamori
Assistant Professor, Laboratory of Structural Function

Chin-Cheng "Scotty" Yang
Junior Associate Professor,
Laboratory of Ecosystem Management and Conservation Ecology

Backstage at the lab

An humanosphere research node for Asia

So, what is the "humanosphere"?

RISH identifies numerous spheres that support and interact with human activities. Institute director Watanabe explains that humanity today faces a rapid increase in problems in the world, including: population growth, global warming, shortages of energy, scarcity of raw materials, the spread of pathogens, and environmental pollution. These have disastrous implications for current and future life on this planet. To better understand these challenges, the joint efforts of scientists from multiple disciplines is a necessity.

So the humanosphere is the totality of environments encompassing human existence.

Watanabe points out that, for example through studies of the atmosphere, we can understand the global environment and how it changes. But that gets us only partway to a solution. Sustainable energy sources then need to be designed in a way to mitigate problems that have been found. Furthermore, to maintain sustainability, more ecologically friendly materials must be developed.

"RISH provides an environment aiding collaboration for both veteran scientists and new, bright-eyed researchers alike."

The humanosphere envelopes all of humanity, requiring international cooperation to sustain the future. To that end, RISH founded the "Humanosphere Asia Research Node (ARN)" in 2016 to strengthen international collaboration and encourage humanosphere researchers to find global-scale solutions. With a new, joint laboratory and satellite office in the Indonesian Institute of Sciences, LIPI, ARN has been designed to make Kyoto University the hub of humanosphere research in Southeast Asia and the world.

"As the program develops, we seek to encourage a new generation of humanosphere researchers. Expanding an international community of scholars will be the only sure way to solve the ecological problems facing humanity as a whole."

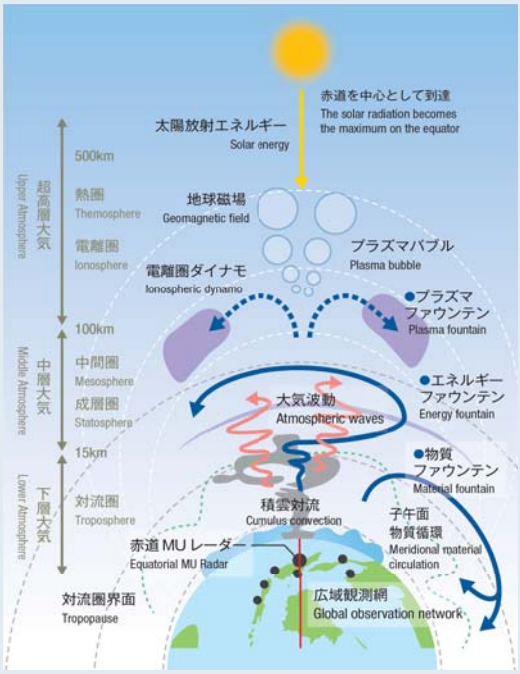
Atmospheric radar collaborations

ARN as a program is composed of three pillars: study of the 'equatorial fountain', utilization of tropical biomass, and cooperation using a humanosphere database.

Before the program's founding, RISH already had strong ties with Indonesia in the study of the atmosphere, a bond that has existed for nearly 30 years.

"In 2001, we completed the Equatorial Atmosphere Radar, EAR, on Sumatra, and it has been running near continuously ever since," explains chief radar scientist Hiroyuki Hashiguchi. "In light of this long history of cooperation, equatorial fountain research was designated as one of ARN's flagship projects."

The facility has become a symbol of collaboration with the scientific community in Indonesia. One key organization to join with RISH was the Indonesian government's space agency, LAPAN. The two have continued to build strong connections,



The "equatorial fountain", to be observed by the planned Equatorial MU radar in West Sumatra

2nd ARN Symposium attendees touring RISH's Shigaraki MU Observatory in Shiga prefecture (July 2017)

and have jointly held workshops to train students and researchers on how to use the radar. They are hoping that, with the implementation of ARN, interest in the radar in the atmospheric sciences will increase.

Along with workshops, ARN has organized numerous seminars and lectures to smoothly transfer information. Open seminars take place twice a month, where ARN researchers present their work over a live stream connecting RISH, LIPI, and LAPAN.

"These meetings are a bit of a challenge, because the scientists must present their data in a way that colleagues outside of their fields can understand each other's research," says Hashiguchi. "It is a good experience for both participants and lecturers."

Last year, ARN held an "International Premeeting of Humanosphere Asia Research Node on Biomass Utilization", jointly with JASTIP, the Kyoto University-led and Japanese government-funded project for promoting science with ASEAN countries. In November 2016, the Humanosphere Science School and the 6th International Symposium of Sustainable Humanosphere were held in Bogor, Indonesia. Then in January 2017, another JASTIP workshop took place, the first to be organized by ARN.

The first ARN symposium followed in February in Penang, Malaysia, which was a perfect opportunity for students and young researchers to interact.

"If you walked around the seminar hall you could see people from differing disciplines engaged in passionate discussions," remarks Hashiguchi. "And I am happy to say that the number of participants for the 2nd ARN symposium in July was twice the number of the 1st."

And plans are underway for an even bigger radar: the equatorial Middle and Upper atmosphere (MU) radar, ten times more sensitive than EAR and to be built just to its north. To support this, ARN's atmospheric science program is recruiting doctoral students and postdocs to spend extended periods in ARN labs to strengthen collaborative bonds, an attractive prospect that has so far only had a few takers, likely given the project's newness.

"EAR has been a centerpiece of the collaboration between Kyoto U and Southeast Asia, and we hope that with ARN, more people will use our facilities to pursue their research," continues Hashiguchi. "Many Western scientists have expressed interest but don't know whom to turn to. That's where we come in. And we also want to increase involvement from the Indonesian academic community as well."

While challenges remain, Hashiguchi hopes that ARN can act as a conduit for interdisciplinary communication. Through regular workshops and seminars, he aims to explore new research realms and further bridge the institute's departments.

Backstage at the lab

Traditional architecture of the Karo region in North Sumatra

Woodworking traditions into the future

Wood and wood material research have a long history at Kyoto University. The Wood Research Institute, WRI, was established in 1944 and later became one of RISH's first departments. It is appropriate that this field is also a core function of ARN.

Akihisa Kitamori focuses on the development and utilization of wood and traditional architecture in modern structures. Kyoto, of course, is renowned for its multitude of sturdy, adaptable, and beautiful wooden buildings, the most traditional of which were built with wooden joinery and few metal connectors, increasing their tolerance to Japan's humid climate and typhoon- and earthquake-prone environment. By studying traditional architecture, Kitamori seeks to utilize such techniques in modern buildings to increase resilience and reduce cost.

But Japan is not the only country with a long tradition of wooden structures. In Indonesia, wood-based building traditions are equally well-established, but with dramatically different characteristics. This has led to extensive collaboration between the two countries, even before ARN got started.

"Since our two countries face similar natural disasters, one study I am leading seeks to understand if Japanese techniques can work in Indonesia," explains Kitamori. "With ARN, one of our collaborative projects has focused on research and development of affordable housing, combining our traditions with new, affordable materials."

This joint endeavor resulted in boards made from agricultural waste, such as corn and grain stalks. The project hopes to mitigate the costs in time and environmental degradation that result from traditional wood lumber use.

While the focus for these new materials will be on city housing and urban locations, research into traditional architecture centers on rural and remote locations. "In rural Indonesia, it can be extremely difficult to transport materials for affordable, modern housing. Knowing how to build without nails or modern supplies is vital for remote areas."

Despite the newness of ARN-sponsored efforts, preliminary tests with the boards have shown success, and the building of a prototype structure is next. Reliance on ARN's well-equipped joint research facilities at LIPI will be a cornerstone of this work.

