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TWAS newsletter

NEWSLETTER OF THE ACADEMY OF SCIENCES FOR THE DEVELOPING WORLD

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WELCOME TO THIS SPECIAL CONFERENCE EDITION OF THE TWAS NEWSLETTER.

Every three years, in conjunction with the annual General Meeting of its members, TWAS convenes a General Conference in a developing country to review the status and future prospects of science and technology in the South. TWAS members, ministers of science and technology, presidents of science academies and research councils as well as representatives of international organizations from the South and the North are invited to attend.

TWAS in China

This year's 12th General Conference and 23rd General Meeting took place in Tianjin, China, very generously hosted by the Chinese Academy of Sciences and the Tianjin Municipal People's Government. More than 400 scientists from 40 countries, mainly TWAS members from developing countries, attended the event. The theme was 'Science and Sustainability'.

We were deeply honoured that the President of the People's Republic of China, Hu Jintao, travelled specially to Tianjin to present a half-hour speech to the members in a closed session in Tianjin's Great Hall. He spoke on the importance of his government's ongoing relationship with TWAS and commitment to supporting scientific research in developing countries. He then dedicated his time to congratulating each of the prize winners. This honour was greatly appreciated by all present.

The Academy's business meetings had taken place the day before, on 17 September. The new TWAS council, new TWAS members and new prize winners were elected and subsequently endorsed by TWAS members present during the General Meeting on 18 September, with General Conference presentations and lectures continuing until 21 September.

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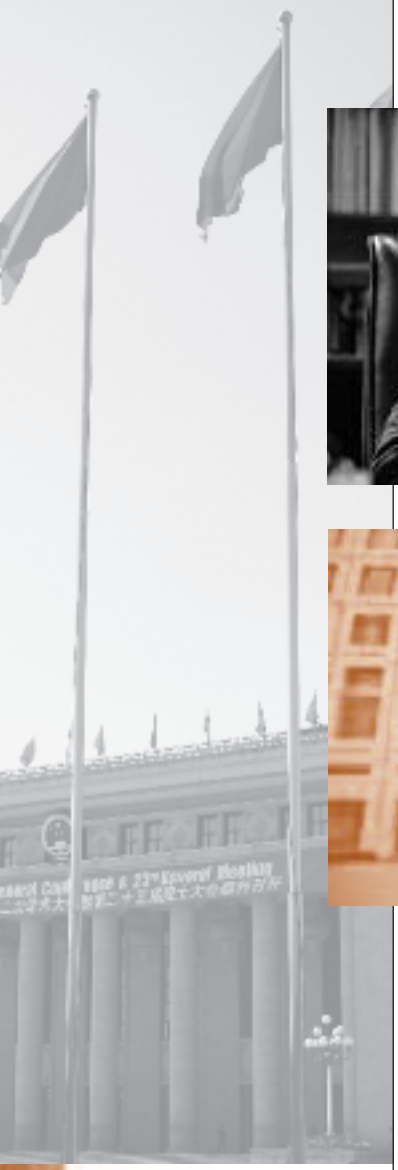


TWAS ELECTS A NEW PRESIDENT

Very important this year was the election of a new TWAS president, Chunli Bai, from China. Incumbents hold the position for three years, and can be re-elected for a second term. Jacob Palis, former director of the Instituto Nacional de Matemática Pura e Aplicada *(IMPA) in Rio de Janeiro and president of the Brazilian Academy of Sciences, has served two full terms for TWAS, from 2007-2012. I have had the great honour and pleasure of working with Jacob Palis for my first year-and-a-half in office. He is an indefatigable champion of TWAS and has done a great deal to ensure that our activities are known and respected throughout the developing world and beyond. He has also made an important contribution to our fundraising efforts. Above all, he has been an expert advisor and supportive colleague. I really wish to thank him and I know that he will continue to play an active role at TWAS, replacing C.N.R. Rao (who likewise has made immeasurable contributions to TWAS over many years) as immediate past president.*

I am delighted that TWAS members unanimously supported the election of our new president. Chunli Bai's credentials for the post could not be better: he has served as TWAS vice-president for the past six years, is currently the president of the Chinese Academy of Sciences (CAS) and is an internationally respected scientist in the field of nanotechnology research, spanning the fields of both chemistry and physics. Judging from the very smooth running and organization of our conference this year, Bai is also a formidable administrator and manager. I am excited at the prospect of working closely with him over the coming years, and continuing to strengthen our relationship with China, whose recent and rapid advancements in science and technology, coupled with the conversion of research ideas into patents and marketable products, have transformed China into a booming economy and a key player on the world stage. Chinese researchers, policymakers and business representatives clearly have a great deal of experience and expertise to offer developing and emerging countries, while developing countries represent new and receptive markets for China. It will be TWAS's privilege to provide networks and opportunities to encourage such mutually beneficial exchanges.

Meanwhile, we thank other long-standing and influential members of our council: TWAS vice-president Atta-ur-Rahman, president of the Pakistan Academy of Sciences and former coordinator general of COMSTECH, who this year has donated an annual prize in chemistry to be administered by TWAS; and Dorairajan Balasubramanian, president of the Indian Academy of Sciences, who has been a particularly active and committed TWAS secretary general.

We are grateful too, to the contributions from outgoing council members Reza Mansouri from Iran and Abdul Zakri from Malaysia.

The incoming secretary general will be Ajay Kumar Sood, also from India, a physicist and TWAS Fellow since 2001. We welcome two new vice-presidents: for East and South-East Asia, Yongyuth Yuthavong, a molecular biologist from Thailand (TWAS Fellow 1991); and for Central and South Asia, Rabia Hussain, a microbiologist from Pakistan (TWAS Fellow 2003). Hussain is the second woman to have been elected vice-president, joining Fayzah Al-Kharafi from Kuwait, who represents the Arab Region.

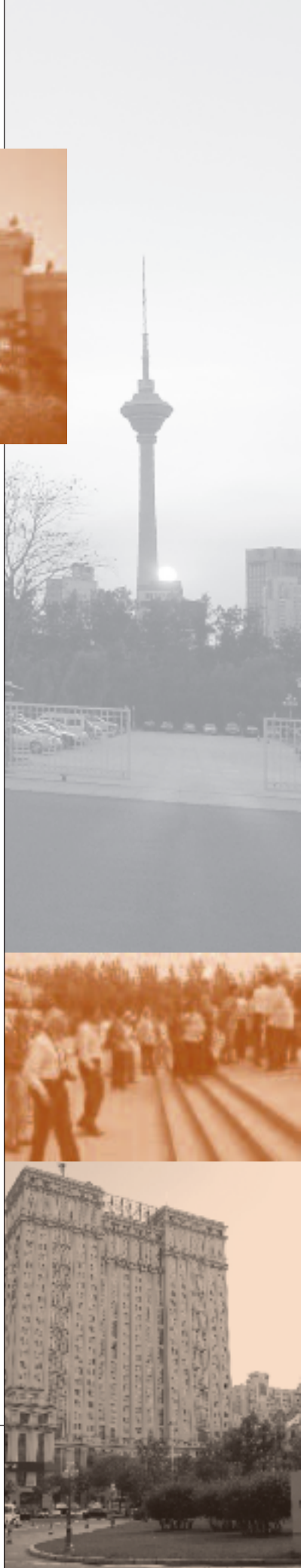
Habib Firouzabadi, a chemist at Shiraz University in Iran (TWAS Fellow 2000) and Farida Shah, a biologist from Malaysia (TWAS Fellow 2002) also take their places as new Council members. Shah is vice-president of TWAS's partner organization, the Organization for Women in Science for the Developing World (OWSD), and I am sure that her keen interest in women's participation in scientific research will ensure that the council has a balanced and inclusive gender perspective. This year saw important and necessary increases of women's representation in both the Council and membership, and this is a trend that TWAS is actively encouraging.

In addition, as director of the Abdus Salam International Centre for Theoretical Physics (ICTP), it is particularly important and fitting to have Fernando Quevedo, a physicist from Guatemala and TWAS Fellow since 2010, represented on the Council. As many of you who have visited us here in northern Italy know, ICTP has hosted our headquarters on its campus in Trieste for the past thirty years. The ex-officio *position on the Council for its director is a measure of how highly we value ICTP's past and continued collaboration and support.*

I am certain that with the continued support and goodwill of our outgoing council members, and the renewed energy and diverse perspectives that the new members will most certainly bring, TWAS will continue to be a highly respected world academy, able to adapt to global changes – be they environmental, political or economic.

I look forward to working with the Council, our membership and our partners to continue to ensure that motivated and committed scientists, especially in the poorest and least connected countries in the South, have access to the resources they need to carry out excellent research. ■

Romain Murenzi
TWAS Executive Director



TWAS MEETS IN TIANJIN

BETWEEN 17 AND 21 SEPTEMBER 2012, TWAS HELD ITS BUSINESS MEETINGS, 23RD GENERAL MEETING AND 12TH GENERAL CONFERENCE IN TIANJIN, CHINA. MORE THAN 400 SCIENTISTS FROM 40 COUNTRIES ATTENDED, MAINLY TWAS FELLOWS FROM DEVELOPING COUNTRIES. A REVIEW OF THE PROCEEDINGS FOLLOWS.

OPENING CEREMONY

For all the pomp and circumstance of the beautifully decked out Tianjin Great Hall, and the anticipation of his arrival, Hu Jintao, president of the People's Republic of China since 1993, walked calmly on to the podium, clapping quietly as he walked. He was followed by Chinese dignitaries, ministers of science and technology and presidents of national academies from 16 countries, as well as representatives of various international organizations, the TWAS president, executive director and members of the TWAS Council. The audience numbered some 2,000, as delegates to the TWAS conference were augmented by scientists from nearby research institutes. President Hu's attendance confirmed his commitment to the aims and objectives represented by this international gathering of scientists and policymakers from the developing world.

In his address, President Hu suggested that science and technology are the crowning jewels of humankind and the driving force behind human civilization. "Every step forward society takes", he argued, "has been closely connected with a revolutionary breakthrough in science and technology: from barbarism to civilization, and from poverty to prosperity."

The President then got down to business, outlining the policy decisions in S&T that have made China an increasingly powerful economy, including a mid-term plan, increased investment in research and development (R&D), and the development of major scientific programmes. China, he reminded us, is among the world leaders in a number of scientific fields, including space exploration, quantum communication and super hybrid rice.

Yet, partly as a conequence of this rapid scientific development and subsequent economic success, China



TWAS COUNCIL, 2013-2015

President: ***Bai Chunli*** *(China)*
Vice-presidents: *Africa:* ***K.E. Mshigeni*** *(Tanzania), Arab Region:* ***F.M.A. Al-Kharafi*** *(Kuwait), Central and South Asia:* ***R. Hussain*** *(Pakistan), East and Southeast Asia:* ***Y. Yuthavong*** *(Thailand), Latin America and Caribbean:* ***F.J. Barrantes*** *(Argentina)*
Secretary General: ***A.K. Sood*** *(India)*
Treasurer: ***M.H.A. Hassan*** *(Sudan)*
Council Members: *Africa:* ***R. Crewe*** *(South Africa), Arab Region:* ***A.E.T. El-Beltagy*** *(Egypt), Central and South Asia:* ***H. Firouzabadi*** *(Iran), East and Southeast Asia:* ***F.H. Shah*** *(Malaysia), Latin America and Caribbean:* ***H. Ramkissoon*** *(Trinidad & Tobago)*
Ex-officio Council Member: ***F. Quevedo*** *(Guatemala) [Director, ICTP]*

still faces pressing issues and challenges. The country's 1.3 billion people put increasing demands on agriculture and food supplies, whereas limited resources alongside the desire for a healthy environment mean that uncoordinated and unsustainable development are no longer acceptable – or even possible. President Hu warned that there are challenges especially in terms of food security, energy security and climate change, but he was confident that science and technology, especially when linked to innovation, could help to overcome these challenges. He cited China's recent advancements in three areas of technology: information, energy and bio- technology, which have helped make people's lives "healthier and happier", he said.

President Hu also emphasized China's commitment to international scientific collaboration, especially between developing countries, an issue central to the objectives of TWAS. In fact the President, who also opened TWAS's previous General Conference in China in 2003 shortly after taking up his post, confirmed his appreciation of TWAS's role in supporting science in the South by announcing a USD1.5 million contribution to the Academy from the government of China.

President Hu then bestowed a great honour on TWAS prize winners by participating in the award ceremony, shaking each of the award winner's hands as they collected their certificates and medals.

TWAS PARTNERS

Sharing the podium with the ministers were some key TWAS partners, whose longstanding support for TWAS has enabled the organization to develop scientific activities and programmes in the South that have really had an impact on countries lagging in science and technology expertise.

There is no better indication of the close cooperation between China and the developing world than that between the Chinese scientific community and TWAS.

Chunli Bai, as host and president of CAS, chaired the opening session, stating that "there is no better indication of the close cooperation between China and the developing world than that between the Chinese scientific community and TWAS."

Long-term donors also spoke of their continuing support for the Academy. Since its very beginning, TWAS has benefitted from an annual financial contribution provided by the Italian government. Immacolata Pannone, representative of the Italian Ministry of Foreign Affairs, was keen to confirm that "the stability that the Italian government's contribution gives to TWAS, together with TWAS's high profile in the developing world, and the support of other generous sponsors, have enabled the Academy to partner with other international scientific organizations and bring them to Trieste, to share the building and facilities. These partners are: IAP, the global network of science academies; the InterAcademy Medical Panel (IAMP); and the Organization for Women in Science for the Developing World (OWSD)."

Gretchen Kalonji, UNESCO's assistant director-general for Natural Sciences, also praised TWAS. "With its unique mandate and well-merited prestige, it has become an important member of the family of international scientific organizations, as well as a valuable partner in the transfer of S&T and the reduction of the gap between developing and industrialized countries." Kalonji underlined and reaffirmed the importance to UNESCO of this long-term support: "As a great platform for relationship building, knowledge sharing and information exchange among leading scientists from the

developing world, TWAS represents a privileged partner for UNESCO. There has always been a strong convergence between TWAS's goals and those of UNESCO in building up science in the developing world. There can be no doubt that UNESCO and TWAS's ability to work together cooperatively has proved to be a powerful tool of synergy with positive results."

