

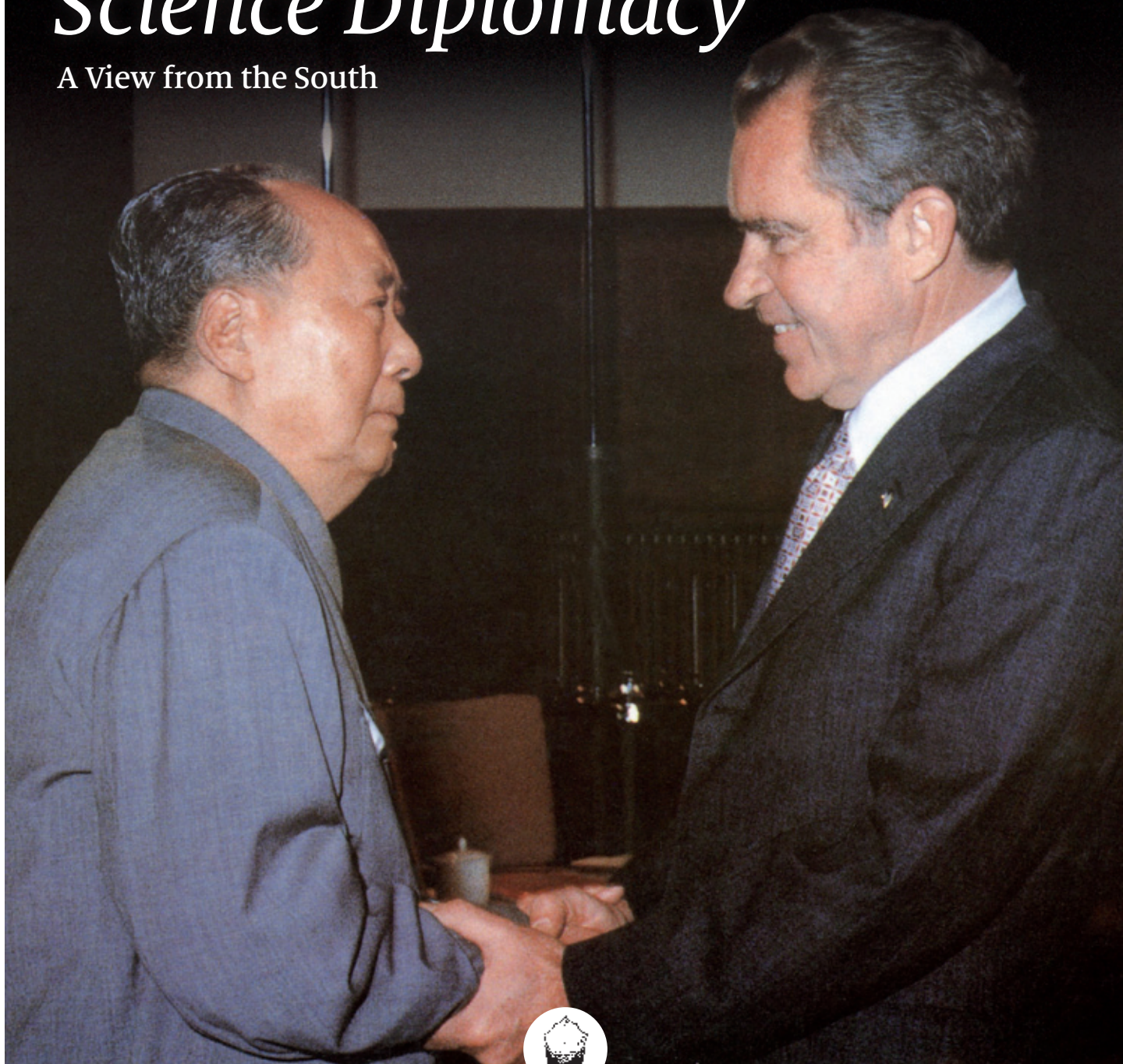
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NEWSLETTER

A PUBLICATION OF THE WORLD ACADEMY OF SCIENCES

The Power of Science Diplomacy

A View from the South





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▲ Epidemiologist François Nosten treats a sick child on the Thai-Myanmar border. [Photo: Shoklo Malaria Research Unit]; a barley field in Kyrgyzstan. [Photo: UNDP].

Cover picture: Science diplomacy initiated in 1972 by Chinese Chairman Mao Zedong [1] and US President Richard Nixon changed the world. [Photo: AFP/Getty Images]

▼ Lin Yee, director of the CAS-TWAS Centre of Excellence for Biotechnology, with Oriola Olasunkanmi Bukola of Nigeria and Qari Muhammad Kaleem of Pakistan.



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EDITORIAL

THE PROMISE OF SCIENCE DIPLOMACY



▲ Romain Murenzi

In February 1972, US President Richard Nixon arrived in Beijing for meetings with Chinese Chairman Mao Zedong and Premier Zhou Enlai. It was a summit of uncommon significance: Separated by geography, culture, ideology and considerable mistrust, the nations for two decades had had only limited contact. But the men were pillars of mid-century world order, and the meeting signalled a thaw.

The summit produced no formal agreement to normalize the relationship. But the Shanghai Communiqué, issued afterward, was a guide for future engagement – and contained the seeds of change. A key passage noted “specific areas in such fields as science, technology, culture, sports and journalism, in which people-to-people contacts and exchanges would be mutually beneficial.”

Press coverage at the time called it “ping-pong diplomacy”. From today’s vantage, it was science engagement that transformed the world. Millions of Chinese students eventually travelled to the United States for study, and the host country reaped huge benefits from their skills. Chinese policy, supported by this engagement, made science, engineering and technology the engine for historic economic growth and development. For many years, the nations have conducted important joint research.

The China-US engagement is a model and inspiration for a new generation of science diplomacy advocates. This issue of the *TWAS Newsletter* has a special focus on science diplomacy in the developing world, and describes the impact in health, climate change, astronomy, education and other fields. Such stories are attracting the interest – and hope – of scientists and policymakers worldwide.

From its earliest days, TWAS has worked to bring nations together to advance science and build relationships. Pakistani Nobel laureate Abdus Salam and Italian physicist Paolo Budinich were employing science diplomacy

when they assembled support for the Academy and an international roster of founding fellows more than 30 years ago.

Today, TWAS is joining with partners to unlock the potential of this field. Working with the American Association for the Advancement of Sciences [AAAS], and supported by the Swedish International Development Cooperation Agency [Sida], we host training courses and workshops that bring a corps of participants to our headquarters in Trieste.

We have worked closely with the Italian Ministry of Foreign Affairs, UNESCO, and with partners in Brazil, China, Hungary and other nations on projects and events that require both science and diplomacy for success. We have signed an agreement with India to produce a series of training sessions, and we are discussing science diplomacy cooperation with Pakistan-based COMSATS [Commission on Science and Technology for Sustainable Development in the South].

For developing countries in particular, science diplomacy can be a means of negotiating access to scientific resources or involvement in regional or global research initiatives. Of course, science cannot solve every problem between nations. While in some cases scientists working together can make great progress, in many others, working with diplomats and policymakers will be essential.

Still, as we address difficult global challenges, we would be wise to develop a science diplomacy orientation. The field is wide open to our creativity, exploration and innovation.

Romain Murenzi, *TWAS executive director*

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IN THE NEWS

Report shows constant rises in vaccine prices

In poor countries, the price to vaccinate a child has increased 68 times since 2001, according to a report by the international organization Médecins Sans Frontières (MSF). MSF called on pharmaceutical companies to slash the price of the pneumococcal vaccine to USD5 per child in developing countries. The pneumococcal vaccine alone accounts for about 45% of the total cost to vaccinate a child today in the poorest countries.

Down to Earth:<http://bit.ly/1zIU7Ky>

To curb climate change, eat less meat

To avert devastating changes to the Earth's climate, the world's appetite for meat must be better controlled, says a new report from Chatham House, a UK think tank. Fears of consumer backlash are keeping governments from taking action, said the report. Meanwhile, the global livestock industry produces more greenhouse gas emissions than all cars, planes, trains and ships combined - largely from burping cows and sheep and their manure.

The Guardian:<http://bit.ly/12soTu3>

Scientists expose malaria parasite's drug resistance

Scientists from Nanyang Technological University in Singapore have discovered how the malaria parasite is developing resistance to important drugs used to treat the disease, according to findings published in *Science*. Malaria is a mosquito-borne parasite that affects over 60 million people worldwide and can turn fatal. Antimalarial drugs are becoming less reliable as the parasite becomes more

resilient, but the new finding should assist the decision-making of healthcare workers who are treating malaria patients.

Bangalore Mirror:<http://bit.ly/1zIWMnz>

Floating homes for crowded Maldives

The Maldives, an archipelago nation in the Indian Ocean, has embarked on a series of floating developments that could alleviate a severe housing shortage and respond to rising sea levels that are driven by climate change. The 5 Lagoons Project is a joint project between the Maldivian government and Netherlands company, Dutch Docklands. While the first project is aimed at tourists, there are also plans to develop affordable floating homes for citizens. The company is also proposing to build cheaper floating platforms, made largely from plastic bottles, to house schools and essential services in the aftermath of floods elsewhere in the developing world.

SciDevNet:<http://bit.ly/1xfs6V1>

Africa aims for the moon

The Foundation for Space Development, South Africa, has initiated a bold project to launch an African mission to the moon. Partnering with other African organizations, the foundation hopes to inspire young people to pursue their scientific dreams and fulfil their potential. The project is attempting to develop the mission with the support of crowdfunding, aiming to raise USD150,000 for the first phase.

