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Pioneers in agriculture

Mariangela Hungria and Li Jiayang share the prestigious TWAS-Lenovo Science Award

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▲ Top: TWAS-Mohammad A. Hamdan Award winner Abdon Atangana speaking at Jaipur Engineering College and Research Centre University in Jaipur, India, in 2018. Above: TWAS-Samira Omar Award winner Badabate Diwediga (left) conducting on-site awareness raising meetings on land management practices in Togo. (Photos provided)

Cover picture: The two co-winners of the 2020 TWAS-Lenovo Science Award, Mariangela Hungria (left) and Li Jiayang.

▼ Kenyan immunologist Faith Osier (second from right) teaching students as part of the South-South Malaria Antigen Research Partnership (SMART). (Credit: James Tuju/Kennedy Mwai)

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EDITORIAL

THE POWER OF RECOGNITION

▲ Raffaella De Lia, TWAS Editor & Public Information Officer

Awards play an important part in how TWAS recognizes excellence in science. Both the Academy and the awardees benefit from such recognition: on the one side, an institution that motivates scientists attracts the best talents; on the other, prizes play an important role in the development of the awardees' careers. An award is almost like a badge recognizing the achievement(s) of a scientist both within her/his community and worldwide.

For the first time in 2020, the **TWAS-Lenovo Science Award** went to two winners, which only shows the very high level of candidates: Brazilian soil microbiologist Mariangela Hungria and Chinese agricultural researcher Li Jiayang. Now in its seventh edition, the award is arguably the most prestigious honour given to scientists from the developing world in various fields of science. The 2020 edition recognized achievements in agricultual sciences.

In 2020 also, the first edition of the **TWAS-Mohammad A. Hamdan Award** took place. It was established to honour esteemed mathematician Mohammad Ahmad Hamdan of Jordan, who was TWAS Vice-President for the Arab region at the time of his passing, in February. A few months before, Hamdan had permanently linked his name to the Academy's, endowing a large sum to establish an award in his name and "clearly reflect[ing] his true commitment to the cause and mission of TWAS in sustaining scientific capacity building in the developing world," as TWAS Executive Director Romain Murenzi pointed out.

The biennial award is a recognition of outstanding work in pure and applied mathematics, probability or statistics, carried out by a scientist working and living in Africa or the Arab region. It went to Abdon Atangana, a Cameroonian applied mathematician at the Institute for Groundwater Studies in Bloemfontein, South Africa.

This was also the first year of the **TWAS-CAS Young Scientist Award for Frontier Science**. Offered in partnership with the Chinese Academy of Sciences and the Lenovo company, the award recognizes achievements in physical sciences by scientists no older than 45 who live and work in a developing country. The 2020 award went to Ajith Parameswaran, an astrophysicist from Bengaluru, India.

The 2020 **TWAS-Samira Omar Innovation for Sustainability Award**—named after TWAS Fellow Samira Omar Asem—went to Togolese environmental scientist Badabate Diwediga.

The other prizes administered by TWAS in 2020 were: the **C.N.R. Rao Award**, designed to honour TWAS Fellows from least developed countries; the **Atta-ur-Rahman Award in chemistry**; the **Abdool Karim Award in biological sciences**, given to female scientists in low-income African countries; and the **Siwei Cheng Award**, bestowed to economic scientists who have been living and working in a developing country for at least 10 years.

Awards live on with the receivers as a reminder of their achievements long after the monetary gifts are spent. TWAS awards, in particular, honour and recognize achievements that might otherwise go overlooked. Recognition aside, however, the very fact of being nominated for an award may bring career benefits. The process of substantiating an award nomination prompts to reflect on one's skills and progress, may encourage to fill gaps in one's resumé, and seek out advice. In the end, all are winners: the awardees, the nominees and the institutions offering the awards. The ultimate winner, however, is science, particularly when science succeeds to emerge and triumph in the context of developing countries.

Raffaella De Lia
Editor & Public Information Officer

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IN THE NEWS

Mixed messages on 'pay-to-publish' system

A recent survey revealed that the majority of nearly 1,000 academic researchers in South Africa are in favour of keeping a government scheme that offers cash rewards for publishing research papers in accredited journals, even though they agree that this practice can promote unethical practices.
The publication-incentive programme—which awards payments when researchers publish journal articles, conference proceedings and book chapters—is the country's largest single pool of research funding.

Nature News:
www.bit.do/PayToPublish

China lands its Moon rocks in Inner Mongolia

China's Chang'e-5 mission made a triumphant return last 16 December, landing on the dark frozen plains of Inner Mongolia, Chinese state media reported. The capsule's return marks the first time China has collected rocks from the Moon.
The three-week-long mission was the most complicated in the history of China's robotic space exploration programme, involving a lunar landing, scooping and drilling, and then an ascent and rendezvous with an orbiter, which carried the samples back to Earth.

Science Magazine:
www.bit.do/ChinaMoonRocks

COVID-19 affects organ donations

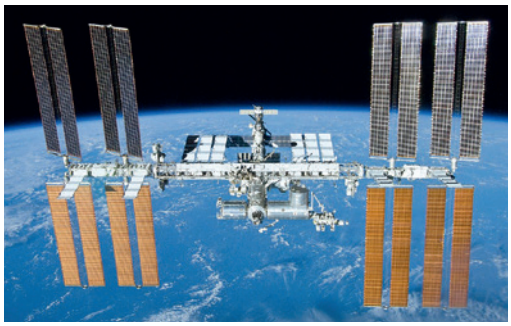
Far fewer organ transplants were performed in late 2020 globally as hospitals closed or diverted resources to treating COVID-19, creating a significant backlog of patients on waiting lists.
Plummeting supplies have only added to an already increasing global demand for organs. Prior to the pandemic, less than 10 per cent of the global need for organ donations was met every year, a World Health Organization spokesperson said.

SciDev.Net:
www.bit.do/COVIDTrafficking

Space station makes for unique stem cell lab

A team of researchers sent 250 test tubes of carefully prepared human stem cells to the International Space Station (ISS). It wanted to study how the near-weightless environment of the ISS affects these building-block cells. Scientists hope that studying the properties in low Earth orbit might help answer some sensitive questions. This will, in turn, guide researchers that are developing better stem cell therapies.

Washington Post:
www.bit.do/StemCellISS



Dust may have been the cause of big star's dimming

In late 2019, the bright star Betelgeuse suddenly dimmed for no apparent reason. Some scientists speculated that Betelgeuse was about to explode in a brilliant supernova that would outshine the full moon.
That is why, when the star started acting strangely, some Betelgeuse researchers aimed their telescope at the dimming giant. Over the following months, the star returned to its usual brightness, and the excitement over an imminent supernova faded. It turned out a dust cloud may have been to blame.

Science News:
www.bit.do/BigStarDim

LENOVO AWARD CO-WINNER

SCIENCE TO IMPROVE FARMERS' LIVES

TWAS-Lenovo Science awardee Mariangela Hungria, a Brazilian soil microbiologist, introduced environment-friendly agricultural practices

by **Cristina Serra**

Sometimes, receiving an unforeseen book may have an impact on a life and a career. This is what happened to Mariangela Hungria at the age of eight, when her grandmother, a biology teacher, gave her Paul de Kruif's book titled *Microbe Hunters*. That book fuelled Hungria's desire to learn more about the invisible world of microorganisms, marking her future forever.

