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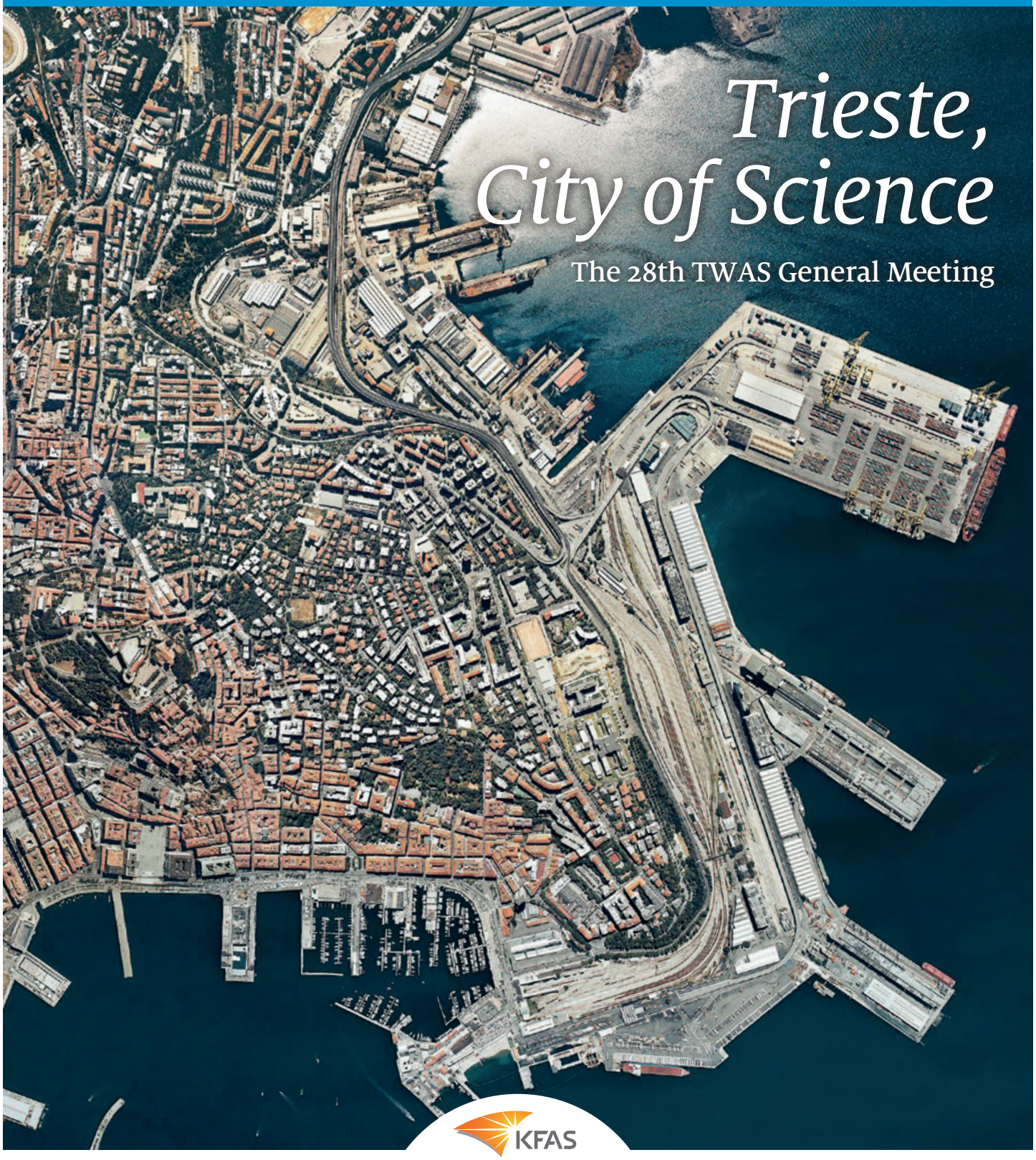

Trieste, City of Science

The 28th TWAS General Meeting

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▲ (top) Fabrizio Nicoletti, minister plenipotentiary in the Italian Ministry of Foreign Affairs and International Cooperation, delivered remarks at the opening ceremony of the 14th TWAS General Conference and 28th General Meeting. To the right are TWAS Executive Director Romain Murenzi and Ylann Schemm, director of the Elsevier Foundation; (below) Mohamed Hassan (left), just after his election as TWAS president, is congratulated by Mohamed M. El-Faham, scientific adviser to the Bibliotheca Alexandrina in Egypt. (Photos: TWAS/Paola Di Bella)

Cover picture: Trieste, Italy, is a world capital of South-North science cooperation – and the headquarters of TWAS. The 14th TWAS General Conference and 28th General Meeting were held in Trieste in November 2018. (Photo: Universal Images Group North America LLC / DeAgostini / Alamy Stock Photo)

▼ Ismail Cakmak, a 2016 TWAS Prize winner in agriculture from Sabanci University in Turkey, visiting field trials in Zambia.

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EDITORIAL

BAI CHUNLI: DISTINGUISHED SERVICE

▲ Romain Murenzi, TWAS Executive Director

The past six years have been a period of robust growth and gathering strength for TWAS. We now have members in more countries than ever before, and our programmes are serving more scientists. These advances have done much to burnish the Academy's international reputation, both in the South and the North.

Many factors contribute to this success – our allies, our Regional Partners, our Secretariat, and our effective global communication. But to understand the Academy's recent growth, one conclusion is inescapable: TWAS President Bai Chunli has been instrumental in guiding us to historic new heights.

Bai was president of the Chinese Academy of Sciences (CAS) when he took office at TWAS in 2013, and within weeks, he delivered a major new initiative: The CAS-TWAS President's PhD Fellowship Programme initially offered 140 PhD scholarships per year, and soon expanded to 200 per year. Today, thanks to the CAS-TWAS Fellowships, TWAS has more than 1,000 young scientists from the developing world at top research centres pursing their PhDs.

This initiative was promptly followed by the opening of five CAS-TWAS Centres of Excellence, focused on key areas such as climate, water, environment, biotechnology and green technology.

Lenovo, the global computing and technology leader, emerged that same year as a vitally important partner. Lenovo had sprung from the fertile soil of CAS in the mid-1980s, at about the same time TWAS was taking its first steps. Now the company underwrites the prestigious TWAS-Lenovo Science Prize, and it provides essential support for the TWAS Young Affiliates Network (TYAN), a platform for the unification and collaboration of young scientific talents in the Global South.

From the start, Prof. Bai has urged us to expand our membership to more women and to more countries. At the start of 2013, 9.8% of TWAS Fellows were women; today the number is 13.1% – over a quarter of our new Fellows in these six years have been women. And we have met his goal of expanding membership to 100 countries – 104, to be exact.

Under Prof. Bai's leadership, TWAS has had an important role at conferences on climate in Asia and on climate, ecosystems and human livelihoods in Africa. He has built our relationship with the Royal Society, and enthusiastically supported the founding of academies of sciences in Ecuador and Rwanda.

These accomplishments and others, taken together, have transformed the Academy. Through these contributions, Prof. Bai takes his place alongside past presidents José Vargas, C.N.R. Rao and Jacob Palis, each of whom has earned a permanent position of honour in the annals of science for the developing world.

Prof. Bai will serve an important role as immediate past president. And he has left the Academy in the hands of another good leader.

I am pleased to welcome Mohamed Hassan of Sudan as the new president of TWAS, effective in 2019. Mohamed is a storied figure in our history: founding executive director of TWAS, close adviser to TWAS founder Abdus Salam, a globally influential science diplomat. In November of this year, Prof. Hassan was inducted by Pope Francis into the elite ranks of the Pontifical Academy of Sciences.

With such eminent leadership, drawn from throughout the global South, we can be confident of the Academy's continued success in the years to come.

Romain Murenzi, *TWAS Executive Director*

▼ TWAS President Bai Chunli

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IN THE NEWS

Experts urge Africa to get more electric cars

Africa needs low-carbon transport system such as electric cars to cut air pollution, say environmental experts. Electric vehicles reduce burning of fossil fuels, the main source of transportation-induced air pollution. Africa has many used cars that have little to no emission control mechanisms and that run on low-quality fuel.

The combined effect is that for most African cities, air pollution is heavily a result of the emissions from motor vehicles, says David Rubia, a program officer of UN Environment.

SciDev.Net:
www.bit.do/AfricaElecCars

Asian powers bring focus to biofuels

New policy schemes in India and China are anticipated to significantly boost the market for biofuels.

For example, India recently announced a new national biofuels policy that allows ethanol production from agricultural waste and crops residue such as corn, cassava and sugarcane. This could boost farmer income and help address the severe pollution that engulfs Delhi every winter, caused by the annual burning of crop stubble.

India Climate Dialogue:
www.bit.do/IndiaBiofuels

Infrastructure plans could disrupt wildlife

A committee appointed by India's Ministry of Road Transport & Highways has endorsed plans to lift the night-time closure in Bandipur National Park in Karnataka and build elevated corridors and fences despite agencies advising against them.

Infrastructure intrusions like roads, railways and power lines commonly disrupt protected areas in India, leading to problems such as habitat fragmentation and wildlife-vehicle collisions. Experts call for stringent Environment Impact Assesment with the involvement of wildlife biologists.

Mongabay:
www.bit.do/RoadsWildlife

Zimbabwe's chronic cholera crisis

Residents of Harare's poor suburbs of Glen View and Budiriro endure dry traps, burst pipes, and human excrement flowing out of leaking sewer lines daily. Worse still, they now live in the epicentre of Zimbabwe's deadliest cholera outbreak in a decade.

The outbreak – one of several in Zimbabwe this year – has claimed at least 54 lives nationwide, with three quarters of the nearly 10,000 infections in densely populated Glen View and Budiriro.

The New Humanitarian:
www.bit.do/CholeraOutbreak

Special passport could aid climate refugees

Nearly half a million people lost their countries during World War I and had to use the Nansen Passport till they could get citizenship of one country or another. A higher number may lose their countries as the sea level rises due to climate change.

They should get a climate passport, said Dirk Messner, Director of the United Nations University Institute for the Environment and Human Security and Co-chair of the German Advisory Council on Global Change.

The Third Pole:
www.bit.do/ClimatePassport

TWAS: A VITAL VOICE FOR SCIENCE

At the opening ceremony of the 28th General Meeting, science and policy leaders praised TWAS for its work in sustainability, the advancement of women and science diplomacy.

by **Edward W. Lempinen**

Address global challenges, train a new generation, use diplomacy to build science cooperation – these core missions are required for global scientific progress. At the opening ceremony of the 28th TWAS General Meeting, a distinguished panel of science and policy leaders cited TWAS's leadership in these areas and urged the Academy to extend its influence in the years ahead.