Sen:<http://bit.ly/1EYrLdz>



SCIENCE DIPLOMACY


A VIEW FROM THE SOUTH



Science diplomacy has helped to create a safe zone for treatment and research at the Shoklo Malaria Research Unit in Mae Sot, Thailand. [Photo: Novartis AG]



As developing nations begin to embrace science diplomacy, a new perspective is emerging that reflects the South's different history and different needs.

 by **Sean Treacy**

Edward W. Lempinen contributed to this report

At a biotech conference in Hyderabad, India, Dorairajan Balasubramanian of India met fellow biologist Anwar Nasim of Pakistan. They're both TWAS Fellows, and when they retired to Balasubramanian's home for an evening of tea and poetry, the conversation between them turned to a source of pride for India: the development of a new, inexpensive hepatitis B vaccine.

That kindled Nasim's interest. After all, millions of Pakistanis are exposed to hepatitis B. So Balasubramanian – Balu, for short – arranged a meeting between Nasim and a representative of the Indian vaccine-maker Shantha Biotechnics.

"India had become a world leader in vaccine production", said Nasim, "so they took us to visit several industries, plus a knowledge park. Balu and I discussed the possibility of India and Pakistan joining together, joining hands, to produce vaccines."

That was the beginning of the Vaccines for Peace initiative a decade ago, providing the Indian firm with millions of potential customers and providing Pakistanis with affordable vaccines.

Vaccines for Peace is just one example of how science diplomacy can advance science and form bonds across borders, even when countries have uneasy political relationships. In the past half-century, developed nations have led the field of international relations based on science. And today, the developing world's interest is growing.

But there's an important difference in the South's perspective, experts say. In developed nations, even well-meaning science diplomacy may include an element of soft power. In the South, after decades of colonialism and Cold

War geopolitics, unease about the intentions of global superpowers remains. But for nations keen to build their science strength and technological capability, it can be a way to engage in scientific projects or access resources that otherwise might be out of reach.

One measure of the growing commitment in the developing world is a recent high-profile speech by new Indian Prime Minister Narendra Modi. Science and technology are "at the forefront of our diplomatic engagement", Modi said during an address at the 102nd Indian Science Congress. "There is a growing trend of international collaboration in research and development, not just among business enterprises, but equally among researchers and scholars at universities and laboratories. We should take full advantage of this."

Balasubramanian, a former TWAS secretary-general, was one of five winners of the 2014 TWAS Regional Prize for Science Diplomacy. Scientists, he believes, are in a unique position to bring countries closer.

"Movies and music have willy-nilly brought people together. Cricket matches do the same", he added. "Why not science and technology?"

HOW SCIENCE WORKS ACROSS BORDERS

Science diplomacy is a broad way of describing how scientific teamwork between nations can solve human problems and improve international relationships.

Nations and cultures have long built relationships based on science. But the modern era of science diplomacy emerged in the latter half of the 21st century, when the United States used scientific research as a basis for building better relationships with China and the Soviet Union.



Today, science diplomacy takes many forms. Science can support diplomatic efforts, as when researchers provide insight to support a new treaty on protecting oceans. Increasingly, nations are placing scientific attachés in their overseas embassies. Diplomacy may help lay the foundation for a multi-national science project. Or scientific cooperation can begin with the explicit intention of improving relations.

TWAS has long encouraged international research cooperation and it has recently emerged as a hub for science diplomacy in the South. In 2011, TWAS signed an agreement with the American Association for the Advancement of Science [AAAS] to host science diplomacy workshops and courses on topics such as energy and agriculture. In 2013, TWAS worked with the Italian Ministry of Foreign Affairs and the Hungarian Academy of Sciences on a roundtable exploring how to refit Cold War science links to 21st century needs. In 2014, TWAS worked with Rwandan President Paul Kagame and the World Bank to support a forum on improving African higher education.

The Swedish International Development Cooperation Agency [Sida] provides key funding for TWAS's science diplomacy programme. Last year, TWAS and India's Department of Science and Technology signed an agreement to provide science diplomacy training and events in India and Trieste, Italy, where TWAS is based. TWAS is also exploring cooperation on science diplomacy with the Commission on Science and Technology for Sustainable Development in the South [COMSATS], an intergovernmental organization based in Islamabad, Pakistan.

A PERSPECTIVE OF MANY PIECES

How does the developing world as a whole view science diplomacy? The answer is complex. While there is no single, over-arching perspective, there is a patchwork quilt with a recognizable pattern. And each country has to figure out where it falls into that pattern.

Collaborative projects tied to science diplomacy are on the rise in Latin America and the Caribbean, said Jaime Urrutia Fucugauchi, president of the Mexican Academy of Sciences, in an email interview. But the character of science diplomacy varies widely. "Many factors



▲ From top: Dorairajan Balasubramanian and Anwar Nasim

▼ Italian physicist Paolo Budinich, left, and Pakistani physicist Abdus Salam with a model of the International Centre for Theoretical Physics (ICTP) building, during the cornerstone-laying ceremony on 18 June 1964. [Photo: ICTP Archives]

“ Movies and music have willy-nilly brought people together. Cricket matches do the same. Why not science and technology? ”

Dorairajan Balasubramanian

are involved to different degrees, including geography, history, economics, politics, social development”, he said. “Perceptions change over time.”

The result: a broad spectrum of reasons for developing countries to pursue science diplomacy. One way to imagine this spectrum is with “access” at one end and “influence” at the other, said Vaughan Turekian, director of the AAAS Center for Science Diplomacy. The confluence of access and influence becomes especially important for developing countries that are emerging as more active global players.

“As developing countries begin to take a larger role in global politics and economics, increasing their influence in the larger debates becomes a national priority”, Turekian said. “So many of the issues important to developing countries – economic growth, sustainable development, agriculture, attracting talent, building innovative and entrepreneurial systems – are underpinned by science and technology development.





▲ TWAS Regional Prize for Science Diplomacy winner François Nosten treats a sick child at the Shoklo Malaria Research Unit on the Thai-Myanmar border. [Photo: Shoklo Malaria Research Unit]

▼ From left: Jaime Urrutia Fucugauchi, Vaughan Turekian and Imtinan Elahi Qureshi

As such, science diplomacy takes on a very special role: first, to increase their influence and input into global issues that affect them, and second, to build those connective links with other nations that allows them to meet their national priorities.”

Like many countries, Pakistan has been engaged in international science cooperation projects, said Imtinan Elahi Qureshi, the executive director of COMSATS. It has been involved with CERN [the European Organization for Nuclear Research] since the 1960s. It has bilateral scientific cooperation agreements with more than 50 countries and scientific staff in its UN missions.

But in an email interview, Qureshi said some factors could slow the uptake of science

diplomacy in the South. Many scientists and policymakers don't see how science diplomacy is different from conventional science cooperation. Also, developing countries often don't have the funds or local expertise to take part in big multinational science ventures that rely on science diplomacy.

And after generations of colonialism and geopolitical manoeuvring, developing nations may be wary of science engagement with the North. In negotiating a treaty, Qureshi said, they may “find it intimidating to confront those who have the support of world's best scientific manpower and institutions”. If there are conflicting interests or interpretations, he added, the concern is that “science becomes a mechanism of political gains rather than an instrument of universal good”.

But COMSATS is hopeful about the potential of science diplomacy, he said, and it has recently launched a project to make science diplomacy better understood in the South.

BETTER LIVES THROUGH ACCESS TO SCIENCE

Increasingly, the developing world sees science diplomacy as an avenue to access existing science. This is helping some countries improve





their infrastructure, invigorate their educational systems and even treat their sick.

Science diplomacy has focused on expanding access to education and opportunities for women. Working with AAAS, top officials from Rwanda and other East African nations convened in 2010 to discuss cooperation in science education. The Kuwait Foundation for the Advancement of Science and the Kuwait Institute of Scientific Research have hosted conferences of women scientists and engineers from the Arab world, involving high-level diplomats from Kuwait, France, the United States and other nations.

TWAS Fellow Peter Mugenyi is a Ugandan physician, a leading figure in HIV/AIDS research and a 2014 winner of the TWAS Regional Prize for Science Diplomacy. He was also a major advisor in the “President’s Emergency Plan for AIDS Relief” [PEPFAR] initiative from the United States, convincing the global power, through research, that Africans would follow antiretroviral treatment regimens. The programme brought life-saving anti-retroviral treatments for up to 7.7 million Africans suffering from HIV/AIDS.

Mugenyi also leads one of Africa’s largest HIV/AIDS treatment and research centres – the Joint Clinical Research Centre – which works

with institutions in Africa, the United States, Europe, Japan and India.

“We didn’t need to invent the wheel”, said Mugenyi. “The point was the fastest way, the quickest way and the most efficient way to bring Africa up to speed was to work in collaboration with other scientists all over the world. And in this process we needed science diplomacy to make it come about.”

Bangladesh, where only 60% of the population has access to electricity, has a science-diplomacy engagement with Russia. Bangladeshi Prime Minister Sheikh Hasina visited Russian President Vladimir Putin in Moscow in 2013, and the two countries signed a deal providing a loan to build a nuclear plant. Russia is also planning to train the plant’s Bangladeshi staff and cooperate on the use of its reactors for research. Bangladesh expects the plant to go online by 2021, generating 10% of the country’s electricity.