Mariangela Hungria is now a professor at the State University of Londrina, Brazil, and a researcher at the Brazilian Agricultural Research Corporation (EMBRAPA). She was a winner of the prestigious TWAS-Lenovo Science Award for 2020 for her studies aimed at providing farmers with more environment-friendly fertilizers based on cheap and effective microbial inoculations, rather than on chemical compounds.

"I would have never imagined receiving this award," Hungria said. "But the first thing I thought when I was notified was: I won't use this money for myself. Rather, I will create some special funds to help women scientists in Brazil, because giving them a better chance in life and career is one of the goals of my life. With the help of the Brazilian Academy of Sciences, we will do the best with this money."

The TWAS-Lenovo Science Award is one of the most prestigious honours given to scientists from the developing world. Now in its seventh edition, the annual award was announced after the 2020 meeting of TWAS Council and includes a prize of $50,000 to each winner provided by the Chinese technology company Lenovo—the largest PC company in the world, global leader in consumer, commercial and enterprise technology. The other winner of the 2020 edition was Li Jiayang, a professor with the Institute of Genetics and Developmental Biology in Beijing, China.

"Mariangela Hungria is one of the leading soil microbiologists in the world, especially in the area of biological nitrogen fixation," said TWAS President Mohamed H. A. Hassan. "Her research contributed to the successful replacement of the environmentally harmful chemical nitrogen fertilizer by microbial inoculants, which resulted in saving billions of dollars in Brazil."

Hungria studied agronomy at the Luiz de Queiroz College of Agriculture, University of São Paulo, Brazil, where she received her Master of Science. Later, she earned her PhD in soil science from the Rural Federal University of Rio de Janeiro, where she studied intensively the process of biological nitrogen fixation (BNF).

Through BNF, soil bacteria can transform molecular nitrogen into ammonia, which is then incorporated into amino acids and proteins. In doing so, bacteria promote the rescue of nitrogen, an essential element for life that would, otherwise, get lost.

When Hungria started her scientific career, late in the 1970s, chemistry was regarded as a relevant discipline in many fields, especially in soil science. But her pioneer vision gave her enough courage to plough her own furrow: she realized that low-cost elite microbes could be equally efficient as fertilizers and started innovative investigations to promote their use as environment-friendly agents.

"Some people tried to discourage my studies on microorganisms, claiming that they would

◀ TWAS-Lenovo Award co-winner Mariangela Hungria (centre) with students in the Laboratory of Soil Biotechnology, at the Embrapa Soybean Center, Londrina, State of Paraná, southern Brazil, in November 2020. (Photo provided)

have no future. But I persisted in what was my love at first sight," she explained. "As a pioneer and an advocate of natural methods, I also received pressures from some companies."

Her personal life was not easy either: She reconciled being a single mother with two young daughters, one with special needs, with an outstanding yet demanding career. In 1982, she received a permanent post at the Brazilian Agricultural Research Corporation, where she still works as a researcher. Later, she acquired international experience working as a postdoctoral researcher at Cornell University in Ithaca and at the University of California-Davis, both in the United States, and at Seville University, in Spain.

Her strong will and determination granted her major achievements, in the scientific world where men were the majority.

Through the study of soil bacteria, she found the right combinations of microbes that, upon inoculation, would help nitrogen fixation and boost the yield without impoverishing or polluting the earth. The impact of her investigations was tremendous: through this approach, she helped Brazil decrease nitrates water pollution and diminish the emission of greenhouse gases.

Even more important, she had an impact on the chemistry-at-any-costs traditional approach.

Chemical companies recommend the use of 30–50 kilograms of fertilizers per hectare of soil, at $1 per kilogram. Following her strategy, farmers spend as little as $2–3 per hectare with the bacteria inoculant.

In 1991, Hungria accepted an offer to start a new soil microbiology group at the EMBRAPA-Soybean Center, in Londrina, Paraná, a state with a major vocation in agriculture. There she began supervising students and working with farmers. "Meeting with farmers, teaching them new technologies and listening to their needs is an important and rewarding part of my work," she admitted.

Discussions with farmers succeeded in finding new combinations of bacteria that, if inoculated simultaneously, were able to double the beneficial effects on soil with a marked increase in the yield.

Hungria is the recipient of numerous awards, including the Award and Medal of the National Merit of Agronomy by the Federal Organization of Engineering and Agronomy (CONFEA/CREA), as the National Agronomist of the Year (2018); the Award and Medal of the National Order of Scientific Merit, Grã-Cruz Order in the area of Agricultural Science, nominated by the President of Brazil (2018); the Award and Medal "Antonio Carlos Moniz", the highest honour of the Brazilian Society of Soil Science, as the Soil Scientist of the Year (2019). She was also

▲ TWAS-Lenovo Award co-winner Mariangela Hungria evaluating the quality of inoculants in the Laboratory of Soil Biotechnology, at the Embrapa Soybean Center, Londrina, State of Paraná, southern Brazil, in November 2020. (Photo provided)

◀ TWAS-Lenovo Award co-winner Mariangela Hungria showing plates containing nitrogen-fixing bacteria, at the Laboratory of Soil Biotechnology, Embrapa Soybean Center, Londrina, State of Paraná, southern Brazil, in November 2020. (Photo provided)

> Women are very good at helping each other, and I always offer my support telling them that they do not have to choose between career and family. *Mariangela Hungria*

the first woman to serve as the Vice-President (1999–2001) and President (2001–2003) with the Brazilian Society of Soil Science.

The list of her publications includes more than 300 scientific papers, introducing over 30 new technologies adopted in the agricultural field. She likes to think of herself, however, as a woman-scientist-mother who encourages other women not to give up their dreams.

"I'm the 'godmother' and 'grandmother' of several of my former students' children. Empowering women and convincing them that they can make it, is a great reward for me. In addition, I think that women are more concerned about the environment, social care and clean technologies," she said.

"I also encourage single mothers and those with children with special needs to follow on with their careers. You may be surprised, as what may seem to be a major limitation in your life can strengthen you at work".

Another major contribution that has granted Hungria the Lenovo award is the support she keeps giving to women scientists, by encouraging young researchers to take on important roles in science without giving up the idea of becoming mothers.

"In my lab, we are completely against the competition: everybody must help others. Women are very good at this, and I always offer my support telling them that they do not have to choose between career and family," the scientist clarified. Not surprisingly, most of her former students are women. And not surprisingly, while the TWAS-Lenovo Science Award was given to her for her outstanding research with microorganisms, it also acknowledges Hungria's efforts to empower women in soil science and agriculture. ◘

LENOVO AWARD CO-WINNER

BIGGER YIELDS, BETTER GRAINS

Chinese scientist Li Jiayang won the TWAS-Lenovo Science Award for his seminal research on the genetics of rice plants. His work led to 28 new varieties of rice being grown in China

by **Sean Treacy**

More than half of the world's population eats rice, making it among the most important crops for agricultural research. And as the world's population grows, people will need more food, which is why learning the genetic information that shapes staple crops such as rice is so important. Also, with anticipated environmental shifts due to climate change, innovative rice production has become a high priority for the elimination of hunger and poverty.

