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TWAS newsletter

NEWSLETTER OF THE ACADEMY OF SCIENCES FOR THE DEVELOPING WORLD

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FOR EVERY YEAR SINCE ITS FOUNDING IN 1983, TWAS CAN POINT TO SIGNIFICANT ACCOMPLISHMENT. SOMETIMES THERE ARE MOMENTOUS EVENTS, AND AT OTHERS THE IMPACT RESULTS FROM THE STEADY ACCUMULATION OF EXCELLENT WORK BY THE MEMBERS, AFFILIATES AND OTHER RESEARCHERS WHO ARE A PART OF OUR GLOBAL FAMILY.

But by any measure, this has been a remarkable year for TWAS. It has been a year of milestones, and a year of change. Now, as it comes to a close, it is a natural time to reflect on our immense good fortune and on the challenges of times ahead.

Reflections on a Time of Change

Jacob Palis is finishing his second three-year term as president, leaving a legacy of impressive growth and profound impact. Our young affiliates programme and regional prizes for young scientists were initiated under his administration. Fellowships and research grants have increased dramatically. Our five regional offices are playing a more prominent role in the Academy's work. Though his time as president is done, we know that we will continue to benefit from Jacob's expertise in the years ahead.

Also this year, TWAS Public Information Officer Daniel Schaffer retired. For more than a decade, Dan's writing and energy helped to raise TWAS's public profile and inform the world about the importance of science and technology to developing nations. Dan has returned to the United States, but we are hopeful that he, too, will continue to share his experience with us on special projects.

Our 23rd General Meeting, held in Tianjin, China, was a great success. Chinese President Hu Jintao, nearing the end of his term, defined our shared challenge in an address before some 2,000 researchers, heads of academies, science policy leaders and top officials from international organizations.

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Genetically modified maize

Soaring population growth is creating extraordinary challenges in food security, energy demand, and environmental protection, Hu said. But, he added: "Take a look at the history of human development, and you'll see that science and technology have been with us throughout the rise, growth and prosperity of civilization."

Mohamed H.A. Hassan, our former executive director and current treasurer, this year won the Abdus Salam Medal – named after the Academy's visionary founder – for a career of contributions to science in the developing world. He, too, sees science as a powerful force for good, with TWAS playing a vital role. "TWAS plants the seeds of seminal shifts in the way that science and scientific cooperation are conceived at the international level", Hassan said. "It has the enormous potential to forge a new course in history."

2012 also has brought us regrettable losses. Italian Nobel laureate Rita Levi-Montalcini, TWAS Associate Fellow 1992, passed away at the age of 103. She was a pioneering scientist and a woman of great courage, and she was a committed friend of TWAS. George Thottappilly, TWAS Fellow 1997, also passed away this year, after an influential career that explored the impact of virus diseases on major crops in developing countries.

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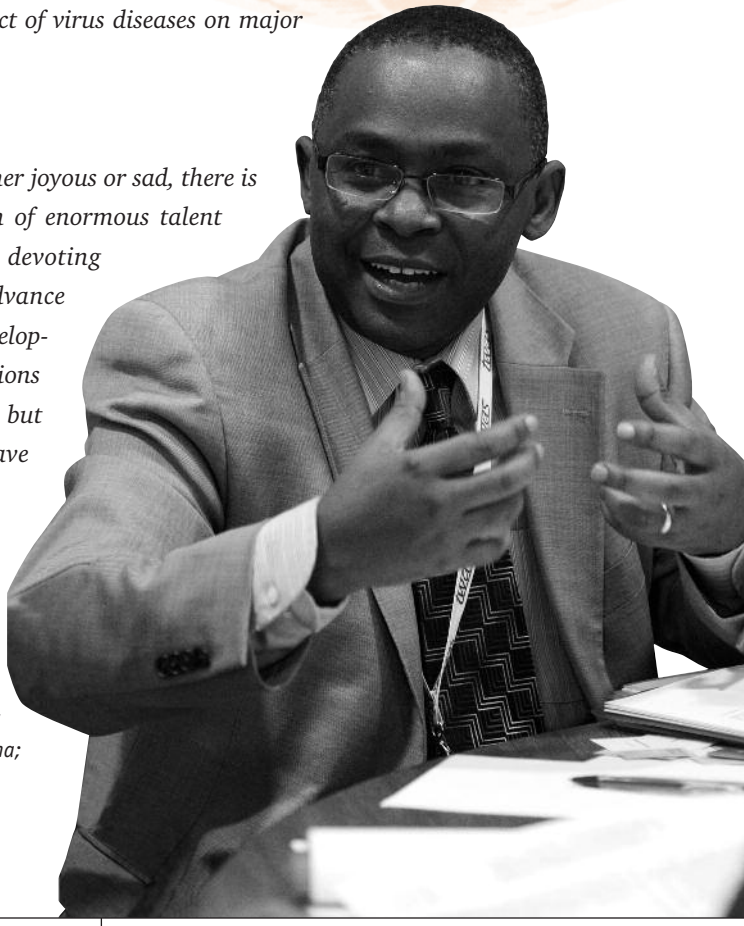
In each of these milestones, whether joyous or sad, there is a common theme: Men and women of enormous talent have joined TWAS in its mission, devoting great portions of their lives to advance science and sustainability in the developing world. And so today, our ambitions and energy are focused on the future, but we never forget the friends who have sustained us across three decades.

When Abdus Salam was working to bring the idea of TWAS to life, the Canadian International



Photos clockwise from top left: Tianjin City Hall; TWAS General Meeting in Tianjin, China; Romain Murenzi, TWAS executive director; Mohamed H.A. Hassan, TWAS treasurer; Jacob Palis, outgoing TWAS president.

From left: TWAS General Meeting in Tianjin, China; Bai Chunli, incoming TWAS president.

Development Agency provided a small but critically important contribution. From the beginning, the Italian government has provided significant and steady financial support and encouragement, even in difficult economic times. In a very real sense, Italy deserves credit for all of our accomplishments.

Following their lead, countries including Argentina, Brazil, China, India, Mexico, South Africa and Sweden, as well as the European Union and others, have provided additional funding and other support, allowing us to expand our programmes and slowly build our endowment fund.

This year, we have been grateful to receive two major new streams of funding. At our meeting in Tianjin, President Hu announced that the Chinese government would donate USD1.5 million to TWAS. And we have received two grants from Sida, the Swedish International Development Cooperation Agency. One will allow our partners at the Organization for Women in Science for the Developing World (OWSD) to support additional fellowships for women in science; the second will provide five years of support for our long-running research grants in the basic sciences programme as well as initiatives in science diplomacy.

Such developments create great expectations for the year ahead. Bai Chunli, an accomplished and influential scholar in chemistry and nanotechnology who also serves as the president of the Chinese Academy of Sciences, begins his term as TWAS president at the start of the new year. He has already shown great interest in TWAS, and he will help us to realize ambitious goals.

In the months ahead, we will be adding new staff at OWSD and in our Public Information Office. Already, we're planning for the 24th General Meeting, which will be held from 1 to 4 October 2013 in Buenos Aires, Argentina, with the help of our partners at the Consejo Nacional de Investigaciones Científicas y Técnicas *(CONICET) and the Argentinian Ministry of Science, Technology and Productive Innovation.*

Clearly, as we prepare to celebrate TWAS's 30th anniversary in 2013, the future appears promising. We have much cause for optimism – and much important work to do. ■

Romain Murenzi
TWAS executive director

JACOB PALIS: THE MEASURE OF ACCOMPLISHMENT

AT THE CLOSE OF HIS SECOND TERM AS TWAS PRESIDENT, THE BRAZILIAN MATHEMATICIAN REFLECTS ON THE ACADEMY'S IMPACT – AND ON THE NEED TO DO MORE.

As Jacob Palis was closing out his second term as president of TWAS, he could calculate his accomplishment in various ways: The heads of state he had met, the number of presentations he made at the highest levels of global science policy, or perhaps the distances he covered travelling the world as a scientist. But the Brazilian mathematician was focused on a different set of measures: the numbers of fellowships and exchanges, the number of research grants, and the opportunities created for young scientists.

For Palis these metrics are critical building blocks of development. When you train young scientists and have them go to different nations, he says, you are preparing a new generation for leadership in research, policy and science promotion across the developing world.

Clearly, the trend during Palis' presidency at TWAS points to a strong positive impact:

- **Postdoctoral fellowships:** up 58.3%, from 35 in 2009 to 56 in 2012;
- **Postdoctoral awards:** up 29.4%, from 34 in 2007 to 44 in 2011;
- **PhD Fellowships** under the Organization for Women in Science for the Developing World: more than doubled, from 22 in 2009 to 46 in 2012;
- **Postgraduate fellowships:** up 18.2%, from 66 in 2009 to 78 in 2012;
- **Postgraduate awards:** up 102.6%, from 39 in 2007 to 79 in 2011;
- **Research grants:** up 88.9%, from 45 in 2009 to 85 in 2012.

"We are very proud of the TWAS programmes for graduate and postdoctoral fellowships", Palis allowed in a recent telephone interview. "But our programmes could be much larger and they could probably have even better quality.

"It's a question of organizing ourselves better in operations and logistics, finding the best candidates and getting the applications. I am confident that if we have even twice as many good candidates, then the countries that provide such fellowships – Brazil, China, India, Mexico and so on – would be happy to accept them."

Other central challenges remain as well, he said: supporting more women in science and engineering, for example, and improving TWAS's digital communications capacity. And, after years of being kindly housed by the Abdus Salam International Centre for Theoretical Physics (like TWAS, founded by Pakistani Nobel laureate Abdus Salam), it is time for TWAS to have its own quarters, as is common with academies of science in Europe.

THE POWER OF TRAVEL

Palis was born in Uberaba, in the interior of the Brazilian state of Minas Gerais. After receiving an undergraduate degree at the Federal University of Rio de Janeiro, he went to the University of California at Berkeley, where he received a PhD and later a postdoctoral fellowship. As a mathematician, his work initially focused on global stability of dynamical systems, and later on bifurcations and fractal dimensions, and the global scenario for chaotic systems.

In 2010, he was awarded the prestigious Balzan Prize for mathematics. The judges recognized not only his "fundamental contributions to the mathematical theory of dynamical systems", but also his work as adviser to more than 40 doctoral students, from 10 countries, across two or three generations.