Awareness of the benefits of science diplomacy is growing among Bangladeshi policymakers, said Tabassum Mumtaz, a biologist with the Bangladesh Atomic Energy Commission and a science ambassador for TWAS’s 2013 science diplomacy workshop on energy. It also helped, she said, that Hasina had been married to a nuclear scientist, M.A. Wazed Miah.

▲ Forty scientists from five Middle Eastern and North African countries convened in Trieste, Italy, in May 2014 to explore scientific responsibility with a focus on bioscience. The training was part of TWAS’s science diplomacy programme. [Photo: Peter McGrath]

▼ From top: Peter Mugenyi, Tabassum Mumtaz





▲ François Nosten

▼ An artist's impression of antennas within the central core of the planned Square Kilometre Array in South Africa and Australia, the result of a collaboration between developing and developed nations. [Photo: Swinburne Astronomy Productions for SKA Project Development Office/ Wikimedia Commons]

For more on the 2014 TWAS Regional Prize winners: www.twas.org/node/8605/

"I would say our prime minister had interests in science and could foresee the benefits of nuclear power", Mumtaz said. "That's how she also played a significant role to fulfil this scientific mission with the cooperation of the Russian counterpart."

WHAT IS TRUST MADE OF?

In Myanmar, science diplomacy has worked in another, arguably unique way. Instead of bringing people together from different countries, it provided a bridge between the government and the Karen people, who have been in conflict for decades.

The Thai-Myanmar border is home to refugee camps crowded with members of the Karen ethnic minority. They are vulnerable to malaria, in part because normal medications are losing effectiveness as malaria develops resistant strains. At the centre is the Shoklo Malaria Research Unit, which juggles both research and treating refugees.

"We know from history that once resistance emerges in this part of the world, then it spreads to the rest of the subcontinent, then

sooner or later it will reach Africa", said François Nosten, professor of tropical medicine, director of the unit and a winner of the 2014 TWAS Regional Prize for science diplomacy. "So, what can be done to stop the spread of resistance? That's where we appear in the picture."

The unit estimates that, since 1986, it has managed to reduce malaria, once the leading local cause of death, by 95%. They have also reduced the deaths of mothers during childbirth by about 99%. But French-born Nosten, who has lived and worked at the Thai-Myanmar border for 30 years, says researchers and policymakers in the developing world haven't focused on science diplomacy until recently.

What changed? Myanmar's government wanted to appear more welcoming to the world after 50 years of military rule. That provided an opening for scientists to emphasize the importance of the drug resistance emerging on their doorstep. The result was rare talks including both the Myanmar Ministry of Health officials and Karen health representatives, where both agreed to allow and support malaria research in areas under the control of either side.

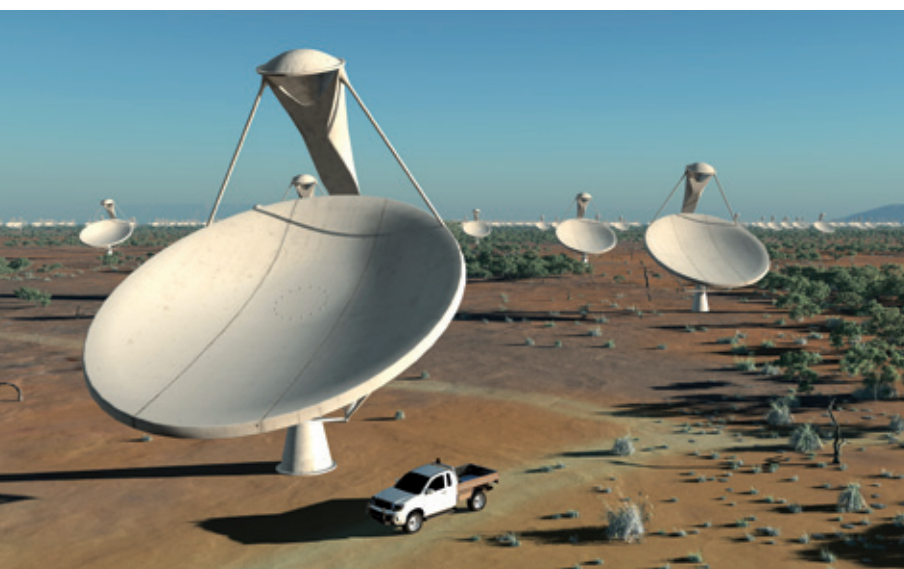
"I've been trying to think over the last 30 years: What is trust made of?" Nosten said. "If the people trusted what we do, it's because we were not doing politics. We were not taking any side."

That trust may be what science diplomacy is best-poised to provide developing nations. Since scientists aren't typically invested in the politics that drive tension between countries, they can bypass the bitter feelings that keep nations from working together. And as science diplomacy continues to bring results, support will likely grow.

Scientists' unique ability to sway political feelings without directly doing politics is what makes such work diplomacy, instead of simply scientific collaboration, said Balasubramanian. He calls science a "diplomatic trump card" that can help to neutralize political pressures.

"Diplomacy looks for any area or attitude of commonality between two parties, and exploits it to bring people, maybe even governments, together", he said. "Science can and does build bridges between people, institutions and nations." ■

“If the people trusted what we do, it's because we were not doing politics. We were not taking any side.” François Nosten





Q&A

SCIENCE DIPLOMACY: SEIZING A NEW OPPORTUNITY

 by Cristina Serra

Science diplomacy holds enormous potential for solving problems and building international relationships. Three science policy leaders explore how the South can build its capacity for a new era.

In recent years, the concept of science diplomacy has gained momentum in the developed world, and today, the idea is winning attention in the developing world. But science policy leaders say that, especially in the South, a focused effort is needed to prepare government officials and scientists to take full advantage.

In interviews with TWAS, three high-level policy leaders suggested that science diplomacy can help build new relationships between developing and developed nations to support advances in food and energy production, pursuit of big, complex science projects, and even public engagement with science. And yet there is a lingering concern that science diplomacy must be a tool for building equitable partnerships, with fair benefits even for the least developed partners.

To explore these issues, TWAS staff writer Cristina Serra conducted email interviews with TWAS Fellow Krishnaswamy VijayRaghavan, secretary of the Indian Department of Biotechnology; Jorge Pastrana, foreign secretary and executive director, *Academia de Ciencias de*

Cuba; and Willie Ganda, the director of research development and innovation for the Ministry of Higher and Tertiary Education, Science and Technology Development in Zimbabwe. Both Pastrana and Ganda participated in science diplomacy events at TWAS.

What is the state of science diplomacy, and the level of awareness of this concept, today in developing nations?

VijayRaghavan: Science diplomacy needs to move to centre-stage from the periphery. Science is the fulcrum on which technology, industry, trade, energy, health and agriculture rest. Many developed countries see this and have taken the lead, but developing countries should see the importance of this soon.

Ganda: In the developing world science diplomacy is still in its infancy and the awareness levels of the concept are very low. In some countries knowledge about the concept of science diplomacy is almost nonexistent. To those already exposed to the concept, interest is growing, but that interest has not been matched with sustained

capacity-building programmes to develop this concept.

Pastrana: The concept of science diplomacy may not define a discipline, but rather describe a tool. Diplomats tend to dismiss the title as it should not be considered any separate entity within diplomacy, while scientists tend to think that science cannot be manoeuvred to support national interests. Since the end of WWII, the way scientific enterprise became part of national development strategies, and science, technology and innovation became unavoidable elements of national development, the need for science advice for decision-making has increased in both developed and developing societies.

Science diplomacy has typically been associated with the US and Europe. Compared to them, are there differences in the ways developing nations might use science diplomacy?

Ganda: Developed countries can apply science diplomacy through leveraging their science resources to interface with other countries, especially in the area of capacity-building and collaborations. Due to limitations in resources, the scope and impact of science diplomacy efforts is limited in developing countries. Developing countries are more inclined to science diplomacy efforts that address social

problems in areas like health and natural resources management which tend to be transboundary in nature.

Pastrana: The differences in convenience of the use of science diplomacy by developed or developing countries must always be questioned on the basis of intentions. Science diplomacy would be an effective tool for developing countries when it allows widening the scope of limited discussion for decision-making across political borders. It will become a liability when diplomacy turns to advocacy on the part of a powerful partner, and it goes beyond discussion to arm-twisting, from advice to interference on sovereignty, and from

Science is the fulcrum on which technology, industry, trade, energy, health and agriculture rest.

Krishnaswamy VijayRaghavan



building understanding to building subversion.

VijayRaghavan: The US and Europe have seen science and education as instruments of foreign policy, of income and of brain-gain. Developing countries have seen science and education in the West as a trade-off between the gains of training against the loss of brain-drain. Developing countries must now push to develop capacity of the highest quality, locally. This can happen with speed only if there is internal will and international collaboration with the West.

What would be some areas where science diplomacy might be most promising for the developing world?

Pastrana: I believe that capacity-building in the advisory role of scientists, public understanding of science, and the building of consensus to support sustainable development efforts are several of those issues that could be beneficial for developing countries and can be better advanced by relations supported by science diplomacy. It will also be effective in any work against widespread poverty and hunger.

VijayRaghavan: Science diplomacy holds promise in the field of life science in general, including health, climate research, renewable energy, agriculture, as well as in the preservation of ecosystems. These are matters that concern the planet as a whole and know no national boundaries.

Ganda: Some areas where science diplomacy might be promising include the bringing together of countries to collaborate and work together at regional level to address transboundary problems in areas like health, agriculture, natural resources exploitation, management and others. These collaborations and sharing of

best practices will foster unity and common understanding and minimize conflicts which may stem from the scarcity of these natural resources.