So, many scientists today are dedicating their careers to breeding new varieties of rice plants that can endure difficult conditions, and can also produce large amounts of grains that are both nutritious and desirable to consumers for their cooking quality. To honour his contributions to this endeavor, Li Jiayang, an agricultural researcher, active in China and worldwide, was one of 2020 winners of the TWAS-Lenovo Science Award.

"In general, the award to rice research indicates that food security is still one of the most important focuses in the world," said Li of receiving the prize. "To me, it inspires myself and my research group to make even greater efforts in developing a 'super' rice that can have higher yield and better quality with less input."

The seventh edition of the annual award was announced after the 2020 meeting of TWAS Council and includes a prize of $50,000 to each winner provided by the Chinese technology company Lenovo—the largest PC company in the world, global leader in consumer, commercial and enterprise technology. The TWAS-Lenovo Science Award is one of the most prestigious honours given to scientists from the developing world. The other winner of the 2020 edition was Brazilian agronomist Mariangela Hungria.

"Dr. Li is one of the most distinguished scientists in his field, and his work has had an impressive impact in China in particular," said TWAS President Mohamed H.A. Hassan. "His work also demonstrates how important basic research is for applied science research that provides food security in the developing world."

"We are most pleased to congratulate the winners of this year's award, who are both impressively accomplished researchers in the agricultural sciences," said Lenovo Senior Vice-President George He. "Both Li Jiayang, who has made indispensable landmark discoveries to rice production, and Mariangela Hungria, who has introduced environment-friendly agricultural practices in Brazil and empowered women in her field, are spectacular researchers. And it is indeed our honour to present this year's TWAS-Lenovo Science Award to both of them."

◀ 2020 TWAS-Lenovo Science Award co-winner Li Jiayang working in a production field in 2017. (Photo provided)

DEVELOPING NEW, BETTER CROPS

Li and his team received acclaim for cloning and studying rice plant genes that allow researchers and breeders to modify what's known as the architecture of plants. This includes the size and number of rice grains and the size of the plant itself, but also the so-called tiller number— a tiller being a shoot that emerges from the core of the plant—and the size of rice plant panicles, which are grain-bearing branch-like extensions.

And a balanced number of tillers is necessary, not too many, not too few. Big panicles and big grain sizes create large and high-quality yields.

Even the height of the plant itself matters: "If it's too tall, then it becomes too easy for it to fall down, then it is not very resistant to lodging," said Li.

Li is also well known for having established a new breeding system through integration of biotechnology, fundamental knowledge of plant architecture and grain quality with rational molecular design, making it easier to provide large numbers of high-quality rice grains.

The genetic code of the rice plant is complex, and each element of the architecture is affected by numerous genes. Li and his team spent 20 years studying how many and which genes govern the molecular chain reactions that affect how the plant is ultimately built by its biology, and how those genes can be modified to get more useful plants.

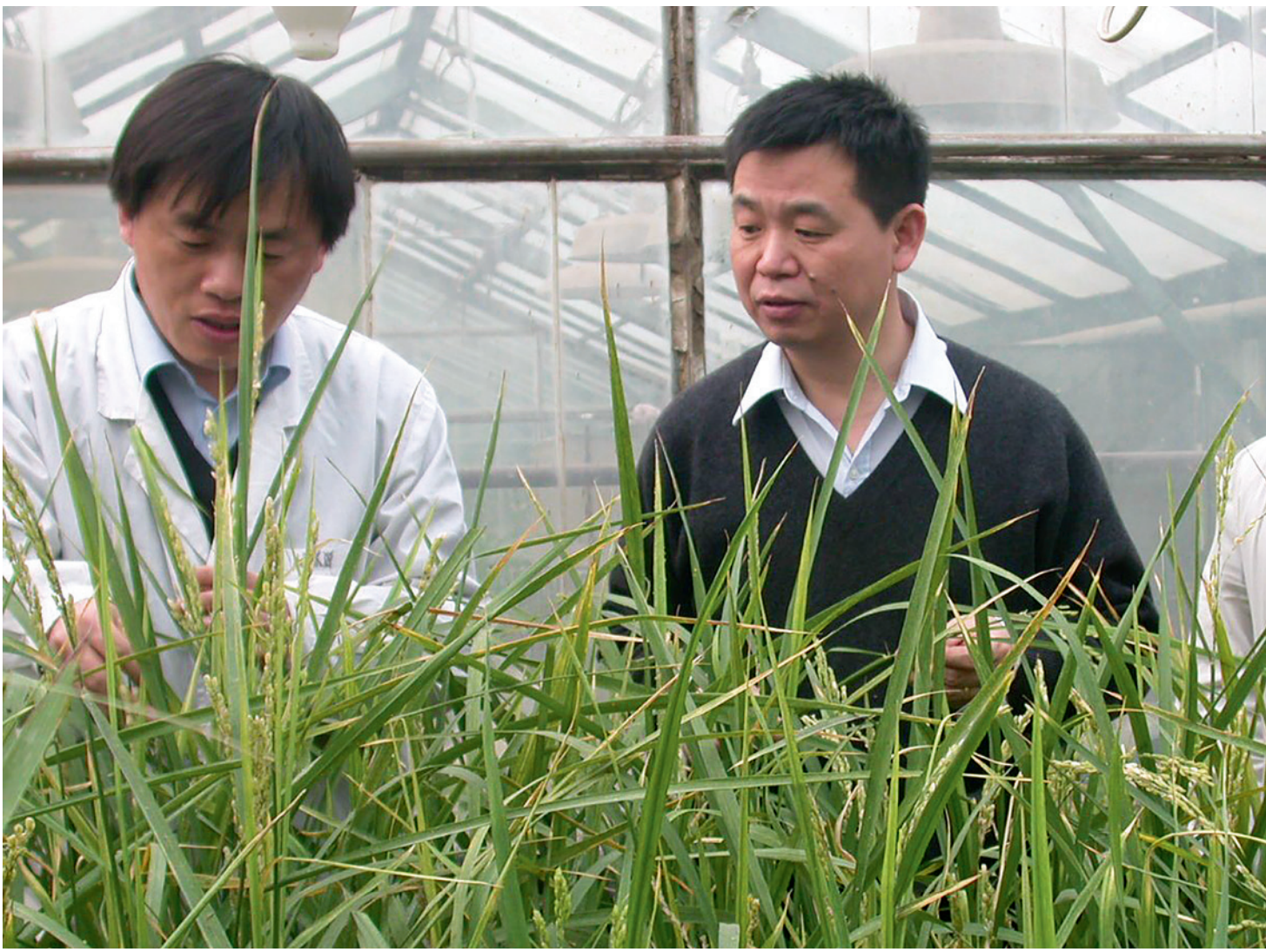
Additionally, different kinds of plants are desirable in different regions. For example, rice farms in southern China near the Yangtze River are more able to accomodate plants with larger panicles because they get more energy-supplying sunlight, while smaller panicles are necessary in northern China where the days are shorter. In total, 28 new varieties of rice plants stemming from Li's original research have become available all over the country. Those plants are grown in roughly 7 million acres of farmland in China, the country that grows about 28 per cent of the world's total rice production.

