



A N N U A L R E P O R T

2009

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TWAS, the academy of sciences for the developing world, is an autonomous international organization that promotes scientific capacity and excellence in the South. Founded in 1983 by a group of eminent scientists under the leadership of the late Nobel laureate Abdus Salam of Pakistan, TWAS was officially launched in Trieste, Italy, in 1985, by the secretary-general of the United Nations.

TWAS has 950 members from some 90 countries, more than 70 of which are developing countries. A Council of 13 members is responsible for supervising all Academy affairs. It is assisted in the administration and coordination of programmes by a secretariat, headed by the executive director. The secretariat is located on the premises of the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy.

The administration and financial operation of TWAS is undertaken by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in accordance with an agreement signed by the two organizations. A major part of TWAS funding is provided by the Government of Italy's Ministry of Foreign Affairs.

The main objectives of TWAS are to:

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

To achieve these objectives, TWAS is involved in various activities and collaborates with a number of organizations, especially UNESCO, ICTP, the International Centre for Biotechnology and Genetic Engineering (ICGEB) and the International Council for Science (ICSU).



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Foreword

Jacob Palis

President

TWAS

During the TWAS 20th General Meeting, held in Durban, South Africa, in October 2009, I was re-elected President of this esteemed Academy. I wish, therefore, also on behalf of the Council members, to extend my heartfelt thanks to all TWAS members for your confidence and support and I pledge that I will continue to work unstintingly on behalf of the Academy and its goals.

A major objective of TWAS is to develop a culture of scientific excellence in all countries. Since the inception of TWAS in 1983, many developing countries have embraced science and technology as a pillar of their social and economic development strategies. Countries such as Brazil, China and India – but also Malaysia, Mexico, Pakistan, South Africa and others – have demonstrated the benefits of investing in research and are widely touted as models for other countries to follow.

The truth is, however, that many countries are still lagging behind when it comes to investment in science and technology. It is towards these countries that TWAS must now focus its efforts. Such efforts will aim at supporting their young scientists through a variety of programmes, as well as attempting to influence national policy-makers so that the contributions that we are able to make, including research grants and fellowships, for example, can be embedded into developing national scientific cultures. As an academy, we can also honour their outstanding scientists by electing them as Fellows of TWAS. And I am pleased to report that TWAS is dedicated to increasing the representation of such countries among its membership.

This is one of the main objectives highlighted in TWAS's Fourth Strategic Plan (2010-2014), which was also approved by Academy members in Durban. This latest Strategic Plan calls on TWAS to focus on the needs of young scientists, increase the number of women in the Academy, pay special attention to the challenges faced by scientifically lagging countries, strengthen the Regional Offices, and take steps to enable the Academy to become more involved in science policy discussions.

I reiterate that we will work unstintingly in tackling these challenges during my second term in office.

A feature of 2009 was the global economic downturn. One effect of this financial situation has been that the TWAS Endowment Fund did not grow as much as expected over the past year – due to both a reluctance of governments to commit funds and also the low interest rate. I am pleased to report that, through the careful management of the fund by UNESCO, we did not lose out during the financial crash – as so many other institutions did. However, the economic situation has served as a wake-up call to TWAS: We need to grow our endowment fund so that

we can start to reap its benefits and supplement our other funding. Now that the global financial situation seems to be improving it is time for us to focus on fundraising. I sincerely hope that in our Fifth Strategic Plan, due in 2015, we will be talking about how to spend the interest on this fund for the benefit of scientifically-lagging countries.

One potential benefit of the economic downturn is that property prices in many countries, including Italy, have fallen. This provides TWAS with perhaps a unique opportunity of acquiring its own headquarters. Since our inception, we have been generously hosted by the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste. While we do not wish to reduce our productive links with ICTP, I believe the time has come for TWAS to obtain its own headquarters – something suitable for the prestigious organization that TWAS has become. I am pleased to report that we are working on possibilities with UNESCO and the Italian government and I hope that we will be able to announce, in the not too distant future, some positive news.

Finally, it is clear that TWAS activities and influence have grown since the creation of the Academy in 1983 – and they continue to grow (hence the need for a new building). A major driving force behind these successes has been the dedication of our executive director, Mohamed Hassan. He is now retiring from this post and – as we move forward in 2010 and beyond with a new executive director – I want to use this opportunity to thank Mohamed for expertly overseeing the development of TWAS from its fledgeling days to the highly visible and credible organization that we see today. I am pleased to note, however, that the Academy will not be losing his services since he has been elected TWAS Treasurer for the next three years.

In conclusion, I can assure everyone that we – the TWAS Council, our Fellows, the secretariat and the new executive director – will be working together to ensure that TWAS reaches ever-greater heights in the years to come.