Some developing countries are using science diplomacy to establish or improve their relationships with neighbouring countries. Is such an approach effective?

VijayRaghavan: To answer this question, we must keep in mind the “hope” underlying science diplomacy. One expectation could be that it is a way to extend national influence. In my view this should not be our expectation, and when it is, it may not succeed, or at least not in a planned way. Our expectation should be, in the context of relationships, that science is a great aid in improving understanding between cultures and peoples in general.

Larger countries have the possibility of starting many kinds of science institutions that smaller nations may not be able to afford. Access should be freely available to smaller countries from the rest of the world at the same terms as for their citizens. This is not easy to do, as we often get caught in structuring different fees and fellowships for different people, and resources are always short.

Ganda: Yes. However this depends on the context and level of cooperation or collaboration. Where big science projects with huge budgets and high impact for countries are involved, the degree and levels of inter-state interactions are sufficiently senior and adequate for significant improvements in country relations. For developing countries, however, science diplomacy may not yet be possible at such high levels, as the status of science has not grown to levels where those directly involved in influencing bilateral or multilateral relations can directly see it as a valuable tool.



Pastrana: Sure. I have defended that point of view in several lectures and papers; notably in the case of Cuba and the United States, but also across countries of Latin America and the Caribbean, and several others in North-South and South-South relations. Although it is difficult to assess how effective it has been in bringing defining results, science diplomacy efforts of this sort have evidently contributed to conflict resolution or at least to establish a climate of rapprochement in many political conflicts during the second part of the 20th century and the beginnings of the present one.

How could science diplomacy be used better, especially in developing countries?

Ganda: In developing countries science diplomacy can be used better through tailor-made and more appropriate strategies that encompass programmes or projects that do not involve a lot of money. Whilst developed countries have applied science diplomacy in large projects or programmes that require significant resources, this may not be possible in developing countries due to lack of resources and personnel to participate in such programmes or projects.

Pastrana: It can be much better used by building and developing the science-policy interface. Most developing countries have not identified a national science, technology and innovation system, or even when they have an emerging STI system, they lack the definition of any established national science policy. To be able to engage on science diplomacy activities, any country must have a recognized national scientific structure with a representative status and an effective science advisory system. Sometimes, they lack independent respected institutions or persons. In other

“ Developing countries are more inclined to science diplomacy efforts that address social problems. ”

Willie Ganda

cases the governmental structure denies every possibility to build such a relation. In both cases national interests suffer because decisions are arbitrarily defined on immediate constraints.

VijayRaghavan: We need to do three things. First, set up teaching, training and research programmes on a large scale in developing countries to be used by developing countries' citizens. [I'm thinking of a developing-country version of the European Molecular Biology Organization and the European Molecular Biology Laboratory]. Second, we need to attract the best scientists in the world to come and work in the new structures that we create in developing countries. Third, we need to make sure that scientists in the developing world have access to major research centres in the West, like synchrotrons, accelerators, telescopes, animal research facilities. All these three require money, but also diplomacy.

Are there obstacles or limits to using science diplomacy in the developing world? What are they, and how can they be overcome?

Pastrana: In the case of developing countries, problems like widespread hunger and poverty can only be solved by the application of knowledge. Most of the knowledge to be applied is to be found in developed and



emerging countries. A good way for science diplomacy to prove its case is the work that can be done across borders in this sense. This shall in time contribute to better relations between neighbouring countries of different levels of development. The way to overcome problems would depend on the will to use this tool for government, and the capacity to do it. Both the will and the capacities can be created and promoted.

VijayRaghavan: There is only so much strategy-planning one can do. Scientists are least equipped in predicting what will happen in the world of politics. If the purpose of science diplomacy is to build relationships on a foundation of science, realpolitik

“ Many big science tools and big projects these days cannot be run by one single nation. ”

Jorge Pastrana

will always have to be taken into account. But a tradition of scientific relationships can be a balm in troubled times. So, even in the most difficult of relationships, exchanges in science and art and culture can be an important component for communication and the building of a new direction.

Ganda: Yes, obstacles do exist. One includes limited financial resources for countries to initiate or collaborate on science diplomacy programmes or initiatives. The second is the lack of the required human skills to enable collaboration or engagements in science diplomacy. The third obstacle is the general lack of appreciation of science, hence it's not prioritized when it comes to national processes of allocating resources. To overcome these obstacles, a lot of capacity-building needs to be done focusing on science education for policymakers so that any initiatives to promote science and in turn science diplomacy are well supported.

What is the role of science diplomacy in facilitating and supporting big global projects that bring together



BIOGRAPHIES

Krishnaswamy VijayRaghavan is the secretary of the Indian Department of Biotechnology. He is distinguished professor and former director of The National Centre for Biological Sciences, Bangalore, India. He received the Padma Shri prize, the fourth highest civilian award in the Republic of India [2013].

Jorge Pastrana is the foreign secretary of the Cuban Academy of Sciences [CAS] since 1996. He is a member of the Advisory Commission on International Relations of the Ministry for Science, Technology, and Environment of Cuba. He has been involved in the establishment and coordination of international programs of cooperation of CAS since 1975.

Willie Ganda is the director of research development and innovation for the Ministry of Higher and Tertiary Education, Science and Technology Development in Zimbabwe. He holds a master's degree in business administration [Edinburgh Business School, Heriot Watt University] and a Master of Philosophy in engineering for sustainable development [Cambridge University, UK]. He has also worked in consultancy, manufacturing and academia.

the developed and developing world, like the European Organization for Nuclear Research (CERN) or the Square Kilometre Array radio telescope project in Australia and South Africa?

VijayRaghavan: The poorest of the poor must be exposed to the best of world science and must have an education that allows them to dream to become a deep-sea explorer, an astronaut, a mathematician, or go to CERN. Massive training programmes in basic science and mathematics at the school and college level are needed. Then we will have bright leaders of the future from developing countries and not just from the West.

Ganda: Science diplomacy can help in facilitating such projects through capacity-building programmes that enable developing countries to fully participate in such projects. Whilst opportunities to participate can be availed, everything boils down to capacity to make any meaningful contribution. Science diplomacy


can thus help by putting initiatives that build the required capacities in developing countries so that they can meaningfully contribute and participate in such large projects.

Pastrana: Many big science tools and big projects these days cannot be run by one single nation. The International Space Station and the Large Hadron Collider are glaring examples of that. Since many countries will participate in any such effort, the need to include developing countries is the result of the realization that we need scientific capacity and literacy everywhere if we are to address global issues and solve global problems. The way to achieve that is through capacity-building, and the need to support such a position should be recognized not only by developed, but by developing countries. The administration of such programmes should be in partnership, but the financial support must come for those more affluent, considering those expenses as an investment toward a rewarding future solution of shared problems. ■



COMMON THREATS, COMMON SOLUTIONS

Researchers from Central Asia and India see that science diplomacy could help the region cope with climate change.

 by Sean Treacy

In Central Asia, where the livelihoods of almost half the region's population depend on agriculture from irrigated lands, climate change presents a grave threat. Days are getting hotter, nights are getting cooler, and rising temperatures are causing the essential source of the region's water – high mountain glaciers – to melt away.

Dzhamin Akimaliev, the director of Kyrgyzstan's Scientific Research Institute of Agriculture, said the temperature in his country has risen 1.6 degrees Celsius in the past 100 years. Meanwhile, the melting glaciers atop his country's Tien-Shan mountains are shrinking, causing more agriculture-feeding water to flow. That increase will last for 15 to 20 years, but then, once the glaciers disappear, so will the water.

"For more than 10 years I have been saying that mountain-area research is important for our country," he said, "because the future of agriculture is in the mountain area."

How can the five former Soviet states there,

which are already competing for existing water resources, work together and address this common challenge?

This is what Akimaliev and six other representatives of four Central Asian countries sought to answer at a recent TWAS science diplomacy workshop in Trieste, Italy. The workshop, "Climate Change and a Global Research Agenda for High-Altitude Agriculture in Central Asia and India", was attended by scientists from Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan. Running from 9 to 11 December 2014 in Trieste, Italy, it had 17 participants in all and included scientists and policy experts from India, which has experience dealing with similar climate issues, Italy and the United States.

It was the latest event under an agreement between the American Association for the Advancement of Science (AAAS) and TWAS that created a science diplomacy programme focused on developing nations. The workshop was organized by Peter McGrath and Sara Dalafi, who coordinate TWAS's science and diplomacy initiative.

At the workshop, science served as a bridge between countries that don't always agree on how to best use natural resources. But it also presented a starting point for collaborative thinking on an issue that is already putting pressure on their people. In Central Asia, every country has this in common: They are all downstream.

A PRESSING DEMAND FOR WATER

Agriculture in all of the Central Asian countries is fed by water that flows from mountain ranges concentrated in Kyrgyzstan and Tajikistan.

All five Central Asian nations are using the water at an intense pace, mostly to support crops in soils that aren't ideal for agriculture. Turkmenistan uses more water per capita

▼ Workshop participants, from left, Timur Ustabayev and Svetlana Dolgikh of Kazakhstan, Kamolidin Abdulloev of Tajikistan, and Saujanendra Swain of India. [Photo: Cristina Serra/TWAS]





“ The future of agriculture is in the mountain area. ” Dzhamin Akimaliev

than any other nation in the world, according to a *Nature* report, and the other Central Asian nations are not far behind. This leads to conflicts between the countries as they compete for water.

