# We Are *Tomodachi*

## Early Summer 2020

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FEATURE

# Innovation and Dedication for a Healthier World

Japanese Experts Driven by a Passion for Saving Lives

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It introduces topics such as Abenomics, Japan's economic revitalization policy, and the attractive investment environment that it has created. In addition, it highlights Japan's contributions toward international development, including efforts to spread the fruits of innovation and quality infrastructure worldwide.

You'll also find the articles of all past issues of "We Are *Tomodachi*" (https://www.japan.go.jp/tomodachi).


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We Are *Tomodachi*
Early Summer 2020

"We Are *Tomodachi*" is a magazine published with the aim of further deepening people's understanding of the initiatives of the Government of Japan and the charms of Japan. *Tomodachi* means "friend" in Japanese, and the magazine's title expresses that Japan is a friend of the countries of the world—and which will cooperate and grow together with them.

FEATURE

# Innovation and Dedication for a Healthier World



**COVER**

On April 7, 2020, Prime Minister ABE Shinzo held a press conference regarding the novel coronavirus at the Prime Minister's Office after declaring a state of emergency.

PORTRAITS OF JAPAN
和歌山
高知

# Concerto of Early Summer Blue

With much of its land blessed by bountiful forests, Japan offers many sites, easily accessible on a short trip, where a person can be surrounded by vibrant natural beauty. Read about and discover these exceptional sceneries of blue.

Ino | **KOCHI** 高知



## Flower garden in refreshing blue

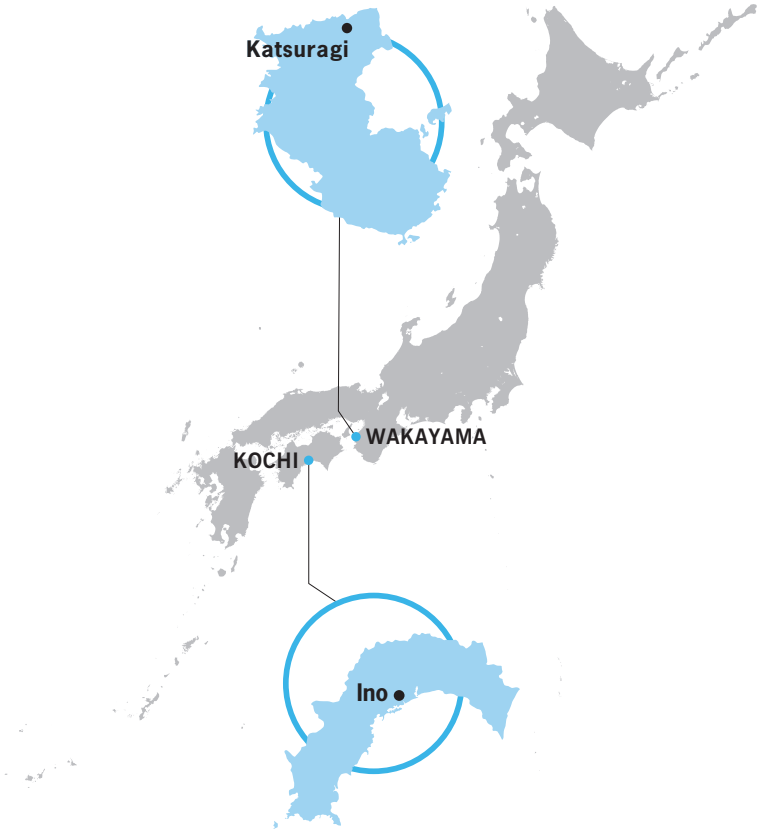
Wakayama Prefecture is located close to Kansai International Airport, the gateway to western Japan. From Mount Koya, designated as a World Heritage Site, a popular scenic road runs along the mountain ridges at an altitude of about 1,000 meters, stretching to the south for 43km. In Katsuragi, a town along the road, 3,500 hydrangeas, planted in a park of 7,500m$^2$, cover the hillside. The floral blue sparkling in the sunlight, skies of clearest blue, dazzling verdant hills, and refreshing breezes blowing through the highlands—a pleasant welcome to visitors to the hilltop.

**https://en.visitwakayama.jp/**

## Sacred blue plunge pool

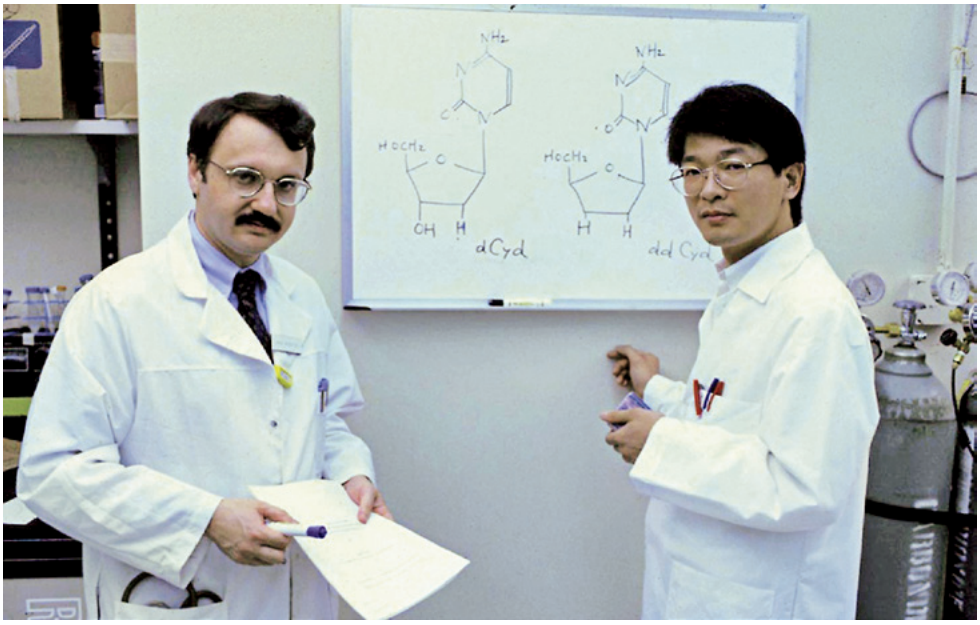
The Niyodo River, running through Kochi Prefecture in the southern part of Shikoku, is known for some of the highest quality water in Japan. The blueness of the water, transparent down to the riverbed itself, is known as “Niyodo Blue.” This blueness seems intensified in one tributary flowing through Ino Town. A particularly magical blueness radiates from a mysterious plunge pool—Nikobuchi, a deep pool beneath a stunning waterfall. Legend tells of a water deity, in the form of a great serpent, living in this sacred place. Bathed in the sunlight that filters through the tree branches, a jewel-like glitter dancing over the water’s surface, perfectly surrounded by a vibrant yet solemn tranquility.

**https://visitkochijapan.com/**



# A Conqueror of AIDS Confident of Curing the Novel Coronavirus

As of mid-May 2020, more than 4.4 million people worldwide have been infected with the novel coronavirus and have come down with COVID-19, over 300,000 of whom have lost their lives. With the race on to develop therapeutics, one scientist is fighting to save lives.

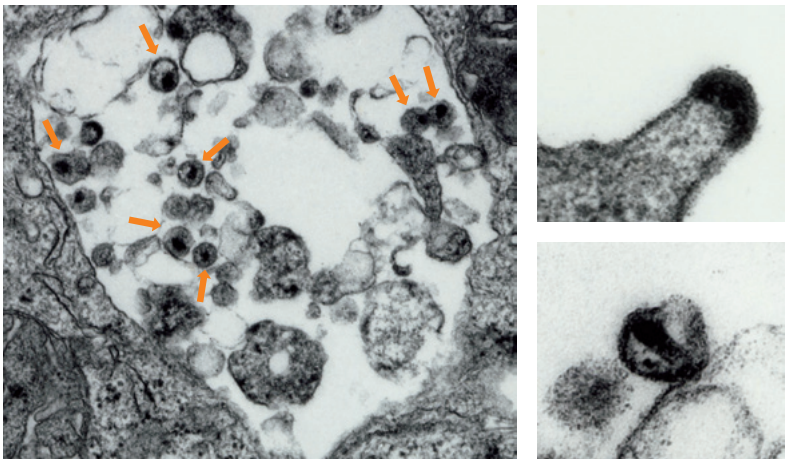



In 1984, working under supervisor Dr. Samuel Broder (left), Dr. Mitsuya commenced research to develop anti-HIV medication at the National Institutes of Health (NIH) in the United States.

"We certainly will be able to develop therapeutics for COVID-19." The man behind that powerful statement is Dr. MITSUYA Hiroaki, a scientist who was a primary contributor to the discovery of the first three medications ever for AIDS, the acquired immune deficiency syndrome that once terrorized the world as a death sentence to those it afflicted. He later went on to help develop the fourth therapeutic treatment for AIDS.

The human immunodeficiency virus, or HIV, is the virus that causes AIDS. HIV enters the immune cells of the human body, where it hides inside their genes and replicates within the cells before eventually destroying those critical cells, thus rendering the immune system powerless. The result is that AIDS patients later become infected with other viruses and bacteria or develop cancers, which they are unable to fight against, eventually leading to their death.