2009: The Year in Review

Mohamed H.A. Hassan

Executive Director

TWAS



Matching last year's 25th anniversary 'Silver Jubilee' celebrations was always going to be a challenge. However, with the success of the TWAS 11th General Conference and 20th General Meeting in South Africa and the launch of a new range of programmes, I am pleased to say that the Academy has managed to maintain its upward trajectory.

As with TWAS's 19th General Meeting held last year in Mexico City, our meeting in Durban, South Africa, also gained world-wide exposure. Perhaps of even greater significance, however, was the fact that it was the first TWAS meeting held on the African continent for 10 years – and that it appears to have paved the way for closer collaboration, through the Academy of Science of South Africa (ASSAf) – our partners for the event – with the scientific community in South Africa and the regional connections that such partnerships bring. This can only be to the benefit of scientists in the southern African region as they have increased access to the global scientific community.

As usual, the annual TWAS General Meeting provided the platform for the election of new members to the Academy. Fifty new members were elected, bringing our total membership to 950. In addition, the winners of the Ernesto Illy Trieste Science Prize and the 2009 TWAS Prizes were announced (see pages 20-21 and 22-31). Indeed, we were pleased to have the winners of the Ernesto Illy Trieste Science Prize, Pramod Kumar Aggarwal from India and Carlos Clemente Cerri from Brazil, with us in South Africa.

In 2009, the efforts of the TWAS secretariat were not focused solely on the 11th General Conference, however.

Among the other highlights of TWAS's 2009 activities were:

- *Fourth Strategic Plan.* The Academy's Fourth Strategic Plan was developed and finally approved by the General Assembly in South Africa. The plan sets out in detail the aims and ambitions for TWAS for the years 2010 to 2014.
- *South-South Fellowships programme.* A total of 167 South-South Fellowships were awarded, of which 160 were accepted, beating the previous year's highest ever annual total (see pages 38-39, 66 and 67). In 2009, the programme continued to expand, with fellowships being awarded to young scientists wishing to carry out research in Mexico for the first time.
- *Grants for Research Units from Science and Technology-lagging Countries.* With support from the Swedish International Cooperation Development Agency (Sida), TWAS provides US\$30,000 grants to research units and US\$15,000 grants

to individual young scientists in 80 science and technology-lagging countries. In 2009, 13 capacity-building grants were awarded to research units and another 21 research grants to individual scientists (see pages 44-45, 46-47 and 67).

- *TWAS-UNESCO Associateship scheme.* This programme provides scientists in developing countries with opportunities to develop long-term links with more than 100 centres of excellence in the South. In 2009, 23 scientists were selected for the award. These scientists will make two visits to their selected host institution during a three-year period (see pages 36-37 and 66).

- In June, TWAS collaborated with IAP to organize a conference on 'Afghanistan and its Geographical Context: Development of a Regional Network of Cultural and Scientific Cooperation' with the Italian Ministry of Foreign Affairs during the G8 Foreign Ministers' Meeting in Trieste, Italy. The conference was attended by Franco Frattini, the Minister of Foreign Affairs of Italy; Rangin Dadfar Spanta, Minister of Foreign Affairs of Afghanistan; and Makhdoom Shah Mahmood Qureshi, Minister of Foreign Affairs of Pakistan. About 100 people, largely scientists and science administrators, attended the conference, including representatives of the Afghan, Chinese, Egyptian, Indian, Pakistani, Russian and Turkish academies of sciences and research centres. The directors of Trieste's scientific institutions were also present.

- *Regional Prizes.* In 2009, each of TWAS's five Regional Offices selected the winners of the third round of TWAS Regional Prizes, this time dedicated to the 'Building of scientific institutions'. The names of the winners, three of whom were TWAS Fellows, were announced during the Academy's 11th General Conference (see pages 12-17 and 58-59).

- *Regional Conferences for Young Scientists.* Organized by TWAS Regional Offices, six Regional Conferences for Young Scientists (RCYS) took place in 2009. The Arab Regional Office linked the TWAS/BioVision.Nxt event with BioVision 2009 held in Lyon, France. In sub-Saharan Africa, the Fourth TWAS-ROSSA RCYS took place in December 2009, on the theme 'S&T Enterprises in Africa'; in India, TWAS-ROCASA organized a Young Scientists of Asia Conclave on 'Pressing Problems of Humankind: Energy & Climate'; TWAS-ROESEAP also participated in the organization of the TWAS RCYS on 'Food, Health and Fuel: Plants for the Future', held in Selangor, Malaysia; while in Latin America, the Fifth and Sixth TWAS-ROLAC RCYS were held at the Brazilian Academy of Sciences, in May and December, respectively (see pages 54-59).

- The EuroAfriCa-ICT consortium, of which TWAS is a member, held its 'First Euro-Africa Cooperation Forum for ICT Research' in Brussels, Belgium, in March 2009, attended by some 300 participants, including high level speakers from the European Union, African Union and UNESCO (see page 51).