Palis has served as adviser for generations of PhD students. From left to right: E. Pujals, C. Moreira, A. Avila, J. Palis, W. de Melo and J.C. Yoccoz. Pujals, Moreira and de Melo are top-level former PhD students, and Avila is a former PhD student of de Melo. Yoccoz is a 1994 Fields Medalist who has frequently collaborated with Palis.

Since 2007, Palis has served as the president of the Brazilian Academy of Sciences. But over the span of his career, Palis has been a truly international scholar. He was elected a TWAS Fellow in 1991; before his election as the Academy's president, he served as its secretary-general from 2001 to 2006.

He is a member of the national academies of sciences in Brazil, the United States, France, Germany, Russia, Chile, India, Mexico, Italy (Lincei), Portugal and others.

His insight into the importance of exchange programmes undoubtedly reflects his own years as an exchange scholar in the United States.

The year was 1964. Palis was due to go to the US to study, but under Brazil's military government, fellowships were suspended. With a sense of urgency, Palis applied for a Fulbright Scholarship. He received it, and departed for Berkeley.

The openness of campus culture and merit-based assessments of his work changed how he saw the world – and how he saw the relationships between science, government and culture. When he returned home in 1968, he became close to a colleague, physicist Sergio Rezende, who had just returned from MIT.

New TWAS president Chunli Bai with outgoing president Jacob Palis.

"The two of us, plus a few other people, started having discussions with some more senior scientists about the importance of being open to the world", Palis recalls. "This was amazing for that time, because we did not have a lot of resources. We certainly had good scientists, but not so many. And we were just young kids."

Their discussions yielded a document that was intended as a reflection of their time abroad, but it evolved into a relevant contribution to Brazilian international scientific cooperation.

Both men were launched into their careers. Rezende in time would become Brazil's minister of science and technology, and, like Palis, he was later elected a TWAS Fellow.

But the lessons of their time abroad and their return home linger. Says Palis: "This is a major point: to be open to talents from other countries. And this is true for every country. There is always a country that's less developed than yours. And it's very important to be open to all countries, including the less developed ones.

"This way, the visitors have a chance to inherit the professional values of science that are common in more developed counties. When they return home, they can talk to their colleagues, or even to politicians, about the importance of science and technology for the sake of their society."

THINKING BIG

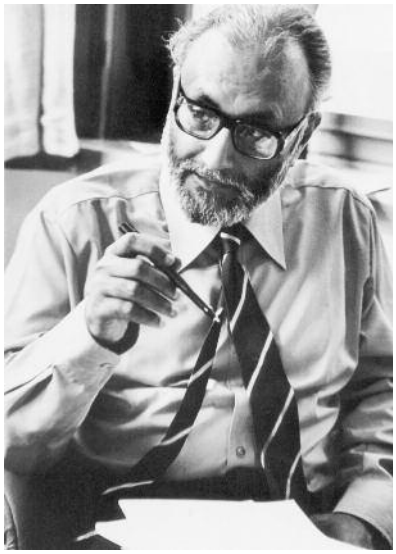
As he became involved with TWAS, Palis met Abdus Salam, the Nobel laureate and the Academy's founder. Salam had some important advice: "My son, think big!"

"I was privileged to hear that from him", Palis recalled in the interview. "I was not the only one – other friends had the same experience. He put in our heads the idea of being ambitious enough to pursue big, impossible dreams. How to open our own countries, our own institutions, to the world."

And over the course of nearly 30 years, TWAS has changed the world, Palis said. The numbers of fellowships and research grants are just one measure. But there is also the way in which nations welcome the TWAS General Meeting, or the way in which developing countries – from China, India and Brazil to South Africa and Malaysia – have embraced science as a means for improving people's lives.

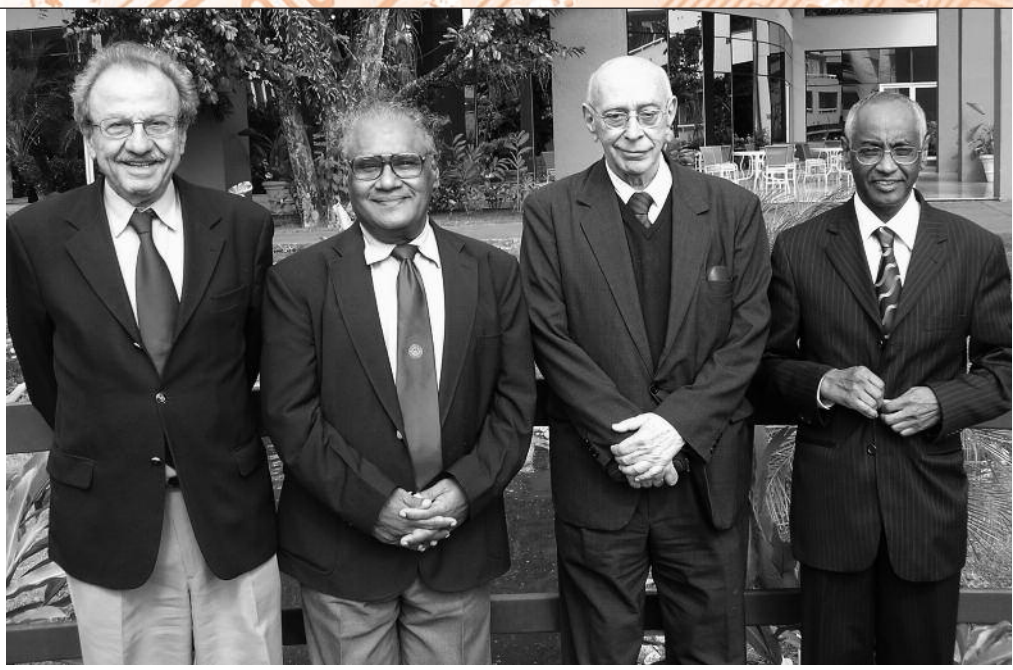
In the years of his presidency, TWAS took other major evolutionary steps: developing and expanding its five regional offices, and creating new prizes to honour and encourage ambitious research. Meanwhile, TWAS has been able to expand its endowment fund by 46.4%, from USD9.5 million at the end of 2006 to just under USD14 million at the end of 2012.

But Palis declines to take personal credit. He points to the entire team of leaders and staff, and especially to the government of Italy



Abdus Salam

and others, including Brazil, China, India, Kuwait and Sweden (through the Swedish International Development Cooperation Agency, or SIDA), which have provided the financial support that has allowed TWAS to pursue big dreams. His predecessor as president, C.N.R. Rao; former secretary-general D. Balasubramanian; and former treasurer José Luis Morán-López have played critically important roles, he says. Incoming president Bai Chunli, secretary-general A.K. Sood, executive director Romain Murenzi and former executive director/current treasurer Mohamed H.A. Hassan are also very well-prepared to continue the progress, certainly with innovative steps.



From left: Former TWAS presidents Jacob Palis, C.N.R. Rao and José I. Vargas; and TWAS treasurer Mohamed H.A. Hassan.

FOR THE SAKE OF SOCIETY

For today's leaders, and for the future, Palis sees a fundamental challenge: TWAS can do more – in doctoral, post-doctoral and visiting fellowships and other areas.

A crucial area of concern is recruiting and supporting women into TWAS programmes and as members, Palis says. Since he took office at the start of 2007, the proportion of women among TWAS members has risen from 6% (51 out of 839 members) in 2006 to 9% (98 of 1,071 members) today. And TWAS this year received a grant from the Swedish International Development Cooperation Agency that will allow the Organization for Women in Science for the Developing World to support additional fellowships for women.

"The situation is better than before", Palis says, "but we have to continue our efforts. Life can be more complex for women, in that they often provide most care for the children. But by no means do they have less talent. The whole world now recognizes this fact."

TWAS also needs to upgrade its digital and online systems to allow for electronic applications for fellowships, grants and other programmes. "It used to be true that computers were not available in certain countries in the developing world", Palis said. "But that's not true any more."

And, finally, a more complex challenge: finding a range of ways to engage scientists to continue to work in their home countries, building science communities there while also building vibrant international networks. Sometimes that means allowing scientists to maintain a relationship with colleagues from the country where they obtained their doctoral degree or held a post-doctoral position even after they return home. Sometimes it may mean appealing to their idealism, what Palis calls their sense of solidarity with colleagues in the developing world.

"They don't do it for more salary or other rewards", he says. "They do it because they believe in the importance of it for the social advancement and well-being of their people. The way I see it, it's *magic*. It's the same magic in India and China and Brazil and Mexico and other countries. That's what allows us to have our best scientists engaged in promoting science and technology at the local level, in their own countries and other countries, for the sake of their societies." ■

Edward W. Lempinen

CLOSING THE GENDER GAP IN SCIENCE

NEW RESEARCH SHOWS THAT IN BOTH DEVELOPED AND DEVELOPING NATIONS, WOMEN ARE NOT FULL PARTNERS IN THE KNOWLEDGE ECONOMY. AND THE ECONOMIC EFFECTS CAN BE PROFOUND.

In the realm of global science leadership, there is widespread agreement that women must be more fully integrated into the fields of science, engineering and technology. And yet, countries and cultures worldwide are struggling to achieve this goal. Women have low enrolment rates in every field of scientific study except for the life sciences, and among those who do finish their studies in science, the dropout rate after university and throughout the career trajectory is high.

This creates a cascade of negative effects: It represents a loss of the investment in women's education. If a country is not developing all of its potential skill in science-related fields, then progress in developing a knowledge economy will be slowed. And clearly, research shows that when women are more fully represented in fields related to innovation, economic benefits flow not just to the women, but to a nation's entire economy.

This is an important issue for all countries. Building capacity in agriculture, engineering, health, and the social sciences is essential for achieving economic development. Science, technology and innovation (STI) can also improve food security and living conditions, ensure adequate infrastructure, promote employment and livelihoods, and increase the quality of life in developing and developed countries alike.

With a team of international researchers, we recently undertook a pilot assessment of the status of women in the knowledge society – collectively the STI and the information and communication technology (ICT) sectors – looking at the potential for and actual contributions of women in six countries and one



region: Brazil, India, Indonesia, South Africa, South Korea, the United States and the European Union.

Our overall finding is that all the countries in this study have failed to include women to an equal extent in the knowledge economy – and in many cases, their inclusion is negligible. But the assessment also highlights policies that can help put countries on the right track to women's inclusion. Among developing nations, for example, Brazil and South Africa are among the strongest performers in science and technology, and the evidence shows that they have had considerable success in bringing women into science-related sectors.