Azidothymidine (AZT), the first-ever anti-HIV medication, which Dr. Mitsuya was directly involved in developing, attacks the reverse transcriptase of HIV. This enzyme regulates the replication process that HIV must undergo to multiply. By halting the reproduction of the virus's genes, AZT stops the virus from replicating. Didanosine (ddI) and zalcitabine (ddC), the second and third drugs—the development



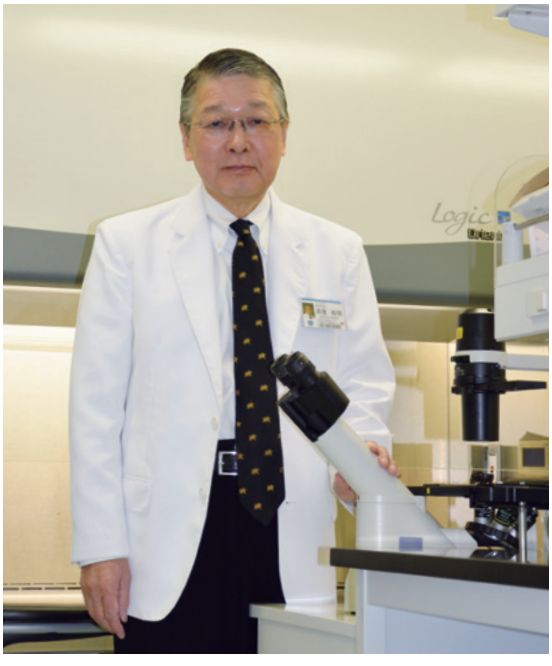
Top left: When HIV infects a lymphocyte, a type of white blood cell that plays a major role in the body's defense, copious numbers of the virus (arrows) emerge, destroying the cells.
Top right: When HIV emerges through the membrane of the infected cell, each virus leaves the cells by "budding".
Lower right: After HIV emerges from human cells, the virus matures to have a dark "core" and becomes infectious.


AZT (left), the first anti-HIV medication ever developed in the world. The second-generation drug darunavir (right), is the world's first registered anti-HIV medication available for use by developing countries with patent royalties waived.

process in which Dr. Mitsuya played an indispensable role—likewise inhibit the mechanism behind HIV's propagation. Since human cells do not possess reverse transcriptase, attacking them does not prevent our body's cells from multiplying or functioning: it only stops the virus from multiplying.

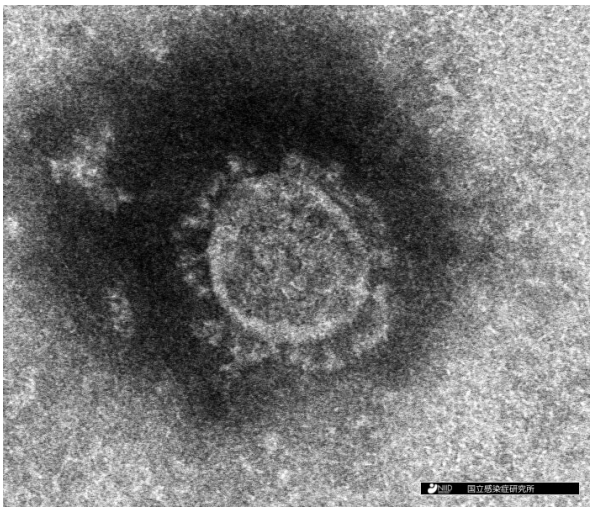
Darunavir, the fourth anti-HIV medication, for which Dr. Mitsuya also played a central role in developing, comes from a "second generation" of drugs. This drug targets the protease, another kind of enzyme that breaks down proteins by cutting premature viral proteins like a saw or a pair of scissors. When HIV infects human cells, it takes over their protein synthesis function to begin making HIV proteins. To do so, HIV first makes the cell produce large virus proteins. It then uses its own protease to precisely cut those large virus proteins into small, mature, and functional proteins. Next, those parts are assembled into virus particles. HIV protease appears and functions in a way different from that of the proteases in human cells. Therefore, attacking HIV protease does not interfere much with the functions of human cells, all the while impeding the formation of virus particles. Such protease inhibitors against HIV have proven to be a powerful deterrent to HIV reproduction as well.

It has been 33 years since the first anti-HIV medication, Dr. Mitsuya's AZT, was approved. After that pioneering drug, many more powerful medications have been created with fewer side effects and simpler administration. Thanks to that drug development, AIDS has gone from a disease that at its peak took 1.7 million lives a year and was fatal to nearly 90% of patients within two years[1], to a controllable chronic disease, allowing people living with HIV to pursue careers, raise families and children, and lead lives much like those who do not have the virus. Treatment can also prevent people living with HIV from infecting other people.



Dr. MITSUYA Hiroaki currently serves as director of the National Center for Global Health and Medicine (NCGM), located in Tokyo, and head of the HIV and AIDS Malignancy Branch's Experimental Retrovirology Section at the National Cancer Institute, part of the National Institutes of Health (NIH) in the United States.

[1] UNAIDS DATA 2019




Electron-microscope image of the novel coronavirus isolated at the National Institute of Infectious Diseases (NIID) in Japan.

Dr. Mitsuya is now working to develop therapeutics for COVID-19 in a partnership with the National Center for Global Health and Medicine (NCGM) in Japan, as well as with scientists and the National Institutes of Health (NIH) in the United States. SARS-CoV-2, also known as the novel coronavirus, is the pathogen that causes COVID-19. To develop therapeutics for SARS-CoV-2, scientists target the virus much in the same way that they have done with HIV. An examination of infections around the world strongly suggests that it may not be a seasonal virus, which means it could continue to pose an immense threat to humans throughout the year. It is as yet unknown whether people who develop antibodies against SARS-CoV-2 gain long-term immunity. There is still much to learn about the virus, but according to Dr. Mitsuya, "there are many lessons we can learn from the development of drugs to treat AIDS", which can be applied to new therapeutics for combating SARS-CoV-2.

Dr. Mitsuya sees three targets in attacking the virus. The first is when SARS-CoV-2 enters a human cell. The second is the virus's unique RNA polymerase that mediates the reproduction of SARS-CoV-2 genes. The third is the protease of SARS-CoV-2, in particular, the main protease that plays a primary role.

The main protease has a different structure and function from those of human proteases that break down proteins in human cells. According to Dr. Mitsuya, researchers have already obtained chemical compounds in test tubes that exhibit potent effects against SARS-CoV-2. He claims that he has also already identified multiple novel chemical compounds that completely block SARS-CoV-2 from infecting cultured cells, without having any major impact on human cells.

Dr. Mitsuya goes on, "We've also administered some of them to mice, and they remained apparently unaffected. We still need to examine


Japan's National Center for Global Health and Medicine (NCGM), under Dr. Mitsuya's direction, is dedicating all its strength to the development of new drugs.

them in clinical trials, but I have high hopes that several of such chemical compounds will not be acutely toxic and will be efficacious against the virus." However, when drugs that have tested as beneficial to animals are administered to patients in clinical trials, they do not always have the expected effect. In many cases, extreme side effects are observed.

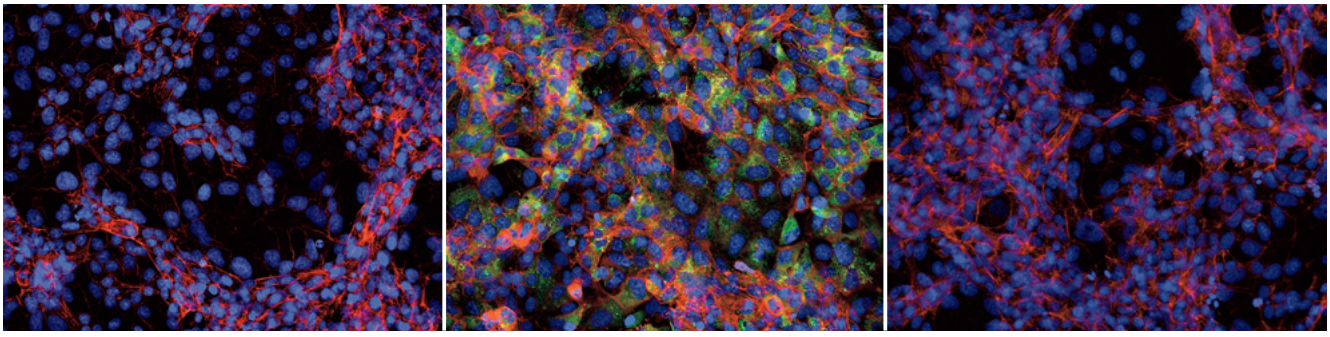
Cautioning that it is too soon to judge, Dr. Mitsuya continues, "When we developed AZT, the first anti-HIV medication, we broke records in that we won approval in only 25 months after discovering its effect against HIV. The approval process had never moved with such speed before. Now we want to do that in a year." When AZT was first reported, Dr. Mitsuya said he already had ddI and ddC on his hands. He adds, "I have the same situation now."

Looking back, Dr. Mitsuya concludes that AZT was "a tough medicine" because of its strong side effects. "However, it surely helped save lives. If you can help save lives, then you can come up with better and better drugs to make patients healthy again." Once a body is infected with HIV, the virus embeds itself in critical cells' genetic codes, which means that the virus can seemingly never be completely removed. SARS-CoV-2, though, does not enter the genes. That means that we "can no doubt eradicate it." The scientist's words carry great weight. (Interview conducted on April 24, 2020.) ✻

## Latest Report on Mitsuya's Drug Development Research in Response to the COVID-19 Pandemic

### GRL, which targets the essential enzyme (main protease: $M^{pro}$) of SARS-CoV-2, completely protects VeroE6 cells from SARS-CoV-2 infection.

When VeroE6 cells, which are susceptible to SARS-CoV-2 infection, were cultured alone, they stain in red (showing healthy act in filaments of normal cells) and in blue (showing the nuclei of the cells). When VeroE6 cells were exposed to SARS-CoV-2, the cells additionally stain in green (showing the presence of virus antigens). However, when VeroE6 cells were exposed to SARS-CoV-2 and cultured in the presence of a novel small chemical, named GRL, the cells were completely protected by GRL from SARS-CoV-2 infection and the cells do not stain in green. The staining method is called immunocytochemistry.