"ARN is a program with phenomenal potential. Who knows what we will find next in our collaboration? We may discover new techniques and technologies that we can incorporate into buildings in Japan," says Kitamori.

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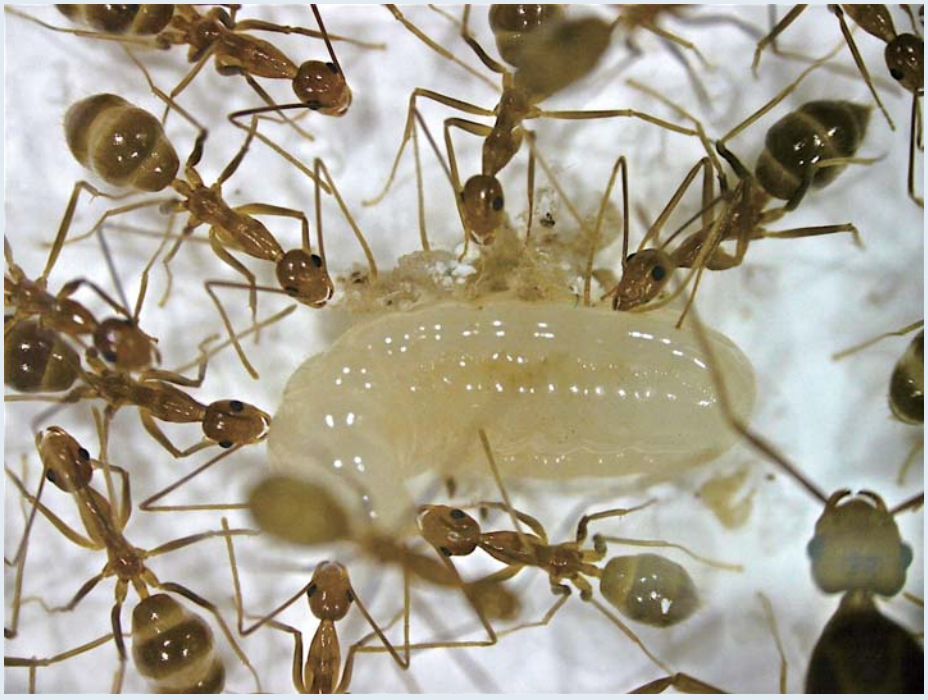
Sustainable building material made from corn and grain stalks



Yang's research includes study of the invasive "yellow crazy ant"

Crawling with Ant-icipation

Before Scotty Yang moved to Kyoto, he was at National Taiwan University in Taipei. His first reaction to an offer from RISH was hesitation: he didn't know Japanese, and was unfamiliar with the research community here. But after looking into it more and hearing about ARN, he realized that the potential resources available to him would make for a great opportunity.

Yang's contributions to the study of 'yellow crazy ants' — an invasive species in much of the world — are another example of ARN at work. While this species most likely stems from Southeast Asia, no one knows its exact point of origin.

Using ARN to tackle this question, Yang has enlisted the help of fellow academics and even members of the public residing in Indonesia, Malaysia, and Singapore.

"The beauty of this collaboration is that we can avoid risks associated with invasive species," he explains. "Since we cannot bring the ants into mainland Japan, in-country, satellite sites are absolutely vital to the research."

Yang has been collaborating with institutes in Southeast Asia by sharing his protocols and visiting these hubs himself. Most of this joint work has been conducted at USM in Penang, but starting in 2017 he will be doing more at LIPI in Indonesia.

Another aspect of his research is finding biological control agents for the ants. Such study involves an enormous amount of work in the field, using bioassays and laboratory manipulation. So again, live ants and local labs are needed to find answers.

To facilitate cooperation, Yang holds workshops for research colleagues in the region, through which he has gained access to local citizen science networks. This has expanded his scope even further.

"I think this is a perfect example of how ARN is building a network of humanosphere science," says Yang. "Not everyone is a trained scientist. But they are just as passionate about the research, and having them involved and building bonds of science is a sure way to get very valuable data."

Yang sees the future of ARN as not just a research network for Kyoto University and Southeast Asian institutes, but as a hub that connects Southeast Asia to the world.

"Many institutes in the West and even in other parts of Asia want to collaborate with the academic community in Southeast Asia, but they don't know where to start. We can help show them the way."

ARN is next planning a short-term exchange program for students and researchers that will surely bring about even closer contacts. The more the network of collaboration grows, the better it is for science and society.

"Building a strong student community between institutes is very important to strengthen our bonds," adds Yang. "I hope that as ARN grows, more institutes will come into the fold."

Looking forward with ARN

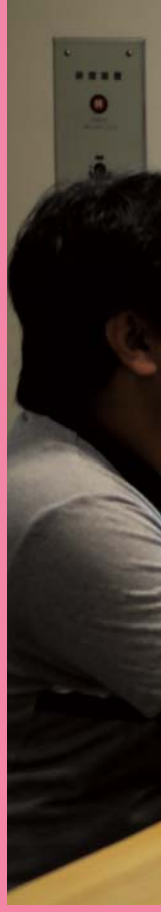
Kyoto University's mission statement includes the line, "…educate outstanding and humane researchers and specialists, who will contribute responsibly to the world's human and ecological community."

RISH and ARN strive for exactly that. The world is complex and intertwined, and where humans can live is limited. To improve our understanding of the earth's ecology, a scientist working alone in a lab is not enough. From weather problems to new biofuels; animal ecology to wood materials; the oceans to space: a multi-pronged and international approach is necessary to solve the problems we face together.

RISH already understood the necessity of international collaboration when it was founded. Now with ARN, these bonds can be strengthened by training a new generation of scientists and supporting new and ongoing projects between participating countries.

This work has only just begun. Continues RISH director Watanabe, "ARN is not merely a symbolic project intended to 'internationalize' an institute; we are building a community to produce good science for the world. ARN's three pillars aim at nothing less than to reinvent society."

ARN: student perspectives



Satoshi Oshiro, Yuri Takeda, Didi Tarmadi, Subir Kumar Biswas
Research Institute for Sustainable Humanosphere

What is it like being a student researcher in the Asian Research Node? RISH faculty member Chin-Chen "Scotty" Yang sat down with three grad students and one postdoc to discuss their perspectives on ARN, and how the program affects their research.

Satoshi Oshiro, Japanese, postdoctoral fellow at the Research Institute for Sustainable Humanosphere (RISH). Primary topic: engineering of enzymes that utilize woody biomass

Yuri Takeda, Japanese, second year doctoral student in the Graduate school of Agriculture, Division of Applied Life Science. Primary topic: metabolic engineering of grass lignocellulose using rice as a model plant

Didi Tarmadi, Indonesian, third year doctoral student in the Graduate School of Agriculture, Division of Forest and Biomaterials Science. Primary topic: elucidating lignin degradation and its effects on the physiological activities of wood-feeding insects

Subir Kumar Biswas, Bangladeshi, first year doctoral student in the Graduate School of Agriculture, Division of Forest and Biomaterials Science. Primary topic: utilizing cellulose nanofibers to fabricate advanced, high-performance nanocomposite materials in simple, scalable ways

ARN impressions

Scotty: As students, what are your impressions of the ARN program?

Subir: We all know that RISH is highly multidisciplinary, with labs studying everything from insects to phenomena in the upper atmosphere. But ARN has its focus beyond Japan, pursuing the objectives of RISH on a global scale, with a focus on Asia. ARN also connects with programs elsewhere, such as Europe. This is especially true of the RISH Data Server, which we can use to study and understand the humanosphere —and how to improve our lives.