One example of a crop fed by this water supply is cotton in Uzbekistan, a desert country that supports its fields with irrigation. Workshop attendee and TWAS Fellow Ibrokhim Abdurakhmonov, director of the Center of Genomics and Bioinformatics of the Academy of Sciences of Uzbekistan, said his country is also concerned that more extreme day and night temperatures could hurt cotton yields.

Central Asia's dependence on agriculture is also a pressing issue. The Soviet Union used the land to support a large, sprawling super-power. Now that they are separate nations, each country has to produce the goods needed to sustain itself.

Even the farmland giant of the region, Kazakhstan, is facing threats. Workshop attendee Svetlana Dolgikh, head of the Kazakhstan Division of Climate Research, said less rain in the summer will lead to lower

▲ A grain field in Kokshetau, Kazakhstan [Breshuk/Wikimedia Commons]

Learn more: www.twas.org/node/8698

agricultural yields, and higher temperatures will mean more stress on livestock. Kazakhstan, she said, will need water-saving technologies.

“This workshop was really like a first step to use science as a platform to more strongly link the collaboration on an issue of common importance, which is climate change, because it does affect them all”, said Cristine Geers, a programme associate of the AAAS International Office.

IDEAS FOR A UNITED EFFORT

As the climate changes, researchers will need to gather information, store it, and share it among colleagues. To some degree, systems to manage this information already exist in each of the countries, said Kamolidin Abdulloev, a consultant for Tajikistan's Pilot Programme for Climate Resilience. What's needed, he said, is a regional system, especially since fields such as biotechnology are new for some Central Asian countries.

“We need to have a very good coordination mechanism for these activities”, said Abdulloev. “As it is now, when I am looking for expertise on farmed goods from Uzbekistan or maybe from India or from other countries, or if I need some information about new agricultural practices or climate-resilient crop, the information is not accessible.”

TWAS Fellow Manju Sharma, distinguished woman scientist chair of the National Academy of Sciences, India, and former secretary of India's Department of Biotechnology, said field work is important. Knowledge centres in India, she said, have been successfully getting climate information to rural populations that speak regional dialects.

“So monitoring infrastructure has to be created at the field level through site visits to monitor what the farmer is getting, how much advantage he's getting, and what is the benefit or disadvantage”, said Sharma.

Participants also concluded that they should write a white paper – a document that outlines research strategies and policy recommendations that can be made available to decision-makers. Researchers from each country could help create the document, presenting a united front. ■



ICTP: A HALF-CENTURY OF PROGRESS

For 50 years, the Trieste-based research centre has supported science in developing countries. At an anniversary celebration, world policy and science leaders – and many TWAS Fellows – shared memories and visions for the future.



by Edward W. Lempinen

Sean Treacy contributed to this report

The presidents of Italy and Rwanda, joined by Nobel laureates, global science leaders and many TWAS Fellows, celebrated the illustrious past and ambitious future of the Abdus Salam International Centre for Theoretical Physics at 50th anniversary festivities in Trieste.

The four-day event, from 6 to 9 October 2014, featured visits from Rwandan President Paul Kagame, UNESCO Director General Irina Bokova, and Prince El Hassan bin Talal of Jordan. There were leaders from such prominent science bodies as the International Atomic Energy

Agency (IAEA), the European Organization for Nuclear Research (CERN), the Pakistan Atomic Energy Commission and the World Meteorological Organization. Also attending were at least three Nobel laureates, former presidents and prime ministers of other nations, and, from Italy, top officials from the Ministry of Foreign Affairs, the province of Friuli Venezia Giulia and the city of Trieste.

In a letter from Rome, then-Italian President Giorgio Napolitano joined the others in praising ICTP's global impact. The Centre's "history

▼ Rwandan President Paul Kagame speaks at ICTP's 50th Anniversary celebration. [Photo: ICTP]



of excellence transcends national borders,” Napolitano wrote, “and now embraces an international panorama, allowing scientists and experts from different countries to compare and share experiences for the benefit of technological progress in the entire world.”

TWAS also had a prominent role in the celebration and basked in ICTP’s glow. Some two dozen members of TWAS attended, many of whom have had close ties with ICTP and its founder, Abdus Salam. Many speakers regarded TWAS as ICTP’s younger sibling, both sprung from the vision and energy of founder Abdus Salam of Pakistan, himself a Nobel laureate. TWAS founding Executive Director Mohamed H.A. Hassan and current Executive Director Romain Murenzi were featured speakers at the event.

SCIENTIFIC GENIUS, TRUE HUMANIST

Salam and his contemporary, Italian physicist Paolo Budinich, received broad praise in the opening ceremonies. In the early 1960s, they were among a small corps globally who recognized the importance of science and technology for the progress of the developing world.

Salam and Budinich “had a dream more than 50 years ago, to create an institution that can bring scientific excellence to all corners of the world”, said ICTP Director Fernando Quevedo of Guatemala. “They managed to turn this dream into a reality.” Over the years, Quevedo added, ICTP “has become more and more relevant to the needs of our planet and its inhabitants, for science as a key component of our culture, science for development and as one of the most effective means of our survival.”

On behalf of Italian Prime Minister Matteo Renzi, I tell you we are proud – we are very proud – to have you all here. ”

Mario Giro, under-secretary of state in the Italian Ministry of Foreign Affairs



▲ From top: Irina Bokova, C.N.R. Rao and Fernando Quevedo

See ICTP’s collection of articles, photos and videos on the event: www.ictp.it/ictp-50th-anniversary.aspx

Read an interview with ICTP Director Fernando Quevedo: www.twas.org/node/6413

Read more about ICTP’s 50th anniversary: www.twas.org/node/6583

Others joined in praising Salam – his vision, his character and his political skill.

Bokova called him “a scientific genius (and) a true humanist, because science is also about humanism.”

“There is one scientist who really stood for the right things in the world and worked for it and created institutions”, said former TWAS President C.N.R. Rao, the renowned Indian chemist. “Salam is a man who cared for the poor, cared for equality and cared for the well-being of all.”

Kagame, a strong advocate for science and technology in Rwanda and other developing nations, echoed those themes at the opening ceremony.

“The tools pioneered at ICTP, which have since been adopted more widely, aimed to stem the brain drain by bringing young scientists from developing countries into top-notch research networks”, Kagame said. “This made the beneficiaries better able to build scientific communities in their own countries, and helped to reduce the isolation that caused precious talent to be wasted. The ICTP’s strategy also recognized that, at the end of the day, what is important is to use science to speed up social and economic transformation in the developing world.”

THE POWER OF MULTIPLICATION

While ICTP was applying itself directly to research and training, it was also helping to generate a new family of science centres in Trieste – including TWAS – that were focused on the developing world and on global cooperation.

“In the future, that will certainly create more synergies for the development of science for sustainable growth”, said Mario Giro, under-secretary of state in the Italian Ministry of Foreign Affairs. “On behalf of Italian Prime Minister Matteo Renzi, I tell you we are proud – we are very proud – to have you all here.”

Giro, Bokova and others also singled TWAS out for praise. Added Jordan’s Prince Hassan: “TWAS believed, and believes, in science diplomacy and the importance of effective partnerships between scientists, policymakers and diplomats.” ■



AFRICA CALLING

Scientific and diplomatic leaders from Africa, Italy and TWAS celebrated their historic partnership – and future cooperation.

by Cristina Serra



Africa's social and economic development in fields such as health, education, food security and water management has greatly benefitted from international scientific cooperation. Through strong historic ties with Africa, the Italian government and TWAS have played an important role in this process.

To celebrate this partnership, high dignitaries, diplomats, policymakers, members of the Italian Parliament and scientists from Italy and Africa met in Rome on 27 May 2014, during the international Africa Day, to set the stage for future collaborations.

The meeting – “Africa and Italy: Scientific Cooperation for Sustainable Development” – was organized by the Italian Ministry of Foreign Affairs [MAE], which has a long partnership with TWAS and Africa. The event also marked the 51st anniversary of the formation of the Organization of African Unity, which was renamed the African Union [AU] in 2002. The event was held at Farnesina Palace, headquarters for MAE.

“Italy wants to be part of the virtuous dynamism of the African continent by making the most of a historic presence that has already contributed to the social growth and infrastructure of Africa”, said Federica Mogherini, at that time the Italian Minister of Foreign Affairs, in her opening speech.

Mogherini was introduced to the audience by MAE Secretary-General Michele Valensise, who chaired the event.

Marièm Aouffa, Mauritania's interim ambassador to Italy, spoke on behalf of Mohamed Ould Abdel Aziz, president of Mauritania and current chair of the AU. She said that Africa is a rich and young continent with remarkable growth rates and potential. But she also observed that agriculture and food security should be at the heart of its development.

Among the African diplomats was Mamadou Kamara Dékamo, the ambassador to Italy of the Republic of Congo since 2000 and the Minister of Health and Population from 1997 to 1999. In his speech, Dékamo urged the international community to take action against civil turmoil

Africa has the world's youngest population and the highest concentration of arable land, plus advancing use of the Internet and mobile phones. *Segenet Kelemu*

▲ Participants in the Africa Day celebration, from left: Minister Roberto Cantone, MAE Undersecretary Mario Giro, Italian Embassy Counselor Pier Attinio Forlano and Marièm Aouffa, Mauritania's interim ambassador to Italy.

▼ TWAS Executive Director Romain Murenzi, left, hands the TWAS President's Award for lifetime achievement in building scientific capacity in Africa to Jean-Pierre Ezin, a professor at University of Abomey-Calavi, Benin.