**VeroE6 cells alone**

**VeroE6 cells exposed to SARS-CoV-2**

**VeroE6 cells exposed to SARS-CoV-2 but protected by GRL**

# Contributing to Global Health by Fighting Against TB

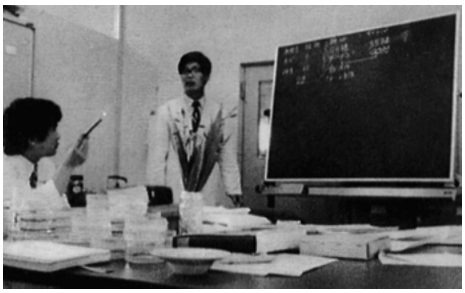
Tuberculosis, alongside HIV/AIDS and malaria, is counted as one of the three major infectious diseases. The use of a breakthrough drug developed by a Japanese pharmaceutical company is making its way across the world as part of the quest to conquer the illness, which threatens global health.

Tuberculosis (TB), which spread profusely in the countries of Western Europe during the industrial revolution, was once a threat to the entire world. However, from the 19th century onwards, improvements in living standards and healthcare led to a decline in the number of persons afflicted with the disease. Now, TB is considered by people in those countries to be a disease of the past. That assumption, however, is incorrect. According to a report by the World Health Organization (WHO), an estimated 1.7 billion people are currently infected with the bacteria that causes TB worldwide. Even now, 1.5 million people die from the disease each year, making it one of the top 10 causes of death in the world. In fact, outbreaks sporadically occur not only in developing countries, but in Western countries as well.

Exacerbating the problem in recent years has been the appearance of multidrug-resistant tuberculosis (MDR-TB) strains that show resistance to existing TB drugs. At the Kyushu-Okinawa Summit in 2000, Japan made combating infectious diseases, including TB, one of the summit's major agenda topics. Driven by Japanese initiatives to tackle infectious diseases, the Global Fund to Fight AIDS, Tuberculosis, and Malaria was formed in 2002. Amid renewed awareness of TB as a global health problem, an anti-TB drug developed by a Japanese pharmaceutical company is offering new hope. The drug in question is delamanid, which was developed by Otsuka Pharmaceutical Co., Ltd., and received regulatory approval in the EU and Japan in 2014. As the first new anti-TB drug in about 40 years, it is proving to be effective against resistant strains and its use is increasing throughout the world.

When a standard treatment for TB was established in the 1970s, the development of anti-TB drugs came to a standstill around the world, but Otsuka Pharmaceutical continued its development. "Patients must receive TB treatment over a much longer time compared with other infectious diseases. In quite a few cases, treatment is halted because the side effects are too severe, and without administering continuous treatment, its elimination becomes difficult. We believed that this was a therapeutic field that showed the promise of improvement from a quality-of-life perspective as well," says KAWASAKI Masanori, Global TB Project leader. "If no one else was going to do it, we felt that we must continue the research, and that ultimately led to the development of

Otsuka Pharmaceutical is cooperating on a project to improve TB treatment in developing countries. In Indonesia, it is working with a local university to support the evaluation of treatment for TB and MDR-TB.



When Otsuka Pharmaceutical began drug discovery in 1971, it selected TB as one of its first research themes. Its untiring research efforts yielded fruit, realizing innovation that has spurred new drug development.

The Global TB Project, driven by Otsuka Pharmaceutical, is comprised of members from various countries (photo taken at the Princeton office in the United States).

delamanid."

Rather than being administered by injection or drip, delamanid is taken orally. That is a huge advantage because oral medicine is much easier for patients to manage versus injectable drugs. Another benefit of delamanid is that there are few drug interactions with the treatments for HIV/AIDS or diabetes, meaning it could also be effective for patients with coexisting medical conditions.

After earning its first approval in Europe in 2014, delamanid has since been approved in 15 countries, including South Africa and India. In the Russian Federation, the major pharmaceutical company R-Pharm was granted licensing rights in 2017 as part of the Eight-Point Cooperation Plan. Furthermore, as of the end of 2019, the use of delamanid is now possible in over 100 countries, thanks to an agreement in 2016 between Otsuka Pharmaceutical and the Stop TB Partnership, an organization established in collaboration with WHO and other partners.

The development of a drug to defeat bacteria that cause TB strains, which are difficult for antibiotics to act on, was not easy. The development team at Otsuka Pharmaceutical was exhaustively selective when deciding which candidate compounds to choose as the starting point of the drug discovery process. Through repeated trial and error, such as adopting unorthodox drug synthesis methods, the team finally achieved its goal.

Presently, the team is developing a next-generation drug candidate that will work by a different mechanism of action from delamanid. In February 2020, Otsuka Pharmaceutical joined hands with the Bill & Melinda Gates Foundation, Gates Medical Research Institute, Johnson & Johnson, Evotec SE, and GlaxoSmithKline plc, to set up the "PAN-TB collaboration," a consortium established to accelerate new treatments for TB on a global scale. The company is providing its knowledge gained so far through TB research. Assuring us that his team will continue to direct their efforts toward fighting TB, Kawasaki says, "As demonstrated by the novel coronavirus crisis, it is important that all countries cooperate in treating infectious diseases as a global issue. As part of that, our mission is to create an environment where treatment can be administered to patients easily and more effectively." ✻


On World TB Day, March 24, 2017, Otsuka Pharmaceutical, in cooperation with South Africa's Ministry of Health and a non-governmental organization, launched an access program for delamanid (trade name Deltyba) that is still in progress. The image shows one of the first patients to have received the drug.

# Cambodia and Japan to Improve Maternal and Child Healthcare

After its civil war ended in 1991, Cambodia desperately needed to improve its maternal and child healthcare to help rebuild the country. Japan was quick to extend assistance, and for over two decades now it has been offering support to ensure both mothers and newborn infants there enjoy healthy lives.


A mother with her baby after giving birth at the NMCHC. About 7,500 babies are born each year at this health center.

In Cambodia, childbirth is referred to as *chlong tonle*, meaning "to cross the river." The expression compares giving birth to crossing a large river, in that you never know when you might lose your life in the depths and fast-flowing waters of the river. By the end of the Cambodian civil war, many medical facilities had fallen into disrepair, and many healthcare professionals and midwives had lost their lives. A large number of expectant mothers in Cambodia thus had no choice but to give birth at home, and as the name *chlong tonle* implies, childbirth was a life-threatening event for them.

With one of the lowest maternal and neonatal mortality rates in the world, Japan was quick to reach out to Cambodia, a country that has been rebuilding its maternal and child health system ever since its collapse during the civil war. Japan sent a medical adviser to Cambodia's Ministry of Health in 1992, one year after the war ended. And in 1997, it provided grant aid for the construction of the National Maternal and Child Health Center (NMCHC) in the capital city of Phnom Penh. The NMCHC currently has a clinical function with about 150 beds in its obstetrics and gynecology and neonatal departments, along with an administrative function that manages maternal and child health, as well as a teaching function that provides necessary training for midwives, doctors, and students from all over the country. With all these functions combined, the NMCHC plays a central role in maternal and child healthcare in Cambodia today.

Built in 1997, the NMCHC has been affectionately nicknamed "the Japan Hospital" by locals.

Dr. IWAMOTO Azusa (front row, right) with Cambodian doctors of the Neonatal Care Unit at the NMCHC.


Japan's support, however, is not limited to just the construction of the NMCHC. It started running a technical cooperation project in 1995, before the facility was built, to improve hospital management, clinical services, and training in Cambodia, with the aim of developing systems and human resources for the NMCHC. Since then, Japan has been continuing to provide such support, while understanding the needs of the local people. This support has contributed to a drop in the maternal mortality ratio in Cambodia, which was 1,020 per 100,000 live births in 1990, falling to 437 in 2000, and to 170 in 2014. It thereby achieved, ahead of time, the goal of reducing maternal deaths to 250 per 100,000 live births by the year 2015, as set out by the United Nations Millennium Development Goals. Currently, over 80% of expectant mothers in the country give birth with skilled birth attendants such as trained midwives, and awareness regarding giving birth in health facilities is growing, even in rural areas where many babies have hitherto been delivered at home.

Moreover, a project was launched in Cambodia in 2016 to encourage continuum of care for mothers and their babies. The project provides training about necessary care for newborn infants, such as teaching adequate timing of cord clamping and giving advice on initial breastfeeding just after birth. It also provides training about treatment methods for premature and sick babies, as well as follow-up care for mothers and their children after leaving the health facility. The project's chief advisor, Dr. IWAMOTO Azusa, talks about the importance of the project. "The problem about giving birth is that we don't know when a normal birth will become abnormal. That's why continuum of care before and after birth is needed, not just during labor."

Dr. Iwamoto describes the relationship between the Cambodian staff members who have been working to improve maternal and child health in response to local needs, and the Japanese staff members who have been helping them with technical support, as "colleagues who have worked hard together." She continues, "We share the idea of cooperating to improve Cambodian maternal and child health, rather than the idea of supporting or being supported. We are working together on projects so that mothers and their babies can live a better life together." The strong bond that has been built across borders in hope of a healthy life for mothers and children will no doubt continue to bridge the river for many years to come. ✻

Doctors learn how to use ultrasound to check the baby's heart in the Neonatal Care Unit at the NMCHC. Midwives, doctors, and students from across the country have been trained there.

# Genome Catalog Opens Up Future of Individualized Cancer Treatment

The Pan-Cancer Analysis of Whole Genomes, an international project involving 37 countries, has analyzed entire cancer genomes. Japanese experts participated in the project that has made a major contribution to building a foundation for genomic treatment of cancer.