CONNECTING GENETICS RESEARCH AND BREEDING

Li's work built a bridge between basic and applied science. The basic research—cloning

▶ 2020 TWAS-Lenovo Science Award co-winner Li Jiayang working in a rice field in Hainan, the smallest and southernmost province of the People's Republic of China, in 2006. (Photo provided)

▼ 2020 TWAS-Lenovo Science Award co-winner Li Jiayang (centre) working in a greenhouse in 2000. (Photo provided)



> My lab is the first lab in China to establish how to clone genes from rice. If you have this system, you can then manipulate the genes of the rice.
>
> *Li Jiayang*

genes from rice plants and understanding their complex genetic systems—led to the important work of rice breeders who use this information to develop elite varieties of the plant for farmers, showing a direct line between research that has an impact within science and research that has an impact on the lives of millions. Most of this progress stems from studies published by Li and his team in leading science journals, including *Nature, Nature Genetics* and *Proceedings of the National Academy of Sciences of the United States of America*.

Cloning provides a full map of the genetic code, which then can lead for example to the identification of a gene that provides a plant with large panicles and a strong root system.

"In China, there are probably several thousand scientists working with rice, identifying components of regulation and otherwise," Li said. "My lab is the first lab in China to establish how to clone genes from rice. If you have this system, you can then manipulate the genes of the rice. Otherwise, you cannot identify and isolate the genes you need to explore."

"Cloning genes is important to plant architecture," he added. "It elucidates the genetic network that controls the rice grain yield and the eating and cooking qualities. Not only do you want to produce more rice, but also you want this rice to have a good taste, so people will want to eat it. Normally it's very difficult to get the high yield and the good quality."

Revealing the genetic code ultimately opens the gateway to the knowledge of which genes are key to producing a crop's annual yield.

"That's why people really want to get the gene," said Li. "For breeders, nowadays, and for basic research scientists, all of us really wanted to have the genes [...]. If you discover key genes for yield, you will get a good high-yield variety. Or you'll try to get a good gene for quality. This is the base we are working on. Those are the key things."

In addition to his research, Li was the Vice-Minister of Agriculture in China and President of the Chinese Academy of Agricultural Sciences (CAAS) from 2011 to 2016. He is also Professor and Principal Investigator at the Institute of Genetics and Development at the Chinese Academy of Sciences (CAS). He has been a TWAS Fellow since 2004, and delivered a TWAS Medal Lecture in 2006. ◘

ABDON ATANGANA WINS NEW HAMDAN AWARD

The applied mathematician's work has found use by scientists across many fields

by **Sean Treacy**

The first-ever TWAS-Mohammad A. Hamdan Award has been given to Abdon Atangana, a Cameroonian applied mathematician with the Institute for Groundwater Studies in Bloemfontein, South Africa. His predictive equations—differential and integral operators—have found broad application in modelling across many fields for they allow to make more complex predictions.

The award is named for TWAS late Vice-President for the Arab Region, who passed away in February 2020. It's given for outstanding mathematical work carried out by a scientist working and living in Africa or the Arab Region, with an award of $5,000, every two years. The award can be given for work in pure mathematics, applied mathematics, probability or statistics.

Atangana's work developing predictive differential and integral operators applies to many fields of science, technology and engineering in which modelling is important. His operators and the resulting models can help predict the spread of infectious diseases among people in a given settlement, for example, including how many new people will be infected each day, how many will recover and how many will die.

They can also help predict how groundwater flows in a complex geological formation or how pollution could move within aquifers—geological formations that contain water. This helps water management agencies pump water from them without depleting them or inadvertently harming the population.

"You don't know what is happening in the ground," said Atangana. "If you don't anticipate it, you will deplete the aquifer, so we rely on models to advise people who are drilling."

At the centre of Atangana's work are the Atangana-Baleanu fractional differential and integral operators, which are named after him. Through them, it's possible to describe not only the rate at which something will change, but also the so-called 'cross-over effects' that might interfere with and modify that rate of change. He used as an example a plane ride

ABOUT MOHAMMAD A. HAMDAN

An esteemed mathematician, Mohammad A. Hamdan's scientific career focused on a branch of statistics called estimation theory, as well as on the concept of distributions in probability theory. In Jordan, he served as Minister of Education and Higher Education and Scientific Research, and as Secretary-General of the Higher Council for Science and Technology. He was also President and a founding member of the Yarmouk University and of the Hashemite University in Jordan, and of the Arab Open University in Saudi Arabia. His profound dedication to science was coupled to an equally deep commitment towards TWAS goals and mission. During the Academy's life, he participated in many TWAS general meetings and conferences, offering precious advice on issues of importance for the Academy, and supporting science and innovation in developing countries.

▲ TWAS-Mohammad A. Hamdan Award winner Abdon Atangana receives recognition in 2017 from the international conference "African Days on Applied Mathematics", which offers a forum for the promotion of mathematics and their applications in African countries. (Photo provided)

from one location to another: One can predict how long a trip might take from point A to point B, but hazardous weather might interfere with the speed of the trip in unpredictable ways. His concept helps models account for such disrupting factors and produce better projections.

These models can even predict the change happening in tension between certain kinds of prey and predator, and nature, identifying species whose numbers are at risk of depleting rapidly.

Atangana's rate of citation has stood out in recent years. In 2017, he had the most cited study in the world in mathematics, signalling that his equation and mathematical work was useful to a broad range of modellers and other mathematicians. In 2019, he was named as one of the world's highly cited mathematicians and in the top one per cent of scientists on the global Clarivate *Web of Science* list. In 2020, he was named as one of the world's highly cited mathematicians with cross-field influence. He has been invited to and attended more than 25 international conferences as a keynote speaker, plenary speaker and invited speaker.

Atangana came from humble beginnings, in a single-parent home in a small village: he used to travel long distances by foot to high school and then university. And still now, he says, African researchers receive little support.

> There are lots of people with the potential to become brilliant, but they're lost because they cannot last through the hardship and need support.
>
> *Abdon Atangana*

"There are lots of people with the potential to become brilliant, but they're lost because they cannot last through the hardship and need support," he said. "They need support or else you have no choice but to go back to your village and till the soil."

He hopes to help African youths become inspired to build a stronger scientific legacy in their continent, for them to be proud of Africa. He also hopes his work and career can help propel African science into a brighter future, and awaken the African potential for scientific aptitude to flourish. Currently, Africa produces only 0.02 per cent of the world's scientific publications.

"I would like an African child to proudly say that this formula was created by an African, because it's the only way we can bring a little bit of balance," he said. ■

AJITH PARAMESWARAN WINS NEW CAS AWARD

Indian astrophysicist receives the TWAS-CAS Young Scientist Award for Frontier Science for his contributions to the understanding of gravitational waves

by **Cristina Serra**

As a young student, Ajith Parameswaran's dream was to become a cinematographer. Unexpected events, however, led him elsewhere, to astrophysics, proving that unforeseen shifts in life can disclose successful paths.

In 2020, he was named the winner of the TWAS-Chinese Academy of Sciences (CAS) Young Scientist Award for Frontier Science "for his pioneering contributions to the development of phenomenological models of gravitational-wave signals from coalescing binary black holes."

This annual award was established in 2020 to recognize achievements by young scientists living and working in a developing country. The recipients receive $10,000 provided by Lenovo, the largest PC company in the world and global leader in consumer, commercial and enterprise technology.

"I did not expect this recognition," he admitted. "I knew I was nominated, and I felt very honoured and humbled when I received the news. I have high respect for TWAS and its activities connecting the international scientific community, especially developing countries. And I have huge respect for Abdus Salam, a major figure in modern physics."