Meeting in Trieste, Italy, the headquarters of TWAS and the European City of Science for 2020, the leaders praised the Academy's positive influence in its home city, in the Friuli Venezia Giulia (FVG) region and across Italy. At the global scale, they said, TWAS has a crucial role in assembling the expertise – both senior and early-career researchers – to address the United Nations Sustainable Development Goals (SDGs). And they observed that TWAS, along with colleagues at the Organization for Women in Science for the Developing World (OWSD), show a growing impact in creating opportunities for women scientists.

"We all know that today, the need for science diplomacy is growing," said Fabrizio Nicoletti, minister plenipotentiary-principal director for innovation and research in the Italian Ministry of Foreign Affairs and International Cooperation. The Ministry, he added, "strongly believes that TWAS can connect globally and locally, with an integrated approach toward the local scientific communities and an expanding global vision."

Some 300 accomplished scientists, along with top Italian officials and the leaders in international science and policy bodies, attended the opening ceremony on 27 November 2018. The three-day meeting was held on the campus of the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy; additional support was provided by the International School for Advanced Studies (SISSA) and the National Institute of Oceanography and Applied Geophysics (OGS), both based in Trieste. All of the organisations will play prominent roles in preparations for next year's EuroScience Open Forum (ESOF 2020), with Trieste hosting the event as the European City of Science.

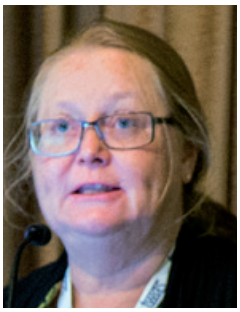
▲ From top: Fabrizio Nicoletti, minister plenipotentiary-principal director for innovation and research in the Italian Ministry of Foreign Affairs and International Cooperation; Flavia Schlegel, assistant director general in UNESCO's Natural Sciences Sector.

Following TWAS President Bai Chunli's opening address [www.twas.org/node/14641], dignitaries stressed the themes of partnership and cooperation in addressing challenges confronting humanity and the Earth. Several themes were prominent:

The SDGs define an urgent mission for international science.

The SDGs are "actually the first development agenda that puts sciences as a driver, as an enabler, at the heart of all the initiatives to sustainable and peaceful development," said Flavia Schlegel, assistant director general in UNESCO's Natural Sciences Sector.

"TWAS Fellows and TWAS prize winners, you are essential for contributing to achieving the Agenda 2030 Sustainable Development Goals," added Eva Ohlsson, senior research



▲ From left: Eva Ohlsson, senior research adviser in the unit for research cooperation at the Swedish International Development Cooperation Agency (Sida); Alessia Rosolen, FVG's counselor for Education, Universities and Research for the region of Friuli Venezia Giulia; Vaughan Turekian, executive director of the Policy and Global Affairs Division at the US National Academies of Sciences, Engineering and Medicine.

adviser in the unit for research cooperation at the Swedish International Development Cooperation Agency (Sida). "You are so important for asking the critical questions, developing new methods, and seeking further knowledge using the situated perspective that only you have."

Science diplomacy is essential for bringing nations together to pursue the SDGs and for other science-related initiatives.

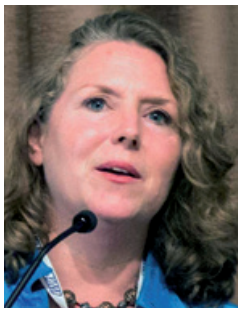
"In a landscape marked by big global challenges….the internationalisation of research requires frequent interactions between science and diplomacy," said Alessia Rosolen, FVG's counselor for Education, Universities and Research.

"The critical ties developed through scientific research… offer a productive way to build and maintain the connections among people, communities, institutions and nations to reach a better world," said Vaughan Turekian, executive director of the Policy and Global Affairs Division at the US National Academies of Sciences, Engineering, and Medicine. "In many ways, this is the hallmark of science diplomacy."

Increasing and improving opportunities for women in science is required to advance scientific knowledge and address global challenges.

"TWAS has been a forerunner in terms of sustainability science, but also in terms of gender," said Ylann Schemm, director of the Elsevier Foundation. Schemm cited TWAS efforts to increase women among its Visiting Experts and in other programmes, and the OWSD role in organising and supporting the OWSD-Elsevier Foundation Awards for Early-Career Women Scientists in the Developing World.

▼ From top: Ylann Schemm, director of the Elsevier Foundation; Trieste Mayor Roberto Dipiazza.



But, she added: "How can we create an inclusive environment in our organisations and conferences so that men and women feel a part of it, so that people from Africa feel a part of it, so that we really can bring all of our amazing brains here and work together… We have a positive role to play as partners to keep up the positive pressure."

> "[The Ministry] strongly believes that TWAS can connect globally and locally, with an integrated approach toward the local scientific communities and an expanding global vision."
>
> *Fabrizio Nicoletti, minister plenipotentiary in the Italian Ministry of Foreign Affairs and International Cooperation*

TWAS is an important leader among the research institutions of Trieste, Friuli Venezia Giulia and Italy.

TWAS's "presence here in Trieste underlines once more the international role of our city within the scientific world," said Trieste Mayor Roberto Dipiazza (in a prepared statement read by TWAS Executive Director Romain Murenzi). "The proof of that is the EuroScience Open Forum nomination of Trieste as the European City of Science in 2020…. Science can act as a bridge that links different cultures, a common ground where all can work together to help our communities and our nations grow." ◘

Read more about the opening ceremony*: www.twas.org/node/14640*

Watch the opening ceremony *of the 14th TWAS General Conference and 28th General Meeting at https://tinyurl.com/TWAS-2018-opening-video*

Q&A BAI CHUNLI: AN ERA OF GROWTH AND IMPACT

TWAS has experienced significant growth during the six-year presidency of Bai Chunli. In an interview, Bai explored the challenges and opportunities that await in future years.

Bai Chunli, an accomplished Chinese materials scientist, was elected to serve as the president of TWAS six years ago, and in the years since TWAS has achieved sustained, substantial growth.

Bai also serves as president of the Chinese Academy of Sciences (CAS), and with support from CAS, TWAS has strengthened its fellowships and prizes programmes, founded the TWAS Young Affiliates Network (TYAN) and added five centres of excellence in China.

In an email interview, Bai expressed confidence that TWAS would continue its historic influence – provided it remains at the forefront of a changing scientific environment. The interview was conducted by Edward W. Lempinen, the TWAS public information officer. The version below has been condensed; please see the full interview at www.twas.org/node/14538.

After two terms as TWAS president, what accomplishments are you most proud of?

● It has been my great honor to serve TWAS in these six years. With the solid foundation it has, TWAS has grown bigger and better in these years, and more people are hearing its voice.

I am proud, more than anything, of the significant growth of TWAS in its representation, programmes, impact and involvement in international science and education. Including nearly 50 new Fellows to be elected this year, over 250 excellent scientists from the world's science elites have been admitted to TWAS, and among these about one in five are women. Eighteen of these new Fellows are from the TWAS list of 66 S&T-lagging countries, and 10 from Least Developed Countries (LDCs). We have extended our membership to eight new countries, including two LDCs: the Central African Republic and the Democratic Republic of Congo. For the first time, we have members representing over 100 countries – 104, to be exact.

Our PhD programme has doubled its volume. TWAS awards, prizes and grants programmes are recognizing more and more scientists. A network of young scientists under the TWAS framework was launched and is functioning in good shape.

I have seen more and more involvement of TWAS in the discussion and engagement of issues of global concern, the United Nations Sustainable Development Goals, displaced and refugee scientists, and others. Helped by its science diplomacy programme, TWAS is taking a lot more real actions.

The Academy has shown significant growth since you took office in 2013. In your view, what have been the drivers for this growth?

● I personally think this progress is backed by three key factors:

First, the role of science has been more and more recognized globally. From the imbalance of globalization to poverty eradication, from climate change to energy shortages, to food security and worldwide pandemics, all these challenges are deeply rooted development issues. More than ever before in the history of human civilization, science development and scientific capacity-building have been accepted as the key driving force for national development and sustainability. TWAS's development is embedded in this global trend.

Second, there is a growing need for the developing world to develop science capacity and to apply science to address societal challenges. More investments for science and innovation have been made in different parts of the world. I recently visited Panama where I saw a new modern research institute in

bioscience built with the strong support of the government. That the institute could become a reality is a result of the contributions of a TWAS Fellow – Mahabir Prashad Gupta of Panama, who serves on the TWAS Council.

Third, the world is growing more and more connected. TWAS serves as a good linkage between academia and society, between the developed and developing countries.

Is it possible to demonstrate that the Academy's accomplishments and growth have already had an impact in building the strength of science in the developing world?

● With TWAS's advice and assistance, the Rwanda Academy of Science was officially established from scratch with the great support of President Paul Kagame and the Rwandan government. TWAS also helped the establishment of the science academy in Ecuador.

TWAS has made huge efforts in promoting young scientific talents training. The TWAS Young Affiliates Network (TYAN) is actively engaging young scientific talents in our community.

The CAS-TWAS Center of Excellence for Green Technology (CEGT) transferred green mining technology in the largest copper mine in Myanmar. On a more individual level, one TWAS Fellowship graduate, by cooperating with the biodiversity institute in Myanmar, has discovered more than ten new plants species.

In your view, do the emerging nations have special experiences to share with the LDCs? Do the emerging countries have a particular responsibility to support science-related development in the LDCs?

● Emerging countries do have a responsibility to support science development in LDCs as they were once under-developed themselves. Emerging countries have gone through very different ways of development and experienced different challenges in terms of social economic development.

For the LDCs, I believe it is important to find a way that suits their own characteristics, to build their future success on their current strength and advantages. And it is highly important to prioritize their agenda and to set achievable goals for development.

Young talents training is a key for continued success. This would be lesson No. 1. Another great lesson would be to be fully engaged in international interactions and collaborations. From our experience, international exchange brings in information, knowledge and resources. It helps build one's own strength in the long run.

TWAS President Bai Chunli

From your perspective, what are two or three of the most important challenges confronting TWAS? Do you have any recommendations or advice to share with the next generation of TWAS leaders?

● There certainly are lots of challenges ahead of us, yet I am optimistic there are even more opportunities. I would recommend that TWAS should always be fully engaged in the global science agenda, always stand on the collective strength and wisdom of the whole community and always try to lead and keep track of the frontier of global science development.

I wish TWAS all the best for the future and will continue to commit my own strength to the cause of TWAS. ◘

For further information, see President Bai Chunli's address – "Partnerships, the key to our future" – at the opening ceremony of the 28th TWAS General Meeting in Trieste, Italy: www.twas.org/node/14641

MOHAMED HASSAN ELECTED TWAS PRESIDENT

by **Edward W. Lempinen**

As its founding executive director, Mohamed Hassan helped to build TWAS into a global voice for science. Now he returns as president, seeking to guide it to new achievements.

Mohamed H.A. Hassan, a distinguished and highly influential Sudanese advocate for science in the South, has been elected to serve as the sixth president of The World Academy of Sciences for the advancement of science in developing countries.