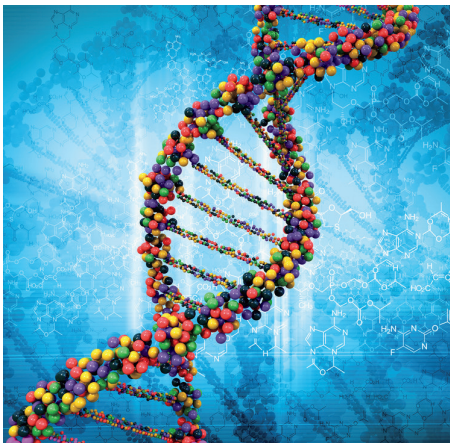
Cancer is a disease that arises from an accumulation of mutations and abnormalities in our genomes, the genomic information in DNA that provides the blueprints for our bodies. Identifying how a normal genome mutates to become cancerous is an essential step in developing individualized therapies and drugs.

The Pan-Cancer Analysis of Whole Genomes (PCAWG), an international project involving 37 countries, analyzed the genomic information of 2,834 samples from 38 types of cancer. According to the findings released in February of this year, the research has identified over 46 million genome variations and their traits. It is a groundbreaking success that could form the basis for effective therapy options for cancer patients.

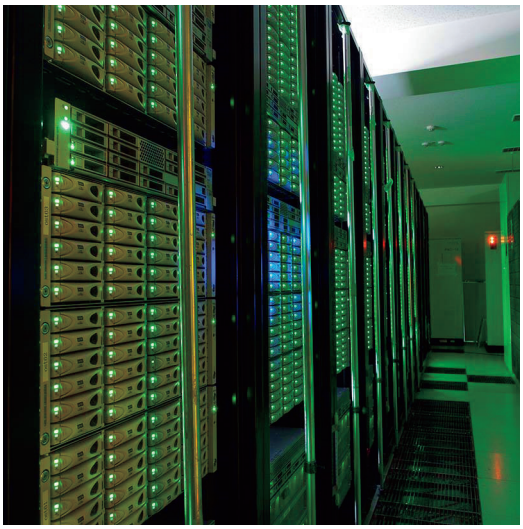
More than 1,300 cancer researchers and engineers participated in the project. Japanese members who contributed to the analysis include team leader NAKAGAWA Hidewaki,

According to Nakagawa, the PCAWG regularly meets face-to-face and has created a valuable network (Boston, 2016).

Nakagawa said, "We must consider how we can apply this project to the treatment of cancer."



Even in patients with the same type of cancer, the effectiveness of drugs and the side effects they produce can differ depending on slight differences in the base sequence of the cancer's genomes.



In the life sciences, SHIROKANE has greater computational power than any other supercomputer in Japan. The latest version, Shirokane 5, shortened the time required to analyze the data relating to an entire genome from over 10 hours down to as little as one hour and 45 minutes, a huge improvement in speed.

from the Riken Center for Integrative Medical Sciences, and Dr. IMOTO Seiya, professor at the University of Tokyo's Institute of Medical Science. Furthermore, Riken supplied data on 270 liver cancer patients, which accounted for 10% of the overall data.

The individual traits of the computer-identified mutation information were revealed by 16 working groups. As co-leader of the working group on cancer immunity and mitochondria, Nakagawa guided young researchers from around the world while also contributing to analyzes by other groups.

"This project was groundbreaking for having made comparisons across various cancers using a global-scale network," Nakagawa says, adding, "We were able to deduce the processes causing mutations in different kinds of cancer and their similarities. Before, our understanding of that was unclear. I expect that this research will lead to the discovery of drugs and the development of new treatments tailored to individual patients."

To complete the database, an enormous amount of data required analysis, which would not have been possible without technological advances and international cooperation. The SHIROKANE supercomputer at the University of Tokyo, along with nine other supercomputers around the world working together, facilitated that analysis by creating a single, gigantic computing environment.

Dr. Imoto, who was involved in the project, reflected on the work, saying, "This was a first-time effort at sharing such a huge amount of genomic data internationally. When two groups are working on the same data, the data must be analyzed via the exact same means. The analytical programs had to be identical. In Japan, we addressed the issue of system configuration very carefully to find a solution, then shared the solution with others around the world. That was a major contribution."

A particular cancer is essentially one of an array of genomic variations. A drug may not work on two patients with the same type of cancer if the mutations exhibit different patterns. The completion of the "cancer catalog" simplifies the task of ascertaining the mutations associated with an individual patient's cancer. We are now on the cusp of an era when we will be able to select therapies customized to a person's cancer genome. ✻

Dr. Imoto of the University of Tokyo said, "This era of dramatic technological advances led to our analysis of entire genomes."

# Cutting-edge Operating Theater Connected by IoT

Previously, surgeons only had their individual skills to rely on. Now that has been transformed by advanced technology in the surgical theater: teamwork is led by Japanese medical science and middleware technology to improve safety.

The interior of Hyper SCOT at Tokyo Women's Medical University, equipped with leading-edge technology, including a robot bed, open MRI, and organic electroluminescent lighting. More than 20 medical devices are networked via OPeLiNK, forming a futuristic space resembling an aircraft pilot's cockpit.

*SCOT® is a registered trademark of Tokyo Women's Medical University.
*OPeLiNK® is a registered trademark of OPExPARK.

The Smart Cyber Operating Theater (SCOT®), in which Japanese technology companies bring their expertise, such as utilizing the Internet of Things (IoT), to the site of leading-edge medical practice, is working at the operating table at last. When the medical devices and equipment in an operating theater are connected and linked to a network, vast amounts of data concerning the progress of the operation and the patient's condition can be comprehensively processed to improve the precision and safety of the surgical procedure.

SCOT is an advanced system that integrates an open MRI scanner and a surgical navigation system with other medical devices used during surgery, such as a rapid diagnostic test system, a 4K3D microscope monitor, and a surgeon's cockpit. A prototype was constructed in 2016. In 2019, Hyper SCOT, the newest version, designed to incorporate advances in robotics and AI, became available for clinical research at Tokyo Women's Medical University. The staff there was the first to use the newly integrated system to conduct brain surgery, with successful results that confirm the value of the approach. Since then, use of Hyper SCOT has steadily been increased within clinical research, including 46 neurosurgical procedures, mostly to treat brain tumors (as of April 8, 2020).

MURAGAKI Yoshihiro, professor at the Institute of Advanced Biomedical Engineering and Science at Tokyo Women's Medical University, explains the significance of the breakthrough.

"Until now, operating theaters have been full of equipment working independently of each other, and data obtained from monitoring the patient, images of the surgical field, and the operating condition of the devices have been displayed


Professor of Advanced Techno-surgery MURAGAKI Yoshihiro (right) of the Institute of Advanced Biomedical Engineering and Science and OKAMOTO Jun (left), a specially-appointed instructor in the same field, both at Tokyo Women's Medical University. Professor Muragaki, director of the Medical AI Center, is an authority on neurosurgery and a world leader in advanced medical science. Okamoto is a developer of iArmS, a surgical robot.


Dr. OKUDA Hideki is executive vice president and founder of OPExPARK, and project general manager of the Social Solution Business Development Division at DENSO. He is involved in researching robotics for medical applications. In addition to his involvement with the SCOT development team, he earned a Ph.D. in medicine from the graduate school at Tokyo Women's Medical University.

without reference to each other, but with SCOT, all the data generated during surgery are synchronized on the same time axis. The data can then be shared over a network in real time with a surgical strategy desk, enabling diagnosis by third parties. The system accommodates telemedicine, allowing even a relatively inexperienced physician to perform advanced surgical procedures under the guidance of a fully-experienced physician."

The platform for connecting all the devices is the OPeLiNK® interface, sometimes called the "brains" of SCOT. The core technology of OPeLiNK is ORiN (Open Resource interface for the Network), which is industrial middleware that is now being used in smart factories around the world. The driving forces behind the development of SCOT were DENSO Corporation, a well-known Japanese automotive components manufacturer, and Professor Muragaki's team. OKAMOTO Jun, a Ph.D. in engineering who is part of the team, says, "Surgical navigation is like an automotive navigation system because it shows the exact location of the body being operated on. But it also acts like a flight recorder on an airplane, keeping a record of all the details, such as the path of an electrical cautery knife used by the surgeon, and showing that on the screen, so that everything can be accurately verified during and after the operation. Information that was previously known only to the veteran surgeons is converted into data that other doctors can access."

Another member of the development group, DENSO's OKUDA Hideki, describes how the company, an automotive firm, approached the field of leading-edge medicine.

"In the automotive business, safety and human lives matter more than anything else. Accordingly, the Japanese automobile manufacturing sector, with its overriding concern for safety and reliability, is already suited to designing medical solutions that save human lives. The automotive industry is already expanding its concept of an automobile from just a mobility device to a service that utilizes applications. Medicine is part of that—the age is coming where new values are created by introducing the IoT."

In October 2019, Okuda and others led the establishment of OPExPARK Inc., a start-up established to accelerate the commercialization of the technology. The first phase of its business involves the launch of an online surgical training service that provides data collected with SCOT to surgeons worldwide. Over 2,000 people have already signed up, mostly neurosurgeons in emerging countries. With surgeons applying SCOT data to their studies, we are entering an era distinguished by a more sophisticated level of medical care.

Now that it is equipped with OPeLiNK, the most practical platform in the world, the day is not far off when SCOT will become one of the primary tools used in operating rooms in hospitals worldwide. ✻

Ultra-high-definition 4K monitors showing comprehensive information from various medical devices within the SCOT theater. The surgery navigation screen, along with the ECG (electrocardiogram) and other physiological data, can be shared with distant medical centers.

# Educating the Next Generation of Global Citizens in Georgia

## International Charter Academy of Georgia works to build bridges between Japan and Georgia

It's fitting that a state with cultural and economic ties to Japan dating back 50 years is now home to a school where children from those two cultures can study alongside one another in pursuit of becoming global citizens.