“Italy wants to be part of the virtuous dynamism of the African continent by making the most of an historic presence that has already contributed to the social growth and infrastructure of Africa.” **Federica Mogherini**

Learn more:
www.twas.org/node/6398



that is troubling nations such as Mali, the Central African Republic and Somalia. He also emphasized the importance of the Africa Day because Africa, he said, is the cradle of humankind.

In the Italian delegation were also MAE Undersecretary Mario Giro; Minister Roberto Cantone, director of the MAE Bilateral and Multilateral Scientific and Technological Cooperation Unit; and Edoardo Vesentini, professor emeritus at the Accademia Nazionale dei Lincei and a TWAS Fellow since 2001.

Today, Africa is a vibrant continent that blends light and shadow. It is a place where education programmes are becoming more substantial, birth and infant mortality are decreasing and some nations are experiencing increased prosperity. But it is also a place where

civil conflict, humanitarian crises and epidemics too often impede progress.

It's a place where foreign direct investment has increased by more than 80% during the past decade, even as 47% of people in sub-Saharan Africa live on \$1.25 a day or less.

TWAS has long focused on Africa's development, a role that was reflected in the Rome event. The Academy's delegation included Executive Director Romain Murenzi; Jean-Pierre Ezin, professor at the *Institut de Mathématiques et de Sciences Physiques de l'Université d'Abomey-Calavi*, Benin; and Segenet Kelemu, a 2011 TWAS Prize winner and now the director of the International Center for Insect Physiology and Ecology [icipe], based in Nairobi, Kenya.

Murenzi, Ezin and Kelemu each gave the audience a vivid personal perspective on African science. Murenzi retraced the origins of the Academy and its evolution until the present time. He mentioned TWAS founder Abdus Salam, a Pakistani physicist and Nobel Prize winner, and Founding Fellows Thomas Odhiambo from Kenya, TWAS Treasurer and former TWAS Executive Director Mohamed H.A. Hassan of Sudan, and chemist Lydia Makhubu from Swaziland, whose inspired vision helped the establishment of the Academy in 1983.

Murenzi also highlighted TWAS's emerging role in science diplomacy, where the Academy has partnered with the Italian MAE on several events. During a ceremony, he conferred on Ezin a special award in recognition of his lifetime achievement in building scientific capacity in Africa.

Kelemu, born in Ethiopia, is the first woman to serve as the icipe director general, and was a 2014 winner of the L'Oréal-UNESCO For Women in Science Award. Africa is not a continent to pity, she said in her speech. "Africa has the world's youngest population and the highest concentration of arable land, plus advancing use of the Internet and mobile phones. That's why solutions for many of our problems are literally around the corner."

Giro gave the concluding remarks. He praised the Trieste system for its international impact and he confirmed the Italian government's commitment to support TWAS and Trieste's other international scientific institutes. ■



PROTECTING RICE, PROTECTING PEOPLE

Rice is a staple for half the world population, but also a major source of arsenic in food. 2013 TWAS Prize Winner Zhu Yong-Guan is combining multiple strategies to obtain safe rice for all.

 by Cristina Serra

Rice feeds half of the world population: It is nutrient-dense and a good source of energy. Arsenic is a chemical element naturally occurring in water and soil, but it is also released by human activities such as mining and coal-burning.

Unfortunately, rice and arsenic establish a dangerous relationship. Arsenic pollutes the soil and becomes easily available to rice, and rice absorbs large amounts of this pollutant through the roots, storing it in its grains.

Zhu Yong-Guan, a professor of environmental sciences at the Institute of Urban Environment at the Chinese Academy of Sciences (CAS) in Beijing, is studying the biochemical pathways that bring arsenic into rice tissues. His aim is to avoid such storage and make healthier, safer rice for consumers.

“Arsenic in food, and particularly in rice, poses health risks to global population, equal to if not more than arsenic intake from water”, points out Zhu, who presented his research at the 25th TWAS General Meeting in Oman.

Zhu is also a 2013 TWAS Prize Winner in Agricultural Sciences, and an influential voice in arsenic pollution worldwide. A member of CAS, he holds a PhD in environmental science from the Imperial College in London. He is now focusing on the biogeochemical mechanisms that make rice a dominant source of inorganic (and toxic) arsenic to people.



▲ Zhu Yong-Guan

▼ From left: a sampling of rice grains [Photo: IRRI Images]; asian rice. [Photo: Jeevan Jose/ Wikimedia Commons]

SERIAL ACCUMULATOR

Rice is a very efficient accumulator of metals and nutrients from the soil, and silicon is one element that rice needs to grow and overcome physical and chemical stress.

Unfortunately, one of the chemical forms that arsenic takes in the soil closely resembles silicon, and rice makes little distinction between the two.

“On average, Chinese people eat around 200 grammes of rice per day”, observes Zhu. “And even if the amount of arsenic that people take in through their diet is not lethal, it may have severe effects on the human metabolism.”

Growing evidence suggests that short-term exposure to arsenic triggers gastrointestinal problems, and lesions of hands and feet. When ingested through food, it increases the risk of skin, bladder and kidney cancer.





“We need to look for effective measures to avoid massive exposure to arsenic”

Zhu Yong-Guan

▲ Cambodian farmers planting rice. (Brad Collis/Wikimedia Commons)

“We need to look for effective measures to avoid massive exposure to arsenic”, observes Zhu. “The good news is that we have several weapons available.”

COMBINING STRATEGIES

Keeping arsenic out of rice is not easy. It enters through the roots, ascends the plant and gets embedded in shoots, leaves and grains. The husk and the bran, the two outer layers of rice grains, are especially prone to accumulating arsenic.

Due to complex interactions occurring within the plant-soil-environmental microbes system, integrated approaches are needed.

One strategy encourages farmers to use silicon fertilisers, which are less aggressive and reduce the arsenic uptake by competing with this substance. A second option is growing rice under non-flooding conditions, where arsenic is less bioavailable.

But Zhu and colleagues have better targets. One is to coax the activity of microbes that live in the rhizosphere (a narrow region of soil

influenced by root secretions and soil microbes), forcing them to shield rice from arsenic.

Zhu explains that in the DNA of soil microbes sits a gene that codes for a protein (an enzyme called methyltransferase) that adds a chemical group to specific molecules, thus converting inorganic arsenic into a less dangerous organic molecule.

“We can stimulate the microbial activity by feeding soil bacteria with organic matter to make them more active, in turn boosting the protein activity. Or we can use genetic engineering and add more copies of the same gene inside bacteria. In doing so, microbes produce larger amounts of the same protein from multiple genes”, he adds.

Working in close collaboration with chemists, biologists and soil engineers from the US (Barry Rosen) and UK (Andy Meharg), Zhu’s team came up with another modification on the rice plant itself.

They genetically modified the rice genome by inserting a gene from a bacterium called *Rhodopseudomonas palustris*. The resulting transgenic plants are able to transform arsenic into a volatile gas, thus reducing the amount of toxic compound inside the tissues.

FUTURE PLANS

A parallel project Zhu is expanding targets iron in the soil. “We are studying how to use another group of soil bacteria that trigger the oxidation of ferrous iron, resulting in the precipitation of iron oxides in the soil and on rice roots. Iron oxides, in turn, sequester arsenic from soil solution acting as a shield, thus preventing arsenic from entering the roots”, he says.

Which of these strategies holds promise in clearing arsenic from rice? “The more we learn about arsenic and rice,” Zhu concludes, “the more we realize that the rice-soil-bacteria system is way too complex, thus requiring multidisciplinary approaches.”

Finding ways to solve this problem is becoming more urgent: Women are subjected to arsenic exposure also during pregnancy, and children who consume rice regularly have increased concentrations of arsenic in their urine. Says Zhu: “Protecting them means protecting our future.” ■



REVEALING THE SECRETS OF MONSOONS

An international team of scientists explored new research on the important Asian storms at a workshop sponsored by the Chinese Academy of Sciences and TWAS.

BEIJING –The annual cycle of monsoon storms have for millennia shaped Asia’s culture and economy. In good years, the monsoons soak farm fields and replenish water systems. In bad years, crippling storms wipe out crops, destroy villages and wreak economic havoc. And in the absence of monsoons, there can be deep droughts.

At a workshop sponsored by the Chinese Academy of Sciences [CAS] and TWAS, young scientists from 10 nations heard the latest research into monsoon dynamics and their impacts. And they learned of new forecasting methods that may aid farmers and disaster readiness efforts throughout much of Asia.

In China, India, Thailand and other countries of Southeast Asia, the economy is heavily dependent on agriculture, and agriculture is heavily dependent on the monsoon. Today, however, climate change and other factors may be changing monsoon dynamics. The impacts are uncertain, but they could be felt by up to 60% of the world’s population.

“If flooding occurs, or drought occurs, it’s very serious and very dangerous”, said Bueh Cholaw, deputy director of the CAS-TWAS Centre of Excellence for Climate and Environment Sciences [ICES]. “It can destroy 10% of the gross domestic product of an entire country. That’s why so many young people in developing countries are interested in monsoon science.”

The eight-day “ICES International Training Workshop on Asian Monsoon Variability and Predictability” was held in Beijing from 7 to 15 July 2014. More than 30 young scientists and advanced science students heard presentations from scientists from China and the United States, and a number of them presented their own research at the workshop. They also visited laboratories operated by ICES and the CAS Institute of Atmospheric Physics [IAP], which hosts the Centre, and the University of Chinese Academy of Sciences. ICES is one of five CAS-TWAS Centres of Excellence that received new CAS investments in 2013.