Hassan was TWAS's founding executive director and served 26 years in that role, establishing a reputation as a scholar and diplomat who moved effectively at every level of global research, education and policy.

"I am greatly honoured and privileged to be given the opportunity to serve TWAS in a new and more challenging capacity," Hassan said. "I am grateful to the TWAS Council and membership for the faith and confidence they have placed in me and I hope to live up to their expectations – and maybe exceed them a little bit."

Beginning in 2019, he will succeed TWAS President Bai Chunli of China, who took office in 2013 and served two three-year terms. Under changes newly approved by the TWAS Council, the Academy president and Council members will now serve single four-year terms.

Hassan praised Bai for serving with "dedication, distinction and effectiveness" as TWAS president. Bai oversaw a period of "substantial expansion in its membership and programmes", he added, and helped to achieve significant growth in China's contributions to TWAS and its programmes to build science capacity.

Hassan is currently president of the Sudanese National Academy of Sciences. He was elected without opposition by a vote of Academy members at the 28th TWAS General Meeting in Trieste, Italy.

Hassan was an early-career Sudanese mathematician when Abdus Salam recruited him to come to the International Centre for Theoretical Physics (ICTP) in Trieste. In 1983, Salam asked him to help organize the meeting that would establish TWAS – originally the Third World Academy of Sciences. He was appointed the Academy's first executive director in 1985, and in that post, Hassan was a close adviser to Salam and manager of the Academy's day-to-day operations. He led TWAS through the uncertain period following Salam's death in 1996, then used his experience and diplomatic skill to build worldwide networks with far-reaching impact.

▼ Incoming TWAS President Mohamed H.A. Hassan

After retiring as executive director in 2011, Hassan continued to serve as TWAS treasurer until the end of 2015.

In July 2018, Hassan was appointed by Pope Francis to the eminent Pontifical Academy of Sciences based at the Vatican in Rome, Italy. In 2016, then-UN Secretary-General Ban Ki-moon named him to chair the Governing Council of the new Technology Bank for Least-Developed Countries.

He formerly served as president of the African Academy of Sciences, founding president of the Network of African Science Academies and president of the InterAcademy Partnership, an associated partner of TWAS; and as chairman of the Council of the United Nations University.

He has won numerous awards, including the TWAS-Abdus Salam Medal and the G77 Achievement Award.

Read more about the election of Mohamed Hassan and the new TWAS Council: www.twas.org/node/14555

See the statement issued by Mohamed Hassan after his election as TWAS president: www.twas.org/node/14556

ICTP'S QUEVEDO: ABDUS SALAM MEDAL WINNER

by **Edward W. Lempinen**

Fernando Quevedo, ICTP director, joins a cadre of past Salam Medal winners who count among the elite science leaders from the developing world.

The World Academy of Sciences has awarded its prestigious TWAS-Abdus Salam Medal to Fernando Quevedo for his strong leadership of the Abdus Salam International Centre for Theoretical Physics (ICTP) and his efforts to build science in the developing world.

Quevedo, a Guatemalan theoretical physicist and 2010 TWAS Fellow, has served as ICTP's director since 2009. He has credited Salam with being a role model and an inspiration, saying that he sought to emulate Salam's balanced commitment to scientific research and to building scientific institutions for developing countries.

"Professor Quevedo's leadership has had a profound impact on the field of physics in the developing world," said TWAS President Bai Chunli. "ICTP is a thriving institution, and in recent years it has helped to open important new research centres in developing countries. And he has been a very important friend to TWAS. In these ways and others, he embodies Abdus Salam's deep commitment to our shared mission."

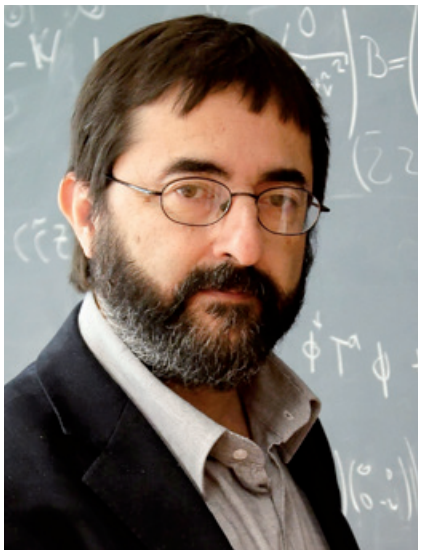
Said Quevedo: "For the past nine years, Abdus Salam's vision for ICTP has guided my efforts in building the centre to what it enjoys today: a vastly expanded presence throughout the developing world, strongly committed to a mission of promoting scientific excellence and opportunities for all. To be recognized for these efforts by an award named after ICTP's founder is a great honour for me."

The medal was presented to Quevedo on 27 November 2018 during the opening ceremony of the 28th TWAS General Meeting in Trieste, Italy.

Salam led efforts to found ICTP in 1964 and TWAS in 1983, and through much of his career he wrote prolifically and travelled the world to advocate the central role of science and technology in bringing the poorest countries out of poverty. At the same time he continued his research, and won the Nobel Prize in physics in 1979.

TWAS inaugurated the Abdus Salam Medal in 1995, a year before his death. The medal is awarded to highly distinguished scholars who have served the cause of science in the developing world.

Among past winners have been entomologist Thomas R. Odhiambo of Kenya, a giant of African science who was a founding Fellow of TWAS; Italian physicist Paolo Budinich, who was Salam's partner in founding ICTP and TWAS; and former TWAS Presidents José I. Vargas of Brazil, C.N.R. Rao of India, and Jacob Palis of Brazil.



▲ ICTP Director Fernando Quevedo

Quevedo was born in Costa Rica and obtained early education in Guatemala. He earned his PhD from the University of Texas at Austin in 1986. His early career included research appointments at CERN in Switzerland; McGill University in Canada; Institut de Physique in Switzerland; and Los Alamos National Laboratory in the United States.

Under Quevedo's leadership, ICTP has expanded dynamically, moving into energy, climate science, medical physics, quantitative life sciences and high-performance computing. ICTP also has worked with partners to open international research centers in Brazil, Mexico, Rwanda and China. All are, or will soon be, UNESCO Category 2 institutes.

Learn more about Fernando Quevedo's accomplishments at ICTP: www.twas.org/node/14548

MASHELKAR WINS TWAS-LENOVO PRIZE

The Indian polymer scientist, a TWAS Fellow, helped develop and find uses for smart gels that opened the door to a long list of discoveries put to innovative use across fields.

by **Sean Treacy**

Indian polymer scientist R.A. Mashelkar was named the winner of the 2018 TWAS-Lenovo Science Prize for his pioneering research on smart polymer gels that have yielded a long list of useful applications.

Mashelkar, a 1993 TWAS Fellow, was honoured for work that has contributed to high-impact developments in agriculture, medicine and other fields. He has had broad influence shaping India's science and technology policies and he served as chairman of India's National Innovation Foundation for 18 years.

The TWAS-Lenovo Prize was announced at the 28th TWAS General Meeting in Trieste, Italy in November 2018. The annual prize, now in its sixth year, includes an award of USD100,000 provided by the Chinese technology company Lenovo, the global leader in consumer, commercial, and enterprise technology and the largest PC company in the world. The prize is one of the most prestigious honours given to scientists from the developing world.

"We are enormously happy to congratulate Dr. Mashelkar for his accomplishments setting the stage for innovations in polymer science," said Lenovo Senior Vice President George He. "His research has been spectacular and it is indeed our honour to present this year's TWAS-Lenovo Science Prize to him, and we wish him many fruitful years of discovery and innovation in the future."

"Dr. Mashelkar is one of the most distinguished scientists in his field, and in polymer research," said TWAS President Bai Chunli. "His work has had an impact on a broad range of applications from agriculture to medicine, and it reflects a deeply ingrained spirit of science: that investment in fundamental research can give rise to discoveries in applied science that have a real and powerful impact on people's lives."

Mashelkar, born in 1943, lost his father at the age of six and, with his mother, moved to Mumbai. He went to a municipal school there and often couldn't even afford a notebook for his classes. But he excelled anyway throughout his childhood and into adulthood, developing a hungry curiosity and a keen interest in science.

◀ 2018 TWAS-Lenovo Prize winner R.A. Mashelkar. [Photo provided]

> We started using chemistry for the good of the people, and then we started asking: Why does such a polymer absorb such huge quantities of water?

R.A. Mashelkar, TWAS Fellow, winner of 2018 TWAS-Lenovo Science Prize

▲ R.A. Mashelkar's work led to the study of smart hydrogels, which produced a long list of high-impact applications. (Photo: Shyni Verghese/Duke University)

"I dedicate this greatest honour in my life to my late mother who, despite extreme poverty, gave me the precious gift of education," Mashelkar said after learning of the honour.

THE PROMISE OF POLYMERS

R.A. Mashelkar's story is the story of a developing world scientist who returned home to help. After serving six years in the U.K. as a lecturer in chemical engineering, he returned to India in 1976, years before the growth and development that has brought new wealth to the country. He had no access to computers, to imported chemicals or much other essential laboratory equipment. Nevertheless, he joined with India's National Chemical Laboratory and began important work advancing the country's prowess in polymer science and engineering.

His group sought uses in India for a special kind of polymer, of which even a single gram could pick up hundreds of grams of water. India is dependent on rain for agriculture, and sometimes the rains start but then stop again for weeks. By coating seeds with this gooey polymer, they would have much longer access to water after a rainfall, helping to ensure that farmers would have a successful crop.

"So we started using chemistry for the good of the people," Mashelkar said, "and then we started asking: Why does such a polymer absorb such huge quantities of water?"

To the naked eye, the gel resembles Jell-O. But zoom in to the microscopic level, and it looks like a series of long chains, that are linked across to each other with smaller molecules. When water enters, the chains repel each other, creating spaces in which enormous quantity of water gets absorbed.

Through more work, they discovered the polymers also suddenly expand and then collapse at very specific temperatures. Still the science behind such super-absorbing and changeable polymers was not well understood. As Mashelkar's group continued to make discoveries, the polymer gel field found innovation after innovation and success after success. The study of smart hydrogels became a hot area of research and a long list of applications emerged.

Mashelkar's group created gel-based enzymes – microscopic substances with multiple functions that can be turned on or off by a trigger, such as light. For example, by switching the ultraviolet light off, the enzyme would carry out a chemical reaction but by switching the UV light on, the enzyme would stop being active, thus stopping the chemical reaction.

His group also discovered a gel with self-repairing properties, which heals tears on its own, behaving like a healthy living tissue. This material can patch up tricky-to-monitor wounds or even help in doing 'suture less' surgery.

Mashelkar emphasised that the greatest satisfaction is not his own discoveries but the fact that many scientists have been able to use his foundational work as the basis for countless more applications.