AnnaKarin Jonsson Norling, representing the Swedish International Development Cooperation Agency (Sida) told participants that it was inspiring to be in Tianjin since there was a strong tradition of research cooperation between China and Sweden: 29 out of 30 Swedish universities have formalized contacts with China and more than 150 agreements between Chinese and Swedish universities and research institutions are in place. However, Norling added, it was clear that China was not simply turning to the developed world for help and collaboration, but was also using its experience in science for development in cooperation with low-income countries, realizing that research cooperation can be a win-win situation even if the conditions for research differ. Norling suggested that an excellent example of this was the TWAS-CAS Fellowship Programme for postgraduate and postdoctoral researchers in China "which provides wonderful opportunities for young as well as established researchers from developing countries." In addition, since 1993, Sida and TWAS, through the TWAS Research Grants Programme, have had an extremely successful collaboration, with the aim of strengthening the basic sciences in low-income countries and focusing on sub-Saharan Africa. Around 20 small research groups and 20 individuals receive funding each year. Norling added, "I am very happy that from 2012 we have a new agreement between the two organizations, with an expanded and even stronger cooperation for the next five years. The amount of each grant for individuals and research groups is increased and a new grant for research consortia is included. The research groups and consortia can also request funds for a Master's student, identified by TWAS as urgently needed to boost the number of researchers in low income countries."

There has always been a strong convergence between TWAS's goals and those of UNESCO in building up science in the developing world.

MINISTRIES AND ACADEMIES

Following on from the official opening ceremony and presentation of the TWAS awards, a ministerial session on 'Science, Technology and Innovation for Economic Growth and Poverty' was held. Ministers of science and technology from Brazil, China, India, Nigeria and Zimbabwe attended, with Argentina, Ecuador, Rwanda and South Africa also represented.

A special 'Forum on National Academies and Open Innovation' followed, with invited speakers from




NEW NAME, SAME ACRONYM

Following a proposal from the TWAS Policy Development and Future Action Committee to the TWAS Council, members present during the TWAS 23rd General Meeting agreed to change the name of the Academy from 'TWAS, the academy of sciences for the developing world', to 'The World Academy of Sciences for the advancement of science in developing countries'. While retaining the acronym 'TWAS', the new name, which still needs to enter into the Academy's statutes, is designed to highlight the new global situation, reflecting the rise in political and economic influence of such countries as Brazil, China, and India, as well as the fact that the majority of the world's population lives and works in the South. Indeed, there will be no change to TWAS's membership categories, or the proportion of Associate Fellows (who live and work in the North), which remains limited to no more than 20% of the total.

Argentina, Australia, Brazil, China, Germany, India, Nigeria, Senegal, South Africa and the United Kingdom.

NEW PRESIDENT

Coming to the end of his six-year term as TWAS president, Jacob Palis opened the General Meeting by welcoming participants and immediately organized the ballot for the new president of TWAS. Chunli Bai, president of the Chinese Academy of Sciences was unanimously elected by members and will take up office in January 2013. Palis told the meeting that Bai had "already contributed a great deal to TWAS as vice-president over the past six years". Palis reminded members too, that the very first TWAS event to be held outside its headquarters in Trieste, Italy, took place in Beijing in 1987 when "participants were able to see first-hand China's ongoing efforts to build scientific capacity and apply that capacity to its economic development goals." A second meeting took place in Beijing in 2003, also hosted by the Chinese Academy of Sciences (CAS).

"This is in fact our third meeting to be held in China", Palis continued. "No other country has hosted so many TWAS meetings and this reflects the strength of the relationship that has existed historically between China and TWAS, which is set to grow even stronger."

NEW MEMBERS

At each year's General Meeting, members of the Academy elected the previous year are inducted during a special ceremony, where each member is awarded a certificate and signs his or her name in a special book. In 2012, TWAS elected 49 new members (45 Fellows and four Associate Fellows), including five women. These members will be welcomed into the Academy next year. The current membership now stands at 1,074.

TWAS is particularly pleased to report that new members have been elected from countries that are under-represented in the Academy, including Jamaica and Argentina. Eight new members come from the African continent: Ethiopia (1), Uganda (1), Egypt (2),

TWAS Young Affiliates are invited to attend TWAS's annual meetings and general conferences.

Kenya (1), Nigeria (2) and South Africa (1). Other new members are from China (16), India (9), Brazil (7), and Taiwan, China (3). The four Associate Fellows, including one woman, have been elected from Japan, the Netherlands, and the USA.

YOUNG AFFILIATES

In 2011, 23 young scientists were selected as Young Affiliates, and 19 of these travelled to Tianjin to attend their first TWAS conference, receive their certificates during the induction ceremony and later, present their research work.

Each year, the TWAS Regional Offices nominate up to five outstanding young scientists from their region. During their five-year tenure, TWAS Young Affiliates are invited to attend all TWAS General Meetings and General Conferences as observers. This can mean travelling to five different countries, often on five different continents, and benefiting from the exceptional networking opportunities such meetings provide.

The Young Affiliates sessions are attended by TWAS members who give support, suggestions and further contacts. Presentations this year were in the fields of medicine, chemistry, earth sciences, molecular biology, astrophysics and mathematics. Especially encouraging were the clarity and confidence with which many of the presenters spoke, and their efforts to present their work in a visually interesting and appropriate way.

PRIZES

TWAS General Meetings are an opportunity for the Academy to award a series of prizes and medals to the many excellent scientists from developing countries who have been nominated and selected by expert juries.

The Academy's most prestigious prize, awarded in recognition of a lifetime dedicated to excellent science in developing countries, is the Ernesto Illy Trieste Science Prize, worth USD100,000, which was this year awarded to Yuk Ming Dennis Lo from Hong Kong (see pages 16–21).

Well known to TWAS Fellows, Mohamed Hassan, former executive director of TWAS, received the Abdus Salam Medal for his outstanding contributions to the cause of science in developing countries. Hassan's presentation of the 26 years he spent at the helm of TWAS was very well received by participants and will feature in the next Newsletter. Hassan continues to be very active in promoting TWAS around the world, has been treasurer of the organization for the past three years, and is currently chair of TWAS's partner organization IAP, the global network of science academies.

TWAS Prize winners from 2011 received their awards and presented lectures on their research, which ranged from practical applications that have a direct and clear impact on developing economies, such as agricultural innovations to enhance food security and sustainability in Africa, or improvements in mobile telephone communications, but also included fundamental and excellent work undertaken in the basic sciences, such as contributions to non-linear fractional elliptic equations.

During the business meetings, the winners of the 2012 TWAS Prizes were selected and subsequently announced at the General Meeting. Awarded annually, these prizes, worth USD15,000, rank among the highest scientific accolades given to scientists in developing countries. The winners, who will be invited to next year's TWAS General Meeting in Argentina to receive their awards and present their work, were: in Agricultural Sciences, Jun Yu (China) and Dilfuza Egamberdieva (Uzbekistan); in Biology, Ann Shyn Chiang (Taiwan, China); in Chemistry, Xiao Ming Chen (China) and Swapan K. Pati (India); in Earth Sciences, Patrick George Erikkson (South Africa); in Engineering Sciences, Abdul Latif Ahmad (Malaysia) and Kalyanmoy Deb (India); in Mathematics, Fernando Codá Marques (Brazil); in Medical Sciences, Quarraisha

ARGENTINA AWAITS

Roberto Salvarezza, Consejo Nacional de Investigaciones Científicas y Técnicas *(CONICET), Argentina, announced during the conference that the TWAS 24th General Meeting will be hosted by the* Ministerio de Ciencia, Tecnología e Innovación Productiva *and CONICET in Buenos Aires, Argentina. The dates have now been confirmed as 30 September–4 October 2013.*



Abdool Karim (South Africa) and George Gao (China); and in Physics, Juan Pablo Paz (Argentina).

This year's conference also saw the announcement of the first ever winner of a new social science prize, donated by the Brazilian government in honour of Celso Furtado, a Brazilian economist whose research arguably contributed to putting Brazil in the strong economic position it is today. The TWAS-Celso Furtado prize – awarded to Ricardo Paes de Barros from Brazil – also underlines the Academy's commitment to honouring and including social scientists as key partners in order to ensure that scientific research and science policy are appropriately and effectively implemented in developing countries.

The C.N.R. Rao Prize, which from 2012 is being awarded annually, carries an award of USD5,000, and brings to the public stage those scientists from developing countries who have made significant contributions to global science. This year's recipient of the prize, Wendimagegn Mammo Deneke, based at the Department of Chemistry at Addis Ababa University, presented the C.N.R. Rao Prize Lecture on 'The synthesis of conjugated polymers: a contribution from Ethiopia'.

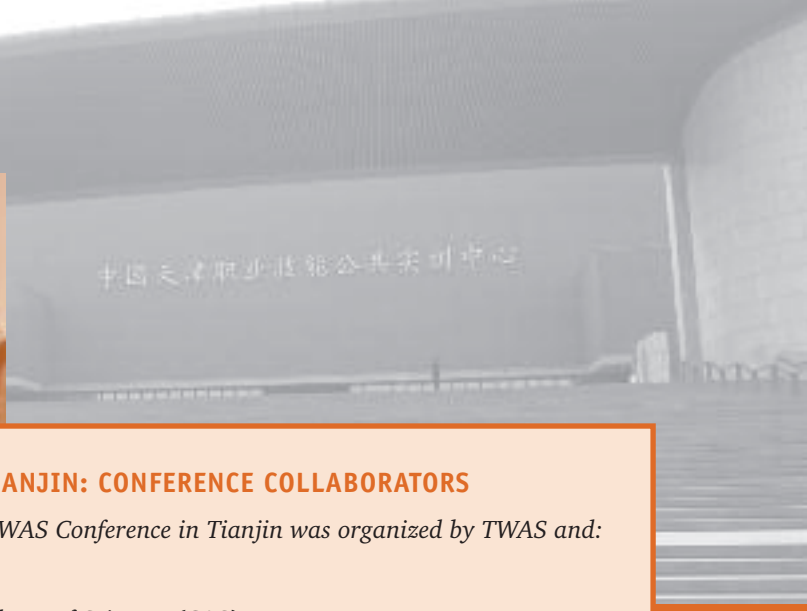
Also inaugurated this year was the Atta-ur-Rahman Prize in Chemistry, awarded to an outstanding woman chemist from Bangladesh, Shamsun Nahar Khan. Khan was honoured *in absentia* for her work on enzyme identification and inhibition, cutting-edge research on the borders of chemistry and biology.

In addition, the winner of the TWAS Regional Office for East and South East Asia and the Pacific region (TWAS-ROESEAP) prize for 'Building Scientific Institutions', Yin Li, was invited to present his work on: 'Building up strength in biotechnological manufacturing: from concept to strategic emerging industry'.

SYMPOSIA

It is a TWAS tradition that the local organizers of each TWAS General Meeting offer a symposium on the state of S&T in the host country. The variety of topics presented this year illustrated the breadth and extent of progress in China. Zi-Yuan Ouyang outlined 'Advances in China's lunar exploration', reminding participants that earlier this year China not only successfully docked a manned spacecraft with a space station, but also sent a woman astronaut into space. Vivian Wing-Wah Yam gave a talk on 'Luminescent metal-based molecular materials: from design to assembly and functions', while Yi-Fang Wang discussed the 'Observation of electron-antineutrino disappearance at Daya Bay'. Chung-I Wu told of China's cutting-edge research on 'Evolution, genomics and cancer', while Xiaohong Fang presented a 'Study of molecular interaction and dynamics in living cells: One at a time'. Closing the symposium, Jian-Wei Pan told participants about the

In June 2012 China not only successfully docked a spacecraft with a spacestation, but also sent a woman astronaut into space.



TWAS IN TIANJIN: CONFERENCE COLLABORATORS

This year's TWAS Conference in Tianjin was organized by TWAS and:

Hosted by:
Chinese Academy of Sciences (CAS)
Tianjin Municipal People's Government

Co-hosted by:
Ministry of Finance of the People's Republic of China
Ministry of Science and Technology of the People's Republic of China
China Association for Science and Technology
Chinese Academy of Engineering
National Natural Science Foundation of China

Sponsored by:
Lenovo Group Ltd.
Digital China Holdings Ltd.
BioSino Bio-technology & Science Inc.

latest developments in 'Scalable quantum information processing'.

A second symposium looked at interdisciplinary overlaps, with an inspiring talk from Abdallah Daar on 'Innovation in global health: Grand Challenges Canada and its Rising Stars program'. Young scientists present at the conference were encouraged to apply.

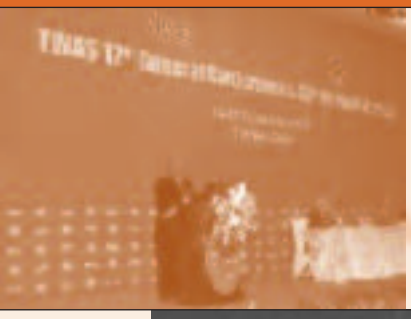
Meanwhile, three TWAS Fellows – Berhanu Abegaz, Jinghai Li and Richard Zare – presented their TWAS Medal Lectures on 'Intra-African cooperation in chemical sciences', 'Meso-scale science' and 'TB or not TB?'.

It was not all work and no play for the scientists. Our local hosts organized three alternative tours, to cultural, educational and training centres. A highlight for many was the spectacular music fountain, on show at the Tianjin Culture Centre, the largest public cultural venue construction project in Tianjin, with an overall floor area of 1 million square metres, of which 470,000 are below ground. The complex includes the Tianjin Museum, art gallery, library, theatre, natural history museum, Sunshine Park, civic square, and science and technology museum as well as a public transportation hub. The buildings surround a man-made lake with the music fountain as centrepiece, specially switched on for the conference participants. The buildings in the complex were designed by 12 architectural firms from China, Germany, Japan and the United States and together provide an impressive example of international project management and collaboration.

An evening ride on a riverboat up the River Haihe gave participants an opportunity to view Tianjin by night and was an excellent way to round off a hugely productive conference.

"This year's TWAS General Meeting and General Conference was really a very successful occasion for TWAS and our local hosts, the Chinese Academy of Sciences and the Tianjin Municipal People's Government", said Romain Murenzi, executive director of TWAS. "There is so much high-quality work being done in science and technology now in developing countries, and it is always a great honour to be able to listen 'in first person' to new discoveries that are being made and learn about work in progress that really has the power to change things. It is most gratifying, too, to see young scientists meeting with senior scientists and exchanging ideas and contact details." ■

TWAS 23TH GENERAL MEETING & 12TH GENERAL CONFERENCE



Tianjin, China, 17–21 September 2012

TRIESTE SCIENCE PRIZE

THE 2012 ERNESTO ILLY TRIESTE SCIENCE PRIZE, AWARDED IN THE FIELD OF HUMAN HEALTH, WAS PRESENTED TO YUK MING DENNIS LO (LI KA SHING INSTITUTE OF HEALTH SCIENCES OF THE CHINESE UNIVERSITY OF HONG KONG, CHINA) FOR HIS WORK ON NON-INVASIVE PRENATAL DIAGNOSIS.