Brazil punches far above its weight in articipation of women in science, technology and innovation.

EXTENT OF THE DIVIDE

The assessment was undertaken by Women in Global Science and Technology (WISAT) and the Organization for Women in Science for the Developing World (OWSD) from November 2011 to May 2012, with support from the Elsevier Foundation. The full study, national reports and national scorecards, are available at www.wisat.org.

The assessment identifies gender barriers in a range of areas – health, social status, the economy and access to resources. These are preventing women and girls from accessing technology, information and learning, and from participating equally in scientific research and employment, decision-making and the private sector.

It also shows that few countries are collecting consistent gender data in any of these areas, leaving an evidence vacuum that makes it difficult, and perhaps impossible, to craft effective policies to support innovation and advance development of knowledge-based economic sectors.

From the data that do exist, the gender divide is also clear. Women are represented equally with men in only health and life sciences education. In most places, including the US and EU, they remain severely underrepresented in engineering, physics and computer science, generally making up less than 30% of graduates in these subjects.

The total number of women working in these fields is even lower and, more troubling, it is declining across the board. Even in countries where the number of women studying science and technology has increased, the rise has not produced higher numbers of women in the workplace.

POLICY AND FUNDING

So what should be done to move in the right direction? A combination of actions in education, economic status, social status and health is required.

Empowerment factors include greater participation of women in public and economic life, greater roles for women in government and politics – in the decision-making that affects their lives – and access to resources,

or the ability to freely access financing, technology, energy and productive inputs. But equally important is support to women's domestic responsibilities which will enable them to balance their work and personal lives: childcare, healthcare and maternity leave, for example. Another important issue is equal pay and recognition for work.

An enabling policy environment is a crucial first step. A cross-government approach is needed to integrate and monitor gender concerns and effects on women and men in all areas – from health and education to infrastructure, energy and banking. For example, does national policy take into account the need for safe, affordable and efficient transport for women's personal, employment and livelihood needs? But good policies also need funding. India has an excellent policy environment for women, but insufficient funding and implementation means it has the lowest ranking among the countries we surveyed.

COUNTRIES DOING WELL

On the other hand, Brazil punches far above its weight by standard development measures. It ranks higher than would be expected based on its GDP, and first in the participation of women in both the knowledge economy and in science, technology and innovation. This result reflects Brazil's substantial national investment in science and technology, as well as serious efforts to reduce social inequality, and support for women's education at all levels. Brazil has put in place strong policies and programmes to support scientific and technological education for all that include substantive funding for research and higher education. The availability and transparency of scholarship awards, particularly at the graduate level and in science and technology, have substantially aided women's participation in the knowledge society.

South Africa scores well too, with a high number of women in science nationally. It has the highest percentage of female members of a national science academy in the study, demonstrating a supportive policy environment and evidence that women can do the work. This high ranking is the result of a number of factors, including promoting female participation in

politics in South Africa (45% of elected and appointed officials are women) and in decision-making and management positions, as well as freedom for women to choose the timing and number of their children. The country has a national quota system that promotes diversity of participation and leadership by race and gender.

OPPORTUNITIES FOR GROWTH

Our study shows that supporting women in education and health are only the first steps. Nations need a multi-dimensional policymaking approach that includes supporting women's ability to fulfill their educational and professional aspirations, providing flexible education and training opportunities, and reinforcing their ability to make choices and decisions about their lives.

And this should be complemented by social and health support such as childcare, flexible work and access to healthcare. Our study found that where women's health and/or social status is low, countries fall behind from the very beginning, even in the presence of an enabling policy environment – India is a case in point. Similarly, South Africa's success is restricted to a minority of its female population due to low economic and health status.

Promoting women's participation in the STI sector will increase benefits for everyone. Data from the World Economic Forum and *The Economist* Intelligence Unit indicate that if women's paid employment rates were raised to the same level as men's, GDP would rise 5% in the United States, 9% in Japan, 12% in the United Arab Emirates and a huge 34% in Egypt. A report by the UN Economic and Social Commission of Asia Pacific (ESCAP) found that restricting job opportunities for women, where 45% of women remain outside the labour market, costs the Asia-Pacific region up to USD42–46 billion per year. In the agricultural sector, the Food and Agriculture Organization (FAO) estimates that equalizing access to productive resources for female farmers – fertilizers, extension, technology and credit – could increase agricultural output in developing countries by 2.5% to 4% and result in 100 million to 150 million fewer hungry people globally (FAO, 2011).

Countries that fail to capitalize on women are failing to develop the knowledge that drives innovation. Clearly, that inhibits development and the potential for growth. And that, in turn, hurts everyone. ■

Sophia Huyer *and* **Nancy Hafkin**

Sophia Huyer is the founding executive director of Women in Global Science and Technology (WISAT) and senior advisor to the Organization for Women in Science for the Developing World (OWSD), a partner organization to TWAS.

Nancy Hafkin is a WISAT senior associate and was recently inducted into the Internet Society Hall of Fame for her work in promoting the Internet in Africa during her tenure at the UN Economic Commission for Africa.

TEACH SCIENCE, CHANGE THE WORLD

HOW WILL SCIENCE BUILD THE STRENGTH TO ADDRESS HUNGER, DISEASE AND OTHER GLOBAL-SCALE CHALLENGES? ONE STUDENT AT A TIME, SAYS MOHAMED H.A. HASSAN, TWAS'S FORMER EXECUTIVE DIRECTOR.

Thirty years ago, the idea that developing nations could invest in science and technology (S&T) to drive economic growth and human prosperity had few adherents, even in developing nations. But as nations as large as China and as small as Rwanda demonstrated that science and technology could transform economies and people's lives, the idea moved into the mainstream.

TWAS was in the vanguard of that movement, with Mohamed H.A. Hassan serving as the executive director. Today, Hassan says, TWAS and its global partners face critical challenges in areas such as climate change, food production, and public health. And to address the challenges, they must set ambitious new goals: support young scientists; identify and nurture talented women researchers; and, above all, advocate broader and more effective science and engineering education at every level and in every developing nation. Whether the student is in elementary school or a post-doctoral researcher, Hassan says, education is essential to create a new generation of problem-solvers.

In a presentation at the TWAS General Meeting in Tianjin, China, last September Hassan urged global science-policy leaders and research agencies to do more to build high-impact networks that can press ahead with progress. And TWAS, he said, must take steps to remain a strong leader in the field.

"TWAS aspires to be the world's leading global merit-based science academy dedicated to building S&T capabilities and promoting scientific excellence in the developing world", he said.

At the meeting in Tianjin, Hassan was honoured for his career achievements with the Abdus Salam Medal

named after the Pakistani Nobel laureate in physics who was TWAS's founding president.

While all nations have a responsibility for addressing global challenges and challenges in the developing world, Hassan said at the award ceremony, TWAS and its five regional offices, along with their many partners, have the perspective and experience to help guide the effort. Programmes to boost the number of advanced degrees in science and engineering fields, improved science education and more scientific exchanges can, over time, create powerful new scientific capacity even in less developed nations.

KNOWLEDGE GAP: SLOWLY DIMINISHING

Working with Salam from TWAS's first days, Hassan helped guide its evolution from an ambitious idea with an uncertain future into an academy of over 1,000 members, recognized globally today as an authoritative voice for science in developing world. In 2011, he stepped down as executive director, but he remains TWAS's treasurer; in addition, he serves as co-chair of IAP, the global network of science academies hosted by TWAS in Trieste, Italy.

In an address at the award ceremony, the Sudanese mathematician took the audience on an excursion through the history of TWAS, describing high points in its history and growth.

The number of TWAS research grants has grown from a little over 200 in 1986 to more than 8,500 as of 2010. The number of fellowships for PhD candidates and other students has grown, too. TWAS has held meetings throughout the developing world, and it has opened regional offices in Latin America, the Arab region, Africa, Central and South Asia.

Such initiatives have helped support a transformation in national and regional development strategies. While there remain big disparities in fundamental knowledge between North and South, Hassan said, "the gap is slowly narrowing."

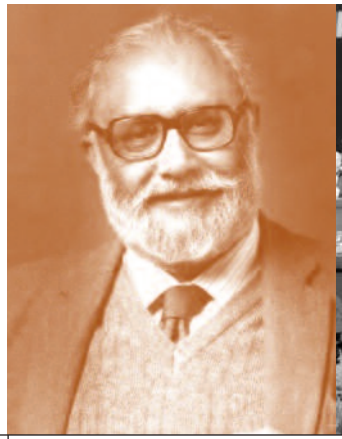
For example, China and India each rank in top 10 of world papers on science, engineering and medicine, with Brazil, Taiwan and Turkey in top 20. But they are only five nations among the top 20. None of them is African. And on the African continent, contributions are dominated by just a handful of countries such as South Africa, Egypt, Tunisia and Nigeria, but even they lag well behind the top 20.

Science centres and museums are important hubs for informal science education. But in Africa's 54 nations, there are only four countries with such centres.

THE MOST SERIOUS GLOBAL PROBLEM

In his address at Tianjin, Hassan focused on significant challenges that have long defined TWAS's purpose:

- **Water:** Over 1 billion people on Earth lack access to clean water; 80% of diseases in developing countries are caused by contaminated water.
- **Energy:** 1.5 billion people in developing countries have no access to electricity; 2.5 billion people rely on traditional biomass for fuel.
- **Health:** HIV affects 36 million people worldwide. Some 1 million people die of malaria every year, half of them children.
- **Biodiversity:** 60% of global ecosystem services have been degraded over past 50 years. Nearly one-third of all species could be extinct by 2050.
- **Poverty**: 1.2 billion people live on less than USD1 a day, and 3 billion on less than USD2 a day. And 300 million children go to bed hungry each night.
- **Climate change:** Water, health, agriculture and biodiversity all could suffer negative impacts caused by disruptions related to a warming climate. It is "the most serious global problem", Hassan said. "Poor countries are most vulnerable because of their fragile ecosystems and weak adaptation capacity."



The question, then, is stark: What can TWAS do to have a significant impact on these global challenges?

While the Academy has helped to change the world, Hassan said, its mission remains unchanged: ensure that all developing countries have sufficient scientific and technological capacity and excellent scientific leadership; help developing countries to apply science, technology and innovation to address global sustainability challenges; and support their efforts to engage in international scientific initiatives as full and equal partners.