"In a developing country, we may start with something practically useful to the farmers and their work," Mashelkar said. "But exploration of fundamental science is absolutely critical so that more applications can actually come out, and some of them come out accidentally, of course! That is the story of science in general, because while we have organized science, a lot of these discoveries are unorganised." ◘

A REVOLUTION IN MEDICAL RESEARCH

In a TWAS Medal Lecture, pioneering researcher Subra Suresh describes the revolutions shaping future treatments of diseases that afflict the developing world.

by **Edward W. Lempinen**

An image glows on the big screen: a luminous purple field populated with a precise grid of more than 100 slightly tapered blocks. The grid is like a maze of obstacles: Small objects stretch and glide easily through the tight channels. But when the objects change shape, becoming more stiff, they get stuck in the channels and obstruct the flow.

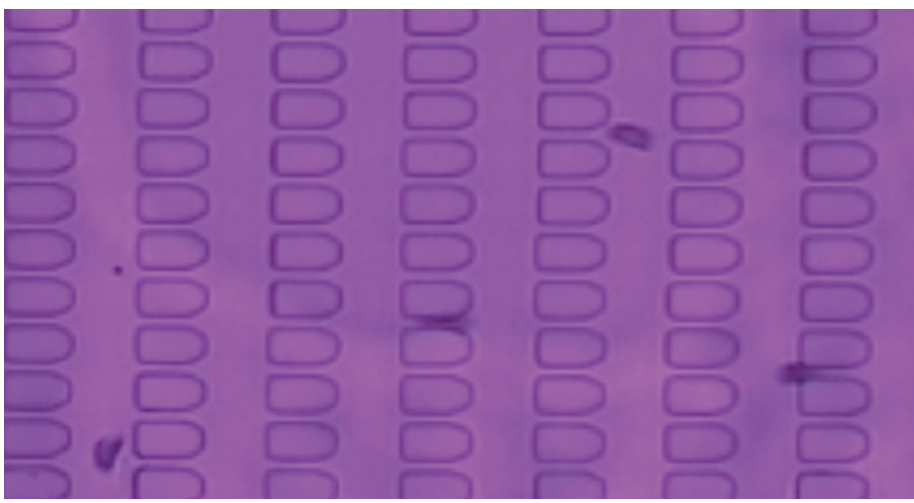
Pioneering researcher Subra Suresh offers the brief video to illustrate the workings of sickle cell disease, a group of hereditary disorders that affect millions of people worldwide. The grid, he explains, is within a tiny microfluidics device with channels – just a few micrometres wide – to simulate blood vessels. Because of a defect in one of the genes that code for haemoglobin, red blood cells that have discharged their oxygen into body tissues then transform into stiff sickles as they circulate back to the lungs.

In this state they can obstruct blood vessels, causing painful swelling and sometimes even strokes. The effect was clearly visible on the screen, cell by cell, as researchers reduced and increased the oxygen.

But in a recent TWAS Medal Lecture, Suresh said the image on the screen also reflects a revolution in medical research. By drawing from chemistry, biology, physics and a range of other fields, and with engineering to develop powerful new technologies, researchers are improving their knowledge of diseases such as cancer and malaria. With new understanding comes the potential for new treatments.

"If you talk to most chemists," he said, "everything is usually chemistry. If you talk to many biologists, everything typically centres around biology. If you talk to most geneticists, everything is probably based on genetics. What I am trying to show here is a combination of all of this. The intersection of engineering, sciences and medicine is very important."

Suresh, a 2004 TWAS Fellow, is renowned for his pioneering work on the mechanical properties of engineered and biological materials and for establishing connections between cell mechanics and human diseases. Today he is the president of Nanyang Technological University in Singapore. He served as president of Carnegie Mellon University in Pittsburgh, Pennsylvania (USA) from 2013-2017; he directed the U.S. National Science Foundation from 2010-2013, and before that he was the dean of engineering at the



▼ Viewed in a micro-fluidic device, healthy red blood cells are supple enough to extend and squeeze through the tightest channels, just as they do in narrow blood vessels. ["Kinetics of sickle cell biorheology and implications for painful vasoocclusive crisis", E Du, Monica Diez-Silva, Gregory J. Kato, Ming Dao, and Subra Suresh, Proceedings of the National Academy of Sciences, February 3, 2015 112 (5) 1422-1427]

▶ Subra Suresh is renowned for pioneering work on the mechanical properties of engineered and biological materials to improve health care.

> Nature wants to work in a very precise way, and these kinds of tools at the intersection of engineering and physics help our understanding.
>
> *Subra Suresh, 2004 TWAS Fellow, president of Nanyang Technological University in Singapore.*

Massachusetts Institute of Technology (MIT). He earned his bachelor of technology degree at the Indian Institute of Technology in Madras.

He delivered the TWAS Lecture on 28 November 2018 in Trieste, Italy, at the Academy's General Meeting.

A MULTI-DISCIPLINARY REVOLUTION

Disease changes the physical properties of the cells, Suresh explained, and, therefore it is essential to better understand cell properties.

Red blood cells, for example, are disc shaped, about eight micrometres wide. (A human hair is about 50 to 100 micrometres.) During a life span of about 120 days, a red blood cell circulates millions of times through the body. In the lungs, it picks up oxygen. It carries the oxygen through the body, discharging it into the tissues. It must be able to squeeze through the narrowest vessels of the brain – about two to three micrometres in diameter. Then it returns to the lungs for an oxygen recharge.

"If it loses its ability to stretch," he said, "we will get a disease."

In Suresh's view, creative new applications of physics, genomics and computing are opening new fields for medical research. With parallel advances in fields such as nanotechnology, these innovations are having an impact across medical sciences.

"Nature wants to work in a very precise way," Suresh said. "And these kinds of tools at the intersection of engineering and physics help our understanding."

NEW INSIGHTS ON MALARIA AND CANCER

As researchers use these new technologies to better understand the physical properties of cells, Suresh said, they set the stage for advances in treating diseases.

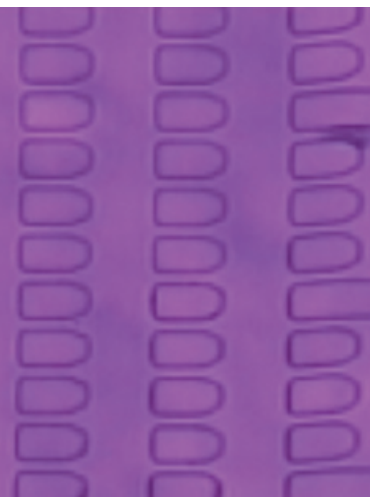
For example, *Plasmodium falciparum* is the parasite linked to 50% of malaria cases worldwide – and 99.7% in Africa. The UN's World Health Organization reports that it is also the most lethal, linked to the majority of 435,000 malaria deaths in 2017. Researchers know that infected red blood cells become stiffer and more sticky, but how much stiffer was unknown.

Research by Suresh and his colleagues used optical tweezers to find that the stiffening was far greater than expected. Such improved understanding "can shape clinical decisions, such as the use of medications, to improve blood flow," he said.

Cancer provides another example. In recent research, Suresh and an international team of colleagues found that sound waves can separate cells of different sizes or different physical properties, without damaging the cells. In one study of breast cancer patients, they were able to isolate one cancer cell from as many as 100,000 healthy cells.

"If we could have one more diagnostic tool," he said, "if we can diagnose someone's cancer a little bit earlier, then how many lives could we save? That's the spirit of this work." ◘

Learn more:
www.twas.org/node/14736/



MAKING LIGHT BOUNCE AND BEND

Hala J. El-Khozondar, a Palestinian materials scientist and TWAS Fellow, delivered a TWAS Medal Lecture about her research on "metamaterials" that can control the behaviour of light.

by **Sean Treacy**

Special "metamaterials" have provided researchers with new and exciting ways to control the behaviour of light, said Palestinian materials scientist Hala J. El-Khozondar in a TWAS Medal Lecture. Reflecting on her own work in the field, the Palestinian researcher said the applications are broad and are already having a powerful impact in medical, security and solar technology.

El-Khozondar is a 2011 TWAS Fellow and she has won worldwide respect for her research, which has had implications for wireless communication, optical communication, optical fibre sensors, renewable energy and other areas. She currently is a professor in the electrical engineering department at the Islamic University of Gaza.

Based on her accomplishments, she was awarded a TWAS Medal and invited to deliver the TWAS Medal Lecture on 29 November at the Academy's 28th General Meeting. The TWAS Medal Lectures were established in 1996; a General Meeting typically features two or three leading scholars who have been awarded the honour and invited to present their work.

El-Khozondar's focus has been on metamaterials, structures in which atoms are arranged in a pattern where each is less than one nanometer from the other. This distance is much less than the wavelength of visible light, and by adjusting the distance between the atoms within metamaterials, scientists can make light bend and bounce in ways that open up new options for innovation to researchers across countless fields.

Making her work even more remarkable is that El-Khozondar's research was developed in the Palestinian territories, at the Islamic University of Gaza, where she and her colleagues had scarce resources and no access to advanced equipment such as high-powered microscopes.

"We work much harder than normal," she said. "We spend a lot of time doing paperwork and computer simulations."

The idea for metamaterials has been around since 1968, conceived of by the late Russian physicist Victor Veselago. But it wasn't produced in a lab until 2000, in an experiment proposed by British physicist John Pendry and carried out by American physicist David R. Smith. Since then, metamaterials have been used in numerous fields.

"These metamaterials have attracted attention the last decade," El-Khozondar said. "And they attracted a lot of attention because they have applications."

CONTROLLING LIGHT WITH PRECISION

The way metamaterials refract light is not found in nature. One way to conceive of it is to imagine a glass of water with a straw in it. Light can move directly through air without changing direction, but it will bend at an angle when it hits water in a glass, making a straw in the water look slightly off, as if it were at a different angle below the water line. But the light generally will still travel in a similar direction, so the straw does not look drastically disjointed. A straw in "negative" water functions as metamaterials

▶ TWAS Fellow Hala J. El-Khozondar delivers her TWAS Medal Lecture at the 28th General Meeting in Trieste. (Photo: Paola di Bella/TWAS)

> [Metamaterials] have a lot of applications because we can control them. We can control the gap size of the atoms, and these all affect the applications.

2011 TWAS Fellow Hala J. El-Khozondar of Palestine

do: once that light hits the water, it will bounce back the way it came as if it ricocheted off an invisible wall placed down the middle of the water. Since the behaviour of light determines what the human eye will see, the portion of the straw inside the water would appear wildly out of place, entering the water at a completely different location.

This effect provides researchers with precise control over the behaviour of light.

The material is useful in communication, because it provides for more radio antennae designs by presenting more options for manipulating radio waves, a form of light. It's also useful for security technology as well as camouflage and stealth technology, making people and objects – and even their shadows – invisible to the naked eye. An object surrounded by a "cloaking device" made of the metamaterial will be practically invisible to the naked eye.