A native of Bengaluru, he earned his PhD at the Max Planck Institute for Gravitational Physics (Albert Einstein Institute) and was a postdoctoral scholar both at the Institute and at the California Institute of Technology in the United States.

Parameswaran subsequently became a brilliant researcher and an esteemed member of the international collaboration called LIGO-Virgo. (LIGO stands for Laser Interferometer Gravitational-Wave Observatory, while Virgo is its sister observatory in Italy). The collaboration between LIGO and Virgo aimed to inaugurate a new branch of astronomy through the observation of cosmic gravitational waves—invisible ripple in space that offer a completely different way to observe the universe and represent a new branch of astronomy.

Today, he is an associate professor with the International Centre for Theoretical Sciences (ICTS) of the Tata Institute of Fundamental Research in Bengaluru, India, and a principal investigator of ICTS Astrophysical Relativity group.

Gravitational waves were predicted by Einstein's theory of general relativity and were first detected in 2015, by the LIGO-Virgo collaboration. They are extremely tiny disturbances that travel at the speed of light through the space-time fabric.

Detecting them is a challenge: Their signals are very weak and are usually buried in detector noise. "The best way to extract gravitational-wave signals is to compare the incoming data with theoretical models of the expected signals," he explained.

For some sources of gravitational waves such as binary star systems of black holes—two black holes orbiting around each other—it is possible to construct accurate models of the expected signals. In the first slow-paced part, called the inspiral phase, the two celestial objects rotate one around the other; then, as they get closer

▶ TWAS-CAS Young Scientist Award for Frontier Science winner Ajith Parameswaran giving a public lecture, Thiruvananthapuram, Kerala, 20 April 2019. (Photo provided)

and closer, they accelerate almost up to the speed of light and eventually coalesce into one single more massive, spinning black hole.

"In the inspiral phase, we can describe the system's evolution using an approximation of Einstein's theory, called the post-Newtonian approximation. But in the later phases, these approximation techniques do not work, and we need to resort to supercomputer calculations."

The pioneering idea to merge 'old-fashioned' analytical calculations using the post-Newtonian theory with the computational power of supercomputers—in what is called the 'phenomenological method'—led Parameswaran to obtain accurate models of gravitational waves from coalescing black hole binaries.

> I have high respect for TWAS and its activities connecting the international scientific community, especially developing countries. *Ajith Parameswaran*

Theoretical models constructed using his phenomenological method are now widely used in international experiments like those of LIGO-Virgo to extract the properties of faraway sources from gravitational-wave observations. This also helps confirm that the signals astronomers observe are consistent with Einstein's theory of general relativity.

As a member of the team that discovered gravitational waves, Parameswaran was also the recipient of the 2016 Special Breakthrough Prize in Fundamental Physics and the 2016 Cosmology Prize of the Gruber Foundation. He also received the Ramanujan Fellowship from the Government of India, the CIFAR Azrieli Global scholarship from the Canadian Institute for Advanced Research, and was the head of ICTS Max Planck Partner Group.

Today, he is the principal investigator of a team of about 10 people including postdocs, faculty members and young students. In the last three years, his team has been exploring a new topic called the gravitational lensing of gravitational waves. What is it about? Einstein's theory predicts that clusters of matter interposed between a source of light and an observer will bend the light due to their gravity, while the light travels towards the observer. Astronomers have been observing this phenomenon regularly for over 100 years. It turns out that gravitational waves are 'lensed' by massive objects in the same fashion.

"We have not observed this phenomenon directly, but there is a high chance that we can observe it in the next few years," is Parameswaran's optimistic view. For now, he is focused on the potential benefits stemming from TWAS award. "This award not only brings important recognition," maintained the scientist, "[but] I hope it will help us attract better and better people to our group. We are a still relatively young community, a young institution, and a young group. Still, we are making quite an impact. We certainly want to do better in the future, and this recognition will help us to do better."

Parameswaran's career, in any event, is not limited to research: He is also actively involved in science outreach and community development, and works closely with the Jawaharlal Nehru Planetarium in Bangalore, India. ◘

BADABATE DIWEDIGA WINS OMAR AWARD

Togolese scientist and winner of the TWAS-Samira Omar Award teaches farmers efficient methods to oppose soil degradation through sustainable land conservation

by **Cristina Serra**

Badabate Diwediga is a passionate environmental scientist from Togo, an expert of soil conservation and a renowned consultant, active in coaching farmers and spreading information on good agricultural practices.

He received the 2020 TWAS-Samira Omar Innovation for Sustainability Award "for promoting sustainable land management towards agricultural innovation, rural transformation, and climate change mitigation in Africa."

"When I saw the eligibility criteria of the TWAS-Samira Omar Award, I thought I could participate, but I probably never thought I could be the winner," Diwediga said. "This award is going to have a huge impact on my career: it gives me more visibility, offering opportunities to further develop international collaborations. Also, it's an encouragement to work harder to get more results."

Badabate Diwediga is an Assistant Professor at the University of Lomé, Togo, in the Laboratory of Botany and Plant Ecology of the Faculty of Sciences, University of Lomé, Togo. His passion for nature, however, dates back to his schooldays when he learned about ecosystems and their function. He developed a profound interest also for land conservation, realizing that forest depletion and land overexploitation for agricultural purposes were increasing rural poverty and damaging the environment.

He earned his PhD in climate change and land use in 2016 at the Kwame Nkrumah University of Science and Technology, in Accra, Ghana, through the West African Science Service Center on Climate Change and Adapted Land Use—a German-led initiative.

With the support of his mentor and supervisor Quang Bao Le, he then started a collaboration with the International Centre for Agricultural Research in Dry Areas (ICARDA) to participate in African and Asian projects on sustainable land management. "I was always fascinated by nature and I wanted to know what is nature," he recalls thinking of his early-career years.

"When I realized how devastating agricultural practices and wood harvesting for charcoal production were, and their impact on forest resources, I decided I had to develop, and teach, a more holistic view to explain the

▼ TWAS-Samira Omar Innovation for Sustainability Award winner Badabate Diwediga (fifth from left) engaging local practitioners and farmers on soil fertility management in semi-arid areas of Nigeria. (Photo provided)

▲ TWAS-Samira Omar Innovation for Sustainability Award winner Badabate Diwediga. [Photo provided]

consequences of such practices on soil capabilities and ecosystems, and to introduce a new vision."

His case-study model was the Mo River basin, a subunit of the Volta basin in central Togo, where he applied a four-level approach. First, he took records of vegetation growth and losses from 1972 to 2014. Second, he analysed the vegetation structure by building a forest species inventory, to understand the extent of human impact on the basin's vegetation.

Then, he quantified the soil carbon and nitrogen content of the upper layer (up to 10 cm), to gain indications about soil resilience—soil reaction to human impact. Finally, he applied the so-called RUSLE model—the Revised Universal Soil Loss Equation model—to suggest possible interventions to local and rural communities in Togo.

"Modelling has replaced the traditional time-consuming methods of soil monitoring regarding long-term perspectives," explained Diwediga. "And modelling soil erosion is efficient for simulating the extent and intensity of soil erosion, identifying the spatial patterns of sediment sources and deposition sites."

The approach of his investigation was extended to Tunisia and northern Nigeria, where he contributed to projects carried out by ICARDA in collaboration with the Federal Ministry of Agricultural and Rural Development of Nigeria.