"A minimum S&T capacity in each country is essential to generate local solutions and to enable effective participation in global efforts", he told the Tianjin audience.

THE POWER OF EDUCATION

To achieve those goals, and ultimately to address the greatest challenges of our time, Hassan said the focus must be on two main challenges. First, improve the quality of education and problem-solving research, especially in science- and technology-lagging countries. And second, TWAS and its allies and partners must take the initiative in driving science-related solutions to global sustainability problems.

Some of the responses require growth and evolution within TWAS. In Hassan's vision, TWAS's structure would be more decentralized and regional offices would take a greater role. Collaborations with key partners would grow stronger and more ambitious. TWAS would engage more women and other talented young scientists in its work and activities. And TWAS's Future Action Committee would play a vital role.

In addition, Hassan detailed a strong role for IAP, which is comprised of 106 science academies worldwide. And he urged that TWAS and its partners revive the Consortium for Science, Technology and Innovation for the South (COSTIS), established in 2006 as a forum for top policymakers and agencies – science ministers, national science foundations and research councils, national science academies and related private-sector institutions.

But Hassan counselled that TWAS and its partners must also look for the most effective ways to build science-based knowledge and innovation in the developing world – and then help to get the job done.

Science education is particularly important, and many dimensions must be considered.

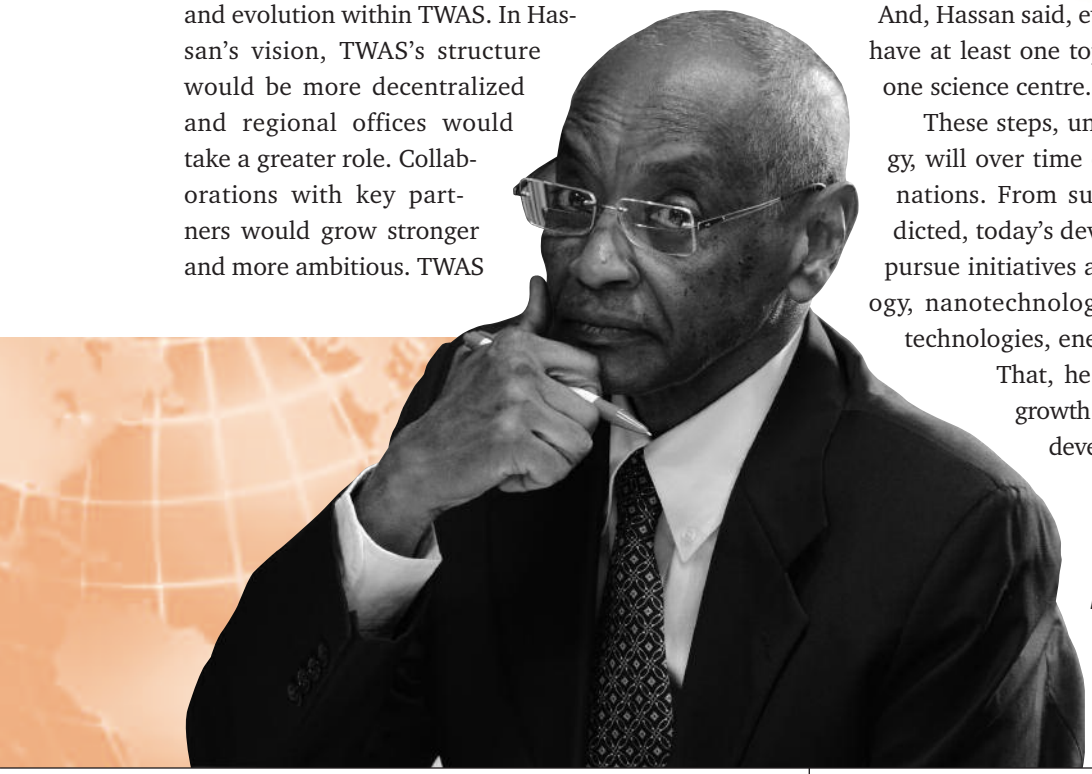
Inquiry-based education – in which students work on real research, and learn to think and work like scientists – must be advanced. That will require new training to make science teachers as effective as possible in motivating and guiding students.

Science centres and museums are important hubs for informal science education. And yet, in Africa's 54 nations, there are only four countries with such centres.

And, Hassan said, every nation in the South should have at least one top-class research university and one science centre.

These steps, undertaken with focus and energy, will over time expand capacity in developing nations. From such a foundation, Hassan predicted, today's developing nations will be able to pursue initiatives and partnerships in biotechnology, nanotechnology, space and communication technologies, energy and green technologies.

That, he said, is the road to economic growth and better lives for people in the developing world. ■



From left: Abdus Salam; Mohamed H.A. Hassan shaking hands with Chinese President Hu Jintao at TWAS's Tianjin meeting in September; a recent portrait of Hassan

TWAS IS HEADQUARTERED IN TRIESTE, ITALY, ALONG WITH A NUMBER OF OTHER SCIENCE CENTRES. IN SEPTEMBER 2012, THE CITY HELD ITS FIRST 'TRIESTE NEXT' CELEBRATION BRINGING SCIENTISTS FROM AROUND THE WORLD TOGETHER WITH 30,000 PEOPLE. TWAS INTERVIEWED TWO SPEAKERS, ROGER BEACHY, A PIONEER IN PLANT BIOTECHNOLOGY, AND NICK DAVIDSON, A GLOBAL AUTHORITY ON WETLANDS PRESERVATION.

GMOs AND SUSTAINABLE DEVELOPMENT

During more than two decades of research, Roger Beachy established some of the basic principles for the genetic engineering of plants that make them resistant to viral diseases. He is held in high esteem worldwide for his work in molecular virology, gene expression and for the development of virus-resistant transgenic plants. Some see him as the father of green biotechnology. But Beachy also knows well the fears provoked by genetically modified organisms (GMOs) and their perceived threat to human health and the environment.

Beachy was elected a TWAS Associate Fellow in 2009. As the former director of the National Institute for Food and Agriculture (NIFA), part of the US Department of Agriculture, Beachy served as an adviser to President Barack Obama. At Trieste Next, he helped to focus the discussion by presenting a historical overview of the rationale for GMOs and describing the first experimental steps that led to the green-biotech era.

Cristina Serra, from the TWAS Public Information Office, interviewed Beachy after his presentation at Trieste Next. An excerpt of the interview follows.

Professor Beachy, when you took your first steps using recombinant techniques aimed at genetically engineering plant genomes, these techniques were in their infancy. Did you envision possible environmental risks or drawbacks for human health at that time?

The first experiments we carried out were conceived to test the feasibility of the techniques that result in genetic engineering of plants. For this reason, the GMOs were confined to laboratories and controlled glasshouses where they grew under controlled conditions. When we moved to field trials, we took precautions such as removing flowers or fruits before pollen or seeds could

Roger Beachy

be dispersed into the environment. However, we were quite optimistic about the idea of genetic modification *per se*. The reasoning behind our enthusiasm was the following: When nature shuffles genes by standard genetic cross-pollination, it does so on a random basis, and the results can be positive or negative in terms of the outcome; hence, the results could be positive or negative for the environment and human health. In the case of such genetic crosses, neither scientists nor consumers demand in-depth examination of the genetic configuration of the hybrid plants. Nor does any authority assess the safety of newly arisen variants of 'natural products' that result. On the contrary, when scientists and plant breeders introduce a foreign gene into a host genome by means of laboratory techniques, which is indeed what genetic engineering does, we now can determine precisely where the gene has been inserted, when it is switched on and what protein or other gene products it produces. In addition, food authorities perform a safety assessment on products of genetic engineering before sending them to the marketplace.

GM technology was developed to provide innovative solutions to the ever-increasing demand for food. Will conventional breeding be discontinued if this technology becomes well-established?

I like to point out that the technology we use today is not the first example of genome modification. Back in the 1940s and 50s, the Italian Creso durum wheat variety (with shorter and more resistant stems) was obtained by irradiating the Cappelli wheat variety with X-rays and inducing unknown mutations, some of which were valued as potential new traits. In 1974, the Creso wheat was included in the Italian national register of durum wheat varieties and in a few years it became the most cultivated variety in Italy.

Coming to lab-engineered GM crops, I think they should be regarded as one solution to develop new crop varieties that can increase food production, not as the sole solution. Nature, and the world itself, is much too intricate and it would be wrong to think that we can devise a one-size-fits-all answer to most problems in biological systems. Whether it relates to agriculture, biofuels, or other topics of general concern – for example, climate change – we have to keep in mind that we must walk along many roads in parallel. Biotechnology is one of the roads being used to improve agriculture, and like solutions taken in other biological systems, should be evaluated on a case-by-case basis.

People's concern about GMOs sits at various levels. The practice of mixing genes from different species in the same genome, for example, placing an animal gene into a plant genome, sounds worrisome. Could it pose a real danger?

Each DNA fragment is a sequence of units, called nucleotides, that are joined to form a chain which contains genetic instructions to assemble RNAs and proteins, the combination of which

Beachy with a group of colleagues in a field of maize in Niger

defines the nature of an organism. These units are 'chemical bricks', similar to letters of an alphabet that must be combined and read in the proper way; all living organisms have similar codes, and many of the RNAs and proteins from different organisms are similar but not identical to each other. Others are unique to specific organisms. Hence, using the DNA instructions from one organism in different organisms can result in very modest, but useful, changes to the recipient. And whether the gene comes from a bacterium or a plant and is introduced to another bacterium or plant, the modest change can be quite useful. What is important is that the process gives rise to a useful and safe product. Although the process itself is safe, scientists cannot entirely rule out that unpredictable results might occur, just as in more classical types of plant breeding. However, products developed through genetic engineering are strictly controlled and evaluated before they are released to farmers for planting, while other breeding products are not similarly evaluated.

Since their inception, gene-transfer techniques in agriculture have mainly focused on two kinds of modifications: herbicide tolerance and insect resistance. This seems a limited achievement compared to the investments this strategy has received and the hopes it has raised.