Didi: Since I am from LIPI, the Indonesian Institute of Sciences, ARN is very important for me, especially when it comes to collaboration between institutes. One of the goals of ARN is strengthening international collaboration, particularly for students and young scientists, which I am hoping will benefit my country. Indonesia faces a number of environmental and biodiversity challenges, but we lack the technology and skills to solve these efficiently. I am counting on ARN to help us build a brighter future.

Yuri: I study the molecular breeding of plant biomass. South Asian countries are very rich in bio-resources, so there are a lot of avenues to explore. We students tend to isolate ourselves

in our labs and focus solely on our work, but that doesn't open our eyes to new projects and questions. For example, if our work is utilized outside of the lab, we need to know what kind of environment the plants will be facing. That would be impossible for me to do alone. Having international communication is necessary for future studies and research.

Satoshi: ARN is great for collaborating with Asian countries. Asia and the world face a lot of problems right now, such as environmental degradation, global warming, expansion of tropical diseases, and human population pressures. Sharing information and conducting good science between institutes to solve these problems is very important. I study enzymes and their application to biomass, a field which can contribute to the utilization of bio-resources in Asia. One key role we can play is in the degradation of pollutants in air and water. But we need people who are familiar with their local environments for this to work. ARN can help us get in touch with these people.

Scotty: So ARN acts as a hub to connect scientists. Kyoto University is trying to connect Japanese researchers to scientists throughout Asia. As we develop, ARN can act as a mediator to introduce Western researchers to science in Asia, making Japan a hub for Asian scientific collaboration. As the program grows, we hope to develop new techniques and technology to utilize resources in a more sustainable way.

Education at ARN

Scotty: Another important function of ARN is education. We hold workshops and symposia throughout Southeast Asia and also here at Kyoto University, such as a seminar series in Penang where all of you presented posters and had a chance to interact with scientists in the region. What did you take away from that?

Satoshi: ARN's educational opportunities are an important way to experience real research happening in Asia. Of course you can get information about Southeast Asian studies and research on-line, but it is not possible to gain the full experience through these sources alone. You need to go see the area yourself and talk to people doing research there. ARN provides for this. Initially I knew very little about microbes, insects, and tropical plants native to Southeast Asia, nor did I have any idea which research topics were popular there. The ARN symposium was a great opportunity to expose myself to ongoing research, and to interact with other researchers.

Yuri: This was my first time to visit Southeast Asia. I am relatively familiar with my research topic of biomass, and how important it is to the future of

Personnel profiles

Satoshi Oshiro

Yuri Takeda

the world. But I was not aware of the research going on in other labs throughout Asia. During the symposium, I was able to talk to many students and scientists close to my age about their research and the problems they face. We also discussed ongoing environmental problems and how to tackle them. It was a real eye-opener.

Didi: Education is a very important part of my life and research. Many people from my country do not care about the environment, and that is a big problem. The knowledge I gain from going to symposia, meeting young researchers, and learning about their work is very important for when I go back to my own country. But what I found very interesting during the symposium was the discussions I had with researchers from Malaysia. There are some conflicts between our countries when it comes to ecological preservation. We talked about this extensively, and I came out of it with a better understanding of each side. Being part of ARN made this connection possible.

Subir: One of the most unique things about ARN at RISH is that it is a multidisciplinary endeavor. Most institutes usually focus on a single theme or topic. RISH gives us the opportunity to interact with people and research I may have never known about. The nature of the symposium and this institute as a whole almost forces us to be knowledgeable of other humanospheric sciences. Perhaps from there, we can develop new solutions and technologies.

Scotty: I agree. The advantage of this institute is being exposed to many fields of research. This can help us develop creative solutions when obstacles arise. I can see a future in which we solve the world's problems using a multifaceted approach.

In the lab

Scotty: So, let's talk about your research and how you benefit from ARN.

Satoshi: I engineer enzymes to degrade lignin, a key component of woody biomass and a potential replacement for fossil fuels. I am trying to enhance the enzymes to facilitate biomass conversion with higher efficiency. My research contributes to ARN through the utilization of bio-resources in Asia. The enzymes I study are also used to decompose environmental contaminants in waste water. My expertise can help other nations with contaminant problems, and also possibly enhance their energy future.

Yuri: I also work on biomass. Grass biomass crops are an important resource for future bio-refineries, to make bio-fuels and bio-materials. But to establish a cost-effective bio-refinery system we need to improve the properties of biomass. I am genetically engineering rice plants in my lab to produce different structures of lignin, and then examine their properties. One day my research may provide alternative strategies for engineering lignin to efficiently convert biomass into fuel.

Didi: Miss Takeda's research is very interesting. She is involved in actually increasing the lignin content in plants. Those plants are very important for energy generation through bio-fuels.

Scotty: But are there concerns about genetically engineered plants? This is a sensitive topic for the public.

Yuri: There are no worries about that. When the results of my study are applied to the breeding of grass biomass crops, we will select mutant lines in order to obtain natural variants with the same genetic mutations. Biomass conversion and biomaterial synthesis are important topics for countries and institutes affiliated with ARN. My work can be utilized and improved through collaboration since there is a lot of relevant research in Southeast Asia.

Didi: I study insect physiology, specifically of termites which can degrade lignin. So, this is about biomass again (laughs). These insects produce hydrogen and methane when they feed on wood. All these compounds are vital for a non-petroleum based energy future. Of course, conversion efficiency is still low, so we need to find the mechanisms behind these metabolic processes. In order to do that, I need to collaborate with researchers who are more familiar with this science. I am thankful that ARN and RISH are providing me with this opportunity.

Subir: My focus is on cellulose, the essential substance that makes up trees. There is

a material called "cellulose nanofiber" that we can extract from trees, which is amazing because it has strength comparable to steel. My research combines cellulose nanofibers with plastics to build very strong nanocomposite materials. I am also interested in the microstructure of insects. For example, the mandibles of termites: they are very strong. But why? Thanks to the elegant composite structure of nanofibrous chitin and inorganic elements, which we can also incorporate into new sustainable materials. Sustainability is a big topic in ARN countries. As I interact with more people from different research backgrounds, I am hoping we can discover new candidates for sustainable biomaterials and more efficient and scalable mechanisms to produce them.

ARN and beyond

Scotty: Subir and Didi, what do you plan to do after graduation? How will your studies at ARN affect your work if you decide to continue your research in your native countries?

Didi: A general problem we face at home is technology. At Kyoto University we have access to cutting edge equipment and research materials. Unfortunately, in our country, that technology may not be available. I hope that I can utilize the knowledge and resources I gained here to improve research back home. This is an opportunity for collaboration. We can run preliminary tests and extractions in my home town, and then send it to Kyoto for deeper analysis. The ARN framework is perfectly conducive for that kind research workflow.

Subir: I am from Bangladesh, where ARN does not currently operate. So I have asked the heads of ARN to expand the program into more Asian countries. The entirety of South Asia and Southeast Asia is rich in bio-resources and biodiversity. But economically, many areas are poor. I feel that ARN can be a driving force to promote efficient use of bio-resources while also enhancing member countries' intellectual resources.

Scotty: That is a very good idea. The organizers of ARN are thinking of expanding our partnership into other countries in Asia. We hope you can be a seed for that endeavor to expand our collaborative map.

Life and studies in Kyoto

Scotty: What do you find special about working at Kyoto University, and how are you enjoying the beautiful city of Kyoto?

Subir: If you go to universities in South Asia you can see a lot of students gather at one place to chat with each other. The environment here is very different. Students here are completely involved in their studies and research. Kyoto University also has RISH, which contains so many academic disciplines, and where you can easily talk to scientists and professors from many disciplines. That is harder to do at other institutes. As for living in Kyoto, I am very happy to be in such a beautiful city. I can walk five minutes from my house and go to a beautiful temple or castle. Everybody I know gets jealous when I tell them where I work.