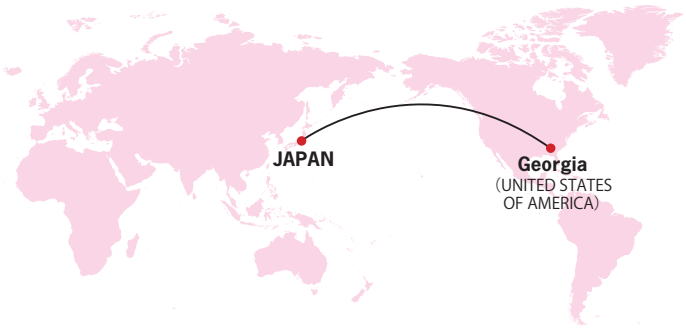
International Charter Academy of Georgia (ICAGeorgia), the state's first Japanese-English dual language immersion school, opened its doors in fall 2018. The school is a statewide charter school available free of charge to any K-5 student residing in Georgia. ICAGeorgia uses the dual language model to provide both Japanese and English instruction, where the ratio of time spent studying each language favors Japanese in the younger grades and shifts to balance more evenly between Japanese and English as students age. In general, students at ICAGeorgia spend part of their day immersed in Japanese-speaking classes and the rest of the day in English-speaking classes. During both Japanese and English immersion, students are exposed to a wide range of content learning areas, such as Math, Reading, Science, Social Studies, Art, Music and Physical Education. Specifically, kindergarten students are immersed in Japanese and English instruction at a ratio of approximately 80 to 20 percent. Grades 1st and 2nd are immersed 60 to 40 percent and Grades 3rd, 4th and 5th are immersed 50 to 50 percent.

Teachers at the school, all of whom are native speakers of the languages they teach, work hard to ensure that students attain a high level of language proficiency by using the Japanese Ministry of Education curriculum in the Japanese department and complying with State Performance Targets and the Georgia Standards of excellence in the English department. Additionally, English and Japanese core content, ESOL (English for Speakers of Other Languages), and JSOL (Japanese for Speakers of Other Languages) teachers collaborate across departments during team meetings and professional development to improve instruction, increase student achievement and ensure the success of both native and non-native Japanese and English learners. Overall, teachers help students use what they know in one language as a resource for acquiring and refining their proficiency in their partner language.

Beyond learning Japanese language, ICAGeorgia students experience elements of Japanese culture and school life including, but not limited to, moral

**Principal and Board Members**

The authors from left: Tara Ranzy, Principal; Minako Ahearn, Founder and Governing Board President/Chair; Robert Johnson, Governing Board Vice Chair; and Jessica Cork, Governing Board Secretary.




education, student leadership, *shigyoshiki* (start of new school year ceremony), *mochitsuki* (rice pounding), *kakizome* (first calligraphy), tea ceremony, haiku, and so on. Students also learn about one another's cultures in what is a very diverse community. Non-native learners of the English language comprise about 41 percent of the student body. Approximately 30 percent of students are Asian, 26 percent are black, 6 percent are Hispanic, 26 percent are multi-racial, and 10 percent are white. Students represent over 20 countries and speak nearly as many languages.

The Principal, Tara Ranzy, describes ICAGeorgia as "a multi-ethnic, multi-racial, multi-linguistic community working together to promote world peace through the exchange and mutual respect of both Japanese and American culture and languages." During a recent Monday morning assembly, she asked students to look around to observe the incredible diversity: "People with different color skin, different hair texture; we see boys, we see girls, women, and men; people of different shapes and sizes. Some of us speak Japanese, English, Spanish, French, Korean, Mandarin, Arabic, and so on. Some of our parents were born in Haiti, South Korea, Bulgaria, Mexico, Jamaica, China, Japan, Florida, Georgia, Cleveland and so on." She asked, "Are you taking advantage of the opportunity to respect each other, work together, and learn from one another? At our school, success is *not only* earning good grades; success is also your ability to work with people who are different." At the end of this lesson, she challenged the community to have lunch with someone who is different from themselves, or help a classmate with different color skin or hair texture, or of a different shape or size. At ICAGeorgia, world peace is promoted through day-to-day interactions like these, care and consideration.

ICAGeorgia Founder and Governing Board President/Chair Minako Ahearn, comments, "We must learn to help each other because the world is interconnected. Every day, we are finding out that our local news is no longer local, but global. The service-learning activities like the ones being led by our principal will be the first step toward the children learning to serve not only locally, but globally. Children and adults both find it hard to think beyond our immediate crisis and suffering. That is why I frequently pose the question to the children: 'What do you want to see 100 years from now?' I like to quote from *Hyaku-nen-go no furusato o mamoru* (Protect your hometown 100 years from now), a true story that appears in a Japanese textbook. In the 1800s, a man saved many lives from a large earthquake and tsunami, and then led his community to plan against future tsunamis. We challenge our students to imagine 100 years ahead and serve globally."

According to current midyear survey data, ICAGeorgia families and staff love the "family feel, innovation, strong PTO, diversity, and warmth of the teachers and faculty." When asked, "What do you love about ICAGeorgia?" students replied, "The teachers are gentle, nice, hard-working and easy to understand." They

also described the environment as "peaceful." One child said, "I like how everyone is a part of one big community in peace." Another stated, "I think our school is special."

Vice Chair of the ICAGeorgia Board, Robert Johnson, agrees that ICAGeorgia is a special place. "The diverse student body of ICAGeorgia is truly a reflection of Japan's profound economic, social and cultural influence in Georgia and around the globe. The miracle of ICAGeorgia today is that as a public charter school, we now can offer to more young citizens of Georgia the unique opportunity to study and learn Japanese, which is one of the most beautiful languages in the world and the key to the heart and soul of Japan!" Board Secretary, Jessica Cork, agrees. "I have chosen to send my children to ICAGeorgia not only because I want to share with them my love for the Japanese language and the culture of Japan, but also because I want them to understand that the world is an incredibly diverse place, made more wonderful because of its amazing variety. I know that ICAGeorgia is preparing my children to understand and appreciate the perspectives of others, co-exist peacefully with those who differ from them, and work effectively in an increasingly interconnected world."

The choice of Georgia for a school like ICAGeorgia is an obvious one given the state's economic ties with Japan. Japanese manufacturers began establishing operations

in Georgia in the early 1970s under the leadership of then-Governor Jimmy Carter. Official relations were inaugurated in 1973 with the establishment of a Georgia State Department of Industry, Trade and Tourism office in Tokyo, the first such office for any U.S. state. The opening of the Consulate General of Japan in Atlanta in April 1974 offered a major boost in bilateral political relations. Today, with over 600 Japanese-affiliated companies operating in the state, Georgia is regarded as the center of Japanese industry in the U.S. Southeast. Japanese-affiliated companies have invested $10.4 billion in Georgia and employ nearly 37,000 Georgians. Some major Japanese firms with operations in Georgia include Kubota, Murata, Panasonic, Ricoh, TOTO, Toyo Tire, Yamaha, and YKK. Georgia's imports from Japan amount to over $4 billion, making Japan the 5th largest international importer, and Georgia's exports to Japan amount to over $1 billion, making Japan the 6th largest export market. Over 50 Georgia companies have operations in Japan including Aflac, Coca-Cola, Delta Air Lines, NCR, Newell Rubbermaid, and UPS.

Japanese has proven to be a valuable language for study given the opportunities afforded by these ties. Yet recent national studies reveal that foreign language instruction is rare in American elementary schools, and only 15 percent of the nation's high school students study a language other than English. This is quite different in other countries, where studying a second language is the norm. In Georgia, foreign language study is also limited, and yet, as the United States works to increase its influence and strengthen its economic position abroad, Americans who communicate in more than one language can gain personal, educational, and professional advantages. Preparing students for such opportunities is a major objective of the ICAGeorgia Language Immersion Program. Moreover, research has proven time and again the benefits of dual language immersion education. Lindholm-Leary (Dual Language Education, 2001) found that students who speak two languages often have more mental flexibility, superiority in concept formation, and a more diversified set of mental abilities.

The establishment of International Charter Academy of Georgia is further recognition of the strong partnership between Georgia and Japan and the importance of raising the next generation of leaders who can sustain and build that relationship in the 21st century.

For further details about the school, visit www.internationalcharteracademy.org ✻

# Pursuit of Clean Oceans Driven by Locals in Ishikawa

## — Visit Ishikawa and save its rich ocean waters of the Sea of Japan —


Ishikawa Prefecture, which faces the Sea of Japan, has prospered notably since the Edo Period (1603-1867) thanks to one of the country's most prominent castle towns, which also has been a center of culture and the arts. Today that city is Kanazawa, the prefectural capital, which is home to several tourist attractions that hark back to that history. Examples include Kenroku-en, one of Japan's three great gardens, and the Higashi Chaya District, a historic quarter that still retains its original atmosphere.

Ishikawa Prefecture is also blessed with abundant nature. Along the seaside coast, which stretches 581km from north to south, there are numerous picturesque spots, such as the Chirihama Nagisa Driveway, the only route in Japan where one can literally drive on the edge of the sea, and the expansive rice terraces of Shiroyone Senmaida, which are inscribed on the Globally Important Agricultural Heritage Systems, Noto's Satoyama and Satoumi.

In addition to its wonderful seasonal scenery, Ishikawa possesses rich fishing grounds. In recent years, however, ocean garbage has cast a dark cloud over that setting. Ocean currents and seasonal winds wash up trash onto the Sea of Japan coast, and even drifting boats can flow into the area, especially during winter. Meanwhile, with each passing year, the amount of plastic waste drifting ashore from nearby countries grows ever larger. For 25 years, the prefecture has been active in organizing coastal cleanup drives, such as those promoted on local radio.