Through a collaboration with the research university Eidgenössische Technische Hochschule Zürich, in Switzerland, and the association Étoile Verte, in Togo, Badabate Diwediga is now part of a team carrying out a pioneer study, funded by the Swiss National Science Foundation, on the adoption of good practices to secure a future for conservation agriculture in his country.

"Suggestions include simple but efficient methods to oppose soil degradation, such as planting trees on river slopes, avoiding cultivations on river banks, building stone embankments to contain deposition of sediments," he explained, underlying how these practices, if well adopted, can help to fight rural poverty.

Through aerial explorations carried out with a drone, he and his colleagues gained a wider perspective of the multifunctional landscapes around the village of Donomade, in Togo. "Now with the Swiss National Science Foundation-funded project, we are trying to enhance the establishment of the "climate-smart village of Donomade", a small community of about 600 people who adopt sustainable management practices."

The final outcome is to promote the adoption of soil and water conservation measures that make lands more resilient, while sustaining the livelihoods of these smallholding farmers.

For his research and achievements, Diwediga received other prestigious awards, which include the Green Talents Award in sustainability research of the German Federal Ministry of Education and Research, in 2018, and the Chinese Academy of Science President's International Fellowship Initiative, in 2019.

> This award is going to have a huge impact on my career: it gives me more visibility, offering opportunities to further develop international collaborations.
>
> *Badabate Diwediga*

Today, Diwediga is an authoritative expert committed to raising awareness on the importance of creating sustainable socioecological landscapes to contain the impact of land-grabbing and climate change. His strong motivation and his attitude to learning and exploring new avenues allowed him to achieve concrete results.

Working with farmers and local communities still remains his priority: "The TWAS-Samira Omar Award will have beneficial effects for the economic progress of this region: it will strengthen my influence with decision makers, policymakers and private firms, when I promote the integrated management of ecosystems and a sustainable rural transformation." ◘

RAOELINA ANDRIAMBOLOLONA WINS RAO AWARD

Physicist from Madagascar is awarded the 2020 TWAS-C.N.R. Rao Award for urging students to use self-motivation to build resilience in hardships.

by **Cristina Serra**

▲ TWAS-C.N.R. Rao Award winner Raoelina Andriambololona (centre, standing with crossed arms) with personnel and students of the National Institute for Nuclear Sciences and Technology in Antananarivo, Madagascar. (Photo provided)

In 2020, Madagascar was among the 47 United Nations least developed countries, low-income countries confronting severe impediments to sustainable development. Oddly enough, in Madagascar, nuclear science flourished decades ago, in the 1970s, despite a shortage of funds and the lack of researchers and laboratories. Raoelina Andriambololona, a forward-thinker and a pioneer of the peaceful use of nuclear technology, made this miracle possible.

Andriambololona is the founder and Director-General of the National Institute for Nuclear Sciences and Technology in Madagascar and a 1985 TWAS Fellow. He was named the winner of the 2020 TWAS-C.N.R. Rao Award for Scientific Research for developing peaceful uses of nuclear science and technology, both in Madagascar and in Africa, and advocating the use of nuclear power for environmental protection.

"It's a pleasure for me to receive this award, in the name of a prestigious Indian scientist—C.N.R. Rao—whom I had the privilege to meet during many TWAS General Conferences," Andriambololona said. "I dedicate it to my wife, who never stopped helping me go further, and to the several hundred students that I have trained to the level of doctors. This prize is an encouragement for us, researchers from least developed countries, recognizing internationally all our efforts."

The award, named after TWAS Founding Fellow and former TWAS president C.N.R. Rao, is designed to honour TWAS Fellows from least developed countries who have made significant contributions to global science.

Andriambololona started his education at the University of Madagascar in 1956; then he moved to the the University of Aix-Marseilles, in France, until 1962, where, in 1967, he earned his *doctorat ès sciences* (PhD) in theoretical physics.

"At that time I was working at the Centre de Physique Théorique (CPT-Marseille), a laboratory depending on the French National Centre for Scientific Research, but my heart was in Madagascar," he said. "So, when I told my supervisor that I was planning to go back home, he told me that I was crazy. Eventually, he accepted my motivations."

Upon his return home, Andriambololona received support from the Ministry of Higher Education and Scientific Research and the International Atomic Energy Agency (IAEA) and set up the Laboratory of Nuclear Physics and Applied Physics (LPNPA), with no facilities, no researchers and no technicians. "I always thought that science can beat ignorance and mystification, and that nuclear energy was

▼ TWAS-C.N.R. Rao Award winner Raoelina Andriambololona. (Photo provided)

> This prize is an encouragement for us, researchers from least developed countries, recognizing internationally all our efforts.
>
> *Raoelina Andriambololona*

a clean form of energy that could shape our future," he recalled.

In 1989, he set up the African Regional Cooperative Agreement for Research, Development and Training related to Nuclear Science and Technology (AFRA), serving as the president in the AFRA-Fields Management Committee from 2001 to 2002.

A few years later, LPNPA became a centre of reference, renowned at the international level. This prompted the Malagasy Government to turn the laboratory into the National Institute of Nuclear Science and Technology.

Andriambololona's interests are not restricted solely to nuclear energy. He is also an expert in linear and multilinear algebra and applications, quantum field theory, special and general theory of relativity, radiation protection, and environmental pollution.

He is also the Executive President of the *Commission Raoelina Andriambololona pour la NANOtechnologie*, which had been set up in 2013 by the Ministry of Higher Education and Scientific Research.

"Nanotechnology is one of the most rapidly developing technologies today, which will have an enormous impact on societies and human life. Many applications—like energy storage, water remediation, food processing and storage—are tied to the UN Sustainable Development Goals. Therefore, nanotechnology and development are intimately intertwined, and important for the development of Madagascar," he maintained.

Colleagues describe him as self-directed and motivated. He's also strongly determined: "I never gave up in my career, and always promoted science with policymakers and governments, knowing that they do not keep science in high consideration because they need immediate results, which science cannot give."

Andriambololona is a fellow of the most prestigious international academies and associations, including the International Energy Foundation, The New York Academy of Sciences, the American Physical Society and the European Physical Society. Among his awards, there is the *Grand Croix de 2ème Classe de l'Ordre National Malagasy* (1997) and the *Commandeur de l'Ordre du Mérite de Madagascar* (1991).

A nature lover, professor Andriambololona used to exercise and jog. Now he keeps himself in good health with long outdoor walks. His thoughts are always for the new generations of Malagasy scientists: "Some of my former students left the country to work in advanced countries, but many stayed despite the unmotivating salaries and difficulties," he said.

"These contributed to developing research and higher education in the country. This is why, I consider the C.N.R. Rao prize a reward for all the efforts I've made to develop scientific research in Madagascar."

Andriambololona is the second Malagasy recipient of the C.N.R. Rao Award: in 2006 compatriot Philippe Rasoanaivo was a co-winner with TWAS Fellow Berhanu M. Abegaz. ◘

BASANT GIRI WINS ATTA-UR-RAHMAN AWARD

The Nepali scientist is developing easy-to-use tests for screening pesticides, poor-quality drugs, and other chemical hazards

by **Sean Treacy**

Nepali chemist Basant Giri is the recipient of the 2020 TWAS-Atta-ur-Rahman Award in Chemistry. Giri's research focuses on developing low-cost portable tests to help screen the quality of food, drugs and water, simple enough to be used without advanced technical training.