The first targets that scientists in universities and the private sector selected were experimental in nature. Subsequently, as the technologies were perfected, scientists in the private sector focused efforts on the two traits that you mentioned. Others, including my lab, worked to develop technologies that would result in disease-resistant crops with the hope that the new varieties would require less use of chemicals to control the insects and diseases. Scientists were becoming increasingly aware of the potential damage that may come from a naïve over-use of agrichemicals. To give you an example, in the report entitled 'Tropical Farmers at Risk from Pesticides', the International Rice Research Institute (IRRI) showed that 55% of Philippine farmers who worked with pesticides suffered abnormalities in eyes, 54% in cardiovascular systems and 41% in lungs. Of the estimated 400,000 to 2 million pesticide poisonings that occur in the world each year, resulting in between 10,000 and 40,000 deaths, most occur among farmers in developing countries.

After 20 years of experience, and with the reality of climate change and increased food demand by a growing population, the work in modern gene technologies and plant breeding have shifted towards new targets. Scientists are identifying genes that trigger tolerance to drought or induce a reduced need for irrigation, and are transplanting such genes into crops that lack these traits. Others are working to increase the production of valuable chemicals in plants, or to develop plants that have a higher nutritional content.

In addition to technical changes, we are observing a marked shift in research groups to focus more on local problem-solving in the way agro-biotechnology is used. Africa is a good example of this. Many African universities are now implementing agricultural research programmes by working to solve local problems by using advanced genetic technologies to complement local indigenous knowledge, often by forging strong links between scientists, farmers and business communities. The isolation of a drought-tolerant gene in maize and the development of high-yielding, *Striga*-resistant sorghum varieties, carried out by Sudanese scientists, are good examples of locally driven research. Another example is to attempt to eliminate a severe virus disease of African sweet potatoes, which are often heavily infected by feathery mottle virus and chorotic stunt virus. These viruses propagate very easily leading to small stunted growth, whitening of the tissues (chlorosis) and reduced production of the edible roots. As a result of a partnership between scientists and farmers in Uganda and Kenya and my lab at the Danforth Plant Science Center, we are working together to develop disease-resistant varieties. Finding an effective strategy to counter these sweet potato viruses, through collaborative partnerships, is extremely important for people who depend on sweet potato as a primary source of food.

Can we consider GM technology among the possible responses to climate change?

GM technologies give us the chance to modify crop features, including adjusting them to adapt to environmental changes brought about by climate change. Extreme events such as droughts, floods or abrupt temperature increases or decreases often expose crops to severe conditions that result in significant damage to yields. Water scarcity, whether it is caused by pollution or by the need to irrigate more fields, is also a real problem. Between 1950-51 and 1965-66, 4.5 million additional hectares came under irrigation worldwide. Furthermore, between 1965-66 and 1979-80, 9 million new hectares required irrigation. GM technologies make it possible to develop varieties that are more resilient to changes in climate than are conventional varieties: such new varieties are expected to become available for farmer use in 2013 and beyond. While some farmers will choose not to use new genetic technologies *per se,* others will adapt the new varieties and under most conditions will see improved yields as a consequence.

However, to gain a true advantage from both older and new technologies, such as GM crops, we still need to build well-conceived

SNAPSHOT: ROGER BEACHY

Roger Beachy – plant biologist, geneticist and expert in molecular virology and gene expression – obtained his PhD from Michigan State University, and became a leading expert in plant virology and biotechnology. He is internationally recognized as the founding father of green biotechnology, the scientist who created the first genetically modified crop: a virus-resistant tomato that was tested in a growth chamber, a greenhouse and eventually in field experiments, indicating the potential for use of genetically engineered protection in agriculture.

From 1978 to 1991, Beachy was a member of the Biology Department at Washington University in St. Louis, Missouri, where he served as professor and director of the Center for Plant Science and Biotechnology. From 1991 to 1998, he headed the Division of Plant Biology at the Scripps Research Institute in La Jolla, California. Then, from 1999 until 2009, he was the founding president of the Donald Danforth Plant Science Center in St. Louis, where he helped establish the scientific mission of the centre. From 2009 to 2011 he served as an appointee of President Barack Obama as founding director of the National Institute of Food and Agriculture in the US Department of Agriculture.

He is a member of the US National Academy of Sciences and a recipient of the Wolf Prize in Agriculture (2001) "for the use of recombinant DNA technology to revolutionize plant and animal sciences, paving the way for applications to neighbouring fields." He was elected a TWAS Associate Fellow in 2009.

agricultural policies where engineered crops are part of a strategy that will not eliminate traditional breeding and where water management and improved soils are considered to be part of a long-term solution. Once such new policies are set in motion, technological innovations will become part of our world. This was valid centuries ago and remains valid now.

GM foods are often dubbed 'Frankenfood'. Do we have evidence of any hazard for people?

As I said earlier, GM crops are highly regulated by multiple government bodies (European Food Safety Agency in Europe; Food and Drug Administration, Environmental Protection Agency and US Department of Agriculture in the USA) and undergo many studies before they leave laboratories or experimental fields. What I can stress is this: Foods derived from GM crops have been consumed by hundreds of millions, perhaps bil-

Beachy in Uganda at the time of opening of a field site to test genetically engineered cassava for resistance to virus infection

Beachy with the members of his laboratory in St. Louis, Missouri, USA

lions, of people across the world for more than 15 years, with no reported ill effects, or even any legal cases related to damage to human health.

But let us do some more reasoning: Why should one expect that approved GM foods would be harmful when consumed? Just because they contain a foreign DNA sequence? In fact, many of the foods that we consume contain certain amounts of 'foreign DNA' or proteins that were introduced by wide species cross-breeding, or by significant mutations. In the early years of genetic engineering, scientists developed a crop that would confer better nutrition, but it was later discovered that the gene came from a nut tree to which some people are allergic. Work on the GM crop was then abandoned because of the rules and regulations that govern GM crops.

GMOs have always polarized debates among experts and the public. In addition, some farmers are skeptical about the use of this technology compared to conventional breeding techniques. What should scientific institutions do to promote the correct dissemination of information?

To ensure that proper and transparent data are provided to farmers, to the media and others, I think that information should come from people who are trained both in science and in the art of communications. It is true that, if not properly handled, genetic engineering techniques could pose some risks. But we have to understand that these risks are not dissimilar to those that we cope with in agriculture every day. I do not have the perfect recipe for gaining farmer and consumer acceptance of GM crops, but my view is that scientists should assist policymakers in their decisions, when it comes to the environment, agriculture and climate change. In addition, scientists and communication experts should work closely in order to guarantee that the right message is delivered to the public. I think that GMOs resemble the first car: initially they were a scary innovation, but today we can't do without them.

You are an Associate Fellow of TWAS. How do you rate TWAS's work aimed at sustainable development in the South?

I like the way TWAS carries out its mission. TWAS holds a low profile, avoiding boastful claims. It works, instead, to provide substantial solutions to local problems. Its International Programme on Science and Diplomacy, for example, perfectly fits the increasing demand for cooperation at various levels, while its ever-increasing support to young scientists helps develop skills and expertise.

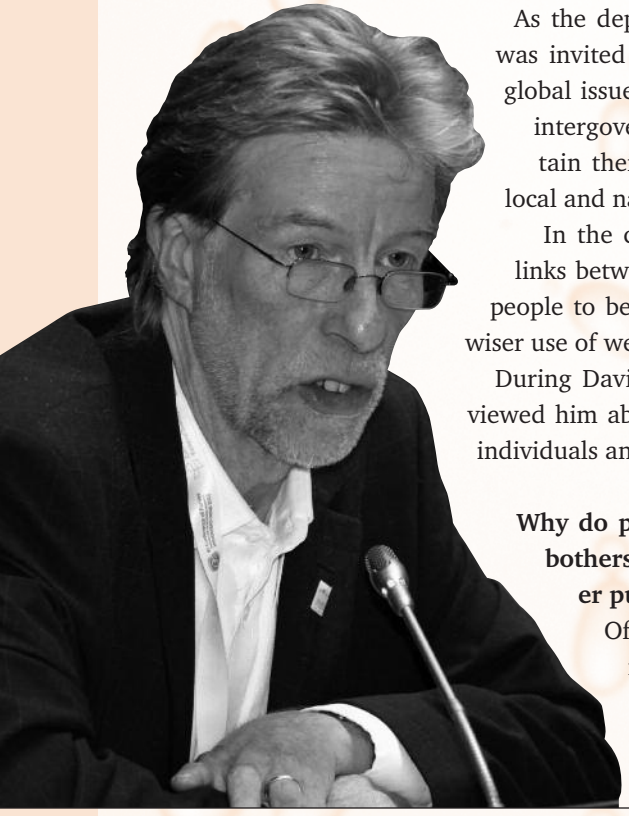
What I'd personally like to see is a more comprehensive involvement of young scientists from the North with their colleagues from the South: Sharing ideas from different perspectives – such as different civil, social and geographic backgrounds – would be highly beneficial for all concerned. ■

Swamps, marshes, mangroves and bogs – in the realm of human literature and film, these are often places of darkness and threat. We imagine them as a maze of foul, unsanitary water, home to poisonous spiders and vicious, flesh-eating reptiles and fish that lie in wait for any human to enter.

Nick Davidson, an internationally recognized expert in wetlands and water policy, understands the archetype, but he devoted his career to urging people to see past it and to recognize the value and beauty of these ecosystems.

Wetlands, he says, are not wastelands. Rather, they are critically important for a healthy planet and for healthy people. They are a vital habitat that helps feed humans. They manage floodwaters and protect against rising oceans during storms. And they can hold vast stores of water that are used for agriculture, industry, and domestic needs.

HEALTHY WETLANDS, HEALTHY PLANET



As the deputy secretary-general of the Ramsar Convention, Davidson was invited to Trieste Next to share his experience and expertise on a global issue of broad local importance. That is Ramsar's focus: It is the intergovernmental treaty that commits its member countries to maintain their wetlands and to plan for their sustainable use – through local and national actions and international cooperation.

In the closing ceremony of Trieste Next, Davidson urged stronger links between environmental science and governance, and encouraged people to be more involved in influencing practices and policies for the wiser use of wetlands and water.

During Davidson's visit to Italy, TWAS staff writer Cristina Serra interviewed him about the science and policy surrounding wetlands, and what individuals and their communities can do to make a difference.

Why do people still think of wetlands as useless areas filled with bothersome insects, only fit to be drained and converted for other purposes?