Going back even further, members of the Sodegahama Beautification Club in Wajima, a city in the north of the prefecture, have been involved in seaside conservation since 1970.

Kanazawa is an old city and one of Japan's premier tourist destinations. It is a popular place to visit by both domestic and international travelers due to the distinctive atmosphere of its streets.

Shiroyone Senmaida in Wajima is a place of great scenic beauty. The terraced rice paddies, carved into steep slopes, are farmed according to traditional methods of cultivation.

A huge amount of garbage drifts ashore onto the beaches of Wajima City. Much of the plastic waste has labels with text from non-Japanese languages.

Many people come to the beach at Sodegahama in summer to jump into the water and swim. In fact, it has been selected as one of the 100 most pleasant places in Japan to swim in the ocean. The beach, which runs along a large inlet, is famed in the country for its view of the gorgeous setting sun as it dips below the Sea of Japan.

The club was originally formed spontaneously by people who cherish Sodegahama. According to a man among their membership who takes it upon himself to clean up the beach once a week, there has been a dramatic increase in plastic waste as of late. In 2018, the city of Wajima disposed of 415 tons of garbage that had drifted ashore. With urgency, the man says, "Since long ago, this has been a great place for casting a line or spearfishing. I want people to know what a big impact their casual littering has on the environment." Over time, these volunteers' efforts have gained notice within the local community, among whom they have recruited like-minded people. They are also raising awareness in nearby coastal areas among younger people who will one day lead their communities, through activities that include an annual survey of trash on the shore by elementary students.

The problem of garbage washing up on the seaside is not limited to just one region. At the G20 Summit in June 2019, countries agreed to swiftly take action both nationally and internationally, in partnership with relevant stakeholders, to prevent and significantly reduce discharges of plastic litter and microplastics to the oceans. In addition, the "Osaka Blue Ocean Vision," which aims to reduce additional pollution by marine plastic litter to zero by 2050, was shared. Even so, the amount of plastic litter carried across the sea continues to increase unabated. Today, the people of Ishikawa continue their battle against ocean garbage. For the sake of a future where people and marine life can live in health and harmony together, it is important to know that there are people today keeping up their steady efforts to tackle the problem. ✻

This local resident is a member of the Sodegahama Beautification Club. Diligently cleaning up the trash, he says, "I do it because I love this beach."

The world's largest facility for producing hydrogen using renewable energy is the Fukushima Hydrogen Energy Research Field (FH2R).

UPDATE

# Giant Leap Towards a Hydrogen Society


The world is looking towards hydrogen as a next-generation clean energy source. In Japan, the Fukushima Hydrogen Energy Research Field was completed in March 2020. With the start-up of the world's largest hydrogen production facility, a giant leap towards the realization of a hydrogen society has been made.

Hydrogen, unlike petroleum or coal, produces no carbon dioxide when used. It can also be produced from a variety of resources, allowing renewable energy sources, such as solar, wind, and biomass, to be used. Thus, the entire process, from production to utilization, can be nearly carbon-free, which is indispensable for achieving the Sustainable Development Goals (SDGs) of climate action and affordable and clean energy.

Amid calls for a global conversion to clean energy, Japan is leading the world by applying its technological strengths, such as introducing the world's first commercially viable fuel-cell vehicle (FCV), moving forward to the realization of a hydrogen-fueled society. Japan is also showing leadership in other ways, such as through the action plan known as the Basic Hydrogen Strategy, established in 2017, and by hosting the Hydrogen Energy Ministerial Meeting, which in 2018 was the world's first cabinet-level discussion devoted to the issue.

In those efforts, a vital role is played by the Fukushima Hydrogen Energy Research Field (FH2R), completed in March 2020. Equipped with a 10,000kW class hydrogen production facility, the plant is producing hydrogen by

At the FH2R opening ceremony, Prime Minister Abe took a test ride in an FCV. When automobiles fueled by hydrogen generated by renewable energy become more widespread, it will contribute greatly to reducing $CO_2$ emissions.

utilizing electricity generated from solar panels arrayed around its perimeter. Enough hydrogen fuel can be produced at the facility every day to supply power for about 150 households (monthly consumption), or to fill 560 FCVs.

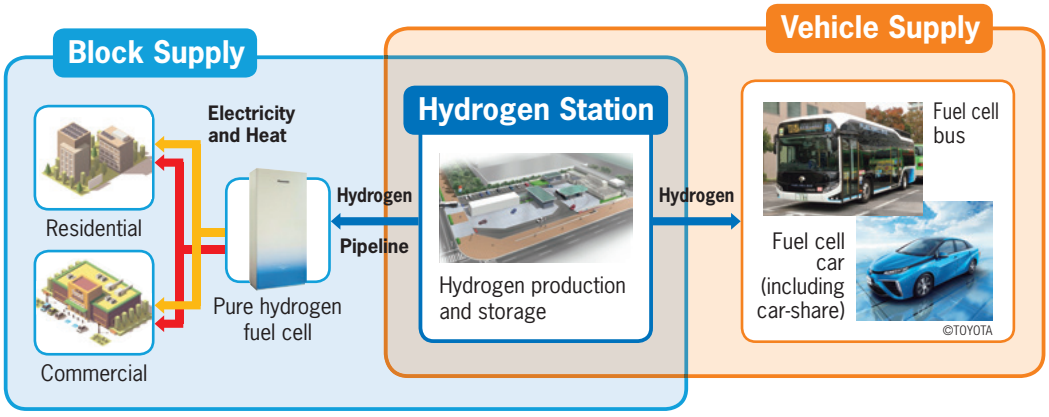
Achieving a hydrogen society requires promoting the total integration of the making, storing, and using of hydrogen. A particularly critical issue is responding to fluctuations in electrical power when the hydrogen is made from renewable energy sources that vary according to the weather and other factors. FH2R uses information from a hydrogen demand-and-supply forecasting system for predicting the market demand for hydrogen, and additional data from a power grid control system, so as to maximize the use of electricity from renewable sources. The goal is to develop the most efficient hydrogen energy management system.

Compared to conventional energy, hydrogen offers new possibilities for storing and transporting energy, necessitating the development of appropriate methods. Accordingly, based on an understanding of hydrogen's properties as a fuel, verification of the safest management and transportation methods is being carried out. The operation of FH2R, where verification tests can be run on the entire process—from making to storing—is a giant leap towards realizing a hydrogen society.

In Japan, the stage of using hydrogen began prior to the stage of making and storing. Iconic examples are the Ene-Farm fuel-cell (for residential use), Mirai (the world's first fuel-cell vehicle), and the introduction of fuel-cell buses on Tokyo's metropolitan bus lines and elsewhere. Moreover, the Olympic Village area in Tokyo will be furnished with a hydrogen station, a hydrogen pipeline, and pure hydrogen fuel cells. When the Olympic and Paralympic Games Tokyo 2020 finally end, the area will be designated for residential and commercial use, and will utilize the electricity generated from these facilities. Buses and automobiles equipped with hydrogen fuel cells are being introduced as a legacy of the Tokyo 2020 Games, enabling Tokyo to be a model of an environmentally-advanced city transitioning towards a carbon-free society.

Hydrogen, a clean fuel that can be stored and transported, provides flexibility and new possibilities to society beyond what was previously available with conventional energy sources. With humanity facing so many problems in need of solutions, great hopes are being placed on the switch to hydrogen. ✻

The Olympic Village area for the Tokyo 2020 Games is designed as a model of advanced urban planning, utilizing hydrogen fuel.

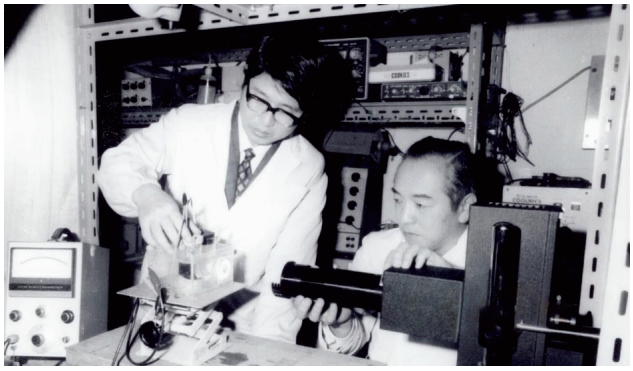



Utilization of hydrogen in the Olympic Village area. Not only is the hydrogen supplied from a hydrogen station used as bus and automobile fuel, but plans also include broadening the extent of practical applications for utilization in residential and commercial facilities.

# Artificial Photosynthesis Changes $CO_2$ into Energy

Fuel can be produced by combining the hydrogen produced from solar energy with greenhouse gases emitted by humans. A method to convert $CO_2$ into energy has been proposed by Dr. FUJISHIMA Akira, the discoverer of photocatalysis.

It is not widely known that the glass pyramid in the courtyard of the Louvre Museum in Paris has a transparent coating that exhibits an antifouling effect upon exposure to natural light. Dr. FUJISHIMA Akira, a Japanese researcher, pioneered the discovery of that photocatalysis reaction, which involves the principle of breaking down dirt without using any energy or incurring any cost. Although photocatalysis has been widely developed and put into practical use in the areas of antifouling and antifogging, research on artificial photosynthesis—the process of extracting hydrogen through photocatalysis—has also been garnering significant attention in recent years as a technology with the potential to contribute to a decarbonized society.



Fujishima (left) conducting an experiment with Dr. Honda in 1967. Initially, nobody believed the pair's findings, namely, that water could be broken down with light energy alone.