Didi: Kyoto University amazes me because of the closeness of the students with the professors. I feel very comfortable talking to my professor, asking questions and even arguing about my work. I can even ask for personal advice, and often find the time to talk. I feel that I cannot find that in my home country. Everybody here is very friendly. Kyoto is such a pretty place to live in, and I enjoy the architecture and the food.

Yuri: One quality of Kyoto University that I love is the many satellite offices all over the world, especially for RISH. This gives me many chances to contact researchers from other countries —a strong global connection has helped me gather data that I have used in my research. I hope to continue using these resources.

Satoshi: I am originally from Tokyo and moved to Kyoto two years ago. I feel that Kyoto University has a very healthy sense of academic freedom, one of the hallmarks of the university. There are many unique collaborative projects that may not have come without this special atmosphere. There are almost no barriers to pursuing your own research. Most professors here actively support and even encourage original thinking. I really enjoy the academic environment here.

Didi Tarmadi

Subir Kumar Biswas

Scotty Yang

Energizing immune cells to combat cancer

Since the first reports of clinical success in 2010, PD-1 inhibitors have become standard treatment for a wide number of cancers. However, while for some patients these drugs are a miracle cure, for a frustratingly large minority the therapy has little effect regardless of cancer type.

Kyoto University immunologist Tasuku Honjo, who first identified PD-1, has an unmatched understanding of how PD-1 regulates multi-functional T cells — and why only some patients respond to treatment based on PD-1 inhibition.

"PD-1 regulates autoimmunity. It prevents T cells from attacking host cells. But it also prevents T cells from attacking cancer cells, which are also host cells," explains Honjo.

In a study published in the *Proceedings of the National Academy of Sciences*, Honjo and his team of scientists report on a series of molecular events through which PD-1 inhibition could be enhanced to strengthen the anti-cancer activity of T cells.

PD-1 blockade therapy has previously been shown to enhance mitochondrial activity in T cells, leading Honjo to theorize that, "the difference between responder and non-responder patients lies in the molecular mechanisms that activate the mitochondria."

"Mitochondria produce reactive oxygen species (ROS), which are found to enhance PD-1 therapy," adds first author of the study, Kenji Chamoto.

Chamoto injected FCCP, a chemical that generates ROS, into mice suffering from different types of cancer. Alone, FCCP had no effect on tumor suppression, but combining it with PD-1 inhibitors enhanced any effect compared to its absence.

"Together with PD-1 inhibitors," says Chamoto, "FCCP increased the functional potency of the T cells by activating mitochondria."

The team used these findings to uncover which molecules activate mitochondria through ROS. "We found a number of molecules associated with signal cascades for mitochondrial activity. We can target these because they all enhanced the PD-1 blockade effect," continues Chamoto.

Activation of these mechanisms caused T cells to secrete 'cytokines' for the destruction of cancer cells, a status not seen in patients unresponsive to standard PD-1 treatment.

While the discovery of these mechanisms could lead to more effective anticancer therapies in the future, more immediate impact may come from the identification of responders and non-responders.

Explains Honjo, "Cancer patients and doctors do not have time to test different therapies until finding one that works. This research could eventually help identify which patients will respond well to PD-1 inhibitors and which patients need other options." ■

Visualizing nuclear radiation

Extraordinary decontamination efforts are underway in areas affected by the 2011 nuclear accidents in Japan. The creation of total radioactivity maps is essential for thorough cleanup, but the most common methods, according to Kyoto University's Toru Tanimori, do not 'see' enough ground-level radiation.

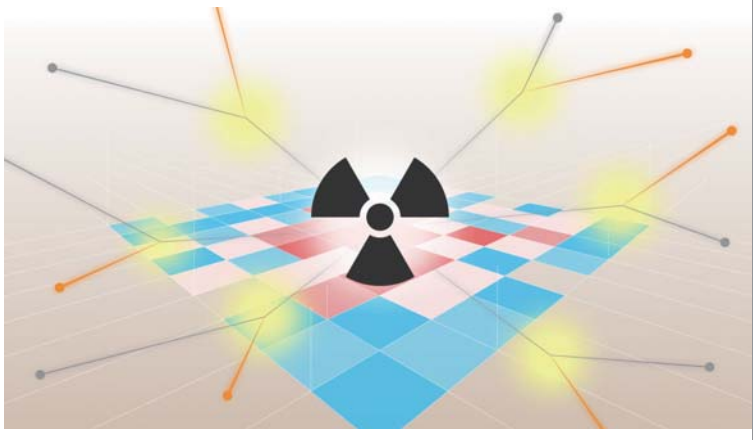
"The best methods we have currently are labor intensive, and to measure surface radiation accurately," he says, "complex analysis is needed."

In their work published in *Scientific Reports*, Tanimori and his group explain how gamma-ray imaging spectroscopy is more versatile and robust, resulting in a clearer image.

"We constructed an Electron Tracking Compton Camera (ETCC) to detect nuclear gamma rays quantitatively. Typically this is used to study radiation from space, but we have shown that it can also measure contamination, such as at Fukushima."

The imaging revealed what Tanimori calls "micro hot spots" around the Fukushima Daiichi Nuclear Power Plant, even in regions that had already been considered decontaminated. In fact, the cleaning in some regions appeared to be far less than what could be measured by other means.

Current methods for measuring gamma rays do not reliably pinpoint the source of the radiation. According to Tanimori, "radiation sources including distant galaxies can disrupt the measurements."



The key to creating a clear image is taking a color image including the direction and energy of all gamma rays emitted in the vicinity.

"Quantitative imaging produces a surface radioactivity distribution that can be converted to show dosage on the ground," says Tanimori. "The ETCC makes true images of the gamma rays based on proper geometrical optics."

This distribution can then be used to relatively easily measure ground dosage levels, showing that most gamma rays scatter and spread in the air, putting decontamination efforts at risk.

"Our ETCC will make it easier to respond to nuclear emergencies," continues Tanimori. "Using it, we can detect where and how radiation is being released. This will not only help decontamination, but also the eventual dismantling of nuclear reactors." ■

Choosing a simpler path to drug discovery

Drug discovery is in essence the designing of compounds to interact with disease-related proteins. And in many recent development efforts, this process increasingly relies on "big data" and complex "deep learning", requiring the harnessing of supercomputing power. But what if this could be done much more simply, requiring less time and expense?

Now a team of scientists has done just that, developing a method using simple models and small data sets — but still achieving a high degree of predictive ability. The researchers from Kyoto University, MIT, and ETH Zurich reported their findings in the journal *Future Medicinal Chemistry*.

The study demonstrates that large amounts of data generated by testing compound activity on protein groups — known for roles in cancer and other physiological processes — could be reduced to a small fraction of the total, which could still accurately explain the full set. The subset required was less than a quarter in most cases, and in some, even less than 10%.

The authors examined 13 aspects of the new method to test its usefulness.

"We tried to intentionally break our system in multiple ways. Not only did it show resilience, but many of the analyses yielded views that supported each other," says corresponding author JB Brown of Kyoto University. "After the analyses and repeated testing for reproducibility, it became apparent to us that this could become a platform for molecule design."

The authors began with publicly available compound and protein activity data, and taught a computer program how to make decisions based on available information by using a collection of 'decision trees'. Hospital doctors, for example, use decision trees to arrive at diagnoses based on patient answers to general questions.

Brown and his team gave the program some basic experience, and then showed that it could be sufficiently predictive when working on additional cases.

"There is nothing wrong with acquiring huge amounts of data and having it available as a reference. However, the extra data's utility in predicting the relationship between drugs and proteins is questionable," explains Brown, emphasizing that the new method could lead to a reduction in drug development costs.