ADVANCING SCIENCE, BUILDING COOPERATION

“With training like this, we can address common challenges more effectively”, said Cao Jinghua, deputy director general of the CAS Bureau of International Cooperation. “CAS emphasizes cooperation with developing countries, and we



▲ A flood in Bangladesh (Photo: UK Department for International Development (Rafiqur Rahman Raqu)

▼ From left: Bueh Cholaw, Xue Feng and D.M. Hasanthie Sandarekha Dissanayake,





“With training like this, we can address common challenges more effectively.”

Bueh Cholaw

believe that by working together here, we'll be able to sow the seeds of friendship for future cooperation.”

“At events like this, you can strengthen your scientific knowledge and build your career”, Edward Lempinen, the TWAS public information officer, told the participants. “But you have a responsibility to share this knowledge. When you go home, share it at your universities and institutes, with your colleagues and your students. That way, they become stronger.”

The workshop opening also was attended by IAP Director General Zhu Jiang; ICCES Director Lin Zhaohui; and Xiao Ziniu, deputy director of the China Meteorological Administration Training Centre.

Learn more:
<http://twas.org/node/6387>

INNOVATIONS IN MONSOON SCIENCE

In basic terms, a monsoon is a large-scale change in the prevailing wind that shifts with the season – usually spring and autumn – bringing changes in rainfall and temperature. In winter, there is a contrast between the warm ocean and the cold land, so the wind comes from the north. In the summer, it's the reverse. The summer monsoon is often associated with heavy rains and sometimes destructive storms.

Research by Xue Feng and colleagues found that the monsoon's source is deep in the Southern Hemisphere. The interplay of low-pressure atmospheric conditions in Antarctica sends air flowing north to engage with high-pressure systems over Australia and along the eastern coast of Africa. That circulates air across to South and Southeast Asia, where it takes shape as a monsoon.

But there are factors that can temper or amplify the pattern. For example, heavy snow in the Tibetan plateau can reduce the contrast in land-ocean temperatures, Xue said.

From year to year, there can be tremendous variability, and the monsoon itself may be changing because of climate change. “In a warming climate, the water temperature is also increasing”, said Bueh. “So atmospheric energy is also increasing. With increased warming, the variability of the Asian monsoon becomes stronger and stronger.

“This is why people in developing countries and Asian countries are more and more concerned about climate change.”

For the young scientists attending the course, the scientific insights that came during the workshop offered practical benefits.

D.M. Hasanthie Sandarekha Dissanayake works at the Industrial Technology Institute in Sri Lanka. Climate change is a priority area in Sri Lankan science policy, and her institute is opening a climate research unit.

The experienced and expert scientists at the workshop “are very helpful, and we can have collaborations with them”, she said. “This is a good chance to build relationships – that will be very helpful to the efforts in our country.” ■



CAS-TWAS CENTRES: EXCELLENCE ON FILM

by Edward W. Lempinen

A new film shows the excitement of young scientists who come to five Beijing-based centres of excellence to work on critical global challenges.

They are young scientists from Kenya, Pakistan and Thailand, and they are focused on improving conditions in their countries by conducting research in areas such as satellite monitoring of farmland, water sanitation and climate modelling.

But they have one thing in common: As scientists from the developing world, they were in Beijing for extended research at one of five centres of excellence organized by the Chinese Academy of Sciences [CAS] and The World Academy of Sciences [TWAS].

The young scientists, and the five CAS-TWAS Centres of Excellence, are

the focus of a new film released by the two academies and posted on the TWAS website and its YouTube channel. The 10-minute film captures the centres' role as global centres of research, and the scientists' excitement to work with world-class faculty in sophisticated labs focused on high-priority human challenges.

"Science holds the promise of solutions, but many developing countries lack scientific and engineering resources", says Bai Chunli, the president of CAS and TWAS, to open the film. "TWAS and the Chinese Academy of Sciences are working together to change that... The Centres are serving as a powerful arm of TWAS in achieving its missions."

In mid-2013, CAS invested USD6.5 million in five existing centres of

◀ Oriola Olasunkanmi Bukola of Nigeria working in a lab at the Centre of Excellence for Biotechnology.

excellence in an effort to add staff and upgrade facilities, and to position them as hubs of high-impact research and training, especially for scientists from the developing world. Since then, hundreds of scientists have visited for programmes ranging from week-long workshops and extended training courses to four-year PhD studies, all with a focus on key challenges and areas of practical need.

The five centres are:

- **The CAS-TWAS Centre of Excellence for Green Technology** (CEGT), based at the CAS Institute of Process Engineering;
- **The CAS-TWAS Centre of Excellence for Biotechnology** (CoEBio), based at the CAS Institute of Microbiology;
- **The CAS-TWAS Centre of Excellence for Climate and Environment Sciences** (ICCES), hosted by the CAS Institute of Atmospheric Physics;
- **The CAS-TWAS Centre of Excellence on Space Science for Disaster Mitigation** (SDIM), hosted at the CAS Institute of Remote Sensing and Digital Earth; and
- **The CAS-TWAS Centre of Excellence for Water and Environment** (CEWE), based at the CAS Research Centre for Eco-Environmental Sciences.

The film was written and produced by Nicole Leghissa, a filmmaker from Trieste, Italy, where TWAS is headquartered. Leghissa also produced *Seeds of Science*, a 2013 documentary about the close links between TWAS, Trieste and four scientists in Kenya who work to increase food production and clean water supplies. ■

See the film on the TWAS website: www.twas.org/node/8714
Or see it on the CAS English-language site: <http://bit.ly/188vqwj>

INGRID DAUBECHIES: A PASSION FOR MATHS

 by Cristina Serra

The beauty of maths, says the influential scholar, is its power to solve problems. She uses it to analyse art, to build the strength of developing nations – and to open doors for women.

Even when she was a young girl in Belgium, it was clear that Ingrid Daubechies had a special talent for maths. Before the age of 6, she was already familiar with complex mathematical concepts, and when she couldn't sleep she did not count numbers as others do, but instead mentally computed powers of 2.

Today, she uses maths in fields that would seem a world away from numbers and equations: She creates mathematical algorithms and applies them to spot art forgeries, or to analyse painting cracks and relieve professional art renovators from a tedious part of their work.

But in her just-completed term as president of the International Mathematical Union, it was a priority to build global mathematics networks that included developing nations. And her work served as a powerful counterargument to the too-common assumption that when it comes to maths, women are less skilled than men.

"I disagree with this view *completely*", she said in a recent interview. "There

is a highly variable percentage of women in academia and in departments of mathematics across Europe. Differences are so enormous that it becomes obvious that it has something to do with cultural habits, which differ from one nation to another, and not with intelligence."

Daubechies is a professor at Duke University in North Carolina [USA]. During her scientific career she worked at Vrije University in Belgium, and in the United States at Rutgers and Princeton universities. She earned an international reputation for her discoveries in the field of wavelets, the mathematical functions used in digital signal processing and image compression, and in other branches of applied and pure mathematics.

She visited Trieste in 2014, during the 2 to 21 June joint ICTP-TWAS School on Coherent State Transforms, Time-Frequency and Time-Scale Analysis, Applications, for which she also served as co-director. Speaking of TWAS, she praised the Academy's work for developing countries, especially with its fellowships programmes.

Daubechies was the first woman to be appointed as the IMU president. Her nomination for the post,

she said, reflected her commitment for building networks.

"Many mathematicians believe mathematical talent is distributed more or less uniformly around the globe," she explained, "and the IMU cares about education in developing countries. This is not just about spotting extremely rare top geniuses, but also about fostering the growth of strong, healthy maths communities that interact productively with the whole mathematics world. Raising awareness about and trying to remediate the scarce number of women in mathematics is, to me, part of that whole package."

In her view, maths is highly important for developing countries. "It has a great appeal because it is so neat", she said. "You literally solve problems and build approaches by just the power of thought." ▣

[Read the full interview with Ingrid Daubechies: www.twas.org/node/6420/](http://www.twas.org/node/6420/)



► Ingrid Daubechies



PEOPLE, PLACES & EVENTS

MURENZI CHAIRS HIGH-LEVEL PANEL

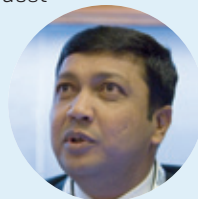
Five TWAS fellows have been named to a high-level 10-member United Nations panel that will study how a technology bank could help the world's poorest countries achieve development. TWAS Executive Director **Romain Murenzi** will chair the panel. The nominations came from United Nations Secretary-General Ban Ki-moon. The panel will draft recommendations on the "Technology Bank and Science, Technology and Innovation Supporting Mechanism". The bank would be a repository for scientific information and a tool to link developing world innovators with resources such as funding, legal support and patent licensing.



Among its members are TWAS Fellows **Fang Xin** of China [2010], who also serves as president of the Organization for Women in Science for the Developing World [OWSD]; TWAS Treasurer **Mohamed H.A. Hassan** of Sudan [1985], co-chair of IAP, the global network of science academies; **Tebello Nyokong** [2009], distinguished professor of chemistry and nanotechnology at Rhodes University, South Africa; and biochemist **Firdausi Qadri** [2011], director of the Centre for Vaccine Sciences at the International Centre for Diarrhoeal Disease Research in Bangladesh. The bank could include a system to help Least Developed Countries negotiate access to intellectual property rights and provide their researchers with better access to scientific literature.