- *New programmes.* As in 2008, a number of new programmes were instigated in 2009. For example, through agreements signed with Microsoft Research (UK) and the African Academy of Sciences (AAS), and the OIC (Organization of Islamic Conference) Standing Committee on Scientific and Technological Cooperation (COMSTECH), TWAS awarded the first TWAS-AAS-Microsoft Prizes to young computer scientists from Africa, and the first TWAS-COMSTECH joint research grants. The TWAS, International Centre for Genetic Engineering and Biotechnology (ICGEB) and UNESCO International Basic Sciences Programme (UNESCO/IBSP) three-year 'Joint Project on Capacity Building in Basic Molecular Biology' was launched in early 2009, with the selection of the successful applicants nearing completion by the end of the year. TWAS also joined with IAP in a project funded by the European Climate Foundation to organize a series of three capacity-building workshops for climate change negotiators from developing countries in the run-up to international discussion forums. In July 2009, the Academy signed a memorandum of understanding with its host institute, the Abdus Salam International Centre for Theoretical Physics (ICTP) that will, for the first time, formalize collaborative activities between the two organizations. In addition, an agreement was reached with the German Research Foundation (DFG) that will allow up to ten postdoctoral researchers from sub-Saharan Africa to visit laboratories in Germany to develop and undertake collaborative research programmes with German scientists. [See pages 50-53].

- *International outreach.* As well as its regular publications, including the *TWAS Newsletter*, the Academy extended its series *Excellence in Science: Profiles of Research Institutions in Developing Countries*, publishing an in-depth profile of the Ifakara Health Institute located in Ifakara, Tanzania. In addition, a number of editorials and opinion articles were published in such outlets as SEED magazine and the web portal SciDev.Net, helping to maintain TWAS's high profile in the world of science [see pages 48-49].

- *Endowment fund.* During 2009, the TWAS endowment fund reached US\$12,025,738. The fund, which is intended to bring long-term security to TWAS, has a target of US\$25 million. A campaign to help the Academy attain this goal was launched in 2008.

This brief overview of TWAS's 2009 activities demonstrates the diversity of the Academy's activities – from the high-level conferences that often feature ministers of science and technology (the meeting in South Africa was no exception) and the rewarding of scientific excellence through our various prize schemes – to a variety of programmes designed to assist young scientists in the South to develop their scientific careers and so become part of our overall scientific capacity-building initiative.

TWAS's 20th General Meeting and 11th General Conference was held at the International Convention Centre, Durban, South Africa, from 20-23 October 2009. Some 400 scientists from 60 countries – the majority of whom were members of TWAS – attended the event, making it one of the largest conferences ever held by the Academy. The meeting was sponsored by South Africa's Department of Science and Technology and organized in partnership with the Academy of Sciences of South Africa (ASSAf).

TWAS in South Africa



Since the dark days of apartheid that ended 15 years ago, South Africa has emerged from its isolation to become the continent's leading scientific country. It is also actively involved in the global scientific community, enjoying a growing reputation for excellence in a number of scientific fields, including astronomy, archaeology and mineralogy. South Africa's scientists, who were largely shunned during apartheid, have increasingly forged partnerships with TWAS and other international scientific organizations to pursue a wide range of research activities.

Such activities were on full display at the TWAS 20th General Meeting and 11th General Conference where, as Mohamed H.A. Hassan, the Academy's executive director, noted, "South Africa took another important step in showcasing its science to the world, and the world took another important step in integrating South Africa's scientific community into the fold of global science."





The meeting was held in Durban, South Africa's third most populous city and home to 3.5 million people. As a vibrant multicultural centre of commerce and trade, Durban is a microcosm of South Africa's present as well as a window on its future – making it an ideal place to showcase South Africa's substantial scientific capacity and to illustrate the steps that Africa's richest country is taking to pursue a future enriched by science-based sustainable development. It was also, not surprisingly, an ideal place for TWAS to once again put on display the expanding prowess of science and technology in the developing world and the growing networks of scientists and scientific institutions that are helping to advance social and economic well-being across the South.

Highlights included:

- A meeting between Jacob Zuma, President of South Africa; Jacob Palis, TWAS president; Mohamed H.A. Hassan, TWAS executive director; and Robin Crewe, president of the Academy of Sciences of South Africa. The meeting took place in the president's office in Pretoria and included the presentation of the TWAS Presidential Medal to President Zuma.
- A conference session on the impact of the global financial crisis on science in the developing world that included presentations by Naledi Pandor, South Africa's Minister of Science and Technology; Sergio Rezende, Brazil's Minister of Science and Technology; and Prithvirai Chavan, India's Minister of Science and Technology. Additional presentations were given by Jean-Pierre



Ezin, African Union Commissioner for Human Resources, Science and Technology, and Koji Omin, founder and chairperson of the Science and Technology in Society's (STS) Forum and former Minister of Finance in Japan. All discussed the need to retain – and indeed expand – investments in science and technology despite the steep economic downturn. While the governments of Brazil, China and South Africa seem to have been successful in their efforts to insulate their scientific enterprises from the financial storms sweeping across the globe, the African Union and many of its member states appeared to be less able to ward off the impact of budget shortfalls and a steep decline in funding from international organizations and foundations.