The winner of the eighth edition of the Ernesto Illy Trieste Science Prize was announced at the TWAS 12th General Conference and 23rd General Meeting in Tianjin. The prestigious prize, worth USD100,000, rewards scientists living and working in developing countries whose research has had a significant impact on sustainable development. In previous years, the Ernesto Illy Trieste Science Prize has been awarded for research on climate change, renewable energy, and materials science. This year's Prize was awarded in the area of human health. The Prize is sponsored by the world-renowned coffee maker illycaffè (also based in Trieste), supported by the Ernesto Illy Foundation and administered by TWAS.

During the Opening Ceremony of the TWAS 12th General Conference, President Hu of China announced Lo as the winner and presented the specially-commissioned trophy. Later in the week, Lo received the prize money from TWAS president Jacob Palis, and subsequently presented his research to an audience of more than 400 scientists, ministers of science and presidents of science academies from around the globe.

Yuk Ming Dennis Lo is currently director of the Li Ka Shing Institute of Health Sciences and professor of chemical pathology at the Chinese University of Hong Kong (CUHK). He received the award for developing, with his team of researchers, a ground-breaking technology for the genetic analysis of a foetus based on a blood sample obtained from its pregnant mother.

Lo's path to this groundbreaking technology began in 1997 when he demonstrated the presence of high concentrations of cell-free foetal DNA in the plasma of pregnant women, which could then be sampled and tested. This discovery opened up new possibilities for non-invasive prenatal diagnosis, and has effectively reduced our reliance on previous invasive and potentially risky, methods.

ERNESTO ILLY TRIESTE SCIENCE PRIZE

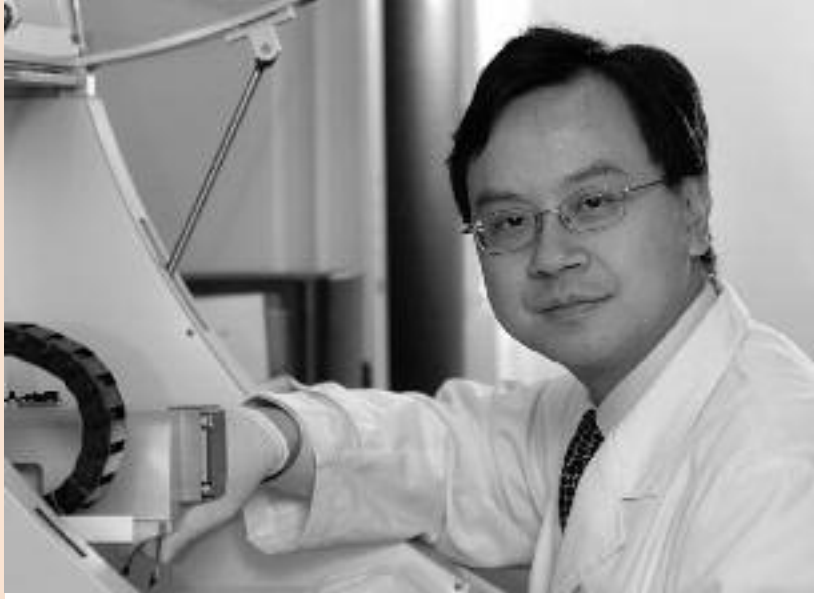
Instituted in 2004 by TWAS and illycaffè*, the Prize is designed to bring recognition and distinction to the developing world's most eminent scientists. The award is jointly named: after Ernesto Illy, the late chairman of* illycaffè*; and after the city of Trieste. Ernesto Illy's passion for the sciences has made the award possible. Trieste, home to TWAS's headquarters, is known for its significant role in promoting science in the developing world.*

Lo commented: "The common procedures for prenatal diagnosis based on amniocentesis (the removal of amniotic fluid from the womb) and chorionic villus sampling (taking a piece of tissue from the placenta) are not entirely risk-free due to their invasiveness. To have a non-invasive test that can give accurate answers is a concrete help in obstetrics and brings tangible benefits to both the mother and the foetus, increasing the safety of prenatal genetic tests during pregnancy and reducing the stress due to invasive procedures. In the long-term, this technology will bring positive healthcare benefits to both developed and developing countries, reducing the suffering and healthcare burden caused by genetic diseases."

Lo graduated from Cambridge University and obtained his DPhil from the University of Oxford in 1994, but his heart remained in Hong Kong, the city where he was born, and he decided to return home in 1997. His move back to Asia was an opportunity to start a new research programme on a hitherto 'high risk' research area, namely, the investigation of extracellular DNA in plasma. Lo and colleagues had already noted previous work describing the presence of tumour-derived DNA in the plasma and serum of cancer patients, an observation that led Lo to wonder if he could also observe foetal DNA in the blood of pregnant women. At the same time, molecular biology techniques that are now widely used were just catching on.

This technology will bring positive healthcare benefits to both developed and developing countries.

"Biology textbooks used to teach that the mother and baby's blood are separate but our research challenged this. You can take blood from a pregnant woman and you can detect male DNA in it. In fact, approximately 50% of pregnant women have male DNA in their blood plasma. We followed this up and found that those pregnant women with circulating male DNA go on to have a baby boy. So in this way we had shown that foetal DNA is present in the blood



LO'S GROUNDBREAKING CONTRIBUTIONS TO HUMAN HEALTH RESEARCH

Lo has published over 300 scientific papers. His main scientific achievements include:

1997

- *Discovered the presence of cell-free foetal DNA in maternal plasma, opening up a new field of research and new possibilities for non-invasive prenatal diagnosis.*

1998

- *Developed a new non-invasive prenatal test of foetal RhD blood group status, especially valuable for Caucasian subjects, in whom 15% of individuals are RhD-negative.*
- *Discovered the presence of the DNA from a transplanted organ in the plasma of a recipient's plasma. This discovery opened up the possibility of using plasma DNA to monitor graft rejection following transplantation.*

1999

- *Discovered the presence of cancer-derived DNA methylation changes in plasma, which has opened up a new class of tumour markers.*
- *Demonstrated that the quantitative measurement of Epstein-Barr virus DNA in the plasma of patients suffering from nasopharyngeal cancer is a powerful diagnostic and prognostic marker.*

2000

- *Demonstrated that plasma DNA measurement can be used to monitor patients suffering from trauma, stroke and cardiac disorders. This work has opened up the future use of plasma DNA analysis for emergency medicine.*

2002

- *First use of DNA methylation differences between mother and foetus to develop a new generation of molecular markers for prenatal diagnosis.*

2003

- *During the SARS epidemic, Lo's research team was the first group in Asia to publicly announce the complete sequence of the SARS-coronavirus. The group was also the first to report the molecular epidemiology, tracing the transmission of the SARS-coronavirus across Hong Kong, mainland China and Taiwan.*

plasma of pregnant women. We could thus use plasma DNA analysis for non-invasive prenatal diagnosis, including the prediction of the sex and blood type of the baby."

Knowing the blood type of the foetus can be crucial in preventing or managing potentially serious disorders that can affect the foetus because of the incompatibility of the blood types. If a woman is rhesus negative, for example, and carrying a baby whose blood type is rhesus positive, the mother's immune system might treat her baby as an intruder. The risk of the mother attacking the baby immunologically can be reduced by injecting the mother with antibodies. It would thus be beneficial for the woman to have this compatibility information. Lo's non-invasive prenatal testing technology allows this to be done safely and has already been adopted in many countries, including Denmark, the United Kingdom and the USA.

Lo's non-invasive prenatal testing technology has already been adopted in many countries.

There have been many positive outcomes of this technology, and Lo is not short of examples: "Another intervention we can do now that we have this information is a test which identifies the sex of a baby at risk of congenital adrenal hyperplasia (CAH). In CAH, the baby produces excess male hormones. If the baby is female, such excess male hormones leads to masculinization of the foetus. If we know the sex of the baby early and intervene by treating the mother with steroids, this can be avoided."

Lo also developed a methodology that allows scientists to amplify and quantify the DNA present in trace

amounts in a plasma sample (such as foetal DNA circulating in maternal plasma that, on average, accounts for 10% of the total DNA in maternal plasma). Applying this technique to an analysis of the plasma of pregnant women, Lo was not only able to determine the sex of the foetus, but also whether the foetus has inherited mutations, such as those causing beta-thalassaemia, from the father.

In a further refinement of the analysis, Lo and his team showed that it was possible to follow the natural

- *Discovered the presence of placenta-derived RNA in the plasma of a pregnant woman. This finding has opened up hundreds of new markers for non-invasive prenatal diagnosis.*

2005

- *Developed a universal DNA methylation for non-invasive prenatal diagnosis. This marker can be used irrespective of the gender and genetic makeup of the foetus.*

2007

- *First report of a method for the prenatal diagnosis of Down's syndrome by using foetal RNA in the plasma of a pregnant woman. The accuracy of this test is over 90%, the most accurate single marker for Down's syndrome up to this date.*


Flickr/David Jones

fluctuating levels of foetal DNA in maternal blood during pregnancy, and that virtually all traces of this DNA disappear within a few hours after birth. An important application of this study concerns some of the most common ailments associated with pregnancy, such as pre-eclampsia (characterized by oedema, proteinuria and hypertension) and pre-term delivery (which occurs before the 37th completed week of gestation). In both cases, as Lo discovered, the detection of abnormal amounts of foetal DNA in maternal blood can be used as a marker of such conditions. In the future, these markers might allow scientists to predict the risk of a pregnant woman developing such conditions.

Down's syndrome (or trisomy 21) is perhaps the most important reason why many pregnant women go for prenatal testing. The syndrome is characterized by the presence of three copies of chromosome 21 instead of the usual two, and causes a general slowing of psychomotor and intellectual development. In 1999, Lo showed that Down's syndrome pregnancies were associated with increased levels of foetal DNA in

2008

- *Demonstrated that through the sequencing of millions of DNA molecules in maternal plasma, one can work out a proportional representation of each chromosome in plasma and hence detect Down's syndrome with high accuracy.*

2010

- *Developed a technology for scanning the entire genome of a foetus from a blood sample obtained from its pregnant mother.*

2011

- *Following the publication of the first large-scale study by Lo's group for Down's syndrome detection and replication by other groups, in October 2011 this approach was introduced into clinical practice. It is now available in China, the USA, and in parts of Europe.*

YUK MING DENNIS LO COMMENTS ON THE CHALLENGES OF DOING EXCELLENT SCIENTIFIC RESEARCH IN A DEVELOPING COUNTRY

The Ernesto Illy Trieste Science Prize is very special and receiving it from the President of China made it even more memorable. TWAS is international, and the prize highlights the fact that scientists in developing countries can achieve the highest standards of scientific excellence despite great difficulties.

It's not impossible to do good research with few resources, but it's certainly a challenge. When I began doing this research, I asked myself what was the cheapest way to extract DNA from the mother's blood plasma. The answer was to get a sample of plasma and boil it. This shows that researchers do not always have to be well funded to do original work.

But of course there is a huge difference in what you can achieve if you have the facilities and back up. In developing countries you simply have to work much harder to have your work accepted by prestigious journals – and to be awarded patents.

Even so, my heart is in Hong Kong and that is where I have chosen to live and work. The students I teach, I think of them as my successors, I am especially attached to them. But I think researchers in Hong Kong in general have better opportunities than they used to. Young researchers need to share their thoughts, their questions, their results. Ideally, as a scientist you need to discuss a lot with people from all over the world working in your field. Now, using Skype and emails, such networking is getting easier. This is the democratization of science.

But still, scientists from developing countries need to pay more attention to science communication. If you are having difficulty publishing in high impact journals – part of that is communication. You need to convince others of the value of your research. Such 'salesmanship' is important when communicating science to your colleagues, to journal editors, to industry, and maybe even the government.

I think it would be highly beneficial for researchers from developing countries to have specific training in, for example, intellectual property rights. Scientists can be quite naïve, they talk about work that's not yet published or patented. Such intellectual property rights are often important for catalyzing the commercial adoption of inventions. Without such protection, very few companies are willing to invest to develop inventions into products. Inventions, if properly protected, would ultimately benefit the researchers' own universities and economies.

maternal plasma. However, the levels in Down's and normal pregnancies overlap to a significant extent. For the next 9 years, Lo and his team explored many approaches to enhance the distinction between Down's and normal pregnancies. In 2008, they demonstrated that by sequencing millions of DNA molecules amplified from maternal plasma, it was possible to work out the proportions of each chromosome and hence detect Down's syndrome with unprecedented accuracy. The technique has now been validated in many large scale studies and shown to be over 99% accurate and is widely used to detect Down's syndrome and a number of other chromosomal aneuploidies (abnormalities in chromosome number) in China, Europe and the United States.

As ever, there are ethical and cultural issues surrounding this test, but in general it is seen as a very welcome advance for expectant parents who would normally take the amniocentesis test, which is invasive and carries the risk that a percentage of babies will abort.

Lo's development of prenatal diagnoses does not stop there. Two years ago, in 2010, it was the turn of

the 'foetal genomic map', obtained by sequencing foetal DNA present in maternal plasma and comparing it with the maternal and paternal genomes.

Describing the complexity of the matter, Lo ventures, "Imagine you have one of those difficult, sophisticated jigsaw puzzles – many, many tiny pieces that all fit together. Well, trying to sequence the human genome is like solving a jigsaw puzzle – it's fragmented in many pieces – but it's a jigsaw puzzle times ten!"

Flickr/Merryly

With over 20 patents filed, Lo is ensuring that his research efforts are being applied where it matters.

Lo found the inspiration for solving this puzzle in, of all places, the cinema, watching *Harry Potter and the Half Blood Prince* with his wife (also a scientist). He explains: "It was one of the first *IMAX* movies to be shown in Hong Kong. When the title appeared in 3D, the words seemed to come straight at me. They got nearer and nearer and then the 'H' in 'Harry' seemed to jump out and I could see in the shape of that 'H', the two members of a chromosome pair, one half from the father, one from the mother. Then, like everything in science, the answer suddenly became obvious." Lo turned to his wife and said, "I think I have the answer! I need to solve the problem in two halves."

And indeed Lo then went on to tackle the problem of the foetal genome by thinking separately about the father and the mother. "I started by looking for DNA sequences that the foetus had inherited from the father, and which were absent in the mother's DNA. Such DNA sequences, as a whole, represented the half-genome that the foetus had inherited from the father."

"Then I turned my attention to the half of the foetal genome that had come from the mother. Such sequences would have an increased concentration in maternal plasma as their concentrations represented a summation of the mother's and the baby's contributions."

The excitement of doing research has clearly never left Lo. "Doing research is like going on holiday every day – but with no guidebook. Research is my hobby." His eyes light up when he is asked about his current research interests and his enthusiasm is infectious.