"Drug discovery can fall into a trap of trying tens or hundreds of thousands of compounds against proteins, with 1% or less success rates," continues Brown, emphasizing that the new technique can reduce the number of initial tests to a few thousand, from which point scientists can check just the most promising ones.

"Not only are the financial implications large, but decision trees let us ask and understand the key science question: why?," says Brown. The team is now evaluating the technology in practical applications for pharmaceutical, medical, and agricultural research. ■

Charting the skies of history

Ice cores and ancient sediments can be gleaned for clues to weather and climate in the past. But astronomical phenomena — such as solar flares or auroras — at best leave only faint environmental traces lacking in specificity. So how can we accurately track ancient astronomical events?

Now in a collaborative effort between the arts and sciences, researchers at Kyoto University and Japan's National Institute of Polar Research (NIPR) and National Institute of Japanese Literature (NIJL) have used historical documents to garner better insight into the patterns of past solar events.

Magnetic storms recorded as auroral sightings in *Meigetsuki* ("The Record of the Clear Moon", ca 1180–1241) by Fujiwara no Teika of Japan, and in *Song Shi* ("History of Song", commissioned 1343) from China, have given researchers the ability to reconstruct a chronology of past astronomical events. Their findings appeared in the journal *Space Weather*.

"An early Japanese record of prolonged auroras, that is, auroras that persisted for two or more nights within one week, was documented 21–23 February 1204 in *Meigetsuki*," says lead researcher Ryuho Kataoka of NIPR. "At the same time in *Song Shi*, a large sunspot was recorded on the 21st." Such sunspots are an indication of intense magnetic activity on the sun, including solar flares.

The researchers continued their investigation by looking further into *Song Shi* to see if there were additional indications of auroras between the years 900–1200.

"We found about ten incidents of prolonged auroras during this period," continues Kyoto University historian Hisashi Hayakawa. "When these dates were compared with radiocarbon data from tree rings, we noted decreased levels of carbon-14 — indicating

Cutting edge

increased levels of solar activity — at these same points."

The team was also able to discern that auroras were more prevalent in the maximal phase of solar cycles rather than the minimum, and that during the sun's least active cycle (1010–1050) no auroras were observed.

The multidisciplinary investigation is even casting its literary sources in a new light.

NIJL Deputy Director Tsuneyo Terashima points out that until now, high regard for *Meigetsuki*'s author Fujiwara no Teika has centered on his role in compiling and editing such classics as the *Tale of Genji* and *Ogura Hyakuninisshu* — work in which his literary and poetic talents have been key.

"Frankly, his observations of the sky have been regarded mainly in the context of his fiction writing," explains Terashima, "and not really valued for their scientific specificity. We now realize that *Meigetsuki* in fact provides a lucid and accurate account of celestial conditions of the period."

A possible new understanding of classical Japanese literature may even result, expanding the cross-pollinating effects of the research.

"Combining literature, tree ring dating, and space observation, we have uncovered clear patterns in solar activity and astronomical events," says Kyoto University space scientist Hiroaki Isobe.

"In the present day, large solar storms can significantly disrupt power grids and satellites. We are ever more susceptible to solar events, and the insight gained through historical documents allows us to better predict and prepare for the future."

Born to love superheroes

We recognize justice before we can talk, reports a research team in *Nature Human Behaviour*.

The study demonstrates that human infants recognize heroic acts from early stages of development, suggesting that our sense of justice — and likewise, adoration for heroes — is innate. The scientists see this as explaining why kids and adults alike have a never-ending love affair with superhero stories in popular culture.

The team, led by Masako Myowa of Kyoto University, showed that preverbal infants as young as six months in age find themselves drawn to figures who protect the weak.

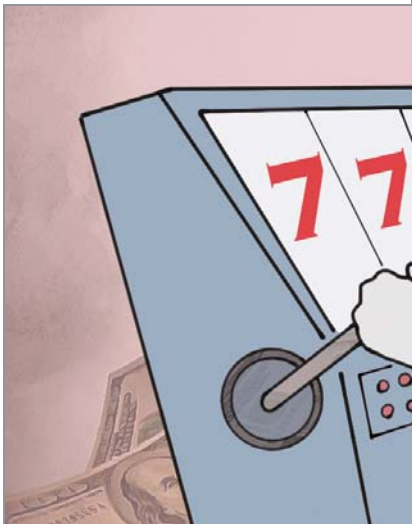
"In human society, selflessly protecting the powerless is considered an act of heroic justice. But understanding this is complex," explains first author Yasuhiro Kanakogi. "You first have to grasp the power relationship between the actors, then that the hero's actions are favorable for the victim but not for the villain, and finally, that the hero acted deliberately."

In a series of experiments, infants were shown animations of one geometric character chasing and bumping into another, as a third character watches from a distance. In one version, this third party character intervenes, and in another, it escapes in another direction. When the infants were then shown real life replicas of these intervening and non-intervening characters, they were more likely to choose the intervener.

"Six-month-old infants are still in an early developmental stage, and most will not yet be able to talk. Nevertheless they can already understand the power dynamics between these different characters, suggesting that recognizing heroism is perhaps an innate ability," adds contributor David Butler.

As infants grow, they develop a more complex understanding about justice. The research team's next step is to track the path of this development.

"In this study, six-month-olds didn't show a preference for intentional help over accidental help, whereas ten-month-olds did," says Professor Myowa. In seeking to understand how a more complex sense of justice is fostered over time, the team ultimately sees "a possibility of contributing to solutions for serious social issues such as bullying."



High stakes, high risk, and a bad bet

You've been losing all night, and now another bad hand. So why raise?

Gambling addiction is a mental disorder characterized by excessive risk-taking despite negative results. Scientific studies using functional MRI — fMRI, a method of looking at active areas of the brain — have previously shown that addicts have altered activity in brain regions related to risk and reward, making them prone to prefer risky choices.

New fMRI research conducted at Kyoto University has now found another explanation for the unhealthy bent: addicts have a poor ability to assess and adapt to high risk situations. The study appeared in *Translational Psychiatry*.

"We noticed that gambling addicts also have higher levels of mood and anxiety disorders," says lead author Hidehiko Takahashi. "Hence pleasure may not be the main goal, but rather an inability to properly recognize risk and adapt accordingly."

We all make action decisions by evaluating the likelihood of success based on the level of tolerable risk. We then make adjustments based on prevailing circumstances.

"For example, if you are losing in the first half of a soccer match, you will likely prefer a strong defense while pushing your attackers forward," continues Takahashi, "However, if you are losing at the end of the second half, you may choose to forgo defense in favor of an all-out attack, because you would lose otherwise."

Addicts, on the other hand, are inclined toward unnecessarily risky action, demonstrating a defect in risk assessment and adaptation.

Flexibility in risk-taking between addicts and non-addicts was determined through a series of gambling tasks, requiring participants to earn a certain amount of credits. Addicts were found to go with a risky strategy even if that choice was sub-optimal.

"We observed diminished activity in the dorsolateral prefrontal cortex, a region of the brain involved in cognitive flexibility," concludes Takahashi. "This indicates that these subjects lack an ability to adapt their behavior to the risk level of the situation."

The team hopes that their findings will contribute to a better understanding of the nature of gambling addiction, and eventually to the development of new methods of treatment.

You don't see what I see?

Perhaps we only see what we've learned to see.

In a multinational study in the journal *Cognitive Science*, a research team led by Kyoto University shows that an ability to perceive differences between similar images depends on the cultural background of the viewer.