- Conference symposia that ranged from examinations of the state of astronomy in developing countries, to an analysis of the current state of knowledge of human prehistory, to discussions on the spread of HIV/AIDS, malaria, tuberculosis and other infectious diseases in sub-Saharan Africa, and to talks on current efforts to improve science education, especially in developing countries.



- The election of 50 new members into the Academy, which brings the total number of TWAS members to 950. The new members include nine women and seven scientists from South Africa – both record figures for the Academy.
- The granting of TWAS Young Affiliate status to promising scientists under the age of 40 who live and work in developing countries. Twenty-five scientists (up to five chosen by each of TWAS's Regional Offices) were selected, 17 of whom attended the conference, where they were officially welcomed to TWAS and given an opportunity to present their research.
- The selection of the new TWAS Council for 2010-2013. The Council will consist of returning members: president Jacob Palis (Brazil); vice presidents Bai Chunli (China) for East and Southeast Asia, Atta-ur-Rahman (Pakistan) for Central and South Asia, and Romain Murenzi (Rwanda) for Africa; secretary-general D. Balasubramanian; and council members Keto E. Mshigeni (Tanzania) and Ahmed H. Zakri (Malaysia). Newly elected council members include vice presidents F.M.A. Al-Kharafi (Kuwait) for the Arab region and

Francisco J. Barrantes (Argentina) for Latin America and the Caribbean; council members Adel E.T. El-Beltagy (Egypt) and Harold Ramkissoon (Trinidad and Tobago); and treasurer Mohamed H.A. Hassan (Sudan).

- The approval by the TWAS Council of the Academy's Fourth Strategic Plan, which is designed to guide the organization from 2010 to 2014. The plan calls on TWAS to focus on the needs of young scientists, increase the number of women in the Academy, pay special attention to the challenges faced by scientifically lagging developing countries, strengthen TWAS's Regional Offices, and take steps to enable the Academy to become more involved in science policy discussions.
- The announcement of the winners of the Ernesto Illy Trieste Science Prize 2009: Carlos Clemente Cerri, senior scientist at Universidade de São Paulo, Brazil, and Pramod Kumar Aggarwal, ICAR national professor at the Indian Agricultural Research Institute in New Delhi, India, who were honoured for their pioneering work in investigating the intricate relationship between climate change and agricultural production (see pages 20-21).
- The presentation of the Abdus Salam Medal to C.N.R. Rao, TWAS founding fellow and immediate past president, who spoke about his long and rewarding journey to firmly establish advanced materials research as an important field of inquiry in his home country of India.
- TWAS 2009 Medal Lectures by Wieland Gevers (TWAS Fellow 2002), general secretary, Academy of Science of South Africa (ASSAf), on 'Biomedical Science in Two Worlds' – the developed and the developing worlds. Gevers has witnessed developments in this field first-hand, first as a doctoral student and young researcher in the United Kingdom and then, upon returning to his home country in the 1970s, as one of South Africa's leading biomedical researchers; Li Zhen-sheng (TWAS Fellow 1990), research professor, Institute of Genetics and Developmental Biology, Chinese



Academy of Sciences (CAS), on the major achievements in wheat genetic improvement in China over the past half century, marked by a five-fold increase in grain yields that has been driven by an innovative plant hybridization system that Li played a major role in developing; and Sergio Rezende (TWAS Fellow 2004), Minister of Science and Technology in Brazil, and professor, Department of Physics, Federal University of Pernambuco, Brazil, on how magnetic materials have played a fundamental role in modern industrial society – for example, in the conversion of electrical to mechanical energy through motors and generators, and in microwave communication.

- The announcement of the winners of the 2009 TWAS Prizes to 11 eminent scientists from the developing world. See pages 22-31.
- Presentations by the winners of the 2008 TWAS Prizes. The talks ranged from an analysis of noncommunicative geometry as a key to unlocking the secrets of the dimensions of space-time, to fabrication and functionality in soft materials, to value-added applications of biotechnology in agriculture, to public health efforts to curb HIV among young women in South Africa.
- Invited lectures by David Block, director of the Anglo-American Cosmic Dust Laboratory at the University of the Witwatersrand, South Africa, on the blind ambition and unquenchable quest for fame that drove the world-renowned astronomer Edwin Hubble to pursue global prominence apparently by stealing the work of less prominent colleagues; and by Michael Atiyah, Fields medallist and honorary professor at the University of Edinburgh, UK, on the endless yet joyful pursuit of truth and beauty that drives the field of mathematics.
- Lectures by the winners of the 2009 TWAS Regional Prizes. The winners are all prominent leaders in science