El-Khozondar's own work has largely focused on improving crystals used to absorb light in solar panels and converting it to usable electricity. It can also help filter or amplify signals in transmission lines, improve sensors that detect bacterial changes in food, and improve the quality of lenses.

"They have a lot of applications because we can control them," she said. "We can control the gap size of the atoms, and these all affect the applications." ◘

Learn more:
www.twas.org/node/14614/

▼ TWAS General Meeting attendees speak during preparations for the opening ceremony.

▲ The winners of 2018 TWAS prizes and awards gathered with TWAS President Bai Chunli and Executive Director Romain Murenzi.

▼ Abdin Mohamed Ali Salih, a 2002 TWAS Fellow from Sudan, left, speaks with new TWAS President Mohamed H.A. Hassan.

▲ TWAS President Bai Chunli speaks with a television crew during the meeting.

▲ Yemeni researcher Fathiah Zakham, winner of the 2017 TWAS-Al-Kharafi Prize, gives a talk at the General Meeting on her tuberculosis research.

▼ Representitives of TYAN, the TWAS Young Affiliates Network, explain how the organization elevates the careers of young scientists at the meeting.

For more photos from the meeting, see TWAS's Flickr page: www.flickr.com/photos/twas

All photos are by Paola di Bella/TWAS

USING STEM CELLS TO RESTORE EYESIGHT

Stem cell transplants create remarkable possibilities to repair eyes that have been injured or scarred, researchers said at the 28th TWAS General Meeting.

by **Cristina Serra**

There are events that change our life and perspectives. One such event happened to a Nigerian factory worker named Ibrahim, whose eyesight was heavily damaged by an explosion in November 2015.

Ibrahim was mixing dangerous chemicals at his workplace, but something went wrong and his face and eyes suffered from major injuries after a violent blast. Luckily, when the acute phase had passed by, he was offered a life-changing surgery that partially restored his sight. He received a stem cells transplantation from a donor, his father, and experienced the therapeutic power of what is known today as regenerative medicine.

"Simple limbal stem cell transplantation offers incredible potential for treating eye diseases arising from limbal stem cell damage," Ayobade Ogundipe, an ophthalmologist from University College Hospital in Ibadan, Nigeria, explained during a symposium at the 28th TWAS General Meeting in Trieste.

Knowing that under proper chemical treatment limbal stem cells may turn into a specific, more mature cell type, Ogundipe added, doctors used this technique to restore Ibrahim's damaged corneal tissue.

PARTNERSHIPS AND BREAKTHROUGHS

Ogundipe is an associate lecturer at the University of Ibadan College of Medicine, and the president of the Ophthalmological Society of Nigeria. He completed his basic medical training at the University of Jos Medical School in central Nigeria.

However, a big step forward in his career came from his post-residency training: while training on cornea and eye anterior segment surgery at the LV Prasad Eye Institute in Hyderabad, India, he met TWAS Fellow Dorairajan Balasubramanian, a distinguished scientist and director emeritus of research at the Institute.

Balasubramanian, an Indian chemist and ophthalmologist and a 1997 TWAS Fellow, served as the director of the Centre for Cellular

▶ Dorairajan Balasubramanian from India charing the session on stem cells at the TWAS General Meeting in Trieste.

▼ Nigerian ophtalmologist Bade Ogundipe during his speech on stem cells at TWAS General Meeting.

> We are lucky, because in the eye there is a specific area rich in stem cells with the potential to regenerate other layers of the eye.
>
> *Dorairajan Balasubramanian, TWAS Fellow and director emeritus of research at the LV Prasad Eye Institute in Hyderabad, India*

and Molecular Biology in Hyderabad from 1992 to 1998. Today he is a leading scholar in the biology of the eye, specialising in stem cell technologies, and a distinguished scientist at the Prasad Institute.

Their partnership turned out to be highly productive over many years for both scientists, and therefore it was natural that they presented a joint lecture at TWAS's General Meeting, on 28 November 2018, in a symposium titled "Breakthroughs in the Science of Stem Cells and Gene Editing", chaired by Balasubramanian.

Stem cells have been the focus of intensive research in recent years. They are undifferentiated cells able to turn into specialized cells, with new features that were not present at earlier stages. In the human body this happens spontaneously. In the lab, stem cells complete their maturation process when cultured in the right medium.

"Stem cells are routinely used in two areas of eye care: cornea and retina," Balasubramanian said in his presentation. "And we are lucky, because in the eye there is a specific area called limbus, rich in stem cells that have the potential to regenerate other layers of the eye, in particular the corneal layer in case of scars or accidental damage."

INNOVATION IN STEM CELL TRANSPLANTS

The ocular surface is made of a layer called conjunctiva, or sclera, and the limbus – a ring surrounding the corneal epithelium, which is covered by a thin film of tears. The corneal epithelium is constantly self-renewing throughout life thanks to the presence of limbal stem cells, located close to the junction between the sclera and the epithelium.

As the scientists noted, in the past, limbal cells (stem cells) were harvested from the limbus and transfered in a culture dish to grow. There, they grew into specialized cells that would still retain the stem cell characteristics. Now the technique has become more sophisticated.

"Today we achieve better results by directly transplanting stem cells harvested from the same patient, or using tissue from a dead body or a living donor," Ogundipe explained.

This is exactly what doctors did with Ibrahim. In the stem cell transplant at University College Hospital, they harvested tiny pieces of limbal stem cells from Ibrahim's father and transplanted them directly onto Ibrahim's burnt cornea, with a minimally invasive intervention.

Medication, bandage contact lens and rest helped the recovery. Today, Ibrahim is autonomos and walks independently. His sight has not been completely restored, though, because too much time had elapsed from the accident to the day of surgery.

Such progress was made possible by the great knowledge acquired in stem cell therapy. However, as Ogundipe noted, there is still much work to do. Especially in Africa, where clinical work remains in its early phase.

"We need collaboration with centres outside Nigeria," said Ogundipe. "I had the opportunity to train at Prasad Institute with Professor Balu. Now it's time to train younger clinicians in Nigeria, too." ◘

Learn more:
www.twas.org/node/14611/

BIG DATA TECHNOLOGY FOR A BETTER FUTURE

A symposium sponsored by the Elsevier Foundation convened experts in big data and machine learning to explain the promise of the technology – and some new dilemmas.

by **Sean Treacy**

The world is more interconnected and more digitally recorded than ever before, and one consequence of this technological shift is that scientists have an unprecedented amount of data to work with. But this has also given rise to new questions, not just about how to use that data, but how to use it optimally and responsibly.

These questions were explored in the symposium "Data Analytics, Social Media and Sustainability", supported by the Elsevier Foundation, at the 28th TWAS General Meeting in Trieste, Italy. The symposium brought together a trio of experts in sustainable development, machine learning and cybersecurity to discuss the promise, potential and challenges presented by the big data era.

Elsevier Foundation Director Ylann Schemm said the symposium was designed to be a "deep dive" into the importance of harnessing the data revolution for good causes, in particular those pursued by the U.N.'s Sustainable Development Goals (SDGs).

"So many of you are involved in sustainability-oriented research," Schemm said to the assembled scientists at the meeting, "but we wanted to have a space where we could zoom out and look at some of the larger issues in data analytics."

THE GLOBAL MISSION OF THE SDGS

Elsevier began expanding into the area of sustainable development to support the efforts around the launch of the United Nations' SDGs in 2015. With powerful data analytics, decision-makers can support research in developing countries that will help address those ambitious goals.

Maria de Kleijn is a senior vice president of analytical services for Elsevier who spearheaded a 2018 report, "Artificial Intelligence: How knowledge is created, transferred, and used". She described the goals as missions, with an intimidatingly large number of targets – for example, providing affordable health care to everyone on Earth.

Digital communication has completely transformed how research is done – how we gather data and produces findings, and then how that information is made available for further analysis, de Kleijn said. In disaster

▼ Attendees of the 28th TWAS General Meeting in Trieste, Italy, listen to the symposium "Data Analytics, Social Media and Sustainability", supported by the Elsevier Foundation. (Photo: Paola di Bella)



▲ From left: Maria de Kleijn, senior vice president of analytical serivces for Elsevier; V.S. Subrahmanian of Dartmouth College; and Tshilidzi Marwala, vice chancellor of the University of Johannesburg in South Africa. (Photos: Paola di Bella)

research, for example, an algorithm can detect almost 30,000 articles across all journals over a five-year period, and then sort them across disaster types. This data can then be contrasted with information about the human and economic toll of disasters.

"If you look at the countries that do the (disaster) research, Japan is one country with both high research and high toll because of the earthquakes," de Klejin said. "High research impact is in Europe where there's almost no toll. But countries doing the disaster research, do that research on disaster types that matter to themselves. If you have disasters that are not present in Japan, China, U.S. or Europe, then they are under-researched."

THE POWER OF MACHINE LEARNING

It's not just big data, but also the method of machine learning that is at the forefront of innovation today, said computer scientist V.S. Subrahmanian of Dartmouth College in the United States. Machine learning is a category of artificial intelligence that automates data analysis. Programmes that use the method learn from the data they analyse to identify patterns and shape models with little human help.

Subrahmanian said the goal of machine learning is to use large tables of data to calculate probabilities. This is useful for the science of global health, which makes it important to achieving SDG No. 3. For example, machine learning was key in predicting the spread of ebola in Western Africa. Subrahmanian's team wanted to predict mortality rates on a week-by-week basis.

"We gathered months of Twitter data from countries, primarily in English and French, and said, 'Can we extract certain variables from Ebola-related tweets?'" he explained. "Such as the intensity of fear in each of those countries – and anxiety, anger, depression and stress."

Tshilidzi Marwala, an engineer and the vice chancellor of the University of Johannesburg in South Africa, has long experience training young scientists in the global South. In South Africa, he said, machine learning has been useful for HIV epidemiology. The country's national department of health provides HIV tests in various circumstances. For instance, hospitals will require it from pregnant women. So Marwala and his colleagues collected the data from the department of health to build models that could estimate its occurrence in the population. This proved useful for researchers.

> "We need to create infrastructure to create our own data. You can't do it alone. We have to do it with our neighbours, and get enough data in order to solve our problems."
>
> *2010 TWAS Fellow Tshilidzi Marwala, University of Johannesburg, South Africa*

Even so, the process presents complications. Statistical models are approximations of reality that will always be inconsistent, he explained, especially since the data received by scientists is always going to be incomplete and imperfect.

"I think we need to produce algorithms that work with limited and imperfect information, and secondly we need to think about regulation of ownership and data," Marwala said. "And thirdly, we need to create infrastructure to create our own data. You can't do it alone. We have to do it with our neighbours, and get enough data in order to solve our problems." ◘

AN URGENT FOCUS ON THE ENVIRONMENT

TWAS Young Affiliates from Tunisia and Ghana identify toxic elements in living organisms – and broader threats to Earth's webs of life.

by **Cristina Serra**

There is little doubt that Planet Earth is facing increasing threats because of humanity's exploitation of resources. This is why many scientists are working intensively to find solutions to environmental issues, setting off an alarm on situations that call for urgent action before they get to a point of no return.