Of course wetlands can cause us trouble, particularly if we move into them – for example building on river floodplains which, when it rains heavily, then flood our properties. But this view does not correspond to what wetlands actually are and do for

us. However, when we say 'wetlands', this is a general term, and it's important to define what we mean. There are many different types of wetland, from peat-swamps at the top of mountains, through lakes and rivers to coastal wetlands such as estuaries and sea grass beds. Some are freshwater, but other are saline. Essentially they are all the parts of our world whose functions are dominated by water. Some wetlands are permanently or regularly covered in water, but many others are dry for some parts of a year and flood annually only in the wet season. At the extreme are places such as the salty wetlands of inland Australia which because of infrequent rains may only flood perhaps once in a decade. It is the presence of water which shapes the land and leads to the presence of specially adapted plants and animals which depend on these wet places for their survival. We could think of wetlands as transitional areas between terrestrial and aquatic systems, where nature … has not made up its mind [laughs].

What percentage of our planet is covered with wetlands?

It's hard to provide a precise figure, because wetlands vary so much in size and shape, according to the seasons, and now also even more so with our changing climate. Recent estimates suggest that inland wetlands cover at least 7 to 9 million square kilometers of our planet: that is roughly 4 to 6% of the earth's land surface. With this uncertainty in mind, and due to their multifaceted character, it comes as no surprise that most people fail to appreciate their importance to the environment and to the world economy, despite the international efforts set in motion more than 40 years ago to change this lack of appreciation.

What happened 40 years ago?

The Ramsar Convention, or the Convention on Wetlands of International Importance, was adopted in the Iranian city of Ramsar, in 1971, with the aim of laying the groundwork for local and national action and international cooperation for the conservation and wise use of wetlands and their natural resources. It acknowledges the interdependence of people and the environment. Its core philosophy, in fact, is the "wise use" of wetland resources; that is, "the maintenance of wetlands' ecological character, achieved through implementation of ecosystem approaches, within the context of sustainable development."

WETLANDS FACTSHEETS

- *There are 2,106 areas designated for inclusion in the list of wetlands of international importance. They cover some 2.05 million square kilometres.*
- *The global value of wetlands worldwide has been estimated to be USD14.9 trillion (1997).*
- *A hectare of wetland can store 9,000 to 14,000 cubic metres of floodwater.*
- *Up to 75% of commercially harvested fish are wetland-dependent.*

What has been the impact of the Ramsar Convention so far?
It has helped move us from the idea of *environmental protection* – conceived as "let's put a fence around and prevent people from using this area", to the broader *sustainable use of resources*, which involves recognizing that through maintaining wetlands we can benefit greatly from what they can and do provide us with. In addition to the commitments to wise use, governments also identify and designate what the Convention calls Wetlands of International Importance (Ramsar Sites) against globally standard criteria for their importance.

Can you name a few benefits that we derive from this type of environment?
Wetlands provide a huge range of benefit to people (often called 'ecosystem services'), largely for free. Some behave as natural sponges that store water and slowly release it. When rivers flood they absorb water and keep damage under control, acting as natural buffers that reduce environmental risks. Coastal wetlands shield us against hurricanes or tropical storms, an important role if we think that a single storm event in the US may cause USD33 million damage per hectare of land. They absorb pollutants before these substances reach rivers or the sea, thus improving the quality of our waters for swimming and drinking, and make water available to plants and animals. In addition, they provide habitat for fish and many other animals on which many people depend for their livelihoods. What's more, they provide us with recreational opportunities, and also aesthetic benefits, that we tend to underestimate.

What future scenarios may we face if we do not protect wetlands from degradation?
Agriculture, extractive industries, energy, paper and cotton industries, as well as recreational and tourism activities, to name a few – all depend on water for their business. The cycle of water, in turn, depends on wetlands' prosperity. We must acknowledge that water is essential for any business, let alone for our individual lives. Take reeds, for example: they grow in swamps, and in recent times they have undergone a marked revival as roofing material, for their insulating qualities and their long life. Destroy or degrade their habitat and that whole business sector is going to be damaged soon.

Is it possible to quantify the percentage of damaged wetlands?
It has been estimated that we have lost 50% of the world's wetlands over the past century alone,

DROPS OF WATER

- *Some 884 million people – 12.5% of the world's population – do not have access to safe drinking water.*
- *About 2.5 billion people lack proper sanitation, due to the lack of water.*
- *Every day, nearly 4,000 people – mostly children under 5 – die from diseases caused by contaminated water.*
- *People in developed countries on average use more than 500 litres of water per day.*
- *Agriculture alone accounts for 70% of freshwater usage worldwide.*
- *Competition for water and lack of access to basic water and sanitation services may become a source of conflict.*

and we have been destroying wetlands in many parts of the world for much longer than that. In some places it is even more: for example in some states in the United States, such as California and Iowa, more than 90% of these areas have been lost. Losses have slowed in some parts of the world, but are accelerating rapidly in others such as Asia, where the rapid economic growth and the demands of feeding a growing human population are overriding maintaining the environment, including wetlands, on which such sustainable growth actually depends. Unfortunately, I have to admit that the problems now haven't changed much from those recognized in the 1960s, which led to the creation of the Ramsar Convention.

What would you suggest to governments to get out of this situation?

We certainly need to be more efficient in our governance arrangements, putting water at the heart of green economy, and recognizing that working with wetlands is often a more cost-effective measure than engineering solutions. New infrastructures and robust governance mechanisms implementing and integrating the Ramsar Convention into national policies would help. Business as usual is more dangerous today than it was in the past. Wetlands must be everybody's business, because we are approaching a no-turning-back threshold of loss.

Is there anything that people can do?

Everyone can help make a difference. The three Rs – recycle, reduce, reuse – are essential. Consumers can act directly, by installing water-saving devices at home, for example. And they can act indirectly, moving away from purchasing items that require huge amounts of water in their production, to items with a lower water demand. Both types of actions require awareness and information. With this, consumers can change manufacturers' choices and the market itself. ■

TWAS PHOTO CONTEST: THE WINNERS

The United Nations Secretary-General in 2012 launched the initiative 'Sustainable Energy for All' to prompt all sectors of society to take effective action.

In the same spirit, TWAS launched its first-ever photo contest. The emphasis was on such topics as sustainable access to energy, energy efficiency, renewable energy, and innovation or homemade solutions devised to meet local needs.

The contest was open to TWAS members, TWAS Young Affiliates, TWAS alumni, and winners of TWAS prizes, fellowships and grants. In all, 21 scientist-photographers from Brazil, Nigeria, China, Pakistan, Taiwan and other countries submitted almost 100 shots.

The winners were announced in late 2012. A monetary prize was granted for the top three photographs.

• **First place:** *Almas Taj Awan, a Pakistani chemist and TWAS fellowship awardee, chose orange bagasse as her subject because of its suitability as bioenergy resource. She took the photo during her stay at the University of Campinas in Brazil.*

To see the pictures in colour,

SUSTAINABLE ENERGY FOR ALL

• **Second place:** *Lee Chih Kung of Taiwan, China, a TWAS Prize recipient in engineering, named this photo 'The Way Forward'. He took it at Miaoli, Taiwan, China.*

• **Third place:** *Akeem Kadiri of Nigeria, an expert in plant taxonomy and TWAS fellowship grantee, chose to depict how useful a solar-powered street light can be for the economy, showing a barber at work after nightfall in a community in Lalupon village, Oyo State, Nigeria.*

• **Special mention:** *Lee Chih Kung, Taiwan, China, for this photo titled 'Wind and Lifestyle' taken at Kaumei, Taiwan, China.*

• **Special mention:** *Fekady G. Mengistu, Ethiopia, took this photo of a solar kiosk in his home country.*

please visit http://tinyurl.com/twas-photo-contest

A FRESH APPROACH TO NORTH-SOUTH COLLABORATION

PEER, A NEW PROGRAMME FROM THE US AGENCY FOR INTERNATIONAL DEVELOPMENT, OFFERS A COMPELLING MODEL FOR BILATERAL SCIENCE AND HEALTH RESEARCH WITH REAL-WORLD IMPACT

Imagine walking through a city on your way to the market to purchase vegetables for your family. You hear the car horns squawking, mopeds buzzing through rows of stalled vehicles, voices calling for tuk-tuks to stop. But you cannot see the shapes behind the sounds. Air quality is so poor that an opaque, white sheet blankets the city.

For many people in developing countries, this is not a mental exercise – it is daily life. The air quality in Ulaanbaatar, the capital city of Mongolia, is among the worst in the world, with particulate matter levels 17 to 35 times those recommended by the World Health Organization. Much of that pollution is linked to the extensive use of traditional stoves to heat poorly insulated tent-dwellings; in the sub-Arctic climate, the coal-burning stoves are in heavy use nearly nine months of the year.

Now put yourself in the position of Sereeter Lodoysamba, a researcher from the National University of Mongolia. In hopes of protecting the health of your fellow Mongolians, you want to monitor the particulates and how levels have risen over time. You want to make an impact on the morbidity and mortality related to air pollution. And you want to convey this information to local and national agencies that might be able to do something about the pollution.

Lodoysamba turned this dream to reality through PEER – Partnerships for Enhanced Engagement in Research – a new programme from the US Agency for International Development (USAID). PEER is investing in game-changing ideas with the potential to solve long-standing development challenges, specifically through the power of research. PEER brings research

Air pollution in the Mongolian capital Ulaanbataar often cloaks the city in an unhealthy white haze.

from different nations together to help developing countries increase their utilization of science and technology (S&T).

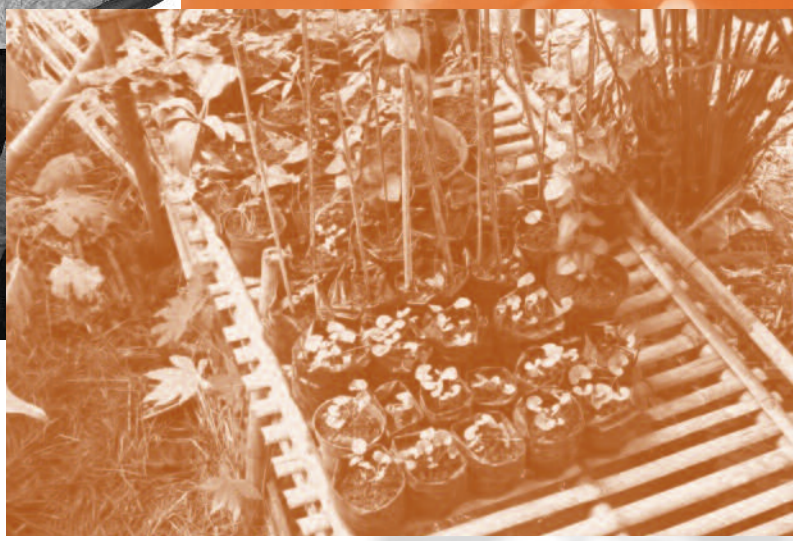
Major challenges facing the world today run the gamut from food security and clean water to infectious diseases, from reducing biodiversity loss and addressing climate change to employing green technology for sustainable urban development. All of these challenges require transformational and innovative solutions.