who have made lasting contributions to scientific capacity building in their countries and regions: Adnan Badran, former Prime Minister of Jordan, who has spent a large portion of his career building institutions of higher education in his native country; Luis Bevilacqua, emeritus professor at the Federal University of Rio de Janeiro, who has been engaged in developing an open curriculum degree programme at his university that promises to greatly impact the way in which university students in Brazil are taught; Atta-ur-Rahman, former Minister of Science and Technology and Federal Higher Education Commissioner in Pakistan, who has been the chief architect of unprecedented national reforms in university research and training; Cheng-Wen Wu, who has spearheaded the drive to build world-class medical research facilities in Taiwan, China; and Venansius Baryamureeba, head of the Makerere University Faculty of Computing and IT, who has championed efforts to forge long term collaborations with local and international information technology (IT) companies to nurture and sustain university research and innovation in Uganda.

- A talk by Akissa Bahri, this year's recipient of the C.N.R. Rao Prize and director for Africa, International

Water Management Institute, Accra, Ghana, examining the role that water plays in agricultural productivity and public health in Africa, and outlining the measures that need to be taken to ensure that the people of Africa have access to sufficient quantities of safe drinking water.

- Lectures by scientists who have led or participated in initiatives by research units in scientifically lagging countries that have been supported by TWAS. Projects discussed ranged from efforts to assess the level of air pollution in Cotonou, Benin, to the impact that arsenic-laced groundwater contamination in Bangladesh is





having on public health and agriculture, to the use of electrochemical sensors to monitor and assess water pollutants and devise cleanup strategies, to studies of Africa's population structures to better understand genetic susceptibility to disease, and to an examination of the key role that microbes play in the ecological health of the Great Rift Valley in Africa.

- Presentations by TWAS Young Affiliates, scientists under 40 years of age who receive five-year appointments that allow them to attend TWAS meetings and participate in Academy activities. Topics ranged from the relationship of growth factors to the rising incidence of diabetes in the developing world, to the multiple nutritional and medical uses of the food plant *Moringa*, to the impact of magnetic coupling on the

properties of ferromagnetic nanoparticle systems, to quantum entanglement, and to efforts to uncover value-added byproducts derived from Nile perch.

- The publication of a comprehensive assessment of the state of science and technology in South Africa, edited

by Roseanne Diab, executive director of the Academy of Science of South Africa, and Wieland Gevers, former president of the academy, which presents a detailed history of scientific research in South Africa. The publication opens with a discussion of the post-World War II boom in science and continues with an examination of the nation's scientific policies and initiatives over the past half century through to South



Africa's present efforts to create a world-class scientific enterprise.

- An announcement by the government of Brazil that it would provide an additional US\$200,000 to the TWAS Endowment Fund. The fund now totals more than US\$12 million.
- Events at the conference were video-streamed live across the globe and were the subject of a lively blog of personal commentaries and observations by Linda Nordling, a freelance journalist working for the news portal SciDev.Net. This marked the first time the activities at a TWAS conference could be heard and read live by those who were not in attendance.
- The conference concluded with the issuance of the Durban Declaration, which urged negotiators at the United Nations climate change conference that took place in Copenhagen, Denmark, in December 2009 to "fully consider the impact of climate change on food, energy and water security issues that will prove vital to the South's efforts to adapt to climate change and "continue on the path of sustainable development."



PROGRAMMES

illycaffé S.p.A., the internationally renowned coffee manufacturing company that, like TWAS, has its headquarters in Trieste, Italy, continues to sponsor TWAS's major annual award designed to give international recognition and visibility to outstanding scientific achievements made by scientists living and working in the developing world. In honour of the former president of illycaffé, the 2009 and subsequent editions of the Trieste Science Prize have been renamed the **Ernesto Illy Trieste Science Prize**. It has also been agreed with illycaffé and the newly-formed Ernesto Illy Foundation, that this and future editions of the prize will focus on different scientific issues relating to sustainability. In 2009, the US\$ 100,000 prize was shared by two experts in the field of 'Impact of climate change on agriculture in developing countries'. The two winners attended an award ceremony in Durban, South Africa, on 20 October 2009 during the opening of the TWAS 11th General Conference and 20th General Meeting.

Ernesto Illy Trieste Science Prize



IMPACT OF CLIMATE CHANGE ON AGRICULTURE IN DEVELOPING COUNTRIES

The 2009 Ernesto Illy Trieste Science Prize was shared between Pramod Kumar Aggarwal from India and Carlos Clemente Cerri from Brazil, who were honoured for their pioneering work on the intricate relationship between agriculture, climate and the environment.