Consider living organisms and how deeply they are connected. This makes them all essential elements in the food chain. Sea urchins are a good example: on the one side they feed on large brown algae seaweeds called kelp, and on the other side they make an excellent food source for starfishes, sea otters and even human beings. But since their habitat is under pressure, they might soon be reduced or removed altogether from this important place in the food chain.

"Urban and industrial discharges, hospital waste and marine traffic all pose increasing risks to marine organisms," warned TWAS Young Affiliate Jamel Jebali, a Tunisian scientist who studies the effect of pollution on marine organisms, and sea urchins in particular.

Jebali, an associate professor of biochemistry from the Higher Institute of Biotechnology of Monastir, Tunisia, gave a lecture to present his most recent data at the 28th TWAS General Meeting, held in Trieste, Italy, from 27-29 November 2018. He holds a master's degree in environmental sciences and a PhD in biological sciences and biotechnology

TWAS Young Affiliates, scientists aged 40 and under, serve five-year terms. Every year, the five TWAS Regional Partners each select up to five Affiliates based on the quality of their work and their future potential. Jebali's term began in 2014 and runs through the end of 2018, after which he will be a Young Alumnus.

SEA URCHINS SIGNAL A GROWING RISK

Environmental degradation and its link with human health was a common focus for many presentations given in Trieste by TWAS Young Affiliates. Jebali focused on sea urchins. The seas where they live are often severely threatened by heavy metals, pesticide residues and pharmaceuticals, which jeopardize the survival of younger larvae and adults.

"In a time frame that may range from minutes to days on the one side, to months and years on the other, pollutant discharges may affect physiological functions, individuals' growth rates and, in the end, whole populations' structure," he explained.

The environmental observations he has carried out produced an important conclusion: sea urchins are particularly susceptible to

> "Urban and industrial discharges, hospital waste and marine traffic all pose increasing risks to marine organisms."
>
> *TWAS Young Affiliate Jamel Jebali, Tunisia*

pollutants, and this is why they can be used as a sensitive model to test toxicity and effects of pesticides and copper in seawater.

In a set of experiments, Jebali and colleagues exposed sea urchin's sperm to pollutants commonly used in agriculture and industrial activities. These substances ultimately reach the marine ecosystem at high concentrations, and have an impact on many organisms.

"We confirmed that sperm exposure to increasing concentrations of a much-used insecticide called deltamethrin and to copper, or to a mixture of the two, caused a significant alteration in the fertilizing capability of spermatozoids," he said.

In particular, he observed that "larvae do not develop full-size and, in addition, exhibit several abnormalities, including crossed skeletal tips and alteration of their general shape."

Jebali's research is making good progress, now. Thanks to his results, Tunisian scientists are developing sensitive biological markers to precisely assess chemical contamination in marine organisms.

LIPSTICK: TOXIC BEAUTY?

Heavy metal and toxic compounds were a focus in other presentations, too. Marian Asantewah Nkansah, a Ghanaian chemist, highlighted the threat posed by toxic compounds like cadmium, which has the potential to infiltrate the human domestic environment.

Nkansah is a senior lecturer in chemistry at Kwame Nkrumah University of Science and Technology in Kumasi, Ghana. She was selected as Young Affiliate in 2017, a year after winning the TWAS-Fayzah M. Al-Kharafi Prize. In her talk, she examined the role of cosmetics: billions of women use eyeshadow and lipstick every day to embellish their look. And most probably don't think of what kind of compounds those cosmetics contain.

"Cadmium is a very toxic heavy metal, which may poison humans by exposure in industrial workplaces, absorption from soil by plants, eating of contaminated foods or inhalation of polluted air," she explained in her presentation at the TWAS General Meeting.

Nkansah has recently developed a keen interest in spotting toxic elements – heavy metals, organic pollutants and polycyclic aromatic hydrocarbons – that are present in water, soil, dust, tea, clay and other unusual places. These and other substances pose a threat to humans and other living things.

▲ From top: Chemist Marian A. Nkansah of Ghana and biochemist Jamel Jebali of Tunisia.

Learn more: www.twas.org/node/14608/

> Users of unregulated lipstick brands could suffer from a toxicological effect, after accidental ingestion of the lipstick.
>
> *TWAS Young Affiliate Marian A. Nkansah, Ghana*

"Overexposure may occur even in situations where trace quantities of cadmium are found, because the dose which is considered not harmful for humans is very low," she said. "Ingestion of even small amounts may cause poisoning and damage to liver and kidneys. In addition, cadmium is a known human carcinogen."

In her investigation, Nkansah examined 20 different lipstick brands sold at different markets and shops in Kumasi to determine lead and cadmium levels. What she found about cadmium should raise concerns both for women's health and for policymakers.

"Cadmium concentrations in 19 lipsticks was above the Health Canada threshold for impurities," she reported. "This is an important indicator that users of unregulated lipstick brands could suffer from a toxicological effect, after accidental ingestion of the lipstick."

Her research showed the importance of regular monitoring of lipstick for all toxic heavy metals to ensure consumer protection, and the need for stricter regulation. But her work goes well beyond this: Nkansah is also a committed mentor to female university students, offering herself as an example and a model for young women who would like to start a career in science or other fields. She is also active in science communication and public engagement with science. ◘

FLOWER POWER – AND SOIL POWER, TOO

Strategies to increase crop yields and food nutrients should seek to improve flowers and soil, experts said at the TWAS General Meeting.

by **Cristina Serra**

With world population projected to reach 9.7 billion by 2050, scientists are focused on solutions that will feed as many people as possible. Today there are two key areas for research: increasing crop yield, and fortify food so that it provides more nutritional value.

Studies suggest that to feed so many more, production of cereal should rise by 60% to 70% in the next three decades. Other research suggests that controlling number and size of flowers could have an impact on shape and size of grains, and that this in turn could increase yield.

"We have been studying the mechanisms responsible for the flower shape in higher plants, particularly in rice, at the molecular level," TWAS Prize winner Zhang Dabing told at the Academy's General Meeting in November 2018. And, he said, the research has found a number of genes that modulate the number of flowers in cereal grains.

Zhang is a plant biologist and molecular geneticist with a PhD in plant molecular genetics from Shanghai Institute of Plant Physiology and Ecology, Chinese Academy of Sciences (CAS). He won the 2018 TWAS Prize in Agricultural Science for his studies on the molecular mechanisms of reproduction in higher plants, especially rice.

In 2004 he was appointed full professor at Shanghai Jiao Tong University (SJTU), and a year later he took a joint professorship position to work between SJTU and the University of Adelaide in Australia to run the laboratory on plant science and breeding.

BREEDING PLANTS TO ENDURE CLIMATE CHANGE

Many plants react to environmental stress lowering the number of their flowers, Zhang explained. At times they become sterile. Through investigation, he and his team have identified genes directly involved with rice sterility, and filed seven patents related to the control of this trait.

"We found that climate change, i.e. temperature fluctuations, has an impact on rice genes that control male plants' fertility," he explained in his presentation. Above 23 °C, a rice variety is sterile because one of its genes is inactivated. With temperatures lower than 23 °C, fertility is recovered.

◀ Plant biologist Zhang Dabing won the 2018 TWAS Prize in Agricultural Science for research on molecular mechanisms of reproduction in higher plants

▶ Ismail Cakmak, a 2016 TWAS Prize winner in agriculture from Sabanci University in Turkey, has a deep interest in biofortification.

Strategies to improve agricultural practices and restore the nutritious potential of exhausted soil took the stage also in other TWAS Prize presentations, demonstrating scientific commitment to solving problems affecting local communities.

Ismail Cakmak, a 2016 TWAS Prize winner in agriculture from Sabanci University in Turkey, has a deep interest in biofortification, the enrichment of cereals as a potential solution to malnutrition.

"We all know that hunger ... affects about 800 million people in the world," he said in his presentation. "What we tend to ignore is that hidden hunger – a lack of food vitamins and micronutrients such as vitamin A, iron and zinc – impacts on as many as 2 billion people."

Cakmak is a professor of molecular biology, genetics and bioengineering at Sabanci University. An expert in soil and plant physiology, he serves in the editorial board of the journal Plant and Soil, and has edited the section entitled "Impacts of Agriculture on Human Health and Nutrition", published by UNESCO in 2009.

NUTRITION BEGINS IN THE SOIL

At the General Meeting, he noted that the deaths of many infants would be preventable with better nutrition. Malnutrition, he added, can be caused by insufficient intake of the right amounts and qualities of food, but also by the loss of micronutrients in the soil due to intensive agricultural practices.

Among the most important micronutrients is zinc, the lack of which affects both soil and humans. As Cakmak's research demonstrates, zinc in the soil, along with potassium and magnesium, helps plants to increase tolerance to environmental stress like heat, drought and light intensity. But zinc has a pivotal role for humans, too: with iodine and iron, it mitigates health complications and chronic diseases.

"To be a good source of zinc for humans, cereal grains should contain 40-60 mg of zinc per kilogram (mg/kg). Currently we are barely reaching 20-30 mg/kg," Cakmak said. "Nutritionists tend to emphasize medical approaches to solve malnutrition problems... But health comes from farm, not from pharmacy."

> Consuming biofortified foods should be pursued in the years ahead, as it could significantly minimize hidden hunger and boost nutrition security. *Ismail Cakmak*

Cakmak is currently the coordinator of an international project called the "Harvest Zinc Project", which began in 2008 and is now in its final three-year phase. Results of the research carried out at Harvest Zinc Project, especially on wheat and rice, emphasize the importance of biofortification of food crops.

This strategy may ultimately help to support human cognitive functions such as learning, reasoning, attention and memory, as well as functioning of the immune system against different types of diseases. Consuming biofortified foods is a strategy that should be pursued in the years ahead, Cakmak advised, as it could significantly minimize hidden hunger and boost nutrition security. ◘

Learn more:
www.twas.org/node/14610/

SOLVING THE PUZZLE OF SANDY SOILS

by **Sean Treacy**

Congolese scientist Lydie-Stella Koutika won the TWAS-Al-Kharafi Prize for work investigating how to enrich nutrient-poor soil at a time of growing poverty and climate change.

Lydie-Stella Koutika can recall, during her childhood in the Republic of the Congo, that farmers used to plant peanuts twice a year, once in March and once in October. But these days, getting a peanut yield in the area's harsh soils is sometimes difficult because, with the changing climate, farmers have less water than they used to. Instead, they have to get the most they can out of the growing seasons available to them.

Koutika, a soil scientist from the Republic of the Congo, has been awarded the TWAS-Fayzah M. Al-Kharafi Prize for her work exploring new plant species to make the sandy soil of her home country more rich, thus allowing more productive growing seasons for farms and forests. This work is important to Congolese people in both the farms and the cities they feed as they develop their nation after a devastating civil war that ended two decades ago.