Significant advances in international development over the past half-century, such as vaccines and mobile technologies, have changed dramatically the trajectory of developing countries for the better. These powerful solutions, based on science, have helped to transcend traditional development barriers and spark revolutionary change. They improved the human condition through their growth potential, and benefited not just a country, but entire regions, and in some cases, the globe. Moreover, these inventions provided long-term improvement, not just quick fixes, and mirrored the developing country's culture and politics. Equally important is the potential to enhance S&T capacity to drive economic growth and help societies move beyond the need for foreign aid.

PEER builds scientific and economic capacity in developing countries by directly funding the local investigators.

PEER was designed for this role. Launched in 2011 with the US National Science Foundation and administered by the US National Academy of Sciences (NAS), PEER complements two longstanding collaborative research programmes between the United States and Pakistan and the United States and Egypt. It addresses global development challenges through collaborative science research partnerships. It builds scientific and economic capacity in developing countries by directly funding the local investigators working with US scientists who have also been funded by the US federal government.

The research has the potential to transform development in many ways, such as producing evidence that drives policy decisions, developing models for improving community programmes, or creating technologies with commercialization potential. Faculty and students are involved in these research collaborations, and engage beyond the laboratory and field to attend professional development workshops and scientific conferences. In addition, PEER promotes bilateral and regional cooperation between US federally funded scientists and developing country investigators that ideally will endure past the life of the research grant.



Researchers at Texas A&M and Bogor Agricultural University (IPB) are developing new teaching and research tools which focus on conserving Indonesia's plant biodiversity and commercializing species with potential market value. Support for this project is through the USAID/Indonesia University Partnerships Program.

PEER POWER FOR NATIONS IN TRANSITION

Two programmes are part of the PEER model: PEER Science and PEER Health. Both are highly competitive grants that invite scientists and engineers in developing countries to apply for funds to support research and capacity-building activities conducted in partnership with collaborators funded by NSF or the US National Institutes of Health (NIH). NAS sends funding from USAID for PEER awards directly to research institutions in developing countries. Applications are peer-reviewed primarily for the scientific feasibility and development impact of their proposed project as well as the strength of the collaboration between the developing country research and the US-funded researcher. The in-country USAID field office then reviews the top-ranked applications that emerge from peer review; finalists are chosen based primarily on the results of these two reviews.

PEER awardees will be future S&T leaders and have voice and visibility to influence policy.

PEER is at the forefront of US diplomatic and development efforts. This year, for instance, USAID extended PEER Science eligibility to include Burma, Tunisia, and Libya – all countries that have recently undergone tumultuous changes or are still in the midst of such changes. Programme eligibility also continues to expand in countries that are emergent, including many Caribbean Islands where S&T can assist in the transition of a country from a foreign assistance recipient to a partner that can robustly address global challenges together with the United States.

PEER Science, a partnership between USAID's Office of Science and Technology and NSF, supports bilateral and regional research partnerships in 87 eligible countries worldwide. In the first round of PEER Science, the programme received almost 500 applications from 63 countries. The 42 grants awarded leveraged USD46 million of NSF funds with USD5.5 million of USAID funds across 25 countries. Together, researchers in the US and developing countries are collaborating to address a wide range of critical development challenges, including food security, climate change, water, biodiversity, disaster mitigation, and renewable energy.

Lodoysamba, the Mongolian researcher, is one of the 42 scientists funded under the programme. He is partnering with Christa Hasenkopf from the University of Colorado on an effort to address air quality in Mongolia.

Undergraduate students from Universitas Mahasaraswati Denpasar conducting field research with farmers about the practices of the traditional Balinese Subak irrigation system (Credit: Surata Kaler)

PEER Science is now reviewing over 250 proposals received in its second call for proposals, which was issued in September 2012. New areas of special funding for the second call based on USAID mission requests are critical development challenges in Indonesia, natural resource management in the Philippines, water issues in the Middle East and North Africa, biodiversity in Brazil and the Lower Mekong region of Southeast Asia, and climate change adaptation in the Maldives. Decisions are expected in spring 2013. A third call for proposals is anticipated in September 2013. Scientists connected to these 87 countries are encouraged to apply with an NSF-funded investigator.

BUILDING RESEARCH, SAVING LIVES

In 2012, USAID's Office of Science and Technology and the Global Health Bureau, together with the NIH, created PEER Health. PEER Health provides support for researchers in 33 eligible countries on implementation science projects within country-specific health priorities. This programme is designed to provide resources to developing country researchers that leverage the knowledge and resources of NIH-funded colleagues. The first call for proposals, with applications currently under review, focuses on child survival related specifically to HIV/AIDS, malaria, tuberculosis, maternal health, child and neonatal health, nutrition, family planning, and neglected tropical diseases. Many of these 33 countries were chosen due to their significant contribution (80%) to the global mortality rate of children under 5 years old. The impact of the PEER Health research will be significant. Not only will it develop local S&T capacity, the data will feedback into measures to save children's lives.

In this first call for proposals, PEER Health received 170 preliminary submissions from 28 countries; over 80 were invited to submit a full application. Decisions are anticipated in spring 2013, with a second call later in 2013 focused on a different area of health research.

SUCCESS BREEDING SUCCESS

The PEER programme is still in its infancy, but the immediate impact is striking. PEER is also supporting female researchers in developing countries. For example, some 31% of the PEER Health applicants invited to submit a full proposal are women.

In January 2013, *The New York Times* featured the PEER Science grant measuring coral health in the coastal reefs of Indonesia. This research is being led by Jamaluddin Jompa from Hasanudding University in Indonesia and C. Drew Harvell of Cornell University. Shem Wandiga of the University of Nairobi and Mark Shannon of the University of Illinois Urbana-Champaign have partnered to address drinking-water quality issues in the Lake Victoria Basin of Kenya. Their goal is to improve water quality using new methodologies and novel purification systems. And in Lebanon, Grace Abou-Jaoude of the Lebanese American University and Joseph Wartman from the University of Washington are collaborating to map earthquake and landslide risk.

In the future, the PEER model may include partnerships with private entities that provide training and equipment to PEER grantees (the first such partnership recently was launched between PEER Science and National Instruments), or grant cycles focused on specific topics, such as water or agriculture. There could be a broad call for innovative ideas to development challenges, or a conference to showcase PEER research in conjunction with USAID missions.

The relevance of the research projects to USAID's local development objectives and engagement of local communities and government with USAID missions

that already has occurred gives confidence that positive outcomes will manifest through these sustained, transnational, global partnerships. Moreover, PEER awardees will be future S&T leaders and contribute equally to the international research community with their developed-country colleagues. They will have the voice and recognition to influence the policy world – locally, regionally and internationally. Increasing the global S&T research community will create a powerful force well-equipped to grow in-country S&T capacity and solve the major S&T challenges of tomorrow.

Back in Ulaanbataar, research focused on air pollution is winning international recognition. The US Ambassador to Mongolia, Piper Anne Wind Campbell, visited this PEER Science research group in December 2012 with her team for an introduction to the project. Lodoysamba and Hasenkopf are expanding public awareness of and involvement in air quality.

Last autumn, the PEER Science team began tweeting and creating a Facebook page that reports the sole source of Ulaanbaatar air particulate measurements. This is the first and only social media source where the Ulaanbaatar public can find daily air-quality data along with simple infographics explaining the information.

The researchers have met with local leaders concerned about local air quality, and have been featured in international and local media (e.g., the *UB Post, National Geographic-Mongolia, Bloomberg Mongolia*, and the *Huffington Post*) to explain the importance of transparent public air quality data and monitoring infrastructure in assisting mitigation efforts. They even received a grant of nearly USD60,000 to install and run their own air-quality monitoring instrument at the National University of Mongolia. The instrument will automatically tweet the readings and post them to Facebook.

It is evident that PEER-funded research is relevant not only to USAID's local development objectives, but engages local communities with governments, both domestic and foreign, in novel ways. The transformative outcomes early in this programme foreshadow the positive outcomes that will result through these sustained, transnational global partnerships. ■

Katherine Himes

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For more information: www.nationalacademies.org/peer

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IN MEMORIAM

RITA LEVI-MONTALCINI WAS AN INSPIRING RESEARCHER AND FOR MANY YEARS A COMMITTED FRIEND OF TWAS.

• **Rita Levi-Montalcini**, the 1986 Nobel laureate in physiology/medicine, passed away on 30 November 2012 at the age of 103.

The neuroscientist shared the Nobel prize with colleague Stanley Cohen for the discovery of nerve growth factor (NGF), which helped to initiate a new era in neurobiology. She had been the longest-living Nobel winner and the first-ever centenarian. A TWAS fellow since 1992, the Italian-born researcher overcame profound obstacles to make an historic discovery about the human nervous system. She will be remembered for her untiring passion for science and the support for all people, women in particular. Through her RLM-Onlus Foundation, she devoted the last decades of her life to promoting education programmes for women and the new generations, and to improving living conditions in countries where people still struggle to meet the basic needs of life.

Levi-Montalcini had close connections with the Trieste System, and TWAS in particular. She was among the first 10 women members of the Academy, and visited the city several times, attending public events organized by the local scientific community. In 1988 she attended the CIDA/TWAS conference on 'The Role of Women in the Development of Science and Technology in the Third World', while in 1991 she received the *Laurea honoris causa* in Medicine from the University of Trieste. She visited TWAS's headquarters again, in 1993, to celebrate the Academy's 10th anniversary and to praise its mission in support of the developing countries.