It was in 1967, while he was at a graduate school under the supervision of the late Dr. HONDA Kenichi, that Dr. Fujishima, alongside his supervisor, discovered the photocatalysis reaction. This phenomenon produces hydrogen and oxygen when titanium oxide is exposed to light under water, in effect reproducing the redox (or oxidation-reduction) reaction similar to that of photosynthesis in plants. So excited was Dr. Fujishima with his discovery—the knowledge that oxygen could be extracted simply through exposure to light—that he was unable to sleep for some time.

Dr. Fujishima's paper, written jointly with Dr. Honda, was published in the journal Nature in 1972, following which the photocatalysis reaction became known as the Honda-Fujishima effect. Ever since the oil crisis of the 1970s, the process of being able to extract hydrogen through photocatalysis has been greatly anticipated as a source of alternative energy to replace oil, and researchers around the world have been working on an efficient means to extract hydrogen via artificial photosynthesis using that principle.

With the United Nations

Photocatalysis acts as an antifouling and antifogging effect simply by the irradiation of light. It has also been used in the glass covering the pyramid-shaped entrance of the Louvre Museum. The glass maintains its transparent beauty by decomposing dirt.

Dr. FUJISHIMA Akira is the director of the Photocatalysis International Research Center at the Tokyo University of Science. He discovered photocatalysis reaction using titanium oxide while enrolled at the University of Tokyo Graduate School. That discovery was later called the Honda-Fujishima effect, with research on artificial photosynthesis then being initiated around the world.

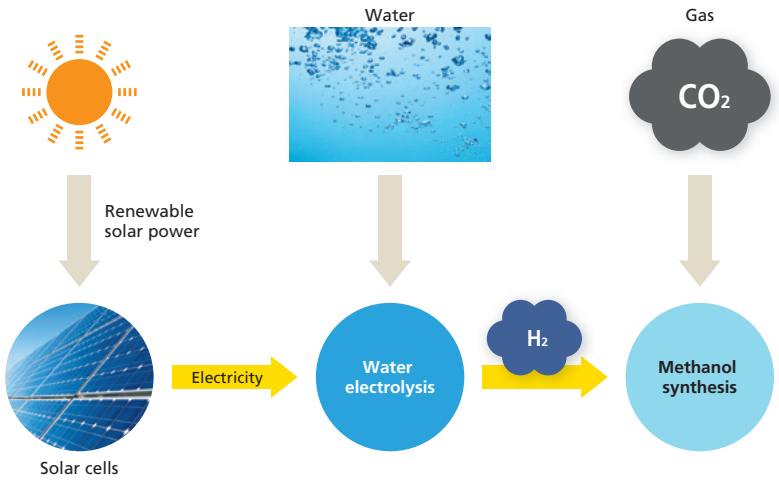
Sustainable Development Goals (SDGs) aiming to reduce greenhouse gases, research on artificial photosynthesis has been increasingly gaining pace, though many challenges still remain. Dr. Fujishima says, "To achieve the practical applications of hydrogen production using artificial photosynthesis, the high efficiency of hydrogen extraction is, of course, the basic key factor. However, the other key factors are whether we can find a catalyst that satisfies the remaining various conditions; this includes whether the materials used as catalysts can be easily obtained, whether a large surface area photocatalyst can be manufactured, and whether any harmful substances are contained in the material. We are waiting for a breakthrough for those things in the future."

Along with the shift to replace fossil fuels with renewable energies such as hydrogen, another important measure to achieving a decarbonized society is carbon recycling, effectively using $CO_2$ as a resource. In consideration of that viewpoint, Dr. Fujishima has proposed the following method; first, extract hydrogen through water electrolysis using the electricity produced from highly efficient solar cells. Next, combine the extracted hydrogen with the $CO_2$ emitted from power plants and factories to produce methanol, which can be used as an energy source. If this process is realized, gases containing carbon, such as $CO_2$, will no longer contribute to the greenhouse effect. Rather, those gases will become "resources" to replace oil and natural gas.

Dr. Fujishima currently heads the Photocatalysis International Research Center at the Tokyo University of Science, where he is leading research on further progress of photocatalysis in the fields of the environment and energy. "I think it's important for science to contribute to the world," he says. Based on his discovery, a decarbonized society, where even $CO_2$ is used as a resource, will soon be realized.

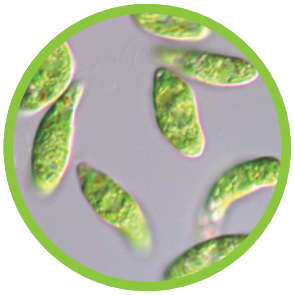
## Converting $CO_2$ into a resource toward a decarbonized society

Generating new energy from sunlight, water, and $CO_2$



# Algae from Japan: Energizing Population and Transportation Networks

The world has always been beset by many problems, but what if there were something we could do to address many of the big ones all at once? A microbe from Japan could provide the means.



Pictured above are microalgae euglena.

The microbe in question is called euglena. At about 0.05 millimeters wide, or 50 microns, it is a type of algae, but possesses the properties of both a plant and an animal. The well-balanced nutritional composition from those two kingdoms makes euglena highly nutritious. Owing to euglena's potential as an excellent source of food, countless attempts have been made to cultivate the microbe on a large scale, but due to its high nutritional value, euglena is also a favorite food of predators such as other bacteria. That poses challenges to cultivation.

Euglena Co., Ltd., a Japanese company, was the first in the world to cultivate euglena on a large scale, and it did so outdoors. It all began when CEO and President IZUMO Mitsuru visited Bangladesh during his university years. In Bangladesh, about 5.5 million children aged five or younger—36% of the total—suffer from stunted growth due to poverty-induced malnutrition.[1] Searching for a way to do something about that, Izumo learned about euglena. He then acted, believing that the microbe could change the world.

At first, Izumo experienced great difficulties with production, with an output equivalent to only one or two grains of rice per month.


Izumo hands out euglena cookies to Bangladeshi children.


The day is approaching when biofuel extracted from euglena will power not only buses, but also aircraft.

But after achieving large-scale cultivation through several years of research, the company received halal certification in 2013 to serve Bangladesh's citizens, the vast majority of whom are Muslim, and in 2014, it produced cookies containing euglena, launching the Euglena "*GENKI* (Healthy)" Program to distribute the treats for free to Bangladeshi children. Because the ingredients contain the microbe, just six cookies are enough to provide a Bangladeshi child with the required amount of daily nutrition. Thus far, over 9.5 million packs of cookies have been handed out in six years through the program.

In addition to its nutritional value, euglena has also garnered notice for its value as a biofuel ingredient. Instead of using fossil fuels, biofuels are made from biological substances, and their use reduces the $CO_2$ emissions that cause global warming. That is why the EU has declared that it aims to replace 32% of fuel used for transportation with biofuels by 2030.

To make biofuel from euglena, the oil produced by the microbe during its growth is extracted and refined along with other raw materials. The fuel can be used for trucks, buses, airplanes, or other vehicles. Although some $CO_2$ is emitted when burning the fuel, it comes from the air used by the microbe during its growth process, meaning that in the end, euglena biofuel results in fewer $CO_2$ emissions than fossil fuels. While conventional biofuels, using such foodstuffs as maize (corn) or sugarcane, come with the downside of pushing up demand and driving up prices, that problem can be avoided by using euglena instead. The microbe's cultivation is even possible in deserts, making it a potential solution for resource-poor countries such as Japan.

In 2014, Euglena Co., Ltd. blended the euglena-based original biofuel with conventional fuel to power shuttle buses. At a meeting associated with the G20 Summit in 2019, the firm showcased standard-sized automobiles navigating public roads using that biofuel. By that time, it had achieved further advancements so that a vehicle could run on the biofuel alone, without placing any unusual stress on the engine. Earlier, in 2018, a demonstration plant was completed, obtaining ASTM D7566 certification in 2020. That international standard is the specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons, as set by ASTM International, which offers global standards development. The certification will allow the company to begin work on producing biofuel for aircrafts.

"Desiring to make a contribution to the world through biotechnology," Izumo continues to make advances with his little green microbes. ✻


Euglena Co., Ltd.'s biofuel production plant will be fully operational in 2020, after completing a two-year trial.

[1] WFP Bangladesh Country Brief December 2017

# Controlling Wildfires with Japanese Eco-friendly Technology

Forest fires occur all over the world, particularly in the Amazon and Australia. An eco-friendly soap-based foam extinguisher, made from a naturally derived soap developed in Kitakyushu, Japan, is expected to be diffused at forests and other sites.

The Shabondama Soap Co., Ltd., a soap manufacturer in Kitakyushu City, Fukuoka Prefecture, developed the world's first soap-based fire-fighting foam in 2007, in collaboration with other manufacturers, academic researchers and local governments. Because naturally sourced surfactant is used, the foam biodegrades rapidly, and since the soap, the basis of the foam, binds with mineral components in nature, the environmental impact is greatly reduced, including its effect on nature and the ecosystem. Another advantage is that the amount of water needed to extinguish fires is significantly less than what would otherwise be required with water alone.

A request to develop a new type of fire extinguisher unexpectedly found its way into the soap maker's office in 2001. Ever since the giant Kobe earthquake of 1995, considerable attention has been given to the idea of a fire-fighting foam that extinguishes fires with a reduced amount of water. However, the petroleum-based surfactants found in fire extinguishers produce foam with poor biodegradability, and when that type of foam flows into rivers and rice paddies, the result is a serious loss of life among microscopic organisms in the water and soil. Sensitive to

Field tests on peatland fires in Indonesia. With its high osmotic force, the foam can extinguish all embers in the peat.