In her research, Koutika has a clear sense of purpose. "It's not only improving soil fertility and helping in climate mitigation by storing carbon in both soil and plants," she said, "but also providing charcoal and wood for the rural and urban population – 94% of homes use forest products as fuel energy – as well as providing us with more wood and food for the population."

The annual Al-Kharafi Prize recognizes exceptional women scientists from scientifically and technologically lagging countries. The prize is named for 2004 TWAS Fellow Fayzah M. Al-Kharafi from Kuwait, the first woman to head a major university in the Middle East. She is also a former TWAS vice president for the Arab Region.

"This prize is definitely going to help me," said Koutika. "I'm very happy and glad because, once I'm able to finish this job, it will help me have the opportunities as well."

BENEFITS ACROSS BORDERS

This work is relevant not just in the Republic of the Congo (RoC) but two neighboring countries, Gabon to its west and the Democratic Republic of the Congo (DRC) to its east. This nutrient-poor, highly sandy savanna soil extends to around 6 million hectares across all three countries.

It contains less than 1% of organic matter, which is low, but typical of sandy soil. Koutika studies how the practice of planting fields of legumes – such as acacia trees, peanuts or beans – can help enrich this soil.

They have already begun widely using this practice in forests in the industrial plantations in the Republic of the Congo, though there is also a research project taking place in DRC and dedicated in agroforestry that has seen some success. But in the Republic of the Congo the issue is urgent, not just for farmlands but for the richness of the earth in forest lands. About 94% of the homes in the RoC use natural wood and charcoal for energy, which is harming the local forestlands. So the demand for food and energy sources is growing.

▲ Soil scientist Lydie-Stella Koutika, Republic of the Congo

The hope is that, after years of studying the effects of the soil-building practices, they will be able to "give the research back to the farmer" and benefit those who produce the food and wood that the big cities depend on.

"In agriculture, we want to be inspired by what is happening in DRC," she said. "It works very well there, where it's more populated. But now things are getting very bad in my country and I think more people will need to be devoted to agriculture." ◘

Learn more: www.twas.org/node/14550/

SURPRISING INSIGHT ON INFECTIOUS DISEASE

by **Cristina Serra**

For her discoveries on malaria, Beninese immunologist Sedaminou Gbenoudon won the 2018 TWAS-Abdool Karim Prize.

African children often experience two infections at the same time, and each child may respond in a different way, with stronger or milder disease, according to the efficiency of his or her immune system. Studying cases with coinfection is therefore an important focus for research into effective treatment.

Sedaminou Judith Gbenoudon, a Beninese immunologist, has been investigating these conditions for years. Her findings that some coinfections cause milder diseases, while others result in a more severe condition, are changing the perception of malaria and other infectious diseases – and offering new curative perspectives. For the impact of her research, she was awarded the 2018 TWAS-Abdool Karim Prize.

"This prize is not only my prize, but a prize for all my team that I'm happy to share with them," Gbenoudon said. "In addition, it comes as a great achievement, an important feedback to all my years of scientific engagement."

The prize is named after TWAS Fellow Quarraisha Abdool Karim, co-founder and scientific director of the Centre for the AIDS Programme of Research in South Africa, in Durban. The award was announced at the 28th TWAS General Meeting on 27 November 2018 in Trieste, Italy.

Gbenoudon is the director of the Laboratory of Immunology for Infectious and Allergic Diseases at the Institute for Applied Biomedical Sciences in Cotonou, Benin.

She earned a master's degree in biochemistry from the University of Compiègne in France and in 2001 a PhD in immunology from Hamburg University in Germany.

Her experience in immunology and parasitology was an asset when she moved back to Benin for family reasons in 2007. At that time, while serving the Ministry of Higher Education and Research as the founding director of the informatics department, she decided to focus on coinfections in children, a frequent event in Benin.

▼ Beninese immunologist Sedaminou J. Gbenoudon

Simultaneous infections from malaria-causing parasite *Plasmodium falciparum* and other infectious agents such as nematodes were among her first targets. Her observations proved that this coinfection actually had the effect of alleviating the severity of both conditions. On the other hand, co-infection with the fungus *Candida albicans* and *P. falciparum* often aggravates both conditions, leading to rapid death.

"We proved that in the case of candida and malaria coinfection, the immune system of the patient produces high amounts of antibodies that promote inflammation," Gbenoudon explained. "This activates a cascade of reactions involving a blood defence system called 'the complement', which unfortunately leads to anaemia, a well-known malaria complication." But these results were a turning point in the current approach to malaria: targeting a mild infection as candidiasis, it turned out, can have beneficial effects on malaria as well.

Gbenoudon hopes to leverage the TWAS honour into more research. "In Benin," she said, "scientists are not working in fully-equipped laboratories. I will use this prize not only to build up projects in the same field, but also to buy equipment." ◘

Learn more: www.twas.org/node/14554/

SUDAN: A VISION OF SUSTAINABLE ENERGY

by **Cristina Serra**

Sudanese engineer Hazir F.A. Elhaj won the TWAS-Samira Omar Prize for her work to produce biofuel from locally grown plants.

Many countries are facing the pressure of population growth, which requires an increase in arable lands and the production of more wood, charcoal and others fuels for heating, cooking and transportation.

Sudan is no exception. Hazir F.A. Elhaj is working there to improve biofuel and biogas production, exploring cost-effective bioenergy technologies with low environmental impact. For her work on the implementation of bioenergy technologies in Sudan, she was awarded the TWAS-Samira Omar Innovation for Sustainability Prize at the 28th TWAS General Meeting in Trieste, Italy. The prize honours scientists from the 47 Least Developed Countries who work in an area relevant to sustainability.

"I didn't expect this prize," she said. "But I'm excited! It is a great pleasure and honour that my efforts are appreciated and brought to the international level. This recognition ... will encourage other researchers in the field, which will bring real progress for the country."

Elhaj is an assistant professor in the department of mechanical engineering at Sudan University of Science and Technology (SUST). She is also a board member of the World Bioenergy Association and a member of the Organization for Women in Science for Developing Countries (OWSD), a TWAS-affiliated organisation based in Trieste.

She studies low-impact bioenergy technologies wishing to support Sudan's advancement on an important economic issue. Sudan's energy demand has almost doubled in the last two decades, and transport is the major source of consumption of oil derivatives, with diesel being the major fuel form.

Bioethanol could be, in principle, a better option to fossil fuels, with less harmful impact on the environment. Sudan produces almost 65 million litres of bioethanol per year, but 90% of it is exported to Europe. In 2014 the government realized that Sudan had to diversify the sources used to produce fuels, and made a blend of 10% ethanol and 90% benzene called E10 Nile-Ultra. But in the long run the idea proved too costly.

▼ Hazir F. A. Elhaj, Sudan

This prompted Elhaj to be an active collaborator in the Sudan Biofuels Roadmap, a national initiative for the development of Sudan's biofuel production for the transportation sector, including aviation. The initiative aims at exploring strategies to optimize production and scale-up of biofuels, and in particular biodiesel.

Biofuels can be obtained from many sources, Elhaj explained. But she tested a small semi-evergreen tree called Jathropa, the seeds of which contain up to 40% oil that can be used to make biodiesel. Once the oil is extracted, residual seedcake can be used to produce biogas or compressed into pellets for heating and cooking, thus reducing the demand for wood and charcoal. "I processed a Jathropa variety grown in Sudan for oil production, and then tested the fuel in commercial engines."

Early tests confirmed that Jathropa could be a good candidate for Sudan's economy. In addition, standardizing the process could help small farms to achieve self-sufficiency and to create a sustainable biofuel market, with more jobs for local communities. "The work currently done lays the foundation for an investment plan for large-scale Jathropa plantings," Elhaj said. "And this prize from TWAS is going to be part of my future efforts ... It will be beneficial both for Sudan and the researchers who work in this field." ◘

Learn more: https://twas.org/node/14541/

"GREEN" CEMENT FOR A BETTER FUTURE

by **Sean Treacy**

Tchakouté Kouamo Hervé of Cameroon won the TWAS-Atta-ur-Rahman Award for work that could reduce greenhouse gas emissions.

Tchakouté Kouamo Hervé, an inorganic chemist at the University of Yaoundé I in the capital city of Cameroon, is the 2018 winner of the Atta-ur-Rahman Award in chemistry. He was honoured for advances in creating an environmentally friendly cement that could be used for future construction projects and sustainable development.

It's called geopolymer cement. Production is more energy-efficient than for conventional cement, and by adding materials such as discarded glass and agricultural waste, it could be even more environmentally friendly.

The award is granted annually by 1985 TWAS Fellow Atta-ur-Rahman, a distinguished Pakistani chemist and a past president of the Pakistan Academy of Sciences. It acknowledges the work of researchers from scientifically lagging countries who have obtained high-impact results in various fields of chemistry.

"I am really grateful and honoured to receive this prestigious TWAS-Atta-ur-Rahman Award," said Tchakouté Kouamo. "It is very important for a researcher to know that people are appreciating his work. This award will enable me to be more productive, and it will also be a source of motivation for me in my future career."

He is not just a lecturer and researcher at University of Yaoundé I, but a product of the university. He received his bachelor's, master's and PhD in inorganic chemistry there, and he has spent his entire career developing a local version of geopolymer cement, using local materials.

Typical commercial cement, known as Portland cement, requires a lot of energy to make, and thus results in heavy release of greenhouse gasses into the atmosphere. Geopolymer cement has already existed for some time, but Tchakouté Kouamo's work is looking to make it even more green by using waste materials such as discarded glass, rice husk ash and sugarcane bagasse (the fibrous matter that remains after juice is extracted) as parts of the cement mixture.

"The synthesis of geopolymer is very simple and we have in Cameroon some waste materials which are not used," said Tchakouté Kouamo. "My main objective is to valorize these waste materials in the production of geopolymer cements."

Portland cement hardens at 1500 °C, while geopolymer cement only needs about 700 °C. This means switching from Portland cement to geopolymer cement reduces emissions as much as 70 to 80%.

▲ Tchakouté Kouamo Hervé, Cameroon.

It's also a better, stronger material in general. "It bears more weight because it has a more compact and denser matrix," Tchakouté Kouamo said. "And yes, geopolymer cement has a long-term durability."

He fuses the recycled materials with volcanic ash to make the geopolymer cement. It's not yet available on the market, but introducing it is part of the plan. He's looking for investors who will help fund its production.

His work was made possible in part by a TWAS Research Grant received in 2016. He used the grant to purchase a compressive strength machine, which applies force to the hardened cement to gauge how much pressure it can take before it breaks, as well as an oven to dry ingredient samples. Now he and his team, including six master's students and three PhD students, are able to produce as many bricks of geopolymer cement as they need to conduct their research. ◘

Learn more: www.twas.org/node/14549/

ZOOMING IN ON MALARIA MOSQUITOES

by **Cristina Serra**

TWAS Fellow Yeya Touré received the TWAS-C.N.R. Rao Award for genetic research that supports new ways to combat malaria mosquitoes.