"Right now I'm pondering the biological meaning of what we are detecting. It's extraordinary that the mother clears the foetus's DNA within two hours of giving birth. This is a message from the foetus that will take another 10 years to decode."

With over 20 patents filed based on his work, Lo is ensuring that his research efforts are being applied where it matters and continue to have a major impact on obstetrics care. In recognition of these achievements, Lo was made a Fellow of the Royal Society (UK) in 2011. ■

HONOURING SOCIAL SCIENCE

BRAZILIAN ECONOMIST RICCARDO PAES DE BARROS IS THE WINNER OF THE INAUGURAL EDITION OF THE TWAS-CELSO FURTADO PRIZE FOR SOCIAL SCIENCES.

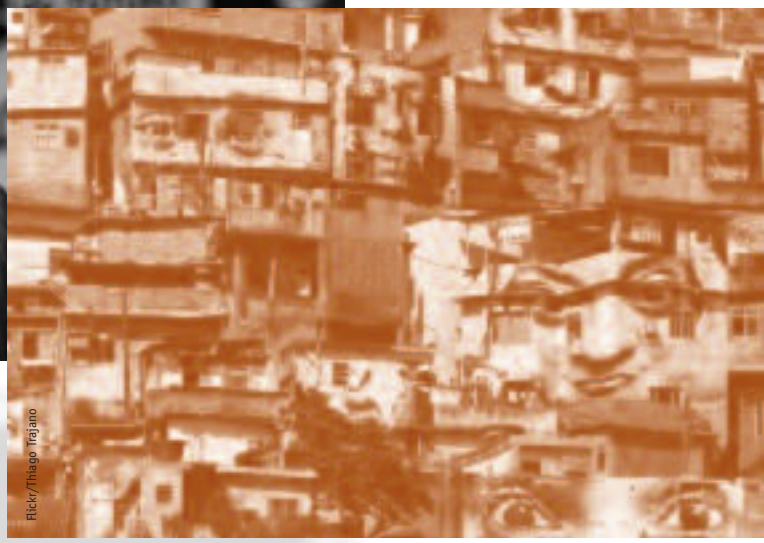
One year ago, the Academy launched the TWAS-Celso Furtado Prize in Social Sciences. The Brazilian Government is providing a four-year programme of sponsorship for the prize in honour of the great Brazilian economist Celso Furtado. Each winner will receive USD15,000. The prize reflects the Brazilian government's strong support for TWAS and, more generally, for helping to build scientific capacity in the developing world.

"The TWAS-Celso Furtado Prize in Social Sciences is an important addition to the TWAS prizes programme," confirmed TWAS President Jacob Palis. "On behalf of TWAS, I want to express our deep gratitude to former Brazilian President Fernando Henrique Cardoso and his Minister of Science and Technology José Israel Vargas, who were both instrumental in securing the sponsorship."

Candidates for the TWAS-Celso Furtado Prize in Social Sciences must be social scientists who have been working and living in a developing country for at least ten years immediately prior to their nomination. They must, too, have made an outstanding contribution in both understanding and addressing social science disciplines such as economics, political sciences and sociology.

The winner of the first TWAS-Celso Furtado Prize in Social Sciences was announced at the TWAS 23rd General Meeting in Tianjin, China. Ricardo Paes de Barros, an economist from Brazil, was selected from a very competitive field for his major contributions to understanding the problems of poverty and inequality in Brazil, and for his advocacy of evaluating and refining public policies aimed at alleviating these problems.

In recognition of his outstanding contributions to academia, a special volume of the *Brazilian Review of Econometrics* was published in November 2000 in Paes de Barros' honour. In the introduction to this volume, James Heckman, Nobel Prize in Economics (2000),



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describes how Paes de Barros' work has influenced the social sciences and politics worldwide:

"Through his quiet, but forceful, influence, Ricardo revolutionized Brazilian policymaking by creating and organizing a rigorous micro database that enabled Brazilian policymakers to understand the causes of poverty and inequality and effective approaches for alleviating them. By creating this culture of evaluation – of evidence-based policy analysis – Paes de Barros has forever changed the dialogue of Brazilian public policy and influenced the evolution of evidence-based policymaking throughout the entire Latin American region."

Paes de Barros revolutionized Brazilian economic policymaking, creating a micro database to understand the causes of poverty and equality.

Paes de Barros studied aeronautics at undergraduate level and went on to do a Master's in statistics at the *Instituto Nacional de Matemática Pura e Aplicada* (IMPA), Brazil, followed by a PhD in economics at Chicago University, USA, and further research at the Centre for Economic Growth, Yale University, USA.

From 1979 until 2011, Paes de Barros was based at the Institute of Applied Economic Research (IPEA), Brazil, where his research focused on social inequality, education, poverty, and the labour market in Brazil and Latin America. Between 1990 and 1996 he returned to Yale as a visiting professor; and from 1999 to 2002 he was at IPEA as director of its Board of Social Studies. Last year, Paes de Barros was appointed the Secretary of Strategic Actions at the Secretariat of Strategic Affairs of the Presidency of the Republic of Brazil in Brasilia, a position he holds to this day.

Paes de Barros has published many articles and books on poverty and inequality in Brazil, Latin America and the Caribbean and has received many prizes recognizing the significance of his work, including the *Haralambos Simedionis* award and the *Mario Henrique Simonsen* award. In 2005, he was admitted to Brazil's National Order of Scientific Merit and in 2010 he was appointed a member of the Brazilian Academy of Sciences.

Elisa Reis, chair of the selection committee for the prize and a TWAS member in the field of social sciences, confirmed that Paes de Barros was a worthy and appropriate first recipient. "His work is closely allied to the kind of approach and methods that Celso Furtado was advocating," she said, "and at the same time he has

Flickr/Francisco Antunes

ELISA REIS COMMENTS

"The introduction of the TWAS-Celso Furtado Prize is a powerful symbolic demonstration that TWAS fully recognizes the social sciences as legitimate partners in its core mission.

Social scientists must become more and more active TWAS members. They should provide meaningful assessments of the costs and benefits of different development strategies, identifying their positive and negative consequences for society in economic, social, political, and cultural terms.

To help in the process of building science capacity in developing countries, social scientists can provide resourceful expertise in evaluating development strategies. Furthermore, they can be instrumental in designing public policies, whether these are aimed at promoting science and technology or directly oriented towards improving mechanisms to generate socio-economic benefits. Moreover, social scientists can play a crucial role in making clear the actual connections between the institutionalization of democratic institutions and values on the one hand, and long term socio-economic gains on the other.

Putting scientific knowledge to serve the goal of promoting better social redistribution of wealth is one of the major characteristics of Paes de Barros' brilliant career as an economist. His successes in devising sound policies to reach such goals in Brazil and elsewhere, and the strong influence he has exerted on both academic and policy communities, make him a legitimate winner of the TWAS-Celso Furtado Prize."

Elisa Reis is a TWAS Fellow in Social Sciences (2006) and was chair of this year's TWAS-Celso Furtado selection committee.

made a very original and effective contribution to alleviating poverty in Brazil and elsewhere in South America."

The Prize's namesake, Celso Furtado (1920-2004) was a famous Brazilian economist whose research focused on the poor in Brazil and throughout South America. He emphasized the importance of economic policies that focused on building a strong industrial base for what he referred to as 'peripheral economies'.

Creating a prize in Furtado's name "is very much in line with TWAS's mission to build scientific capacity in poorer regions in order to stimulate sustainable development," Palis affirmed, "and it also reflects an awareness within TWAS as an organization that social scientists have a great deal to offer the Academy in the pursuit of this mission."

Indeed, the potential contribution that social scientists can make to building scientific capacity in the South was a theme that was warmly taken up by members of the prize selection panel, including Anthony Clayton (TWAS Fellow 2011), a UK-born and trained social scientist, who has been living in Jamaica for the

last fifteen years and is based at the University of West Indies, which serves 14 different Caribbean nations.

"Science policymakers often take it as given that if we can build strong scientific and technical capacity then people's lives will improve," Clayton explained. "However, as social scientists, we know that this is not entirely accurate, because entrenched poverty exists even in countries with advanced technical capacity. For example, many of the inhabitants in poor areas can be trapped in unemployment or marginal, low-waged jobs by a lack of marketable qualifications and skills. We know from many such examples that scientific and technical capacity is a *necessary* but not a *sufficient* condition for national development, and that we can't just inject technology into a country and expect the situation to improve. This is where social scientists can help."

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Neither development nor capacity building can be done by science alone in a social vacuum.

Ratna Ghosh, also on the Prize selection committee and another newly elected TWAS Fellow (with expertise in comparative and international education), agreed: "TWAS focuses on problems of development. And development is about people. The social sciences are crucial to understanding people and their perceptions of how satisfactory their lives are, their standard of living and ultimately their happiness. In addition, TWAS's efforts to build science capacity in developing countries depend on various aspects of the social sciences – education, training, people's attitude to work and their private lives. Neither development nor capacity building can be done by science alone in a social vacuum."

Anthony Clayton

Anthony Clayton agreed. "Probably the most important single determinant of whether a country will develop is not technology, but the strength and integrity of its institutions. If a country has politicized institutions and inequitable laws that serve only the interests of the elite," he added, "it is far less likely to develop a strong and diverse economy."

The *New York Times* bestseller and influential architect of the Millenium Development Goals, Jeffrey Sachs, has argued, on the other hand, that much of the cause of poverty lies in geography and climate. Poor countries tend to be near the equator, where there is a combination of hostile conditions (endemic disease and poor soil, for example) but, Sachs has argued, with the right politics and intervention (in particular a huge investment in aid), poor nations can be pulled out of poverty.

However, this theory is being increasingly strongly criticized, as it has become clear that adjacent countries sharing very similar geography and climate can have markedly different economic and social outcomes. Clayton notes the case of the island of Hispaniola, which is shared by two nations. On the west side of the island, Haiti remains one of the poorest nations in the world, while on the east side of the island, the Dominican Republic is building a strong economy. Clayton argues that these very different outcomes reflect the crucial role of governance. "Without a reasonably competent system of government and a functioning economy, it is very hard for society to progress, no matter how much you invest in science and technology," he concludes.

Paes de Barros will receive his award and present his work at TWAS's 24th General Meeting, which will be held in Argentina in September 2013. ■

TAKING CARE OF EYES AND EARS

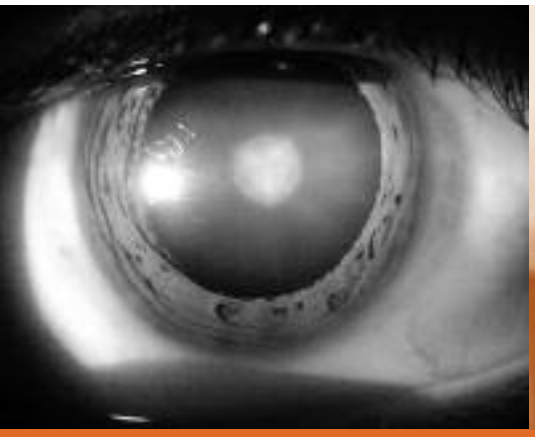
MORE THAN 60 SEMINARS TOOK PLACE DURING TWAS'S 23RD GENERAL MEETING IN TIANJIN, WHERE SCIENTISTS PRESENTED A BROAD SPECTRUM OF INVESTIGATIONS, FROM DEFENSIVE STRATEGIES USED BY PLANTS AGAINST PARASITES, TO INNOVATIVE MATERIALS, TO FUTURE PLANS TO EXPLOIT SOLAR ENERGY.

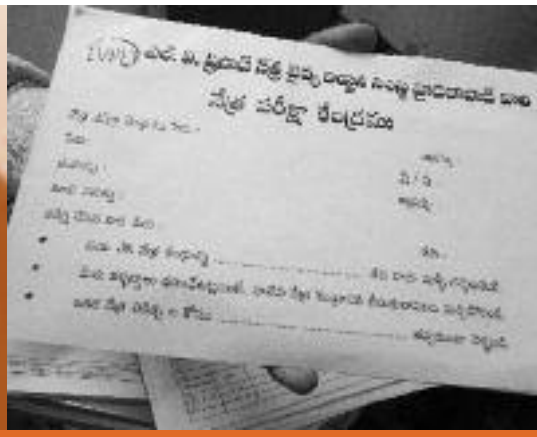
A selection of these presentations focused on pathologies affecting eyes and ears, which are subject to a much higher percentage of serious disease in developing countries than in developed countries. Promising results for eyes were presented by Sheikh Riazuddin (TWAS Fellow 1989) from the Centre of Excellence in Molecular Biology at the University of Health Sciences, Lahore, Pakistan and by Dorairajan Balasubramanian (TWAS Fellow 1997), Director of Research at the L.V. Prasad Eye Institute in Hyderabad, India. Research on hearing loss was presented by Ana Belen Elgoyhen from the Instituto de Investigaciones en Ingeniería Genética y Biología Molecular *(INGEBI-CONICET) in Argentina. An overview of their research follows.*

Many of the pathologies that affect sight and hearing are chronic and defined as non-communicable diseases. While industrialized nations can sustain the economic costs of providing adequate healthcare programmes to keep these pathologies at bay, developing countries cannot.

According to World Health Organization (WHO) estimates, 285 million people are visually impaired worldwide: 39 million are blind and 246 million have reduced vision. Of this latter group, about 90% live in low-income countries, where healthcare systems are often inadequate and the medical assistance provided is not free of charge.

It should not be surprising then, to learn that up to 80% of the cases of visual impairment – including uncorrected refractive errors (myopia, hyperopia and astigmatism), cataracts and glaucoma – could be avoided, either by early treatment or prevention. Given the social and economic burden that eye disease causes, WHO and the International Agency for the Prevention of Blindness (IAPB) have launched a global





initiative, 'Vision 2020: The right to sight', which aims to eliminate *avoidable blindness*.

THE VIEW FROM PAKISTAN

Cataracts, glaucoma, retinitis pigmentosa (RP) and macular degeneration are some of the most common conditions that impair vision, causing blurred or spotty images and creating blind spots. If not treated properly and at an early stage they can lead to blindness.

Although they occur worldwide, these conditions are more frequent in developing countries. Indeed, Pakistan has an unusually high prevalence of the first three conditions (cataract, glaucoma and RP). According to scientists, this could be due to a combination of historical factors that have influenced the local gene pool.

Marriages between first or second cousins have long been a common practice in Pakistan. This, in time, has led to a high degree of consanguinity within families and, as a consequence, to lower genetic variation. There is a high risk that existing mutations will be transmitted from one generation to the next, increasing the likelihood of disease.