Giri and his colleagues combined physical tests—small bits of paper no bigger than a business card that change color when exposed to certain chemicals—with smartphone technology to help field testers make conclusions about the presence of pesticide residue on crops and the like.

The Atta-ur-Rahman Award acknowledges talented young chemists who live and work in scientifically lagging countries. It is provided by Pakistani TWAS Fellow Atta-ur-Rahman, a leading scholar in the field of organic chemistry and an influential advocate of science education.

"The award is a recognition of the work we do in Nepal," said Giri. "Doing scientific research in Nepal is not a common thing for many reasons. And this recognition from TWAS is not only good for me, but also good for other young researchers [...] in Nepal."

The smartphone tool helps quicken and simplify the testing process. Giri's system can be used by low-level technicians from government agencies or private technicians hired at larger vegetable markets.

"The technician only has to take a bit of sample, for example a tomato sample. They cut it down into very small pieces, and soak it in a solvent," Giri said. "Then the pesticide is extracted into the solvent, and they use five microlitres of that [pesticide] extract and put it on the paper device. The [technicians] wait 15 minutes, then take a picture with their smartphone."

▲ TWAS-Atta-ur-Rahman Award winner Basant Giri. [Photo provided]

Through this process, the user learns whether the vegetable needs to be left untouched for a few days, discarded or if it's ready for consumption. The process makes inspections more efficient, Giri added, but doesn't identify the precise pesticide, making it useful primarily for an initial screening.

Even though the tool has yet to go to the public, Giri's research has demonstrated that the technology works. The next step is to develop an official prototype and then commercialize the product.

In Nepal, Giri continued, "there is very little scientific material in the historical record tracking the pesticide problem. But the media and the Government have begun to document that farmers are not using pesticides properly".

"The farmers do not know how to use pesticides; that's the problem," Giri said. "When people use pesticide on some crops, before the vegetable reaches the market there should be a window period. You apply the pesticide and wait 10 to 15 days before bringing it to market. And that rule is not followed by farmers."

The Government is now considering starting programmes to teach farmers how to use pesticides, "but we need to monitor. If we don't monitor we don't know the exact situation," he noted.

This kind of technology can also be leveraged to test water for contamination, and even to

▼ TWAS-Atta-ur-Rahman Award Winner Basanti Giri (centre) explaining the 'paper analytical' device to two of his students. (Photo provided)

screen drug quality. Giri noted that the World Health Organization (WHO) found that about 10 per cent of drugs in low- and middle-income countries are either below standards or counterfeit. That is why it's important to collect drug samples from pharmacies in Nepal, including the remote areas where people don't have access to advanced lab equipment.

"We want to develop the screening technology, so people can test the drugs wherever it's needed—that can even be used at home," said Giri. "Even patients could test their drugs, using very basic chemistry."

Even before the spread of the COVID-19, Giri's work also focused on the efficacy of face coverings. In Kathmandu—the country's capital—approximately 30 per cent of the population already used face masks as a shield against air pollution before the pandemic started. Giri's team developed a smartphone microscope to test the masks' effectiveness. The result of this research was that cloth masks are less effective than typical surgical masks—key information added by WHO while drafting guidelines for mask use and rational use of personal protective equipment.

Giri has been the recipient of TWAS Research Grants—sponsored by the Swedish International Development Cooperation Agency (Sida)—twice: in 2015, to develop the paper testers and in 2019, for his research on a method to screen the quality of drugs. He is also involved in outreach activities, training students on how to write papers and giving high school students lab tours so that they might become inspired to undertake a career in science.

Finally, Giri chairs the National Young Academy of Nepal, which was established in 2020 and brings together young scientists from different disciplines. ◘

> "Doing scientific research in Nepal is not a common thing for many reasons. And this recognition from TWAS is not only good for me, but also good for other young researchers [...] in Nepal." *Basant Giri*

FAITH OSIER WINS ABDOOL KARIM AWARD

TWAS-Abdool Karim Award winner Faith Osier has spent her career making strides towards a malaria vaccine and training the next generation of African scientists

by **Sean Treacy**

Malaria kills as many as half a million people per year, most of them under the age of 5. And the 2020 edition of the TWAS-Abdool Karim Award in biological sciences has honoured a pioneer in the fight against the parasite that causes the disease.

Kenyan immunologist Faith Osier's research focuses on using data from the immune systems of a diverse selection of the African population in hopes of making a single vaccine that can protect a large number of Africans. She has also established a collaboration across seven African countries in an effort to develop the best vaccine possible and train the next generation of immunologists on the continent.

The award is named after TWAS Fellow Quarraisha Abdool Karim, the Associate Scientific Director of the Centre for the AIDS Programme of Research in South Africa (CAPRISA). The award, now in its fourth year, honours women scientists in low-income African countries for their achievements in biology.

"This award reassures me that I'm not alone, that there are others on my journey, who have walked this road before me and appreciate what I'm doing," she said. "It's energizing and motivating to be appreciated and to know that there are many of us out there."

DETERMINATION TO DEFEAT MALARIA

Osier started her career as a pediatrician in a national hospital in Nairobi, Kenya, thus in an urban environment in which malaria was rare. Years later, when she moved out to the countryside, she was taken aback by how many young children were admitted to the hospital's high dependency unit every night during the peak malaria transmission season.

"Some would survive, but some would die," Osier said. "At that time I didn't have children of my own. But when you have to face a parent and tell them you've done all you could, but you couldn't save their child—and you do that every other day because the kids are just not surviving—it's devastating."

A desire to both save lives and spare families the traumatic loss of their children set her on a journey to hunt for a malaria vaccine.

"This is about people's lives, about families, people's futures," she said. "This is holding a whole continent back, which should be moving forward. And if I can't find a vaccine, I want to make sure I've left behind an army of scientists who are equally determined to make malaria history."

Now, Osier's work aims to leverage information on how older people develop resistance to the clinical symptoms of malaria in hopes of being able to immunize children, who are much more vulnerable.

Plasmodium falciparum is the species of the malaria parasite that is responsible for the high mortality in Africa. Antibodies in human blood can stop the parasite in its tracks by sticking to parts of it, blocking its ability to latch onto red blood cells, invade them and cause the disease. A better understanding of how to block this process would help scientists create a highly effective malaria vaccine.

▼ TWAS-Abdool Karim Award in biological sciences winner Faith Osier. (Photo provided)

▼ Kenyan immunologist Faith Osier (second from left) teaching students as part of the South-South Malaria Antigen Research Partnership (SMART). (Credit: James Tuju/ Kennedy Mwai)

In the past, Osier said, scientists have picked a single antigen and tried to make a vaccine with limited success. The challenge is that the malaria parasite's DNA encodes over 5,000 proteins, all of which the human immune system may need to confront. Osier's research considers the complexity of this large number of proteins as well as the diverse strains of the parasite. Mapping out which of these proteins induces protective antibodies is key to making a good vaccine that will work for everyone.

> "...when we neglect parts of Africa in terms of capacity-building for research, we are brewing up a storm. When we really need our own scientists, they will not be there." *Faith Osier*

KEY ELEMENTS: INNOVATION AND CAPACITY-BUILDING

In 2008, Osier was studying six antigens. Now she and her team are working on over 100 at once. Even though this still represents only two per cent of what the parasite presents to the immune system, the team prioritized these proteins because the immune system can easily detect them.