Malaria mosquitoes are not all the same: they belong to genetically different populations with different habitats and lifestyles. Knowing their geographical distribution allows better management of malaria and effective control of the disease transmission patterns.

This is particularly true in Mali, where malaria is the primary cause of death especially among children under 5. In 2015, the Malian national health system recorded about 2.4 million total malaria cases in health facilities.

But malaria has been under close observation for almost 30 years in Mali, with important results. "We realized that there was a weird heterogeneity in spatial and seasonal distribution of vectors and in transmission of malaria, likely related to different types of mosquitoes," said Yeya Tiemoko Touré, a medical entomologist and a former professor of cell biology and genetics in Bamako, Mali.

For his efforts in analysing genetic information on these insects and his involvement in creating new scientific facilities in Mali, Touré received the 2018 TWAS-C.N.R. Rao Award for scientific research. The announcement was made on 27 November during the 28th TWAS General Meeting, held in the Academy's headquarters city of Trieste, Italy.

▲ TWAS Fellow Yeya Tiemoko Touré, Mali

Touré's career in Mali started in 1981, as a researcher at the faculty of medicine and pharmacy. From 1987 to 1991 he was the director general of the *Centre National de la Recherche Scientifique et Technologique* (CNRST), in Bamako and from 2001-2014 he managed the vector biology and control unit of the Special Programme for Research and Training in Tropical Diseases.

Using cytogenetics and molecular genetics techniques, Touré has identified mosquito populations of *Anopheles gambiae* – the malaria vector – with different genetics settings. The findings were surprising.

His team found three chromosomal forms of *A. gambiae* populations named Bamako, Savanna and Mopti, which seemed to be genetically different. In the end they turned out to be only two molecular forms designated as S (for Bamako/Savanna) and M (for Mopti).

They live in slightly different areas, have differences in spatial and seasonal distribution and have different malaria transmission patterns. "The S form prefers humid areas in the south of Mali, breeds in rain-dependent spots and along rivers, and has its transmission peak during full rainy season," explained Touré. "Mopti form lives in a wide range of ecological areas from South humid to North dry zones, breeds in flooded areas and in rice fields, and transmits the disease's parasite at the very beginning, during and mostly at the end of the rainy season."

This has had immediate and important positive consequences on control measures, applied in collaboration with the national malaria control programme, through selective strategies such as targeting the time when transmission is higher, or specific mosquito breeding sites.

"I'm not actively involved in research, now," he said. "But I'm still active as an adviser to the new generations of researchers, and the TWAS Prize strongly motivates me to be even more present in leading young scholars." ◘

Learn more: www.twas.org/node/14540/

PEOPLE, PLACES & EVENTS

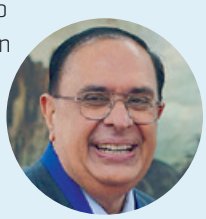
DAUBECHIES NAMED L'ORÉAL-UNESCO LAUREATE

For her outstanding achievements in mathematics, 2015 TWAS Fellow **Ingrid Daubechies** has been named the 2019 North American laureate for the L'Oréal-UNESCO International Award For Women in Science. Daubechies, a professor of mathematics at Duke University (USA), has achieved ground-breaking results in the field of wavelet theory, which find applications in the reconstruction of telescope images, detection of forged documents, medical imaging and other areas. Wavelets are mathematical functions useful in digital signal processing as well as in many branches of applied and pure mathematics.

Daubechies entered Vrije Universiteit Brussel at 17. Later she moved to the United States, where she became a member of the technical staff at AT&T Bell Laboratories. She was elected the first female president of the International Mathematical Union and served from 2011 to 2014. She also was the first female full professor of mathematics at Princeton University. L'Oréal and UNESCO established the prize in 1998 to underline the importance of women scientists in chemistry, physics, materials science, mathematics and computer science.

ATTA-UR-RAHMAN TO LEAD PRIME MINISTER'S NATIONAL S&T TASK FORCE

Chemist and science leader **Atta-ur-Rahman**, a 1985 TWAS Fellow, will chair a newly established Pakistan Prime Minister's National Task Force that aims to promote Pakistan's economic growth through education, science, technology, research, innovation and commercialization. Rahman has been a deeply influential advocate for science and education worldwide, and he formerly served as Pakistan's minister of science and technology and chairman of its Higher Education Commission. He also is a former vice president of TWAS. Rahman earned his PhD from Cambridge University in 1968, and since then he has more than 1,100 publications, 43 patents, 245 books, 70 chapters in books, and more than 750 publications in leading international journals. He has served twice as president of the Pakistan Academy of Sciences and as the president of the Network of Academies of Science in Countries of the Organization of Islamic conference (NASIC). He has promoted important reforms to promote education in Pakistan, including the establishment of a modern digital library. He is the 1999 winner of the UNESCO Science Prize and was elected a Fellow of the Royal Society (UK) in 2006. He is honorary life fellow of Kings College, Cambridge.



BARRANTES ELECTED TO ARGENTINE ACADEMY OF MEDICINE

Francisco J. Barrantes, a 1991 TWAS Fellow, has been elected a plenary member of the Buenos Aires National Academy of Medicine, the oldest academy in Argentina, during a ceremony on 1 November 2018. Barrantes, an esteemed scholar in neuroscience, neurodegenerative diseases and brain functioning, earned his PhD from the University of Buenos Aires (1973). Since then he has visited many important international laboratories to establish collaborations and carry out joint projects, including the Max-Planck Institute for Biophysical Chemistry in Göttingen, Germany; Rockefeller University in New York, USA; and the Weizmann Institute of Science in Rehovot, Israel. He is currently the director of the laboratory of molecular neurobiology at the Pontifical Catholic University of Argentina-CONICET (National Scientific and Technical Research Council of Argentina). His present interests cover the investigation of nicotinic receptors, which he studies using fluorescence and superresolution microscopy, and the effects of cholesterol on the human organism.

KLAUS KRICKEBERG ELECTED FRIEND OF VIETNAM

The German and French mathematician **Klaus Krickeberg**, a 1994 TWAS Fellow, has been awarded the medal "Friend of Vietnam". Krickeberg received this award on 16 July 2018 in recognition of his important contributions to the development of the public healthcare system in this Southeast Asian country. Now a professor emeritus at the Paris René Descartes University, Krickeberg has visited Vietnam 32 times.

He started his career in the 1960s as a professor of mathematics at the University of Heidelberg in Germany. But he befriended a student from Saigon, and that sparked an enduring interest in Vietnam. He helped to instill the power of mathematics in the Vietnamese health system: He

PEOPLE, PLACES & EVENTS

first organized training for high-level Vietnamese health personnel. In 2005, Thaí Bình Medical University asked his help to implement the teaching of public health on modern rigorous grounds. Krickeberg also has worked extensively in Latin America. He is a fellow of the Institute of Mathematical Statistics, USA, and a member of the German Academy of Sciences Leopoldina.

ECOLOGICAL SOCIETY HONOURS CHABI DJAGOUN

Beninese scientist **Chabi Djagoun**, a 2014 TWAS Young Affiliate, has received the Marsh Award for Ecologists in Africa from the British Ecological Society. The award acknowledges "exceptional ecologists across career stages, recognising their contributions to advancing and communicating ecological knowledge." A native of Cotonou, Republic of Benin, Djagoun is a wildlife conservation ecologist with more than 10 years of professional experience in ecological research and conservation planning. He earned a PhD degree in wildlife conservation ecology from the University of Abomey-Calavi in 2013. He is currently a senior lecturer at the faculty of agronomic sciences, University of Abomey-Calavi. His current research interest supports sustainable monitoring and management of ungulate species in Benin National Park but also the impact of bush meat overexploitation on ecosystem functioning. In addition, Djagoun is coordinating the Working Party 8.02.08 (African wildlife conservation and management) for the International Union of Forest Research Organization (IUFRO) and also acts as the scientific director of the African Otter Network (2018-2020).

TWAS FELLOW LAURENCIN HONOURED BY AAAS

Cato Thomas Laurencin, a biomedical engineer, surgeon and 2006 TWAS Fellow, has been honoured with the 2019 Philip Hauge Abelson Prize in recognition of his innovative contributions to biomedical technology. The Abelson Prize is awarded annually by the American Association for the Advancement of Science (AAAS) to scientists who have provided exceptional contributions to the advancement of science in general, or who have proven deep commitment through their services to the scientific community. Laurencin is the Van Dusen Distinguished Endowed Professor of Orthopaedic Surgery at the University of Connecticut. He serves as the founder and C.E.O. of the Connecticut Convergence Institute for Translation in Regenerative Engineering. His research has paved the way for the use of nanotechnology in musculoskeletal regeneration, opening the door to a new era in orthopaedic therapies. His work in bone and soft tissue surgery has led to innovative solutions in anterior cruciate ligament reconstruction surgeries, which are now performed in technologies he originated in at least 25% of the more than 500,000 interventions worldwide each year. He received the Presidential Faculty Fellow Award from President Bill Clinton and the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring from President Barack Obama. He is an elected member of the U.S. National Academy of Engineering and elected Fellow of the African Academy of Sciences.

IN MEMORIAM

Professor **Ennackal C.G. Sudarshan**, an Indian theoretical physicist and a 1986 TWAS Fellow, passed away May 2018 at the age of 86. A professor of physics at the University of Texas at Austin from 1969-2016, he earned an international reputation for his contributions to the understanding of weak interactions, and for his discoveries in quantum optics. At UT Austin, he directed the Center for Particle Theory from 1970-1991. A native of Kerala, India, Sudarshan received his PhD from the University of Rochester (USA) in 1958. He also won the 1985 TWAS Award in Physics and in 2010 was named a winner of the Dirac Medal, issued annually by the Abdus Salam International Centre for Theoretical Physics (ICTP).

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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 Prize winner. Today, TWAS has about 1,250 elected Fellows from about 100 countries; 14 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:

- 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;
- Encourage scientific and engineering research and sharing of experiences in solving major problems facing developing countries.

TWAS and its partners offer over 490 fellowships per year to scientists in the developing world for PhD studies and post-doctoral research. TWAS prizes and awards are among the most prestigious given for scientific work in the developing world. The Academy distributes more than USD1 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 allied organizations on the ICTP campus:

The Organization for Women in Science for the Developing World (OWSD). At its founding in 1989, OWSD was the first international forum uniting women scientists from the developing and developed worlds. Today, OWSD has more than 8,200 members. Their objective is to strengthen the role of women in the development process and promote their representation in scientific and technological leadership.

The InterAcademy Partnership (IAP) represents more than 130 academies worldwide. IAP 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.

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