IN THE GENES

"The history of the Pakistani population is written in its genes, which give us information not only about past migrations and historical events but also about social habits," explained Sheikh Riazuddin (TWAS Fellow 1989) during his presentation at the TWAS General Meeting. Riazuddin is professor and director of the National Centre of Excellence in Molecular Biology (CEMB) at the University of the Punjab in Lahore. "If we can identify the genes responsible for eye diseases, we can observe DNA mutations and their effects in modulating the onset of the hereditary conditions that damage vision. Genetics data", he added, "can be used to orient future healthcare policies in a better way." The results he showed sum up several years of investigations carried out by his team on the most common eye disorders.


Sheikh Riazuddin

If we can identify the genes responsible for eye diseases, we can observe DNA mutations and their effects in modulating the onset of the hereditary conditions that damage vision.

RP is an inherited, degenerative eye condition in which the retina – the sensory membrane lining the back of our eyes – slowly degenerates leading to severe vision impairment and blindness. "Despite the early appearance of predictive signs," explains Riazuddin, "it is difficult to quantify the extent of future vision loss. And once the degenerative process is complete there is no treatment to reverse it." Even during the disease progression, doctors are powerless to intervene since

there are no medicines to slow its course. The only way to prevent the occurrence of RP is through knowledge of the genetic pattern of the two partners (with a family history of RP) who are planning to raise children.

"The identification of healthy carriers is particularly important in families where consanguineous marriages are a common practice", continued Riazuddin. Consanguinity, in fact, increases the risk of inheriting not only an eye disease, but any one of the 5,000 or so recessive genetic diseases that can affect any part of the body.

Five consanguineous Pakistani families with early onset RP identified by Riazuddin's team gave their consent to participate in a collaborative investigation, carried out by the National Center of Excellence in Molecular Biology in Lahore and the National Eye Institute in Maryland, USA. The study aimed to identify specific pathogenic mutations which trigger the recessive form of the disease. A recessive disease develops when both the parents host a defective gene – with a "spelling mistake" or mutation – and transmit it to their offsprings.

"We found seven new genes involved in the onset of familial RP", explained Riazuddin, "a discovery which will greatly contribute to our understanding of the molecular mechanisms underlying this condition."

Working with another group of 12 consanguineous Pakistani families and one Arab-Israeli family (a total of 44 individuals), two brand new genes and nine mutations in a gene called *FYCO1* were identified. The latter accounts for the recessive form of congenital cataract, a clinically diverse and genetically heterogeneous group of disorders which trigger the degeneration of the crystalline lens (the eye structure that, along with the cornea, helps to refract light and focus it on the retina). Cataracts are responsible for one third of the cases of infant blindness, and are prevalent in the Pakistan population.

"We also obtained important evidence on the genes and mutations involved in congenital glaucoma and night blindness," added Riazuddin.

If current trends are not halted, by 2020 we could face an emergency of up to 80 million blind individuals.

Congenital glaucoma is a neurodegenerative process of the optic nerve and the second leading cause of visual loss. Almost 60 million people are affected today, but future predictions are grim: if current trends are not halted, by 2020 we could face an emergency of up to 80 million blind individuals. Night blindness (or nyctalopia), another condition that Riazuddin examined, is not a severe condition *per se*, but makes it difficult or impossible for sufferers to see in relatively low light. Importantly, it is often associated with more severe degenerative conditions.

"Even though we have carried out extensive investigations, our results are far from being conclusive," Riazuddin admitted. "We still don't have a treatment for these conditions. However, we have paved the way

THE COSTS OF CLEAR VISION

Eye disease is not just a health issue: it has dramatic consequences for society and the economy. In 2010, nearly three trillion dollars were spent on providing healthcare and specific assistance to people living with low vision and blindness worldwide. This amount – which includes direct healthcare expenditure, loss of productivity at work, and caregiver time – is set to rise through 2020, unless measures to prevent and treat the problem are adopted soon. But eye disease is not just a financial issue. According to WHO's measurements of the overall burden of disease calculated using so-called DALYs (disability-adjusted life-years), people with visual impairment have been deprived of the equivalent of 118 million years of healthy life due to disability and premature death. This value will peak to 150 million DALYs by 2020 if current trends are not checked soon.

to a better understanding of the molecular mechanisms underlying these disorders and, far more importantly, we have raised awareness – both at the individual level and at a general level – of the importance of offering preventive screening to avoid undesired genetic combinations that affect not only the patient, but their families, and, ultimately, society at large."

RECONSTRUCTING THE EYE

Any damage to the outer surface of the eye, or cornea, (caused by thermal or chemical burns, for example) will affect sight. Corneal injuries are not uncommon: both the workplace and the home can be dangerous environments for our fragile ocular organs. The resulting corneal scars can severely impair vision, sometimes even causing blindness.

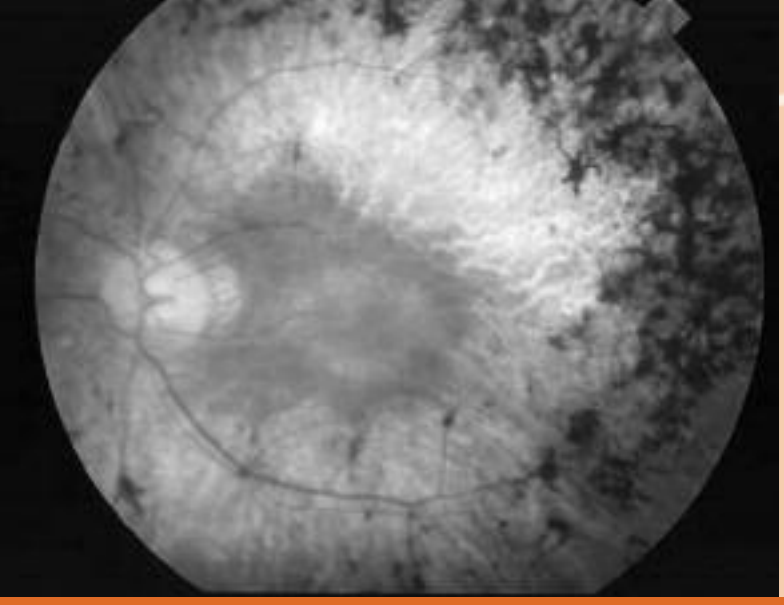
Dorairajan Balasubramanian, director of research at the L.V. Prasad Eye Institute (LVPEI) in Hyderabad, India, has been addressing this specific problem for more than ten years and is an internationally recognized specialist in eye-related research. The institute, in addition, is a WHO Collaborating Centre for the Prevention of Blindness and a Global Resource Centre for *VISION 2020: The Right to Sight* initiative.

D. Balasubramanian

"Networking is essential if we are to provide equitable and efficient eye care to all sections of society," underlined Balasubramanian at the Tianjin meeting. "The LVPEI network, in fact, includes a centre of excellence in Hyderabad, three tertiary centres in Bhubaneswar, Visakhapatnam and Vijayawada, ten more secondary centres and 89 primary care centres that cover the remotest rural areas in the state of Andhra Pradesh, India, as well as several city centres."

Corneal transplants, which might seem an option for replacing diseased or damaged corneas, in fact have very poor outcomes: graft survival at one year is disappointing (33-46%) but at three years it is disastrous (0%). New avenues must be explored to ensure, in the words of the LVPEI logo "That all may see."

Balasubramanian described the alternative and highly successful treatment his team has been working on, taking the audience through ten years of pioneering



applications of limbal stem cells, which are now widely used to reconstruct the damaged corneal epithelium. "Limbal stem cells", he explained, "are a versatile tool for doctors. These cells sit in the anular ring surrounding the cornea and not only self-renew, but also differentiate. This means that, under proper cultural conditions, they can be induced or taught to become the cells we need and used to patch damaged tissue, which is done with the patient's own cells."

IN LIMBUS: CLET AND SLET

The corneal limbus – the white part of our eye – is the perfect factory for stem cells. These are commonly dubbed baby cells for their capacity to grow and evolve into different adult types, providing they are given adequate nutritional support.

Balasubramanian and his team have been experimenting on the use of stem cells in corneal transplants for more than a decade now. First they used a procedure called CLET (corneal limbal epithelial transplantation). As he explained: "We first take a tiny patch of corneal tissue – a biopsy – from a healthy part of the injured eye and put this fragment, less than 2 mm wide, into a special tissue culture medium. Then, after 10-14 days' growth, the fragment reaches a suitable size. The final stage is then to transplant the patch in the recipient eye." The transplant can be obtained from the person's unaffected eye (an autologous transplant) or, if both the eyes of the patient are injured, from an external donor (an allogenic transplant).

This three-stage technique, which has been tested on 200 patients, has many advantages: it is safely repeatable for the donor eye, allows for a rapid recovery, and after 1-2 years the overall success rate (no tissue rejection) is around 71%.

Encouraged by this success, Balasubramanian and his collaborators decided to further elaborate the technique. "We tried an exciting *in vivo* single step procedure," he said. "We took a strip of limbal tissue from the healthy eye of a patient, chopped it into smaller pieces and distributed these fragments over an amniotic membrane placed on the patient's cornea." Results were encouraging: visual acuity improved in 66.6% of patients, with no complications observed. Balasubramanian's team called this procedure 'simple limbal epithelial transplantation', or SLET.

> ***By avoiding the ex vivo step we simplified the procedure, cut the risks for patients and reduced the costs.***

"By avoiding the *ex vivo* step," Balasubramanian commented, "we simplified the procedure, cut the risks for patients and reduced the costs. In addition, the procedure is so simple – and effective – that any qualified corneal surgeon, after minimum training, is able to perform it."

Damaged eyes represent a serious health problem in developing countries, but so too do damaged ears.

TURN DOWN THE VOLUME

Sound-induced acoustic injury is one of the most common causes of hearing loss and tinnitus (ringing in the ear). Tinnitus does not cause hearing loss, but people with hearing loss can have tinnitus. The condition is common among rock stars and their fans who play or listen to loud music.

However, as Ana Belén Elgoyhen explained in her opening remarks to the Tianjin meeting, "It's not just music: our ears are assaulted by daily roars, shrieks, and general blaring noises that severely jeopardize our listening ability." Elgoyhen's research, in fact, has been dedicated to finding ways to protect our fragile ears from acoustic trauma.

Elgoyhen is professor and principal investigator at the *Instituto de Investigaciones en Ingeniería Genética y Biología Molecular* (INGEBI-CONICET) in Buenos Aires, Argentina, and one of two recipients of the 2011 TWAS Prize in Biology, awarded during the opening ceremony of the Tianjin meeing. In her laboratory she studies the neurochemical mechanisms that regulate hearing, trying to devise a strategy to protect the ear from potentially damaging noises.

Elgoyhen summarized how the mammalian ear works, focusing in particular on the inner and outer hair cells. The inner cells, she explained, are connected to the acoustic nerve and are instrumental in sending neuronal signals to the brain. The outer cells, in contrast, have two roles: on the one hand, they increase the sensitivity of the hearing apparatus; on the other they receive messages from the brain. In response to loud noises, the neurons in the brain release a chemical compound (acetylcholine) that binds to receptors on the outer cells. After this binding, the outer cells' sensitivity to loud sounds diminishes.

A. B. Elgoyhen

"This chemical reaction was known long ago, but its precise function was still to be determined. To do this, we devised a mutant receptor which was able to respond for a longer time – and more strongly – to the stimulus of acetylcholine," explained Elgoyen.

When tested on a laboratory model, Elgoyhen and her team were able to observe that the engineered receptor reduced the amplification ability of the hair cells. "In other words," concluded Elgoyhen, "the ear was more resistant and more protected against obnoxious sounds known to induce permanent hearing loss."

EYES AND EARS TOWARDS THE FUTURE

"What is important in these investigations", commented Romain Murenzi, TWAS executive director, "is not just the results. Certainly their findings will improve our ability to treat and prevent eye and ear disorders, but the fact is that these scientists have begun with solving local problems, of relevance to their own working environments in developing countries, but they are also looking towards the application of these solutions in both national and global contexts." ■

BUILDING AN INNOVATIVE COUNTRY

WAN GANG, MINISTER OF SCIENCE AND TECHNOLOGY FOR THE PEOPLE'S REPUBLIC OF CHINA, OUTLINED – IN A PRESENTATION TO THE TWAS CONFERENCE – HOW CHINA HAS SO SUCCESSFULLY LINKED ITS SCIENCE AND TECHNOLOGY PROGRAMMES TO DEVELOPMENT.

As Minister of Science and Technology since 2007, with special responsibility for overseeing the Department of Development Planning, Wan Gang is well placed to give an overview of the links between science and development in China that have taken place over the last decade. Since 2003, he has also been a member (and subsequently chair) of the National Committee of the Chinese People's Political Consultative Conference (CPPCC), an advisory body which includes delegates from a range of political parties and organizations, as well as independent members. In 2007, Wan Gang was elected chairman of the China Zhi Gong Party and is the first government minister in three decades who is not a member of the Communist Party.

There follows an edited extract of Minister Wan Gang's presentation to delegates during the opening ceremony of the TWAS conference in Tianjin.

Developing countries have rich resources, big markets and large populations, with a high percentage of young people. In recent years, many developing countries have made progress in educational development, increased funding of science and technology, improved research and development (R&D) infrastructures and stimulated innovation, generally demonstrating a huge potential for scientific and technological development. As a result, developing countries are gaining increasing influence in the international science and technology community, with their role shifting from that of 'follower' to 'fellow traveller' and even 'front-runner' in certain fields.

As leaders of the world's largest developing country, the Chinese government attaches great importance to scientific and technological development and institutional reform. Over the decades, China's science and technology programmes have developed literally from scratch, gradually expanding in scale, and making important contributions to the development of the country and the improvement of people's living standards. In an effort to manage the economic volatility triggered by the international financial crisis, China's science and technology development has followed the goal of building an innovative country, and focused on addressing major scientific and technological challenges in economic and social development.

Investment in science and technology by the central government has maintained its annual growth at over 23% for five straight years, with the total R&D budget reaching USD138 billion last year.

WAN GANG: LINKING ACADEMIA AND INDUSTRY

Wan Gang began his working life in the rural Yanbian Prefecture in Jilin Province, northeastern China, close to the border with North Korea and graduated in 1978 with a bachelor's degree from Northeast Forestry University in neighbouring Heilongjiang Province. Three years later he received a Master's degree in experimental mechanics from Tongji University, Shanghai, one of the oldest and most prestigious universities in China, continuing to serve as a faculty member there until 1985.

Wan Gang then moved to Germany to read for a doctorate in engineering at the Technische Universität Clausthal*, and for the next decade worked in the research and development department of the German Audi Corporation, in charge of 'computer virtualization'. In 1996, he was promoted to technical manager of the production and technology division and his leadership and contributions were instrumental to the success of the Audi A4 car.*

Invited back to both Clausthal University of Technology and Tongji University in 1994 and 1995, he supervised a group of German doctoral candidates on a successful project on the fuel cell, a device that converts chemical energy into electricity.