Scientists have long recognized that the mental processes behind thinking and reasoning differ between people raised in Western and Eastern cultures. Those in the West tend to use 'analytical' processing — analyzing objects independently of context — while those in the East see situations and objects as a whole, which is known as 'holistic' processing.

While such differences in processing are thought to affect visual perception, lead author Yoshiyuki Ueda of Kyoto University believes that this view is overly simplistic.

"Reports about the effects of cultural differences on visual perception are inconsistent," says Ueda. "Partly, previous experiments have used relatively complex objects, resulting in a lot of 'noise'. We decided to simplify the visual task by using simple geometric figures."

Volunteers from Canada, the United States, and Japan were asked to look at groups of objects such as straight lines with varying properties and discern simple differences between them: angle and length, for example. In looking for the one odd line out of a group, North Americans took more time when the line was shorter, rather than if it was longer. No such differences were seen in Japanese volunteers, who in contrast had a significantly harder time identifying a straight line among tilted ones.

Such a stimulus-dependent cultural difference cannot be explained simply by analytic-holistic theory.

"There are likely other differences in perceptional mechanisms that caused this discrepancy in visual processing," continues senior researcher Jun Saiki of Kyoto University. "Our next step is to find the cause of this discrepancy. One such reason

Cutting edge

may be the orthographical systems the subjects see regularly.

"In East Asian writing, many characters are distinguished by subtle differences in stroke length, while in Western alphabets, slight angular alterations in letters result in remarkable changes in the reading of words."

The researchers eventually hope to gain insight into the role of visual experience in the development — from an early age — of the visual processing system.

Disentangling chloroplast genetics

Proper DNA inheritance is essential for healthy cell growth and division. The same goes for the genetic material found in chloroplasts: the energy centers of all plant cells.

Chloroplast genomes — likely vestiges of ancestral bacteria — are organized into DNA-protein complexes called nucleoids. While significant work has been done to understand the dynamics of DNA in the nuclei of plant cells, little is known about the dynamics of chloroplast nucleoids.

Now Yusuke Kobayashi and Yoshiki Nishimura of Kyoto University, Osami Misumi of Yamaguchi University, and other collaborators have isolated and characterized a protein in chloroplasts that is essential for proper nucleoid segregation. Their findings were published in the journal *Science*.

"To understand the dynamics of chloroplast nucleoids, we focused on their behavior during chloroplast division in the green alga *Chlamydomonas reinhardtii*," explains Nishimura.

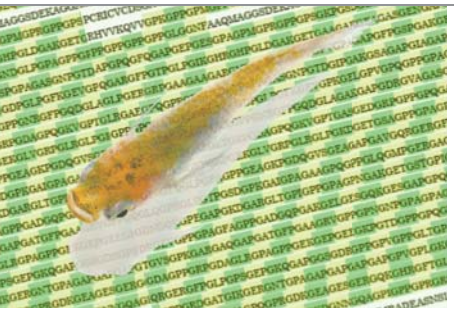
"We screened about 6,000 specimens with random mutations in their DNA and then isolated the ones with defective nucleoid segregation."

One of these mutants was found to have a defect in a gene the team calls *moc1*, for *Monokaryotic Chloroplast 1*. The chloroplasts in this mutant possessed only a single nucleoid, and showed unequal segregation during chloroplast division. A homologous moc1 gene was then found in a land plant commonly used for research, *Arabidopsis thaliana*. When mutated, the researchers discovered that these organisms exhibit growth defects and abnormal nucleoid segregation.

After extensive analysis of this new gene, the team discovered that moc1 functions as a chloroplast-specific 'Holliday junction resolvase', which Nishimura continues, "is very important in untangling a DNA structure called Holliday junctions. These genes have never been found in chloroplasts, until now."

Continuing with their study, the researchers successfully visualized the activity of moc1 on Holliday junctions through the use of high-speed atomic force microscopy and DNA origami technology. They observed moc1 binding to the core of Holliday junctions and cutting them symmetrically.

The team's discovery improves understanding of the highly complex structures maintaining chloroplast DNA, whose proper functioning is essential for good cell health.



Untangling the knots in cell stress

How do cells correctly make proteins?

Part of the answer lies in quality control for newly-minted proteins, which takes place in the sub-cellular compartments of the 'endoplasmic reticulum', or ER. An over-burdened — or 'stressed' — ER can result in proteins becoming disorganized, a condition which cells seek to rectify by undertaking 'unfolded protein response', or UPR.

During this reorganization, 'UPR transducers' in the ER sort the proteins for correction. Humans are known to have ten types of these transducers, but for years, scientists have not been able to explain why so many varieties are needed for the process to work.

In an article published in the *Journal of Cell Biology*, Tokiro Ishikawa and Kazutoshi Mori of Kyoto University describe how different UPR transducers are used selectively, depending on the developmental stage of the cell and the type of stress.

"We started by looking for proteins that cause ER stress during the development of medaka fish embryos, which are known to have the same ten transducers," explains first author Ishikawa.

"We found that at first the production of short chain collagen causes a certain transducer to be activated for quality control." Collagen is the most abundant protein in vertebrates, providing external support for cells.

In the next stage of development, cells received a signal from main actor proteins and started to produce longer-chain collagen. In response to this new ER stress, a new UPR transducer was activated to produce components to export the larger collagen out of the ER. Without this, larger collagen would be unable to leave the cells and do its job.

"This showed us that different UPR transducers are activated to cope with different ER stresses caused by different proteins," says Ishikawa.

Senior researcher Mori continues, "We see UPR working 'backstage', so to speak, to support the main actors during cell differentiation and thereby orchestrating various biological processes"

The team is next seeking to understand how cells discriminate between lengths of collagen to activate different transducers, further deepening understanding of UPR's role in cellular processes and development.

Take a look, and you'll see, into your imagination

Scanning your brain to decode the contents of your mind has been a subject of intense research interest for some time. As studies have progressed, scientists have gradually been able to interpret what test subjects see, remember, imagine, and even dream.

There have been significant limitations, however, beginning with a necessity to extensively catalog each subject's unique brain patterns, which are then matched with a small number of pre-programmed images. These procedures require that subjects undergo lengthy and expensive fMRI testing.

Now a team of researchers in Kyoto has used neural network-based artificial intelligence to decode and predict what a person is seeing or imagining, referring to a significantly larger catalog of images. Their results are reported in *Nature Communications*.

"When we gaze at an object, our brains process these patterns hierarchically, starting with the simplest and progressing to more complex features," explains team leader Yukiyasu Kamitani of Kyoto University.

"The AI we used works on the same principle. Named 'Deep Neural Network', or DNN, it was trained by a group now at Google."

The team from Kyoto University and ATR (Advanced Telecommunications Research) Computational Neuroscience Laboratories discovered that brain activity patterns can be decoded, or translated, into signal patterns of simulated neurons in the DNN when both are shown the same image.

Additionally, the researchers found that lower and higher visual areas in the brain were better at decoding respective layers of the DNN, revealing a homology between the human brain and the neural network.

"We tested whether a DNN signal pattern decoded from brain activity can be used to identify seen or imagined objects from arbitrary categories," explains Kamitani. "The decoder takes neural network patterns and compares these with image data from a large database. Sure enough, the decoder could identify target objects with high probability."

As brain decoding and AI development advance, Kamitani hopes to improve the image identification accuracy of their technique. He concludes, "Bringing AI research and brain science closer together could open the door to new brain-machine interfaces, perhaps even bringing us closer to understanding consciousness itself."

Nicking in new nucleotides

Who in genomics *hasn't* heard about CRISPR/Cas9?

In the five years since the gene-targeting and editing tool was developed, it has effectively revolutionized the field of biology with its cut-and-paste simplicity.

But CRISPR has its problems: the efficiency of gene editing remains relatively low due to a high rate of inaccurate edits.