Pramod Kumar Aggarwal, ICAR National Professor at the Indian Agricultural Research Institute in New Delhi, has developed a broad range of innovative strategies to examine the potential impact of global warming on agriculture, especially in India.

Studies have shown that, in India, global climate change could lead to crop losses of 10% to 40% by the end of this century as a result of rising temperatures, more variable rainfall and declining water supplies for irrigation. Aggarwal acknowledges that simple adaptation strategies, such as changing the date of planting or relying on more drought-





resistant plant varieties, may help reduce agricultural losses – at least initially. But his research also indicates that greater climate variability due to warming will ultimately require more aggressive mitigation and adaptation measures, including developing new crop genotypes and devising alternative water management systems to reduce agriculture’s footprint on the environment.

As one of India’s leading climate change experts, Aggarwal has served as the coordinator of a government-sponsored national network designed to quantify the sensitivity of crops, forests, livestock and fisheries to global climate change. Comprised of 150 scientists from 23 universities and research centres, the network has been a major source of capacity building for addressing climate change challenges in his native country.



While Aggarwal’s research has focused on the impact of climate change on agriculture and food supplies, **Carlos Clemente Cerri**, senior scientist at the *Universidade de São Paulo*, has led the way in examining the impact of land use changes on climate, especially in Brazil. He has earned an international reputation for his studies of greenhouse gas emissions resulting from the conversion of savannas and tropical forests to farm and grazing land in the Amazon.

Cerri’s research has broken new ground in detailing the extent of carbon exchange that is taking place between the soil and atmosphere in the face of rapid development in the Amazon, where over 600,000



square kilometres of tropical forest, covering an area four times the size of Greece, have been converted to farm and grazing land.

Cerri has also developed an innovative research methodology and accompanying technology, that has since been adopted by scientists in many parts of the world, to measure the amount of carbon dioxide that is released by ploughed soil and decomposing plant matter. He has been an influential advocate for the adoption of best agricultural management practices – for example, no tillage and minimum tillage farming – to reduce agriculture’s impact on global warming. Most recently, he has turned his attention to examining the carbon footprint of biofuels produced from sugarcane to help assess the role of biofuels in curbing greenhouse gas emissions.

TWAS Prizes for scientific excellence are awarded annually in the fields of agricultural sciences, biology, chemistry, earth sciences, engineering sciences, mathematics, medical sciences and physics, and rank among the highest scientific accolades given to scientists in developing countries. Each prize carries a cash award of US\$15,000. The TWAS Prizes for 2009 – including three shared prizes – were announced during the TWAS 11th General Conference and 20th General Meeting held in Durban, South Africa. The prizes will be presented at the TWAS 21st General Meeting, scheduled to take place in Hyderabad, India, in October 2010.

TWAS Prizes: Honouring Scientists



AGRICULTURAL SCIENCES

Yang Huey-Lang, Centre of Biotechnology, National Cheng Kung University, Tainan, Taiwan, China, won the TWAS Prize in Agricultural Sciences:

for his outstanding contributions to the understanding of fish immunology, the invention of oral vaccine technology and its application to warm water fish aquaculture.

The grouper (*Epinephelus*) is a high-value fish in east Asian seafood markets. However, efforts to farm it are hindered by nervous necrosis virus (NNV), which can cause up to 100% mortality in very young fish.

Having received his postgraduate and postdoctoral training in the United States, in 1982 Yang Huey-Lang became managing director of a biotechnology company with the responsibility to develop diagnostic kits for various human infectious diseases. He returned to Taiwan in 1989 where he successfully developed further kits for diagnosing important infectious diseases in the Asian population.





Yang then switched his focus to his country's burgeoning aquaculture industry – and especially towards developing bio-medicines for fish. To this end, he built an experimental station at the National Cheng Kung University and established a team of some 40 researchers.

Among his first successes was an oral vaccine against NNV, based on the virus' coat protein. He first cloned the coat protein gene and expressed it in the bacterium, *E. coli*. Once the *E. coli* were producing the viral coat protein, they were killed and fed to *Artemia* (sea-monkeys), which were, in turn, fed to grouper larvae. Results showed that the oral vaccine helped immunize the larval fish and prevent infection by NNV. Yang then improved on this technique by pioneering the use of *Vibrio*, a common marine bacterium that has been shown to induce innate immunity, as a host for the expression of viral subunits. Oral vaccines of inactivated *Vibrio* containing target antigens gave a higher protective immunity than the *E. coli* system.

Based on this vaccine system, Yang has developed an NNV-free indoor hatchery facility that provides pre-immunized disease-resistant fingerling groupers to farmers. Together with his laboratory's success in developing injectable vaccines for the immunization of larger fish against several bacterial diseases, Yang's efforts have helped to decrease the use of antibiotics in fish-farming operations, thus making them more sustainable.

BIOLOGY

He Lin, Shanghai Jiao Tong University, Shanghai, China, shared the TWAS Prize in Biology:

for his basic and significant contributions to the understanding of causative genes and molecular mechanisms of genetic diseases.