In 2000, Wan Gang outlined a proposal for a new type of car which would run on clean fuel and presented this to the Chinese State Council. The proposal was then supported by the Ministry of Science and Technology, who invited him to return to China. He was appointed chief scientist and group leader in developing electric car projects for the State High-Tech Development Plan, intended to stimulate the development of homegrown advanced technologies, and thereby reduce China's dependence on expensive foreign technologies.

Wan Gang's unique blend of excellent scientific credentials together with direct experience in industry made him the ideal candidate for the post of founding dean of the New Energy Automobile Engineering Centre at his alma mater*, Tongji University, where he was also promoted from assistant president, to vice-president and then president in 2004. In 2006, he became vice-chairman of the China Zhi Gong Party and was elected its chairman in 2007. Wan Gang is now Minister of Science and Technology of the People's Republic of China.*



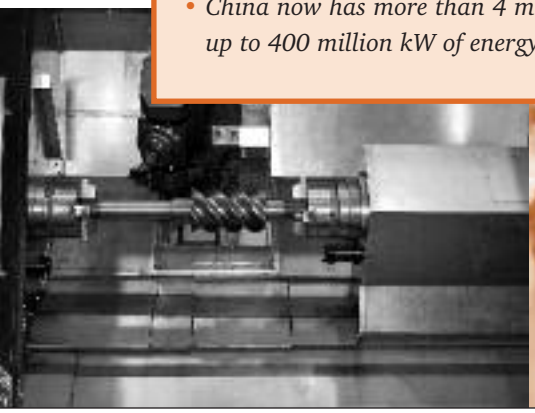
Immediately after the outbreak of the international financial crisis in 2007-8, the Chinese government identified scientific and technological innovation as one of the four key measures in its plan for countering the crisis. The modern history of human civilization shows that scientific and technological innovation has always been the most important driver for sustainable economic and social development. Thus, China has made vigorous efforts to develop strategically important new industries with the aim of boosting industrial development with technological innovation. This strategy has made important contributions to sustaining China's economic growth. Market factors now take a primary role in the allocation of scientific and technological resources, and the policy and legal environment for encouraging innovation and start-up by the business sector and scientists is improving. According to 2011 data, 74% of China's R&D investment comes from the business sector, and 73% of the R&D personnel are hired by businesses. Major progress has been made in the building of national innovation systems, and a market-oriented system for technological innovation, in which enterprises play the leading role and which combines the efforts of enterprises, universities and research institutes, is taking shape.

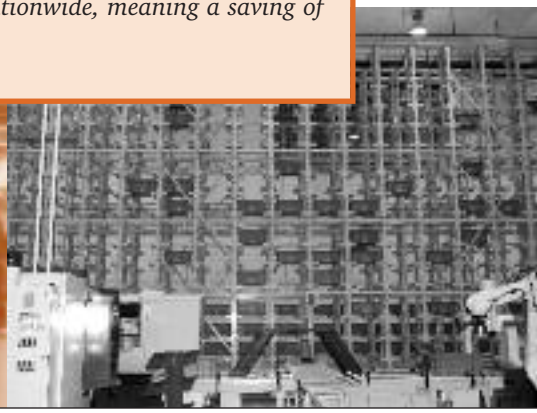
The history of human civilization shows that S&T innovation is the most important driver for sustainable economic and social development.

Indeed, a new industrial revolution spearheaded by scientific and technological innovation is in the making. Progress in information communication technologies, energy-saving and environmental technologies, bio-pharmacy, nanotechnology and the development of new energies and new materi-

CHINA: FACTS AND FIGURES

- *China has launched 16 national major science and technology programmes, made breakthroughs in a number of core technologies and supported the development of strategically important emerging industries.*
- *National high-technology parks are playing an increasingly important role in concentrating resources and leading regional development, and becoming a major engine for economic growth.*
- *Scientific and technological innovation in the agricultural sector is picking up speed. China remains a world leader in super hybrid rice technologies and has increased the proportion of high quality seeds of wheat, corn and cotton being used by Chinese farmers.*
- *China has made significant progress in manned space and moon exploration projects. In June 2012, the docking of the first manned spacecraft 'Shenzhou 9' with the space station Tiangong 1 was completed successfully. The mission's crew included the first Chinese female astronaut, Liu Yang.*
- *Also, in June 2012, China's manned deep-ocean submersible conducted a successful 7,000-metre dive.*
- *China has now produced and sold 19,000 electric vehicles nationwide, more than 14,000 of which are privately owned and used daily on the roads.*
- *China now has more than 4 million light-emitting diode (LED) lights in use nationwide, meaning a saving of up to 400 million kW of energy per year.*





als will change the development perspective, modes of economic operation, the means of production and our way of life across the globe. Such progress will also create new opportunities for developing countries to achieve economic transformation through scientific and technological innovation. Against this backdrop, many countries have adjusted their scientific and technological development strategies, improved the institutional arrangements, and devoted more energy to developing knowledge and technology intensive emerging industries so as to seize the new opportunities provided by these scientific and industrial revolutions.

Significantly, the Chinese government is also committed to advancing international science and technology cooperation, and in particular, cooperation with other developing countries. By the end of 2011, we had signed 106 inter-governmental agreements on science and technology cooperation with 100 countries and regions and joined over 1,000 international science and technology organizations. We have also launched a number of joint projects in high-tech fields like space technology and applicable technologies for agriculture and forestry, which have yielded fruitful results. We have launched the China-Africa and the China-ASEAN (Association of South-East Asian Nations) Science and Technology Partnership Programmes. We have also joined with the United Nations to sponsor trilateral cooperation projects in other developing countries.

The Ministry of Science and Technology organizes technology training courses for developing countries on an annual basis in a wide range of areas and has published the *Applicable Technology Manual — South-South Cooperation on Science and Technology to Address Climate Change*, as well as setting up a platform for international scientific and technological cooperation on combatting climate change and achieving sustainable development.

Thus China is ready to share information on scientific and technological innovation policies and managerial experience with other developing countries, and to work with them to jointly support cooperation projects and exchange personnel, to leverage each other's strengths for mutual benefit, and to deal with the challenges facing the international community to promote common development and prosperity together.

Concluding his presentation to the TWAS conference, Wan Gang quoted a famous poet from China's Tang Dynasty: 'To enjoy a grander sight, climb to a greater height.'

"This is the most vivid expression of my expectation for the future of China's scientific and technological development," he confirmed, "and of China's cooperation with other developing countries in science and technology." ■

CHINA'S WORLD RANKING IN SCIENCE AND TECHNOLOGY

- *The total number of full-time R&D personnel in China increased from 1.7 million in 2007 to 2.8 million in 2011, ranking first in the world.*
- *China has been ranked second in the world for three consecutive years for the number of international papers published and the quality is constantly improving.*
- *The number of patents granted in China has jumped from 68,000 in 2007 to 172,000 in 2011, ranking third in the world.*
- *China is ranked second in the world for the 'added value' of high-tech industries.*
- *According to 2011 data, 74% of China's R&D investment comes from the business sector, and 73% of the R&D personnel are hired by businesses.*

SMALL COUNTRY: BIG AMBITIONS

ECUADOR'S AMBASSADOR TO CHINA, LEONARDO ARÍZAGA, TALKS ABOUT HIS GOVERNMENT'S EFFORTS TO REFORM THE CHAOTIC AND 'UNFAIR' UNIVERSITY SYSTEM THROUGH UNPRECEDENTED INVESTMENT IN SCIENTIFIC RESEARCH CAPACITY

Leonardo Arízaga is an arresting presence: standing tall on the stage of Tianjin's Great Hall during the ministerial session of the TWAS General Conference, dressed in a thick white cotton shirt, he looks more like a chef than a diplomat. But it soon becomes clear his relaxed, open manner goes hand in hand with a thorough knowledge of his subject, making him a compelling public speaker, a highly effective diplomat and a passionate advocat of his country's rapidly improving science and technology infrastructure.

Arízaga is unequivocal about the huge advances in S&T policy and investment Ecuador has made since Rafael Correa assumed the presidency in 2007. Advances which have been aided by substantial financial and advisory input from China, with whom Ecuador has developed strong diplomatic and business relations.

Ecuador, located in the north of South America, is an exceptionally beautiful country, bordered by Colombia to the north, Peru to the east and south, and by the Pacific Ocean to the west. The country straddles two hemispheres and its landscape includes both coastline and mountain ranges, as well as the spectacular Galápagos Islands, located in the Pacific, 1,000 km to the west, and home to unique species, including the marine iguana, giant tortoise and the world's only equatorial penguin. Indeed, Ecuador's varied geography and climate make it the country with the highest biodiversity per square metre in the world. In its 2008 constitution, Ecuador was the first country in the world to recognize legally enforceable 'Rights of Nature', or ecosystem rights, including the directive to "sustainably conserve and manage the natural heritage including its land and marine biodiversity which is considered a strategic sector."

But, aside from encouraging participants to visit his country and see for themselves, it is the healthy state of the Ecuadorian economy, and subsequent investment in scientific research, development and capacity building that Arízaga wants to impress on his audience: "I want to talk about what we are doing – not so much what we have done."

Ecuador is designated a developing country and remains on TWAS's list of 81 science and technologically lagging countries. But, to hear Arízaga talk about his government's latest plans, you wouldn't think so.

Ecuador has the same population as the city of Tianjin (14 million) and one million people have 'left poverty' in the last five years. Like most developing countries, Ecuador exports commodities, but has been

ARÍZAGA: ECUADOR'S AMBASSADOR TO CHINA

Though based in Beijing as the Ecuadorian ambassador to the People's Republic of China since November 2010, Arízaga has long played a key role in developing bilateral relations between Ecuador and other countries. He has worked for over 25 years in the foreign service, having graduated in that subject from Georgetown University, Washington DC, USA, and then obtaining the title of doctor in international relations from the Universidad Central del Ecuador. *Arízaga entered the Ecuadorian Ministry of Foreign Affairs in 1987, held various diplomatic positions in Ecuador and abroad (including Austria and Peru) and has been a representative of Ecuador for the United Nations Industrial Development Organization (UNIDO), the International Atomic Energy Agency (IAEA) and the United Nations office in Vienna. He also served as deputy secretary for bilateral relations in the Ministry of Foreign Affairs and Commerce from 2009 to 2010.*

Directly designated Ecuador's Ambassador to China by President Rafael Correa, Arízaga, on taking up the post, said that his main goal was "to deepen political and diplomatic relations, expand China's investment in strategic and production projects and increase Ecuadorian exports to China."

fortunate to include oil among them. The corresponding high earnings have boosted the economy. "We have not been affected so much by the economic crisis of 2008-9 and, anyway, we do a lot of business with China and India," confirms Arízaga.

Correa heads the government, based in the capital city of Quito, and research policies are managed by the National Secretary of Higher Education, Science and Technology (SENESCYT), with which Arízaga has close links.

"Even though we are a successful, middle income country, we want to change our development pattern and stop depending exclusively on oil and commodities, because we know they won't last forever. We need to transform the productive sector, and science and technology will play a very important role in this.

"Our economy is doing very well and growing – our gross domestic product (GDP), at USD4,000 per capita, is comparable to China's. We don't need financial help," he assures conference participants, "Ecuador can sustain itself. But if we don't invest in our best skills, if you don't bring your colleagues to our country to teach us what you have learned, we will get stuck. We will remain a middle income country with little possibility of changing."

Traditionally, Ecuador's productive sector has depended on adding value to primary resources, including wood products, and fresh, prepared food. In the secondary sector, this added value applies to clothing and shoes, pharmaceuticals, biochemistry, metal mechanics, petrochemistry and vehicles, (including motors, bodywork and parts). The tertiary sector instead has focused on such areas as tourism, environmental services, renewable energies, logistics, transportation and software.

The quite radical strategy that SENESCYT has developed is to transform the country's primary production sectors into secondary and tertiary sectors, such as medicines, vehicles and parts, and information and communication technologies (ICTs). But to do this means expanding scientific and technological research in the life sciences, in petrochemistry, in alternative energies and climate change, and in nano-science and ICTs.

The government is focusing on three main activities to achieve these goals: strengthening general education (which impressively "includes sending all our Eng-

lish teachers abroad to English-speaking countries"); nurturing talent; and strengthening public institutions.

'If we have a coherent policy structure, we can really improve academic levels", says Arízaga, "but we have had to make difficult decisions. For example, we closed down 14 universities in April this year because the academic level was too low."

In 2009, the Ministry of Higher Education, Science Technology and Innovation conducted an evaluation of the country's universities, grading them from A to E. Twenty-four were deemed unacceptable and were warned that they must improve or be shut down.

Indeed president Correa, a former university economics professor, is on record as saying that, "Ecuador probably has the worst universities" in South America. He coined the term 'garage universities' to describe the *ad hoc* private institutions cropping up all over the country to meet the demand for higher education, but without any system of quality control in place, with poor resources and training (often employing only part-time lecturers), but still managing to make a tidy profit. In addition, many students were selected on the basis of 'who they knew', while other students (especially those from the poorest backgrounds) were denied places.

Correa and his left-wing government place a high premium on academic excellence, rather than simply passing as many students as possible through the system. Ecuador's 'scholarship programme for excellence' to address the deficit in suitably trained professors is "unprecedented", says Arízaga. "The present government has awarded 20 times more scholarships than the last seven governments put together." This amounts to 1,702 scholarships to date with the goal fixed at 3,500 scholarships to be awarded by the end of 2012.

"We have selected the best 50 universities in world, and we are sending our best scholars to them, investing one billion dollars over a four year period, that's USD250-300 million per year. We will have 50 scholarships just for China, because we see how successful China has been in building up research capacity and converting research into marketable products. Because I live in Beijing, I have seen that first hand", he explains.

The government is also working on the 'pull factor', attracting professors and high-level researchers to Ecuador through competitive packages. "We have funds for up to 300 professors to visit our institutes and universities through the Prometheus scheme. They can stay from four months to two years." The aim is that they share their knowledge in targeted areas relevant to developing the economy, such as natural resources and renewable energies, health, agriculture fishing and biodiversity. The government provides a competitive stipend for those already with PhDs of USD6,000 per month, while junior scholars are offered USD4,000. Travel and medical insurance are all provided.

The government places a high premium on academic excellence.