In order to improve CRISPR's applicability, a Kyoto University team has used yeast to develop a genome-wide base-editing technology which they have successfully shown to improve editing accuracy. Their research on this new "CRISPR Nickase system" appeared in *Scientific Reports*.

The new system relies on two components, a guide RNA — 'gRNA' — and the Cas9 nickase. The gRNA first targets a specific location of the genome, which the nickase then detects and cuts.

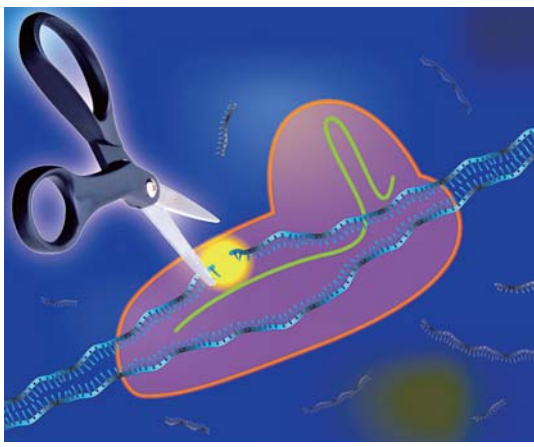
"When editing the yeast genome, we found frequent inaccuracies in DNA regions outside of the gRNA target," explains Atsushi Satomura, first author of the study. "As a workaround, we employed the Cas9 nickase, a variant of Cas9 which only cuts one strand of the DNA double helix."

By "nicking" the DNA instead of fully cutting both strands, the team found that the rate of inaccurate mutations was dramatically reduced.

"We applied this system with a method called 'yeast gap repair cloning', or GRC, to streamline the generation of yeast mutants," continues Satomura. "This is considerably faster than before. Previous methods required a complex procedure that took nearly two weeks."

Combining the nickase system and GRC shortened that time to five days.

"In theory, we can now accurately edit 97.2% of the bases in the yeast genome," concludes team leader Mitsuyoshi Ueda. "We hope our new system will be a robust tool that overcomes CRISPR's limitations, not only for yeast genomics but in other animal systems as well."



News

Now OPEN! Kyoto University Liaison Office in San Diego, USA

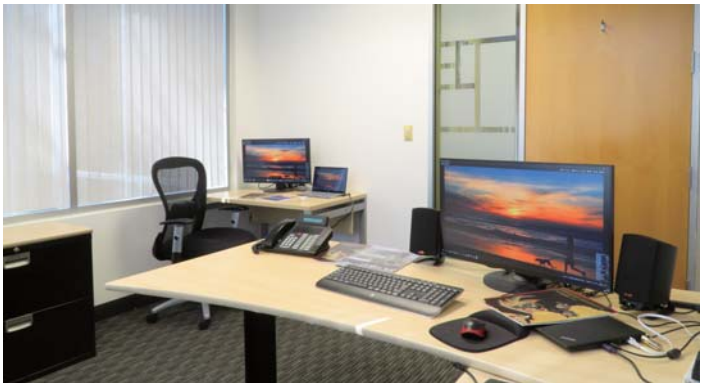
This past July, as evening sea breezes off the Pacific cooled the summer heat, around 50 people gathered to mark the opening of Kyoto University's San Diego Liaison Office in La Jolla, California. A West Coast gateway for multi-sector collaboration, the new office also serves as a stopover for University staff visiting the United States.

The eighth-largest city in the United States, San Diego is known for the University of California, San Diego, research institutions in medicine and biotechnology, wireless technology firms, as well as active industry communities and governmental networks. Its location is also advantageous to the fields of oceanography and Latin American studies. After several years of projects and joint symposia with UCSD, Kyoto University now aims to advance the frontiers of knowledge by collaborating with the rich environment of San Diego.

The opening began with an address by President Juichi Yamagiwa, followed by Pradeep Khosla, UCSD chancellor, Sandra Brown, UCSD vice chancellor for research, and Nagahiro Minato, Kyoto's executive vice-president for research.

Additional distinguished guests included David Graham of the City of San Diego, David Brenner, UCSD vice chancellor for health sciences, Joe Panetta, CEO of Biocom, and finally Kayo Inaba, KyotoU executive vice-president for gender equality, international affairs, and public relations.

The new liaison office is located at Eastgate Mall near UCSD, Sunroad Corporate Center Suite 200.



Heidelberg
European Center

The Kyoto University European Center, Heidelberg Office has been expanding its activities through cooperation and collaborative relationships for three years, since its founding in May 2014. Among these is the Japan-Germany Joint Lecture Series, begun in December 2016. Four lectures, two in Kyoto and another two in Heidelberg, have been co-organized by the Heidelberg Office together with the Heidelberg University Office Kyoto.

To date, leading scholars have introduced their latest literary and historical investigations within the context of Japan-German or Japan-European relations. One of the key features of the series is the presence of a discussant, chosen from among the researchers of the other country, to seek deeper meaning and add new perspectives, further enhancing Japan-German interaction.

The number of dedicated attendees has increased steadily, setting a welcome tone for each occasion with their anticipation, curiosity, and openness for discussion. Young students, faculty, and staff are actively invited, as well as accomplished researchers, creating a place where all can engage in multi-tiered and comprehensive dialogue.

During the 3rd seminar held in April 2017 in Kyoto, for example, a first-year student exclaimed, “This is the history that I was never taught in high school!” On another occasion, a Korean student engaged a lecturer in Heidelberg in a lively dialog.

Interaction begins with people meeting people. These meetings are a solid foundation for building further academic exchange among researchers, students, staff, and the wider community.

Bangkok
ASEAN Center

It has been three years since the Kyoto University ASEAN Center was established to support research, education, and international collaboration in the region.

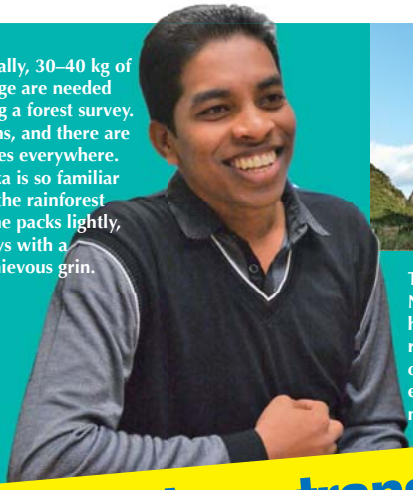
Leveraging its considerable experience in ASEAN, the University also established the ASEAN Network Committee with representatives from 17 (later increased to 20) faculties. This body meets every two or three months to report on activities, share information, and explore opportunities for new collaboration.

To review its progress and expand internal cooperation, the first enlarged ASEAN Network Committee meeting was held on 5 April 2017, inviting researchers and administrative staff interested in educational and research activities in the region. A series of presentations illustrated current conditions, and the ensuing face-to-face discussions offered opportunities to explore future perspectives.

The ASEAN Center in Bangkok and the ASEAN Network Committee together form the Kyoto University ASEAN Platform. Fields of research covered are exceptionally diverse, ranging from area studies to philosophy, engineering to biology, and agriculture to health science. This new collaborative platform provides opportunities to connect researchers from across the University, initiating research and educational collaboration such as the 2015 Japan-ASEAN Science, Technology and Innovation Platform (JASTIP), supporting diverse Japan-ASEAN science and technology cooperation centered on sustainable development research.

The University’s ASEAN Center is thus continually striving to accelerate internal cooperation to open new horizons.

Student voices



Typically, 30–40 kg of luggage are needed during a forest survey. It rains, and there are leeches everywhere. Nalaka is so familiar with the rainforest that he packs lightly, he says with a mischievous grin.