There are several types of brachydactyly – a medical condition that literally means a 'shortness of the fingers and toes'. Brachydactyly type A-1, reported in 1903 and the focus of much of He Lin's research, is the first recorded example of a human disorder with Mendelian autosomal-dominant inheritance. It was He and his team that finally resolved the century-old puzzle by linking the genetic defect to a gene known as 'Indian hedgehog' (*IHH*) and, in particular, a mutation in *IHH* that created a novel molecular pathway.





Moving on, He and his team discovered the genetic basis of ‘He-Zhao deficiency’, the congenital absence of permanent teeth. His team also mapped and cloned several other important monogenic genes.

More recently, research efforts have focused on the molecular mechanisms of various psychiatric disorders, such as schizophrenia, bipolar disorder and Alzheimer’s disease. In the case of schizophrenia, using association studies, some ten susceptibility genes were found.

The type of work carried out by He often requires large numbers of samples and the ability to refer to a collection. Thus, he has been instrumental in constructing a national network-based sample bank thought to be one of the largest neuropsychiatric sample banks in the world. The bank has already played an important role in the investigation of further genetic disorders.

Partha Pratim Majumder, Human Genetics Unit, Indian Statistical Institute, Kolkata, India, shared the TWAS Prize in Biology:

for his outstanding contributions to the understanding of human evolution and diseases through human genome diversity and genetic epidemiological studies in populations and families.



Both culturally and genetically, India is perhaps the most diverse country in the world. For example, more than 1,600 Indian languages are recognized, 29 of which are spoken by more than a million people.



Through his sustained molecular genetic research, Majumder has made significant contributions to the understanding of human evolution, especially the peopling of India. In particular, he has used techniques to analyse mitochondrial DNA, Y-chromosomal DNA and autosomal DNA on a large number of population groups in India.

Deriving from these studies, he has formulated important methodologies for the genetic dissection of complex inherited human diseases, including vitiligo (a chronic disorder that causes depigmentation in patches of skin), prelingual deafness, abdominal aortic aneurysm and hypertension.

Majumder’s current research focuses on the genomics of variability between individuals in response to vaccines. In particular, he has recently

identified genetic markers that are associated with modulation of a Vi polysaccharide vaccine against typhoid. Using samples taken from 1,000 people recently immunized with the standard polysaccharide typhoid vaccine, he and his team have identified seven genes involved in various stages of the immune response that can be polymorphic – and can thus affect individual responses to the vaccine.

In addition to his ongoing research, Majumder is currently establishing a National Institute of Biomedical Genomics at Kalyani, near Kolkatta, after managing to persuade the Indian government of the need for such an institution.

CHEMISTRY

Swapan Kumar Ghosh, Theoretical Chemistry Section, Bhabha Atomic Research Centre, Mumbai, India, shared the TWAS Prize in Chemistry:

for his formulation of time-dependent density functional theory and a theory of covalent binding in molecules by proposing the novel concept of spin-polarized electronegativity and chemical hardness.

Our school text books inform us that density equals mass divided by volume. This concept is based on the consideration of matter as a continuous medium and works well at macroscopic scales. At microscopic length scales, however, atoms and molecules mostly consist of ‘space’. In this case, electron density has played a major role in providing a deeper understanding of chemical binding in atoms, molecules and solids. In the intermediate mesoscopic length scale, which covers a wide class of problems associated with nanomaterials, surface chemistry and soft condensed matter, an appropriate picture of the equilibrium and dynamical processes has been obtained through the single particle number density of the constituent atoms or molecules.

Ghosh, a theoretical chemist, has described many-particle systems (quantum as well as classical) within the framework of a single-particle picture, thus broadening the applicability of the density concept to the domain of multi-scale materials modelling covering the full range of microscopic, mesoscopic and macroscopic length scales. Through his work, he has unified, interlinked and strengthened several diverse approaches in the theory of the structure and dynamics of atoms, molecules, solids and liquids, aiming at a common unified view of the microscopic and macroscopic world.

Ghosh and his colleagues, for example, have formulated a unified approach to covalent binding in molecular systems using the novel concept





of electronegativity. More recently, he has used the concepts of electrostatics, curvature and aromaticity to computationally design metal-decorated carbon nanomaterials for hydrogen adsorption, with potential use in hydrogen fuel cells; he has studied the single-file flow of fluids through nanopores, the optical properties of bimetallic nanoparticles, and the important role of curvature in carbon nanostructures in determining their properties and reactivity.

Wan Li-Jun, Institute of Chemistry, Chinese Academy of Sciences, Beijing, China, shared the TWAS Prize in Chemistry:

for his basic and significant contribution to surface and interface physical chemistry.