While, in the long-term, these programmes will certainly have a major impact on Ecuador's scientific research capacity, the government's flagship project is the design and construction of an entire 'City of Knowledge', a purpose-built centre of academic excellence and a clear symbol to both national and potential international investors, that Ecuador's unprecedented investment in science and technology really means business. The city, called 'Yachay' from the native Quechuan verb 'to learn', is destined to be the first science and technology park in Latin America and it is clear that a great deal of Arízaga's efforts and hopes for the future prosperity of his country are invested in its successful development.

Yachay will be built in Urcuqui, located in the northern province of Imbabaura, close to four airports and spanning 4,270 hectares. Like other science and technology parks that have sprung up around the world (Arízaga cites among others, the City of Palo Alto in Silicon Valley, California, built as long ago as 1951, and *Daedeok Innopolis* built in South Korea in 1973), Yachay will include research centres, an information depository, a university, an agricultural technology development centre and a high-technology industrial park.

Yachay, the City of Knowledge, will make the most of Ecuador's celebrated megadiversity.

Unlike other science parks, however, Arízaga emphasizes that Yachay will make the most, both geographically and academically, of Ecuador's celebrated 'megadiversity', and that the project is based on socially and environmentally sustainable principles. In addition, cross-sector innovation will be encouraged with generous financial incentives.

Does Arízaga have any recommendations or advice for other developing countries wishing to invest in science and technology? He mentions the country's political stability since 2007 (whereas in the preceding decade, 7 presidents had taken office) and demonstrable economic growth as being fundamental in Ecuador's turnaround and key factors for China's continued investment – one of the highest investments China has made in any country, amounting (with loans included) to USD 5.3 billion.

"The good thing about working with China," says Arízaga, "is you can get things done very quickly. For example, we don't yet have a national science academy, so we have asked China to help us. We like the Chinese model. We will send professors to the Chinese Academy of Sciences (CAS) and they will receive our students. CAS will also help us draft the new curricula in nanoscience, for example."

Arízaga is certainly very good at public relations for his country, and is clearly proud of what his government has achieved. "It's easy to sit around and talk about the future," he muses, "but we can really see the results in the projects we have built and that gives me great satisfaction professionally and personally. I'm a diplomat, my father was a diplomat but I hope my son will learn in the City of Knowledge." ■

DURING THE TWAS GENERAL CONFERENCE IN TIANJIN, HENERI A.M. DZINOTYIWEYI, (TWAS FELLOW 1988) AND ZIMBABWE'S MINISTER FOR SCIENCE AND TECHNOLOGY DEVELOPMENT, SPOKE ABOUT THE NEW COALITION GOVERNMENT'S PLANS TO ATTRACT ZIMBAWEAN SCIENTISTS BACK TO THEIR HOMELAND.

Zimbabwe is set to hold elections by June 2013 to end the power-sharing deal between long-standing president Robert Mugabe and recently inaugurated prime minister, Morgan Tsvangirai. Heading the Movement for Democratic Change (MDC), Tsvangirai marginally won the first round of the elections in 2009, but withdrew from the second round, letting Mugabe, representing the Zimbabwe African National Union – Patriotic Front (Zanu-PF), claim victory in that second round. This triggered a political crisis that led regional leaders to broker an agreement of all political parties represented in parliament and Zimbabwe's coalition Government of National Unity (GNU) was born.

CAUTIOUSLY OPTIMISTIC

Zimbabwe's Minister of Science and Technology Development, Heneri Amos Murima Dzinotyiweyi, holds a doctorate in mathematics from the University of Aberdeen, UK, and has been full professor and dean at the University of Zimbabwe. In the mid 1990s he worked on a study of science and technology across the 14-state Southern African Development Community, returning to his post as professor of mathematics prior to his resignation to stand in the March 2008 elections.

After presenting "some challenges in science, technology and innovation (STI) development", to the ministerial session of the TWAS conference, Dzinotyiweyi sat down with the TWAS Newsletter editor and elaborated the points he had raised.

When I began my presentation on how science policy can contribute to improving the economy in Zimbabwe, I was being deliberately provocative. I said that talking about the gap between rich and poor means nothing unless we talk about employment. People must have jobs, the government must have an employment policy, otherwise our science, technology and innovation (STI) policies will be too distant to effect positive change on the poor. We first need to look at building the economy. How else will we have the money to put science policies into practice? This point is obvious, but it is not trivial.

When we meet at these TWAS conferences I think we must focus on understanding what is really happening – what is the driving force behind the issues in need of redress. As a mathe-

matician, I want to know what drives people to act the way they do. This leads me to the second point I wanted to emphasize, namely that poverty is only one of the problems we face in the developing world. The main problem is about life and death. Think about the conflicts taking place, for example. We need to ask ourselves, what are the STI solutions to problems like that?

Another provocative question: why have African countries generally made such little progress since independence and how can STI solve this? I have been a TWAS Fellow for 24 years, and I think that TWAS is in a privileged position to address this challenge.

In Zimbabwe, we had our Second Policy on Science, Technology and Innovation, jointly launched by the President, Robert Mugabe, and the Prime Minister, Morgan Tsvanagirai. This is a Policy whose implementation is assigned to my ministry – the Ministry of Science and Technology Development. We also had the support of UNESCO in consultations held to formulate the Policy. Our vision – the Policy vision – is to integrate science and technology into both individual and national development. Hence even individuals must take stock and ask themselves, 'what does science mean to me this year, next year…?' in order to evaluate personal progress realized through science and technology contributions.

ZIMBABWE CAN LEARN FROM CHINA

Extract from 'Remarks by the prime minister of the Republic of Zimbabwe, the Right Honourable Morgan R. Tsvangirai, on the occasion of the launch of the Second Science, Technology and Innovation Policy, Harare International Conference Centre, Zimbabwe, 13 June 2012.

• *I have just returned from a successful visit to China at the invitation of the Chinese government. In my discussions with Premier Wen Jiabao and business executives from various corporations, it became clear that the success of China has been premised on sound policies that are science and technology oriented.*

The success of companies such as Huawei*, a leading global ICT solutions provider, and* Lenovo*, show the emerging trend of the Chinese focus on technology and innovation. Indeed, science and technology have progressively become a catalyst for China's economic growth.*

Science, technology and innovation have the capacity to help the African Union's vision of having at least 20 of its 54 member states attain middle income status by 2030, besides boosting the continent's presence in published journals.

Zimbabwe must learn from such countries as China and India, which have invested several billions of dollars in science, technology and innovation development.

Today, those countries are the envy of many. These countries have developed to where they are today, not because they had plenty of resources, but simply because they maximized the benefits that they could acquire from the little resources they had through efficiency as a result of investment in technology.

THE EFFECT OF LAND REFORM ON ZIMBABWE'S ECONOMY

Prior to 2000, farmers in Zimbabwe owned large tracts of land and could depend on economies of scale to raise capital, borrow money when necessary, and purchase mechanized equipment to increase productivity.

However, since the 'fast-track land reform programme' was introduced in 2000 there has been a steep drop in total farm output. Crops for export have suffered severely. Zimbabwe was the world's sixth largest producer of tobacco in 2001 but today produces less than a third of the amount produced in 2000, the lowest amount in 50 years. Zimbabwe was once so rich in agricultural produce that it was dubbed the 'bread basket' of Southern Africa, now it is struggling to feed its own population. About 45% of the population is considered malnourished.

Zimbabwean agriculture has undergone a huge structural change and some reductions in yield, particularly those due to decreased farm size, could be permanent. On the other hand, the number of smallholder farmers in tobacco has increased sharply and the output of tobacco, maize, and cotton is recovering, although yields are nowhere near their previous levels. According to a World Bank analysis, collectively these micro-entrepreneurs constitute one of the best performing sectors of the Zimbabwe economy.

Our government has initiated some positive science and technology programmes. For instance, we have just opened a directorate for nanotechnology within the ministry and, under it, one of the projects we are funding is the 'Nano-Filter' water purification project based at Zimbabwe's National University of Science and Technology (NUST). We are contributing USD20,000 towards the development of a pilot plant that will purify water for rural communities, developing this very advanced technology but using locally available clay, in granular and powder form, which filters all known microbiological organisms in water, making it suitable for household use, including drinking. The Nano-Filter has been registered with the Zimbabwe patents office.

The government has also introduced an Innovation and Commercialization Fund (ICF), setting aside USD1.5 million in 2012 to be disbursed through the Ministry of Science and Technology Development on a competitive basis. In doing so, Zimbabwe is one of the few member states to follow the recommendations of the Common Market for Eastern and Southern Africa (COMESA) which met in Lusaka, Zambia, in June 2012.

The fund is used to support research on projects in areas like nanotechnology, energy, water and indigenous knowledge systems and technologies. Proposals can come from anyone but they are evaluated by an independent scientific committee. At the beginning of each year, we advertise for applications to this fund in local newspapers, and urge people in industry to pair up with researchers and institutes and collaborate in their proposals.

Through these ICF funded projects, we have identified a communication gap between entrepreneurs and researchers. Researchers tend to stay too much in the laboratory, and they don't engage with the outside world. So we're also organizing workshops on patenting for researchers to encourage more scientific contributions to come to the fore.

We do not lack clarity or determination. But we do desperately lack funds.

In Zimbabwe, the economic decline was primarily from about 2000. We lost massively on manpower and we know it.

Not surprisingly, many Zimbabweans left the country at that time – to overseas and South Africa in particular. It's a common joke in Zimbabwe that Zimbabweans run South Africa – they are so visible in many top South African positions.

The decline in the economy, triggered by the political situation, was severe over the period 2000 to 2008. Since 2009, the country has been in a process of rebuilding and adjusting to the new recovery programmes under the coalition government, the Government of National Unity (GNU). For instance, Zimbabwe converted to using the US dollar as currency and this has killed inflation and boosted the economy.

With regards to reversal of brain drain, we're focusing on two things. First, we need to encourage Zimbabweans who have left the country – and are scattered around the diaspora – to return, where possible. As a founding member of the eight-year-old Zimbabwe Academy of Sciences, I'm in a good position to use the academy's international contacts to establish links with Zimbabwean researchers now living elsewhere. We are encouraging these people to return but we know many won't until the economic situation improves and the institutions at home are in a position to enable them to continue their research should they return. This leads us to the second point of focus.

TAPPING THE DIASPORA

Extract from Tsvangirai's speech to launch the Second Science, Technology and Innovation Policy

• *The implementation plan of the Science, Technology and Innovation Policy shall provide effective strategies for tapping into the diaspora. It is imperative that we institute ways to lure Zimbabwean scientists who are working in foreign lands back to the country to contribute to national development. Over the last ten years, this country has suffered a deficit of skilled and qualified personnel into the diaspora and these people will not be in a hurry to come back home at the rate needed to sustain our development. Therefore, corporate and academic institutions must rebuild the reservoir of skilled artisans, engineers and other disciplines to fill the void.*

Second, we need to improve the research capacity and quality of our institutions, and develop joint programmes with scholars and institutions outside Zimbabwe. That way, even Zimbabweans in the diaspora can begin to contribute to developments back home through collaboration with our institutions. However, even these modest programmes face constraints. The research and teaching capacity we have left here in Zimbabwe tends to be very low. Some

departments are really run down too far. There is inadequate funding for research. TWAS programmes are definitely helping in this area as universities are running postgraduate programmes with a minimal core of staff.

On top of this, the land reform actions have made many western countries respond negatively to Zimbabwe's calls for foreign direct investment.

In Sub-Saharan Africa, Zimbabwe used to be second in manufacturing only to South Africa. Now its economy is one of the bottom three, comparable to Lesotho and Swaziland. We import many things we used to produce locally. Before, we had a very rich agricultural sector including coffee, cotton, flowers, sunflowers, maize and tobacco – all contributing to exports. Since 2009, tobacco exports have been increasing annually but they are still not close to the 1990s peak, and exports in general are far below what the country needs.

ADDING VALUE

Extract from Tsvangirai's speech to launch the Second Science, Technology and Innovation Policy

• *A challenge that has continued to affect our economy is the capacity to add value to our natural resources. This has made us net consumers of products developed from the very raw materials that we export to developed countries. The second Science, Technology and Innovation Policy is expected to result in a significant improvement in our national capacity to export finished products rather than primary goods that fetch very little on the international market.*

Zimbabwe was a British colony and, from those roots, whites owned most of the land. Then the government took most of the farms to settle the landless black majority in the land reforms. When the farmers left, most resettled black farmers did not have the skills or financial capacity and production went down.

People are not able to generate money and the banks don't have the money to lend. It's a vicious cycle that's destroying the economy. As I said, the starting point in developing any S&T policy has to be: where does the money come from?

The frustration is that, in Zimbabwe, there are people who understand what needs to be done but they can't do it.

You know, TWAS could really help here just by setting up a small team to drive a comprehensive independent analysis of the economy. An analysis to show where things are happening and where they are not happening – that would make the country more obliged to improve. ■

PHOTOVOLTAICS IN CHINA

AT THE TWAS CONFERENCE IN TIANJIN, WANG SICHENG, A SENIOR RESEARCHER IN SOLAR ENERGY AND CURRENTLY DIRECTOR OF THE ENERGY RESEARCH INSTITUTE AT CHINA'S TOP ECONOMIC PLANNING BODY, THE NATIONAL DEVELOPMENT AND REFORM COMMISSION (NDRC), OUTLINED THE STATUS OF PHOTOVOLTAICS IN CHINA AND THE INCENTIVES THAT THE GOVERNMENT HAS PUT IN PLACE TO ENSURE THAT SOLAR ENERGY BECOMES A VIABLE ALTERNATIVE TO FOSSIL FUELS.

Spending a day out in Tianjin after the conference is over, two things strike you. First, the impressive construction projects taking place everywhere on a huge scale. Second, the grey mist obscuring your view of these same majestic buildings.

That mist is not excess moisture in the air, but pollution. While nowhere near equivalent to the lethal 'pea soup' smog that threatened the inhabitants of London in the late nineteenth century, the cause is essentially the same – the burning of enormous amounts of fossil fuels needed to generate electricity for industrial production and transport. Eighty percent of China's electricity is now generated from coal, which is responsible for 85% of the country's sulphur-dioxide emissions and a major contributor to its greenhouse gas total.

The more China is successful as an industrial nation, the more energy it needs, and the more greenhouse gases it inevitably emits. China's coal consumption tripled between 2000 and 2010. And yet, even this huge amount is not enough: it has been estimated that China needs to quadruple the amount of power it generated in 2005 to meet its needs in 2030. Decreased industrial activity is not an option: China must maintain its rate of production in order to feed, clothe, house, and employ its burgeoning population, and to raise the standard of living of the many still in poverty.