The South China Karst, part of Nalaka's survey. He says that this highly unusual area, in which rainforests grow on top of limestone outcroppings, is the perfect place to explore how plants absorb water and nutrients.

Researchers transcending borders between disciplines and nations

Nalaka Geekiyanage (3rd Year, Doctoral Program, Graduate School of Agriculture)

Nalaka has been in Japan for two years. When not doing research, he sometimes travels with friends: "I end up mostly going to forests." *Kayabuki-no-sato*, a historic village of thatched-roof houses in Miyama, central Kyoto prefecture.

At Todaiji. Nalaka was interested to learn that the large number of deer living in Nara Park is impacting the vegetation there.

The world's tropical rainforests — shrinking rapidly — are said to play a major role in the planet's carbon dioxide, heat, and water cycles, but these specific mechanisms have yet to be adequately explained. Nalaka Geekiyanage looks to forest ecology for a key to unlock these mysteries.

"I just love forests."

Born in a village in Sri Lanka, Nalaka grew up with tropical rainforests. Standing in his sun-drenched laboratory, with a plant in hand, he elaborates, "The rainforests, with their multitude of tree varieties, from tall to short, were the perfect playground."

So why come to Japan to study, where there are no such forests?

"I was attracted by the highly advanced research environment, but what appealed to me even more were the extensive networks here among Asian researchers. Japan will surely serve as a hub for such connections in the future."

Specialization in science makes it difficult to share knowledge across disciplines.

"Outstanding researchers of the next generation will pursue collaborations with those in fields outside their own. I can't do genetic engineering myself, but with a well-developed network, I could ask someone to teach me."

These sorts of networks are especially needed in countries — including in Africa and Asia — that are making an effort to cultivate early career researchers in an environment where science and technology are not yet well developed. But here the power of the internet can be brought to bear as an important tool for forging such connections.

Nalaka finds time in his busy schedule to serve as a vice-chair of INNGE, which connects early-career ecologists around the globe. Besides discussing the science itself, INNGE is becoming a place to seek valuable advice from peers about careers in research.

"The only thing I found really difficult about Japan was the climate, which is completely different from that of my country. The cold in winter, especially, really got to me."

Nalaka laughs cheerfully, in spite of this chilly recollection. Cooperating with researchers from many other countries, Nalaka will continue to pursue his goals.

INNGE, International Network of Next Generation Ecologists: http://innge.net/

With Seika Global Network — an exchange organization in the town of Seika in rural Kyoto — Nalaka taught local elementary school children about Sri Lankan culture and language.

After learning how to put on a kimono, participants go out and enjoy the city's famed temples and shrines.

Want to tour Kyoto dressed in kimono?

Former student leader of *Kyoto Kimono Kikaku*

Mai Sugimoto (2nd Year, Faculty of Agriculture)

Kyoto is a city rich in traditional arts, including a vibrant kimono industry, so it is not uncommon to see people dressed traditionally while going about their day. Even for visitors, 'sightseeing in kimono' is becoming a recommended part of the Kyoto experience.

But even in this special city, kimono are not often worn by young people.

"We want to change the image of kimono from stiff and formal to being a more casual, familiar presence in our lives. Certainly there are aspects of traditional culture that can resonate with our contemporaries."

Student group *Kyoto Kimono Kikaku*, led until recently by Kyoto-native Mai Sugimoto, uses kimono as an entry point to past traditions. Planning and running a wide range of programs, including kimono-fittings and exhibits, the group's activities reach far beyond the confines of the Kyoto University campus.

Forming a non-profit organization sponsored by local organizations and companies, the group's members have great responsibility.

"Initially our enthusiasm exceeded our basic knowledge of kimono, but encouraging words from experts motivated us to continue."

Several times a year the group hosts *ikebana* and kimono classes, as well as *jûni-hitoé* (twelve-layered ceremonial kimono) and *yûzen*-dyeing workshops, inviting traditional artisans.

"We like to boast that, of all the students in Kyoto, none know more about the appeal and history of traditional Japanese culture than we do."

A highlight is an autumn, outdoor fashion show at Heian Shrine. All members take part, from choosing a theme to selecting costumes, raising funds, doing publicity and advertising, and running the show for an audience of 1,000.

"The theme for 2016 was *hanafuda* (a traditional card game). Nine boutiques cooperated by providing kimono with appropriate motifs, such as *inoshikachô* (boar, deer, and butterfly) and *gokô* (five lights). Heavy rain sadly forced us to cancel the show, but we put it on in the green room just for ourselves: a moment in which all our hopes and energy came together and brought an amazing vision to life."

The kimono rental business is flourishing. "Just putting on a kimono straightens your posture. Choosing a different *obi* (sash) gives it a completely different look. We want visitors to enjoy mixing and matching in the same way that they coordinate other clothes."

So during your next Kyoto vacation, how about inviting a friend out on the town dressed in kimono?

Kimono gallery "Ichigenya", produced by *Kyoto Kimono Kikaku*.

For many members, the annual *jûni-hitoé* event is the first time they have ever seen the elaborate, ceremonial kimono.

The 2015 fashion show at Heian Shrine. Models were students from Kyoto University, Ritsumeikan, and other nearby universities.

Global outreach

Office of Global Communications

With a focus on relaying the university's research output to domestic and international audiences, the university's Office of Global Communications got started in October 2015. Visit us at Public Relations in the historic Clock Tower building, or reach us via <comms@mail2.adm.kyoto-u.ac.jp> or @KyotoU_News or facebook.com/Kyoto.Univ.E

Overseas centers

Kyoto University European Center
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Kyoto University ASEAN Center
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A Fund to help us grow

Since its founding in 1897, Kyoto University has been committed to a spirit of openness and academic freedom that pervades all levels of academic life, from freshman courses to research in world-leading laboratories.

Protecting and promoting this freedom, and encouraging students to reach even further, is the highest goal of the institution.

The Kyoto University Fund provides an avenue for university stakeholders — from members of the local community to businesses and corporate sponsors — to support these students, their efforts, and their learning and study environment. In addition to a main, central fund, special-purpose funds are targeted toward particular activities and fields of research.

One example is the SPEC (Student Projects for Enhancing Creativity) fund, in which student r&d projects selected through a contest received development funding.

Making dreams a reality for students and researchers throughout the institution: this is what the Fund makes possible.

For details on types and levels of support, as well as payment methods, please see the website below. Your generous support of the university is most greatly appreciated.

Kyoto University Fund

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Artwork by Kyoto University students, combined with artistic scenes as glimpsed by researchers.

おと

Kyoto University Mandolin Orchestra

Title: *Tasogare-Iro* (The Color of Twilight) **Composer: Makoto Hachiya**

The music depicts a twilight scene. When looking up at the sky as nightfall approaches, many are overcome by with wistful reminiscence. This somehow nostalgic melody represents the feelings of a young child, hurrying home after school. The music leaves us with a bittersweet feeling of regret for the day's end.

いろ

Kyodai Cinema Club

Twilight scenes are climactic. As people finish the work day and head home, memory snippets float through their minds. No matter who we are, this precious hour can only belong to us, and to no one else. In our film, we portray the way the light changes color at twilight. View the entire five-minute movie here: http://www.kyoto-u.ac.jp/kurenai/

ことば

Even in departure you were shining
Secretly, your fading profile
Captivated me
And even now as then
You take no notice still

Mokuyokai Literature Club
Yuji Amitani (3rd Year, Faculty of Letters)

When I heard the strains of the mandolins, an image of dusk came to mind: of that time when we part from our friends and go home from school, filled with exhaustion, relief, and hunger. And if, at the same time, you harbor secret yearnings for another, this is no doubt that special joy of youth.

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