Top:The Fire Department of Kitakyushu, a city designated as an SDGs Future City in Japan, is proactively using the eco-friendly foam to fight fires.
Right: A soap-based fire-fighting foam formulated from naturally-sourced soaps, made solely from vegetable fats and potassium hydroxide.

such environmental concerns, the Kitakyushu City Fire and Disaster Management Department placed a request with Shabondama Soap, which had already developed and produced a soap free of synthetic surfactants, fragrances, colorants, and other additives.

The path to development, however, was far from smooth. In order to satisfy technical criteria, such as not causing metals to corrode, and performing dependably regardless of temperature fluctuations, while still producing a suitable foam, a research group from the University of Kitakyushu was asked to participate, and over 800 formulations were tested over a seven-year period. Although he faced a long bleak period without any results, MORITA Hayato, president of the company, said, "We have a corporate culture that withstands setbacks." In 1974, under Morita's father, Mitsunori, the previous president, the company had switched from synthetic detergents to making and marketing additive-free soaps, but that product would not become lucrative for another 17 years. That experience of acting on a strong conviction of "never selling anything known to be harmful to human health or the environment," with all the employees coming together to ride out the hard times, is a lesson that is still remembered.

Currently, field tests of the soap-based fire-fighting foam are underway to develop the most practical way of bringing its superior fire-extinguishing power and good environmental performance to actual wildfires in regions such as South America and Southeast Asia. In 2013-2015, as a project commissioned by the Japan International Cooperation Agency (JICA), fact-finding surveys and verification tests were conducted in Indonesia on peatland fires. The survey found that "The soap-based fire-fighting foam can be an effective agent for extinguishing peatland fires because of its high fire-fighting performance and low environmental impact." Adopted by a JICA's SDGs Business Verification Survey with the Private Sector in 2017, Shabondama Soap is even now focusing on further expansion.

Soap-based fire-fighting foam can extinguish fires using less water, therefore addressing the problem of a lack of water available to douse flames in many wildfires. The foam also retains high permeability and helps moisture to reach embers buried within peat, thus also offering the potential to extinguish peatland fires that continue to smolder deep underground. Consequently, the foam holds the promise of being useful against different kinds of wildfires. "If an eco-friendly fire extinguisher becomes widely available, more of the natural environment will recover and eventually be passed on to our children. I feel a sense of mission, namely, that our technology can make a tremendous contribution to the world," says Morita enthusiastically. ✻

Morita, the president of Shabondama Soap Co., Ltd., eagerly shares his view, saying, "I want the foam to have a global appeal."

# Improving the Quality of Life in Kenya with Irrigation Support

Irrigation expert YAMADA Junichiro, dispatched from Japan to the Government of Kenya to improve that country's rice producing capacity, is advancing close-knit support for Kenya through human exchange and contributing to the future of its agriculture

"When a farmer tells me how Japanese aid activities are gradually improving everyday food lifestyles or giving people educations that were never possible before, I find it very rewarding," says irrigation expert YAMADA Junichiro, a professional agricultural engineer, who has been dispatched from Japan to Kenya. Yamada, currently stationed at the national Ministry of Water & Sanitation and Irrigation, is engaged in agricultural policy related to surveying and planning.


Located on the east coast of Africa, the Republic of Kenya generates roughly 40% of its GDP through agriculture, forestry and fisheries, and these industries employ more than 40% of its workforce. The traditional staple food of Kenya is *ugali*, made from cornmeal, but in recent years, the consumption of rice has been growing due to its great taste and simple preparation. However, Kenya's self-sufficiency ratio of rice is only 10% or more, and the improvement of Kenya's rice production capacity has become an

Yamada (fourth from right) at a pumping station of the Ahero Irrigation Scheme, a project site of CaDPERP, together with local farmers.

The Mwea Irrigation Scheme is Kenya's largest rice paddy region. Japan is providing support in multiple ways, including not only irrigation but also new rice strain development and cultivation techniques.

urgent issue.[1]

As most of Kenya is arid or semi-arid land, irrigation is essential for expanding agricultural land. In 2017, the Kenyan government set the objective of at least doubling the area of irrigated land over the period from 2018 to 2022.

Japan has assisted in those irrigation development efforts as part of the economic and technical assistance provided to Kenya over the years. Significant results have been achieved so far, particularly in the Mwea Irrigation Scheme, Kenya's largest paddy rice cultivation area, through such initiatives as Smallholder Horticulture Empowerment & Promotion (SHEP), which supports small-scale farmers, and Coalition for African Rice Development (CARD), which supports autonomous efforts aiming at expanding rice production. Those initiatives led to the launch of a scheme to dispatch abundantly experienced experts to governments there, with the aim to provide training and further strengthen collaboration with Japan. Yamada was dispatched to Kenya in May 2018. As rice is a traditional staple in Japan, paddy rice cultivation has a long history there. That accumulated knowhow has proved useful in Kenya, not only in infrastructural development such as rice paddy construction, but also for such tasks as providing technical guidance for farmers.

However, "Kenya cannot simply apply techniques from Japan or other parts of Africa without making any adjustments," explains Yamada. "Properly listening to the local governments and farmers is particularly important. My advice must be appropriately suited for the specific local regions, since the needs and outlook of each region are shaped by its unique characteristics and circumstances. Therefore, my stance is always to work together with the local people. Also, I share the challenging aspects of projects with my associates back in Japan so that it may provide a flow-on effect for future activities."

Yamada has actively visited each region of Kenya to listen first-hand to what farmers have to say. As people recognize JICA's long-standing contribution and find him easy to talk to, he has built friendly relationships. By seeing the improvements in quality of life brought by greater production capacity, farmers in Kenya are becoming more motivated, which is positively improving the results from the aid provided.

Launched in early 2019, the Capacity Development Project for Enhancement of Rice Production in Irrigation Schemes (CaDPERP) is providing further support to the national government for rice production in Mwea. This project is also advancing irrigation development along the eastern shore of Lake Victoria, which is another area with high potential for paddy rice cultivation.

Reiterating how enthusiastic both the government and the farmers are in Kenya, Yamada says, "Kenya has both ample land area and water resources, giving it excellent agricultural potential. With Japan's assistance, I think Kenya can further develop its agriculture, which will contribute to raising its overall standard of living." ✻

Right: In the Mwea Irrigation Scheme, the construction of a dam and waterways is steadily proceeding as a Japanese ODA loan project. Top: It is now common to eat rice together with meat and vegetables in Kenya.

[1] Economic Survey 2019, 2019, by Kenya National Bureau of Statistics.

# Empowering Disabled People Through Sport in Laos

Unbound by his own disability, HANE Hiroyuki is passionately promoting Para-sports while guiding people in Laos to greater social participation and autonomy

Even today in Laos, a country replete with abundant nature and friendly compassionate people, many unexploded ordnances remain from war. The number of people in that country with disabilities, including victims from such explosions, exceeds half a million, a number equivalent to roughly eight percent of the population. Many disabled people there have limited opportunities to participate in society, such as regarding employment.

One Japanese man is striving to change these circumstances through the power of sport. HANE Hiroyuki has been coaching Para-athletics in Laos since 2015. Actually, Hane himself has a disability, having lost the function of his left arm in a workplace accident. For a time, the disability had disrupted his life. But the turning point that liberated him from those days of struggle was his first encounter with Para-sports. Using the experience and knowhow he gained as a track athlete back in his student days, he eventually set Japanese Para-athletic records

Together with athletes of the Lao Paralympic Athletic Team. Hane (second from right) says that he wants to be seen as a role model for overcoming his own struggles with disability and illness.


Hane has added his own touch to the training regimes and has adopted effective warm-up exercises. Continuing to compete himself, he joins in with the training.

Having trained a medalist gives Hane great pride and self-confidence as a coach.

in both the triple jump and long jump. He even clinched a victory among able-bodied athletes in a masters' athletics championship.

"There are feats one can achieve even with a disability. By setting goals and challenging myself, my world changed dramatically. I wanted to use my experience to teach sports to people with disabilities in a developing country where there are few role models," he says.

At that time in his life, he came across ADDP, Asian Development with the Disabled Persons, which supports people with disabilities from various Asian countries, notably Laos. ADDP is a Japanese NPO whose main activity is encouraging self-motivation among the disabled through the promotion of Para-sports, as well as helping such people find employment. Upon learning of their work, Hane was driven into action by his passionately held belief: if not me, then who?

Hane, who trained visually impaired Para-athletes in Laos, not only coached them on technical aspects, but also worked on revolutionizing their mindset. For example, he taught them the importance of having goals and identifying what is important to achieving them. Empowered by their newly-acquired, self-directed learning skills, the athletes not only had a greater desire to train but also gained greater motivation to work. That was due to Hane's insistence upon the necessity of doing one's own job in order to earn the funds to continue competing. The athletes who understood that competed with more motivation than ever before, and one of them became the first ever bronze medalist from Laos in athletics at the ASEAN Para Games.

"Only fate will decide whether they will get to compete at the Tokyo 2020 Paralympic Games, but they are in with a good chance. I'm proud to have proven that athletes can achieve the elite level even in countries without a proper training environment, as long as they have a coach with the right knowledge."

In the developing nation of Laos, where people do not consider those with disabilities as special but naturally lend a helping hand to someone who is struggling, Hane believes that inclusive attitudes are actually more common than in developed nations. "I don't think it is difficult to realize an inclusive society—offering a few words is all that it takes. At the same time, I want disabled people to take action themselves and venture out more. I see that my greatest mission in the rest of my life is to contribute to society through broadening participation in Para-sports." ✻

**HANE Hiroyuki**

Born in 1965. After losing the function of his left arm at the age of 37, he participated as an athlete in jumping events in Para-athletics and masters athletics. Since 2015, while battling intractable polymyositis, he has been coaching Para-athletes in Laos and has shown much in the last five years. "I would like to try coaching in other countries in the future and establish Para-sports coaching as a career for others, too."

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