On the other hand, in what has been described by Beijing-based international environmental journalist

WATER, WIND, SUN

China deploys three main sources of renewable energy: hydropower, wind power and solar power. The Three Gorges Dam on the Yangtze River in Hubei province is the world's largest hydroelectric power station and there are plans to build 7 wind power "mega projects" by 2020 bringing China's wind power capacity to about 75% of current world capacity. Until recently, solar power was trailing behind a poor third, but China is now the world's largest producer of solar panels and plans are in place to deploy more and more off-grid systems throughout rural China.

Cristina Larson as the 'great paradox of China', China now also looks set to become, by 2020 if not before, the world's leader in renewable energies at all levels: in research investment, in manufacturing and supply; and in deployment, exhibiting what at first sight seem to be two entirely incompatible elements: both 'green energy' and 'black skies'.

So how can China contend with these two contradictory pulls: a drastic shortage in the energy supply on the one hand, and serious environmental pollution on the other, which is not just lowering but seriously threatening the quality of life. Indeed, some claim that the disproportionately high rates of cancer-related disease, and the limited access to quality water supplies for millions of rural poor, for example, are a direct result of pollution. In addition, the World Bank estimates pollution damages cost the equivalent of 5.8% of China's annual gross domestic product.

How can China contend with a shortage in the energy supply and serious environmental pollution?

Across the globe, but especially in China, just a short decade ago, the future for renewable energies looked bleak: fossil fuels were readily available and relatively cheap, and the infrastructure already existed for their exploitation. Investing money in renewable energy meant substantially increasing production costs, counterbalancing the competitive edge China had enjoyed for many years owing to cheap labour costs, meaning that the ubiquitous 'made in China' products would be out of a market. Until recently, indeed, weighing up China's immediate needs, closing a blind eye to pollution and going full steam ahead with industrial expansion must have seemed like a necessary price to pay.

Flickr/ANR2008

Flickr/gmetrail

It was beginning to seem inevitable that the Chinese were destined to have their beautiful new cities marred by smog. But the Chinese government has taken concrete and effective action to correct this trend, and indeed, in the 12th Five-Year Plan, adopted on 14 March 2011, China introduced measures aimed at turning the situation around. The Plan is wide-ranging and comprehensive in terms of environmentally sustainable measures, including: increased forest cover; greatly improved rail transport (connecting cities via high-speed trains and within cities through subway and light rail systems); strict motor vehicle emission standards; and wastewater and solid waste treatment plants. There is also a strong emphasis on reuse and recycling.

In the Plan, too, China has confirmed its intentions to cut its carbon footprint and become more energy efficient by reducing greenhouse gas emissions, reducing its reliance on fossil fuels and making a huge investment in renewable energies. The Plan sets a goal of 9.5% of overall energy usage to come from renewable sources by 2015 and designates new low-carbon energy technologies as a strategic industry to spur economic growth.

China's 12th five-year plan introduced comprehensive environmental measures.

SUNLIGHT AT THE END OF THE TUNNEL

At the TWAS conference in Tianjin, Wang Sicheng, an expert on solar energy and currently director of the Energy Research Institute at China's top economic planning body, the National Development and Reform Commission (NDRC), outlined the status of photovoltaics in China and the incentives that the government is putting in place to ensure that solar energy becomes a real alternative to fossil fuels – and a viable business proposition.

Among the incentives Wang listed were: the Renewable Energy Law; the National Plan to set near and long-term targets for renewable energy; a government supported research and development programme for photovoltaics (USD80 million per year); well designed business models and innovative financing mechanisms; and government-sponsored projects to deploy renewable energies in rural areas.

"These interventions", said Wang, "mean that significant progress has been made in photovoltaic research and development, mass production, cost reduction and domestic market expansion."

As a result of investment in research and development, and owing to government subsidies to solar panel manufacturers, this government strategy has almost been too effective: China has now become the biggest producer of solar panels in the world, dominating the global market, and entering into an increasing price war with the United States, which has retaliated with duties on Chinese imports. The result, for the Chinese industry in the short term, has been extraordinary overcapacity, with a glut of Chinese solar panel companies, some of which have collapsed. Indeed, even China's largest panel maker, Suntech Power Holdings, has needed emergency funding from the government to stay afloat.

But, with the government's most recent plans to increase domestic deployment of solar panels, this glut is no longer a problem. The goals for photovoltaic installations have become more ambitious with each consecutive 5-year plan. Initially, the quota was set at 18 GW by 2020, now the goal is already 50 GW by 2020 (although even this target could be exceeded).

Reports show huge jumps in installed capacity and production throughout China.

BEAUTIFUL NAMES

In his presentation, Wang talked enticingly about the 'beautiful names' attached to many of the government's incentive programmes for solar energy, and indeed they do inspire: 'The Tibet Sunshine Project', 'The Golden Sun Demonstration Programme', and the 'Brightness Programme'.

When the People's Republic of China was founded in 1949, the vast majority (over 90%) of the rural Chinese population was not connected to the national grid.

According to latest figures, electricity now reaches 99% of that rural population. But this has not been achieved solely by extending the grid, which, given the remote locations and low density of households, is not always cost-effective. Off-grid renewable energy technologies have been more efficient and effective in many cases. Where possible, the government has preferred to build self-contained small hydropower stations, which are cheaper than wind and solar energy systems to install and maintain, but where local conditions are not favourable (where there is no natural water supply, for example), solar and wind energy are being deployed. When the local demand for electricity is not large, solar energy can be reliable and cost effective, especially as the cost of both materials and installation continues to decrease.

The Brightness Programme began in 1996 with the aim of providing electricity (through solar and wind applications) to 23 million people located in Gansu, Qinghai, Inner Mongolia, Tibet and Xinjiang provinces by 2010. Indeed, the target of 100W of capacity available per person has been reached. The first stage of the programme (1999-2002) provides electricity from single photovoltaic solar home systems and from village photovoltaic battery systems to 50,000 people in three provinces. The second stage (2002-2005) was the Township Electrification Programme, one of the largest of its kind in the world. With a total investment of USD 700 million from both central and local government special funds, over 1,000 townships (located in the western provinces) were electrified in less than 20 months, providing almost one million people with electricity. The third stage (2006-2010) – The Village Electrification Programme – brought electricity to around 20,000 villages, all of them located in off-grid western regions of the country.

The Chinese government currently estimates that, by 2020, only 1.5 million people will be without electricity. That's not bad for a population of over 1.3 billion – half of whom live in rural (often remote) areas spread over a vast area.

As well as providing power to millions of people, it seems that photovoltaic panels (along with the deployment of other renewable energy solutions, and policy measures to reduce greenhouse gas emissions) are beginning to ease the daunting problem of pollution in China.

Let's hope that, on our next visit to China, we will have a clearer view. ■



HONOURS

• **Aderemi Oluyomi Kuku** (TWAS Fellow 1989) has been named in the inaugural class of Fellows of the American Mathematical Society (FAMS). The FAMS programme was devised to honour people who have made outstanding contributions to the advancement and communication of mathematics throughout their careers.

Aderemi Oluyomi Kuku

Born in Nigeria, Kuku was vice-president of the Science Association of Nigeria (1983-84) and academic secretary (physical sciences) of the Nigerian Academy of Science. He then served as president of the African Mathematical Union (AMU) (1986-95) and was professor of mathematics at the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy (1995-2003).

Today he is William W.S. Claytor professor of mathematics at Grambling State University, Louisiana, USA, and remains a world leader in several aspects of algebraic K-theory and related mathematics, a field universally acknowledged as a unifying force for mathematical research. His research has produced groundbreaking results in non-commutative algebra, non-commutative number theory and non-commutative geometry. In his honour, members of the National Mathematical Centre in his home country of Nigeria will organize a dedicated celebration, during the forthcoming 8th Pan-African Congress of Mathematicians, AMU Congress in Abuja, Nigeria (1-8 July 2013).

AWARDS

• **Syed Muhammad Qaim** (TWAS Associate Fellow 2001), a German national of Pakistani origin, has been honoured with the 'Golden Jubilee Award', a recognition bestowed by the international journal *Radiochimica Acta* to those members who have made lifetime contributions to the journal. The award was conferred during the 8th International Conference on Nuclear and Radiochemistry that took place in Como, Italy, last July.

Qaim holds a BSc from Punjab University in Lahore, Pakistan, a PhD from Liverpool University, UK, and a DSc in applied nuclear chemistry from Birmingham University, also in the UK. He has been working at the Research Centre, Julich, Germany, since 1970, where he has been division leader since 1985. Qaim's work covers a broad spectrum of fields in chemical sciences such as nuclear chemistry, nuclear reactions, radiochemical techniques, nuclear data for application and radionuclides in medicine.

Syed Muhammad Qaim

CATALYST

• The first **CATALYST project regional workshops** were held in Giovinazzo, Bari, Italy, for the European Mediterranean region, and Addis Ababa, Ethiopia, for the Africa region in September and October, respectively. CATALYST is funded by the European Commission 7th Framework Programme (FP7) and is focused on 'Capacity Development for Hazard Risk Reduction and Adaptation'. TWAS is one of the seven partners of the consortium. The reassessment of the vulnerability of people and cities in the Mediterranean region, to better manage disaster risk – especially from climate extremes and earthquakes – was the focus of the first workshop (27-28 September). In Addis Ababa (10-11 October), experts discussed strategies to implement capacity development focused on the management of and adaptation to natural disasters and climate extremes in African urban settings. As cities continue to grow and become more densely populated, there is a need to share best practices and find low-cost/high-efficiency interventions that can help African communities better respond to anomalous climate-induced events such as drought, heavy rains, floods and earthquakes.

DFG-TWAS COOPERATION

• Young African scientists will have more chances to carry out research in Germany, thanks to a programme of cooperation recently endorsed by the *Deutsche Forschungsgemeinschaft* (DFG, the German Research Foundation) and TWAS. This programme stems from the desire that both DFG and TWAS have to cooperate with developing countries in

the spirit of worldwide responsibility. It also implements and strengthens North-South cooperation, in line with TWAS's mission.

Each year, TWAS and DFG will select 30 postdoctoral researchers from sub-Saharan Africa, who will work at one of the several hundred participating laboratories and research institutes in Germany. Each visit to Germany will last up to three months, with TWAS covering the travel costs while DFG provides a monthly stipend and research costs. The partnership which links TWAS and DFG began in 2010 with the provision of 10 cooperation visits per year and has since been further strengthened.

RECOGNITION

• **Ashok K. Vijh** (TWAS Associate Fellow 1987), an eminent electrochemist and professor at the *Centre Énergie Matériaux Télécommunications* at the *Institut National de le Recherche Scientifique* (INRS) in Montréal, Canada has been awarded the *Docteur Honoris Causa* by the INRS. Vijh, who holds a PhD in electrochemistry from the University of Ottawa, has been senior research fellow at the *Institut de Recherche d'Hydro-Québec* since 1973 and an untiring promoter of the role of science in society. His discoveries have changed the foun-

Ashok K. Vijh

dations of electrochemistry. For example, he promoted a novel approach to several phenomena such as electrolysis, corrosion and the behaviour of semiconductors. In addition, he explored new avenues by applying his results to sectors such as energy, industry and the environment. Among the awards he has received in his career are the prize from the *Association Canadienne-Française pour l'Avancement des Sciences*, the Noranda award and a medal from the *l'Institut Canadien de la Chimie*.

IN MEMORIAM

• **Dame Louise Napier Johnson** (1940-2012), TWAS Associate Fellow 1999, passed away on 25 September 2012, in Cambridge, England, the day before her 72nd birthday. A biochemist and a pioneer in protein crystallography, Johnson graduated from the Royal Institution, London, took a degree in physics at University College London, and received her PhD from London's Royal Institution.

Johnson's first article was published in 1965, in *Nature*, and described the seminal work she had accomplished under David Phillips's supervision, solving the structure of the enzyme lysozyme by means of X-ray crystallography. The structure of lysozyme was only the second protein structure to be determined after myoglobin (from muscles) in 1958 by John Kendrew. She was made David Phillips Professor of Molecular Biophysics at Oxford University from 1990 until 2007, when she retired. Indeed, the X-ray crystallography work she developed with David Phillips helped lay the foundations for modern structural biology research and pharmaceutical industry applications.

Dame Louise Napier Johnson

Among her other achievements, Johnson was instrumental in the development of Diamond, the UK's national synchrotron, and co-authored (with Tom Blundell) an influential textbook on protein crystallography. She was the wife of Abdus Salam (Nobel Prize in Physics, 1979), founder of both the International Centre for Theoretical Physics (ICTP) in Trieste, Italy (which now bears his name) and TWAS, which has its headquarters on the ICTP campus.

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.

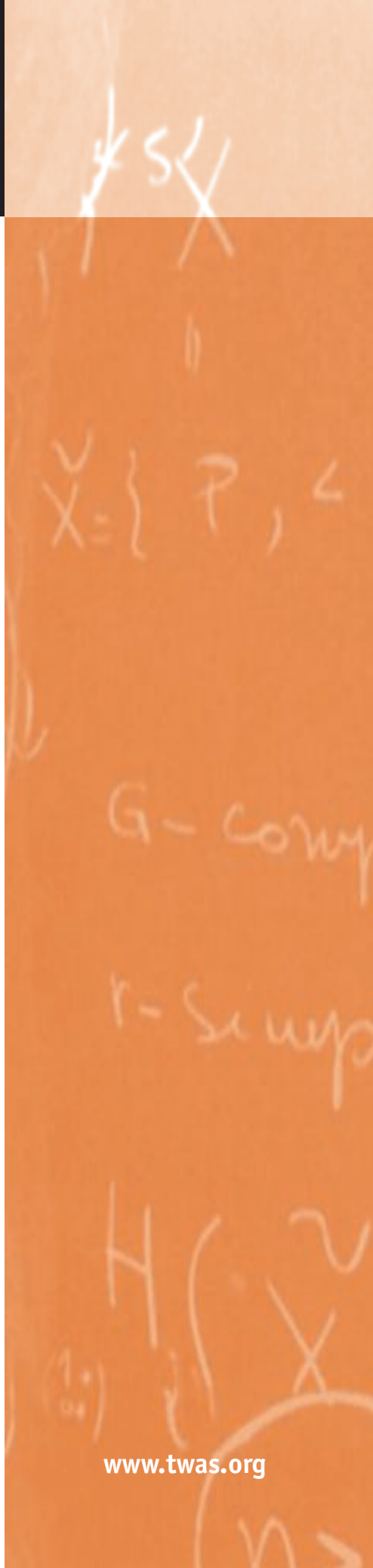
TWAS played a key role in the establishment, in 1993, of the Organization for Women in Science for the Developing World (OWSD, formerly the Third World Organization for Women in Science, TWOWS). Some 3,200 women scientists from more than 90 countries in the South are members of OWSD, making it the largest 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 69 members. **www.iamp-online.org**



www.twas.org