"Rita Levi-Montalcini was one of the most remarkable persons I had the great privilege to meet", said former TWAS executive director Mohamed H.A. Hassan. "She had a great passion towards the plight of scientists in resource-constrained countries around the world. I remember how delighted she was when she was elected as a member of TWAS, in 1992, in recognition not only of her scientific accomplishment, but also for serving the cause of science in developing countries."

Levi-Montalcini was born in Turin in 1909 to Italian-Jewish family. She had a twin sister, Paola, and two older siblings, Gino and Anna. Rita earned a degree at the University of Turin's medical school in 1936 under the supervision of neurohistologist Giuseppe Levi.

Unfortunately, obstacles and discriminations – related to her Jewish heritage, her gender, and the onset of World War II – marked her youth first, and her scientific career later. Benito Mussolini had enacted his Manifesto of Race and the laws banning Jews from academic careers. This measure prompted her and her colleague Giuseppe Levi to move to Belgium in 1938. She continued her studies on the differentiation of the nervous system, working at Brussels University until she returned to her hometown, Turin, in 1940.

This matter of personal challenge soon became instrumental to making her fortune in science, proving that, sometimes, even the most severe tests forge lives in unpre-

dictable ways. "Above all, don't fear difficult moments. The best comes from them", she commented later, during a conference on the occasion of her 100th birthday.

Moved by a deep passion and enthusiasm, and inspired by an article authored by scientist Viktor Hamburger, in 1940 she set up an extemporaneous laboratory – her bedroom – where she carried out her first experiments on chick embryos. Through this investigation, Levi-Montalcini hoped to understand the role of genetic and environmental factors in the differentiation process of the nervous system.

In 1946, Hamburger invited Levi-Montalcini for a six-month visit to his laboratory in the United States, at St. Louis' Washington University. She accepted, not imagining that six months would become 30 years. From 1947 to 1977, Levi-Montalcini split her professional life and career between St. Louis, where the discovery of the nerve growth factor (NGF) took place in 1952, and Rome, where she established a research unit in 1962. The investigations she carried out at Washington University were of paramount importance and mark the dawn of modern neurobiology.

Growth factors belong to a family of naturally synthesized biological mediators which trigger cell growth and differentiation, helping specific nerve cell populations to survive and work. NGF, in particular, stimulates the morphological differentiation of cells of the peripheral and central nervous system.

The breakthrough came during several years of hard work (1949-1952) while Montalcini was studying the effects of transplanting mouse sarcoma tissues into a chick embryo, an experimental procedure aimed at assessing whether a neoplastic tissue could support the development of spinal cord and sensory ganglia. She found that the tumour tissues stimulated over-innervation of embryo organs. This led her to hypothesize, and subsequently prove, that the transplanted tissues were releasing a diffusible factor able to induce growth and differentiation of nerve cells. Indeed, the diffusible factor was NGF. This was the discovery that would earn her the Nobel prize.

Part of her vibrant involvement in deciphering the secrets of our nervous system stemmed from her natural curiosity and inclination to investigate. The teeming scientific atmosphere of those years brought her into close contact with Renato Dulbecco and Salvador Luria, schoolmates who themselves would win a Nobel prize for studies on tumour viruses and for bacteriophage genetics, respectively. (Coincidentally, Levi-Montalcini and Dulbecco had set off for the United States in 1947 aboard the same Polish steamship *Sovietzky*).

From that remarkable finding onwards, her career followed a route of intuition, hard work and brilliant discoveries.

The latest came in 2010, just two years before her death. Her idea of a possible new role of NGF in embryo development prompted one of her early favorite students, Antonino Cattaneo, today group leader at Rome-based European Brain Research Institute (EBRI), to further investigate that hypothesis. From this research, and with close advice from Levi-Montalcini, Cattaneo's team published a paper in the journal *Proceedings of the National Academy of Sciences* (PNAS), in January 2012, which features her as principal investigator.

Developing countries became a life-project that Levi-Montalcini embraced. In 1992, she founded the Rita Levi-Montalcini Foundation, becoming an ardent supporter of women in science. The foundation is a non-profit organization that supports African women by promoting schooling and professional fulfillment. "Education", Levi-Montal-

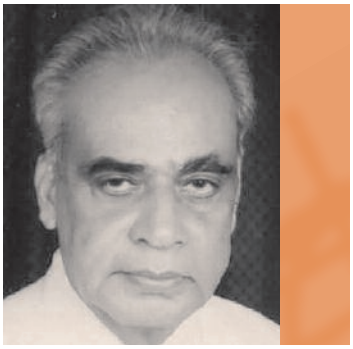
Rita Levi-Montalcini (right) with Italian senator Susanna Agnelli at the TWOWS Conference in 1988

cini used to say, "is the most powerful tool for development." To date, the foundation has launched 142 projects and is seen globally as a landmark institution. Covering a broad spectrum of initiatives in education and professional training, from computer instruction to classes in hygiene and sanitation for childcare, these projects have certainly given young African women better options for their future.

Levi-Montalcini wrote more than 20 books. Most of them have gained worldwide recognition, but some are particularly representative of her life and spirit. They are: *In Praise of Imperfection*, an autobiographical work; *Il Tuo Futuro* ('Your Future'), dedicated to young people who need to make vital choices in their youth; and *Senza Olio e Contro Vento* ('Without Fuel and Against the Wind'), a celebration of courage and resolution as seen in 10 of her friends and acquaintances who 'sailed' difficult lives.

Levi-Montalcini never stopped working, even in the last days of her life. Though her energy was ebbing, she continued to visit laboratories. The night before she passed away, she worked at her desk, writing notes and sketching ideas, and when some visiting friends departed, she told them: "I'll see you on Monday, in my office." *(Cristina Serra)*

• **George Thottappilly** (TWAS Fellow 1997) passed away in April 2012. He was the dean of the biotechnology department of the Sahrudaya College of engineering and technology, Kerala, India, and head of the biotechnology department of the International Institute of Tropical Agriculture, Ibadan, Nigeria.



A native of Karoor in the Indian state of Kerala, Thottappilly received an international education that began in his native country and was continued in Göttingen and Giessen universities in Germany and at the Slovak Academy of Sciences.

A passionate plant virologist and a world-renowned expert in biotechnology, Thottappilly authored two seminal books: *The Sweet Potato* and *Virus and Virus-Like Diseases of Major Crops in Germany*, where he addressed the impact of virus diseases on the major crops in developing countries.

He was member of the National Academy of Sciences (India), the Indian Phytopathological Society and the Indian Virological Society.

HONOURS

• **Eugenia Maria del Pino Veintimilla**, professor of biological sciences at the Pontifical Catholic University of Ecuador (PUCE), and TWAS Fellow 1989, has been awarded the 2012 Eugenio Espejo Prize in the Sciences. This prestigious award is given every two years to distinguished citizens and/or organizations, in recognition of their merits.

Del Pino, a renowned developmental biologist, was selected in view of her scientific activity, in particular for her unceasing promotion of biodiversity conservation in the Galápagos Islands and her conspicuous scientific production.

Ecuadorian President Rafael Correa chaired the ceremony on 9 August 2012, on the nation's day of culture, and bestowed the prize on three winners. The other two prizes were awarded in the performing arts and in literature.

Del Pino was born and raised in Quito, Ecuador. She studied in the United States and returned to Ecuador in 1972 after her doctoral studies.

The Andean marsupial frog (*Gastrotheca riobambae*) is the focus of her investigations. Her comparative studies shed light on the reproductive and developmental adaptations of this frog in comparison with other tropical frogs.

Del Pino is the recipient of many other awards, including the Charles Darwin Foundation's medal for the Galapagos Islands (1999), the TWAS Medal Lecture (2005) and the 2000 L'Oreal/ UNESCO Award for Women in Science. In 2005, she also received the Eugenio Espejo Medal in the Sciences given by the Council and the Major of Quito.

In Ecuador, del Pino combines research and teaching, as she strongly believes in the importance of training young and students to become tomorrow's enthusiastic scientists.

WHAT'S TWAS?

TWAS, THE ACADEMY OF SCIENCES FOR THE DEVELOPING WORLD, IS AN AUTONOMOUS INTERNATIONAL ORGANIZATION THAT PROMOTES SCIENTIFIC CAPACITY AND EXCELLENCE IN THE SOUTH. FOUNDED AS THE THIRD WORLD ACADEMY OF SCIENCES BY A GROUP OF EMINENT SCIENTISTS UNDER THE LEADERSHIP OF THE LATE NOBEL LAUREATE ABDUS SALAM OF PAKISTAN IN 1983, TWAS WAS OFFICIALLY LAUNCHED IN TRIESTE, ITALY, IN 1985, BY THE SECRETARY GENERAL OF THE UNITED NATIONS.

TWAS has more than 1,000 members from 90 countries, 73 of which are developing countries. A 13-member council is responsible for supervising all Academy affairs. It is assisted in the administration and coordination of programmes by a secretariat, headed by an executive director and located on the premises of the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy. The United Nations Educational, Scientific and Cultural Organization (UNESCO) is responsible for the administration of TWAS funds and staff. A major portion of TWAS funding is provided by the Italian government.

The main objectives of TWAS are to:

- Recognize, support and promote excellence in scientific research in the South.
- Provide promising scientists in the South with research facilities necessary for the advancement of their work.
- Facilitate contacts between individual scientists and institutions in the South.
- Encourage South-North cooperation between individuals and centres of science and scholarship.

TWAS played a key role in the establishment, in 1993, of the Organization for Women in Science for the Developing World (OWSD, formerly the Third World Organization for Women in Science, TWOWS). More than 3,200 women scientists from more than 90 countries in the South are members of OWSD, making it the largest organization of women scientists in the world. Its main objectives are to promote the leadership of women in science and technology in the South and to strengthen the participation of women in science-based development and decision-making. The secretariat of OWSD is hosted and assisted by TWAS.

www.owsdw.org

Since 2000 TWAS has provided the secretariat for IAP, the global network of science academies. IAP, which was established in 1993 as the 'InterAcademy Panel on international issues', unites more than 100 science academies worldwide; provides high-quality independent information and advice on science and development to policymakers and the public; supports programmes on scientific capacity building, education and communication; and leads efforts to expand international science cooperation.

www.interacademies.net

Since 2004 TWAS has also hosted the secretariat of the InterAcademy Medical Panel (IAMP), an association of the world's medical academies and medical divisions of science academies. IAMP is committed to improving human health worldwide through the coordinated action of its 70 members. **www.iamp-online.org**

www.twas.org