The ability to study these proteins simultaneously is enabled by a custom device called KILchip that she and her team developed. KILchip allows scientists to test hundreds to thousands of proteins at once, and is the first of its kind in Africa. The device also allows malaria researchers to work with very small sample volumes. This is particularly important when conducting studies in young children.

Osier also established the South-South Malaria Antigen Research Partnership (SMART), which assembled 10,000 samples combined from Kenya, Uganda and the United Republic of Tanzania in East Africa, and Senegal, Mali, Burkina Faso and Ghana in West Africa. This is the largest cohort study of this type and was used to explore combinations of antigens that may be suitable for a new vaccine that could work also for people across many other parts of Africa, even though they are faced with different strains of the malaria parasite.

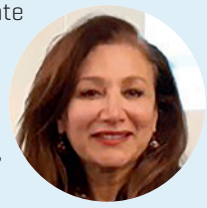
This South-South collaboration also allows Osier to train scientists in African countries where the capacity for research is low. She noted that COVID-19 demonstrated that, in large pandemics, countries predictably tend to focus on their own people. "In a crisis, you look after your family before you rush out to save your neighbours," she said. "So, when we neglect parts of Africa in terms of capacity-building for research, we are brewing up a storm. When we really need our own scientists, they will not be there."

So far, she and her team have trained 10 PhD students on malaria research, and together with the Federation of African Immunological Societies, the ambitious goal is to train 1,000 scientists in 10 years. Initial seed funding from the International Union of Immunological Societies allowed them to attract additional support from the European Education and Culture Executive Agency, with the result of being able to finance the training of 80 Masters and PhD students in Africa. And because well-trained scientists train others in turn, Osier and her team anticipate exponential growth. ◘

PEOPLE, PLACES & EVENTS

SABAH ALMOMIN ELECTED TWAS VICE-PRESIDENT FOR THE ARAB REGION

Kuwaiti biotechnologist Sabah AlMomin, a senior research scientist with the Kuwait Institute for Scientific Research (KISR) and a 2010 TWAS Fellow, was elected as TWAS Vice-President for the Arab Region in December 2020. The TWAS Council chose AlMomin to succeed Mohammad A. Hamdan, who passed away in 2020.



AlMomin is a graduate of the University of Surrey, UK, specialized in genetic engineering, with comprehensive experience in molecular biology, molecular diagnostics and DNA fingerprinting. In Kuwait, she promoted the establishment of a national biotechnology programme that allowed KISR to become affiliated with the International Centre for Genetic Engineering and Biotechnology, where she serves as a liaison officer for Kuwait. Currently, AlMomin is leading a government initiative for the establishment of a National Centre of Genetic Engineering and Biotechnology in her country. She is a member of the Technical Advisory Committee of the Commission on Science and Technology for Sustainable Development in the South (COMSATS).

IN MEMORIAM: MAHABIR GUPTA

Mahabir Gupta, a 2011 TWAS Fellow, an Emeritus Professor of pharmacognosy, and a founding director of the Center for Pharmacognostic Research of the Flora of Panama at the University of Panama, passed away in December 2020. A native of India, he received his Bachelor's and Master's degrees in pharmacy from the University of Rajasthan and Banaras Hindu University, India, respectively. From 1994 until 1997, he served as the dean of the College of Pharmacy, University of Panama, and from 1983 until 1988, was the Director of the international technical cooperation of the Indian State of Uttar Pradesh. He received the Award for International Science Cooperation of the American Association for the Advancement of Science and the Panamanian National Research Excellence Award. He will be remembered for his extensive work on Latin American plants and, in particular, for the study of substances used medicinally by different ethnic or cultural groups (ethnopharmacology).

IN MEMORIAM: LABAN OGALLO

Kenyan Professor Laban Ogallo, the immediate former Director of the Intergovernmental Authority on Development (IGAD) Climate Prediction and Application Centre (ICPAC) based in Kenya, and a 2002 TWAS Fellow, passed away in November 2020. Ogallo was a Professor of Meteorology at the University of Nairobi, Kenya. Before joining ICPAC, he worked at the World Meteorological Organization (WMO) in Geneva, and from 2015 until 2018, coordinated the United Nations Development Programme/African Development Bank project on building resilience to disasters in the Horn of Africa. He contributed to the reports of the Intergovernmental Panel on Climate Change (IPCC), the United Nations body for assessing the science related to climate change, and was among the IPCC scientists who received the 2007 Nobel Price Award.

IN MEMORIAM: RODDAM NARASIMHA

Aerospace scientist Roddam Narasimha, a Department of Science and Technology Year-of-Science Professor of the Engineering Mechanics Unit at the Jawaharlal Nehru Centre for Advanced Scientific Research, Jakkur, India, and a 1988 TWAS Fellow, passed away in December 2020. Narasimha earned a PhD in aeronautics from the California Institute of Technology, US, in 1961, then joined the department of aeronautics at the Indian Institute of Science. He will be remembered for his contributions to the Indian Space Research Organisation and the design of the Light Combat Aircraft, Tejas. In 2008, he received the Trieste Science Prize. In 1987 and 2013, he was honoured with India's third and second highest civilian awards: the Padma Bhushan and the Padma Vibhushan.

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The World Academy of Sciences for the advancement of science in developing countries (TWAS) works to support sustainable prosperity through research, education, policy and diplomacy.

TWAS was founded in 1983 by a distinguished group of scientists from the developing world, under the leadership of Abdus Salam, the Pakistani physicist and Nobel laureate. Today, TWAS has almost 1,300 elected Fellows from 105 countries; 11 of them are Nobel laureates. It is based in Trieste, Italy, on the campus of the **Abdus Salam International Centre for Theoretical Physics (ICTP)**.

Through more than three decades, the Academy's mission has remained consistent, namely to:

- Recognize, support and promote excellence in scientific research in the developing world
- Respond to the needs of young scientists in countries that are lagging in science and technology
- Promote South-South and South-North cooperation in science, technology and innovation and
- Encourage scientific and engineering research and sharing of experiences in solving major problems facing developing countries.

TWAS and its partners offer 260 fellowships per year to scientists of the developing world for PhD studies and postdoctoral research. TWAS awards are among the most prestigious given for scientific work in the developing world. The Academy distributes nearly $1 million in research grants every year to individual scientists and research groups.

It supports visiting scientists and provides funding for regional and international science meetings.

TWAS hosts and works in association with two organizations, also hosted on the ICTP campus: the **Organization for Women in Science for the Developing World (OWSD)** and the **InterAcademy Partnership (IAP)**.

At its founding in 1989, OWSD was the first international forum uniting women scientists from the developing and developed worlds. Today, the Organization has more than 6,500 members. Their objective is to strengthen the role of women in the development process and promote their representation in scientific and technological leadership.

IAP represents more than 140 national and regional science and medical academies worldwide. It provides high-quality analysis and advice on science, health and development to national and international policymakers and the public; supports programmes on scientific capacity-building, education and communication; leads efforts to expand international science cooperation; and promotes the involvement of women and young scientists in all its activities.

TWAS, a programme unit of UNESCO, receives its core funding from the Italian Ministry of Foreign Affairs and International Cooperation.

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