ELITE EDUCATION FOR ALL

TWAS Fellows **Atta-ur-Rahman** [top photo] and **Muhammad Iqbal Choudhary** have established a new website that features classes from some of world's top universities. The LEJ [Latif Ebrahim Jamal] Knowledge Hub website offers video-recorded classes from Harvard, Yale, Stanford, MIT, the Virtual University of Pakistan and online lessons from the popular website Khan Academy. The aim of the Pakistani scholars is to offer students in the developing world instructive programmes that cross geographic boundaries. At the LEJ Hub, they can access basic courses as well as university lessons; students with poor Internet connections or no web access may request DVDs of course videos. In addition, for a small fee they can contact a mentor for help and suggestions.



Rahman is president of the Network of Academies of Science in Countries of the Organization of Islamic Conference and past president of the Pakistan Academy of Sciences. Choudhary is director of the International Centre for Chemical and Biological Sciences in Karachi, Pakistan.

To learn more: www.lej4learning.com.pk

EGYPT APPOINTS EL-BELTAGY AS AGRICULTURE MINISTER

Adel E.T. El-Beltagy, a TWAS Fellow [2005] and TWAS Council member, is the new Minister of Agriculture and Land Reclamation in Egypt.

El-Beltagy is a distinguished agricultural biologist with expertise in dry land agriculture, plant stress and research for development. He is the former director general of the International Center for Agricultural Research in the Dry Areas [ICARDA], and the former president of Egypt's Agricultural Research Center. In addition, he has been an under-secretary of the ministry he now leads. In his new role, El-Beltagy is expected to develop new policies on agriculture, animal husbandry, fisheries and land reclamation. Among his duties are the study of food development, fish production and industrialization.



El-Beltagy also serves as a scientist and professor in Ain Shans University, where he helped establish the Genetic Engineering Research Institute. He is a board member of *Bibliotheca Alexandrina*, a major cultural center in Alexandria, Egypt, that hosts the TWAS Arab Regional Office.

YUTHAVONG NAMED DEPUTY PRIME MINISTER

Yongyuth Yuthavong, TWAS's vice president for East and Southeast Asia, has been named deputy prime minister of Thailand. Yuthavong will address social affairs including science and technology, social development, education and health.



Yuthavong is an accomplished scientist whose major interests are cell and molecular biology. He is also

EARLIER DEADLINE FOR TWAS RESEARCH GRANTS

Beginning in 2015, TWAS’s globally respected research grants programme has a new, earlier application deadline: 1 June. The advanced deadline was set to speed up the selection process and ease administration of the programme. Every year, TWAS awards about USD1.9 million in grants for specialized equipment and consumable supplies and for scientific literature. Grants are available both for individual researchers and for research groups. The grants are funded by the Swedish International Development Cooperation Agency (SIDA) and COMSTech, based in Pakistan. For more information, visit www.twas.org/opportunities/research-grants.

involved in the application of science and technology for development and in human development. After graduating from the University of London in 1966, he obtained a PhD in organic chemistry from Oxford University in 1969. He was appointed professor of biochemistry at Mahidol University, Thailand, in 1983. From 1985 to 1991, he served as the director of the National Centre for Genetic Engineering and Biotechnology (BIOTEC), Thailand.

MAJOR SRI LANKA AWARD TO MOHAN MUNASINGHE

TWAS Fellow **Mohan Munasinghe**, the founder and chairman of the Munasinghe Institute for Development (MIND) in Sri Lanka, has been awarded the “Eminence in Engineering”, the highest prize bestowed by the nation’s Institute of Engineers. He was honoured for exceptional contributions to the profession and to sustainable development in Sri Lanka and worldwide. Tissa Vitarana, the senior minister for scientific affairs, awarded the prize during the 2014 Excellence in Engineering Awards ceremony held by the Institute, which is the highest



engineering body in Sri Lanka. Munasinghe, who shared the 2007 Nobel Prize for Peace, is Colombo and KIVA Guest Professor of Sustainable Development at Darmstadt University, Germany, and the author of some 100 scientific books and more than 350 scientific papers.

GUO LEI HONOURED IN STOCKHOLM

Guo Lei, director of the National Centre for Mathematics and Interdisciplinary Sciences at the Chinese Academy of Sciences, received an honorary doctorate degree from Sweden’s KTH Royal Institute of Technology in a November 2014 ceremony at Stockholm Concert Hall. Guo is a TWAS Fellow [2002], a fellow of the International Federation of Automatic Control, and a foreign member of the Royal Swedish Academy of Engineering Sciences. He also serves as vice-secretary general of the Committee of the National People’s Congress. Guo is an expert on systems analysis and control engineering. His work has addressed a variety of related topics such as adaptive control, system identification, adaptive signal processing, and stochastic systems. His current research interests include



the capability of feedback, multi-agent systems, complex adaptive systems, and quantum control systems, among others.

IN MEMORIAM: PATRICIA BERJAK

Patricia Berjak, a TWAS Fellow [2004] and the vice-president of the Academy of Science of South Africa, passed away on 21 January 2015. Berjak was professor emeritus and head of the Centre for Plant Germplasm Conservation Research, at the University of KwaZulu-Natal [Durban, South Africa], where she served in many capacities for over 48 years.



She served the International Society for Seed Science as president-elect from 2005 to 2008 and as president from 2008 until 2011. In addition, she was a Fellow of the Royal Society of South Africa.

During her career, Berjak specialized in seed biology with a focus on recalcitrant seeds, or seeds that do not survive drying and freezing when stored outside their natural habitat. In 2004, she received the Department of Science and Technology’s Distinguished Woman Scientist Award for her contributions to science, and the Order of Mapungubwe [Silver], the highest honour granted by the president of South Africa [2006].

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IN SCIENCE DIPLOMACY, A SEARCH FOR SOLUTIONS

Abeer Ahmed Qaed Ahmed is still in the early years of her career, but already her accomplishments are impressive. She grew up in Yemen, one of the world's Least Developed Countries. With support from her father and mother, she pursued studies in science. After winning a PhD Fellowship from the Organization for Women in Science for the Developing World (OWSD), she became the first foreign PhD graduate at the Chinese Academy of Sciences. Her PhD work focused on environmental sciences, enzymatic engineering and biotechnology.

Today, Ahmed is back in Yemen, where she serves as head of the Pharmacy Department and a research group director at Al Saeed University in Taiz. The country is torn by conflict. One colleague recently was shot dead just out the university.

In June 2014, Ahmed attended a science diplomacy course offered by TWAS and the American Association for the Advancement of Science. After the final session, she talked with Edward Lempinen, the TWAS public information officer, about the extraordinary journey that brought her to Trieste.

Because I am an OWSD graduate, and because TWAS has provided support to me for workshops, I like to look at the TWAS website to see news about upcoming events. When I saw a notice for this science diplomacy course, I didn't know this idea or the background. I really wanted to understand more. I applied, and I was accepted. I talked to the president of my university, and he was so supportive.

But I had great difficulties getting the visa. Because there is political instability in my country, all the embassies are closed. And this is affecting not just me, but other scientists and students who want to study abroad. But I wanted to understand: What is science diplomacy? How could I contribute in this regard?

And so I travelled to Saudi Arabia to get the visa there, and the process took me 10 days. Yes, a lot of time. It was

hard to be away from my department; every day I called to find out what was happening, and what did my students need.

Finally, the people at the Italian embassy told me: We can give you the visa Thursday at 3:30 in the afternoon. So that day I was in the embassy waiting from 11 in the morning, waiting, thinking, "Now it will come. At 3:40, they handed me the visa, and I rushed out to see if I could get a flight.

There was no flight on Thursday. And on Friday there was no flight. Also on Saturday there was no flight. So, I thought, my only option is to take the bus, even if it's a long way [almost 1,700 kilometres]. Finally I reached home on Saturday at 3 a.m. I had time only to put stuff in my luggage and rush to the airport. My flight was at 8 a.m. to go from Taiz to Sana'a, and then from Sana'a to Jordan, and from Jordan to Rome, and from Rome to Trieste.



▲ Abeer Ahmed Qaed Ahmed

I have no regret about this. Even when you're so tired because you travelled so far, you succeeded in your mission. My mission was to understand what science diplomacy is and how I can contribute. I learned so much here, and I think that when I go back, I can now do so much. You know, I am really excited.

Science diplomacy can play major roles between two or more countries and nations. It can even play a major role between two different areas in the same country... I know my people. They respect scientists. If a scientist came to talk with them, they would respect and understand.

Attending this workshop has changed my way of thinking as a scientist. Now, I understand that as a scientist I can make a difference in the world by science and also by diplomacy. ▣



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A donation to TWAS directly contributes to the advancement of science, engineering and technology in developing nations.

To make a contribution: www.twas.org/support-twas



The World Academy of Sciences for the advancement of science in developing countries – TWAS – works to advance 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 nearly 1,150 elected Fellows from some 90 countries; 15 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, TWAS'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 nearly 500 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 USD1.9 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 three 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 4,000 members. Their objective is to strengthen the role of women in the development process and promote their representation in scientific and technological leadership.

IAP, the global network of science academies. Established in 1993 as the 'InterAcademy Panel on international issues', IAP unites more than 100 science academies worldwide. It 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.

The InterAcademy Medical Panel (IAMP). IAMP is a network of the world's medical academies and medical sections of academies of science and engineering. It is committed to improving human health worldwide through the coordinated global action of its 73 members.

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