Scanning tunnelling microscopy (STM) was invented in the early 1980s and has since had a profound impact on our understanding of molecular science and physical chemistry. Electrochemical STM (ECSTM) is an extension of the STM technique and enables scientists to study the electrochemical solid/liquid interface with a resolution at the atomic level. Wan, an expert in ECSTM, has successfully used the technique to answer fundamental questions in physical chemistry by developing a high resolution

imaging process that can be used to study the structure and conformation of single molecules and their orientation on a solid surface – observations that can be used to predict molecular reactions at solid-liquid interfaces.

For example, Wan has focused his ECSTM know-how on such molecules as calixarenes and graphenes, both of which have potential uses in nano-devices, for example in ion sensitive electrodes or sensors and selective membranes, or in transistors and integrated circuits, respectively.

Wan has also had success in controlling and regulating the self-assembly of nano-structures on a solid surface and at solid-liquid interfaces, for example, by using molecular templates or applying appropriate external stimuli to induce surface molecular reactions. His success in the controllable dispersion and distribution of organic molecules, nanoparticles and biomolecules with molecular templates provides a simple way to fabricate ultra-small electronic components and sensing elements as well as scaffolds for biomaterial engineering.

EARTH SCIENCES

Rafael Navarro-González, Laboratory of Plasma Physics and Planetary Studies, Institute of Nuclear Sciences, Autonomous National University of Mexico, Mexico City, Mexico, won the TWAS Prize in Earth Sciences:

for his outstanding achievements in the discovery of Mars-like soils in the Atacama Desert, a location now used as a training ground for future Mars missions.

Navarro-Gonzalez's research successfully blends laboratory simulations, field work and theoretical modelling across the fields of biology, chemistry and physics. Through his interdisciplinary work, he has made fundamental contributions to several fields related to astrobiology, the origin of life and life in extreme environments.

Among his most significant contributions are those that deal with the detection of organic compounds in Mars-like desert environments on Earth, namely Antarctica (a cold desert), the Atacama (a temperate desert of South America), and hot deserts (the Mojave in the United States and the Libyan desert).

The Atacama Desert is one of the driest and oldest deserts in the world. Geological and soil mineralogical evidence suggest that extreme arid conditions have persisted there for about 10 to 15 million years. Owing to the long-term aridity, organic compounds and culturable bacteria are found in the surface soil only at trace levels. Incubation experiments carried out by Navarro-Gonzalez, however – of the type carried out by the Viking mission to Mars – show active decomposition of organic species in these soils by non-biological processes.

This work has had a profound impact on NASA's plans for future Mars missions. For example, perchlorates detected by a Viking Lander (in the late 1970s) were considered terrestrial contaminants, but work on Atacama soils has caused a re-evaluation. Indeed, the Atacama Desert is now considered a valuable testing ground by NASA and the European Space Agency for instruments and experiments designed for future Mars missions. Navarro-Gonzalez's work has also resulted in a re-design of the organic search instrument that will fly to Mars on the next Mars rover. Navarro-Gonzalez himself will be a member of the science team for the Sample Analysis at Mars Instrument Suite (SAM) for NASA's next Mars probe, scheduled for launch in late 2011.





ENGINEERING SCIENCES

Chen Liang-Gee, National Taiwan University, Taipei, Taiwan, China, won the TWAS Prize in Engineering Sciences:

for his leadership and significant contributions to the joint development of video processing algorithms and VLSI architectures.

Integrated applications for digital image and video technology are essential components in computers, communication devices and consumer electronics. The challenge, believes Chen, is how to optimize the required parallel systems to balance the requirements of image integrity with feasible costs and hardware.

A key breakthrough in this area has been the achievement of real time video processing by adapting VLSI (very-large-scale integration) technology.

Chen began work on VLSI image processing in 1988 with studies covering a range of disciplines, including VLSI design, image processing and human visual perception. During this period, he has made major contributions to algorithm and architecture design on digital signal processor (DSP) architecture design, video processor design, and video coding systems that have been published in more than 430 papers. Chen, for example, proposed the world's first VLSI architecture of MPEG-4, a method that defines the compression of audio and visual digital data, and H.264 that encodes video data, from which most existing VLSI video encoding solutions have evolved. He has also proposed a reconfigurable architecture that drives power-aware multimedia systems for low power applications.

Measures of the impact of Chen's work include the fact that his group has won the Design Automation Conference/ International Solid State Circuits Conference (DAC/ISSCC) Student Design Contest five times since 2004 (a world record); he has registered 15 US patents; and technology developed by Chen has been transferred to industry and used successfully in more than 100 applications.



MATHEMATICS

Enrique Pujals, Institute of Pure and Applied Mathematics (IMPA), Rio de Janeiro, Brazil, won the TWAS Prize in Mathematics:

for his contribution to developing a theory of robust dynamics and the role of homoclinic bifurcation as a universal mechanism for the production of very rich and complex dynamics.

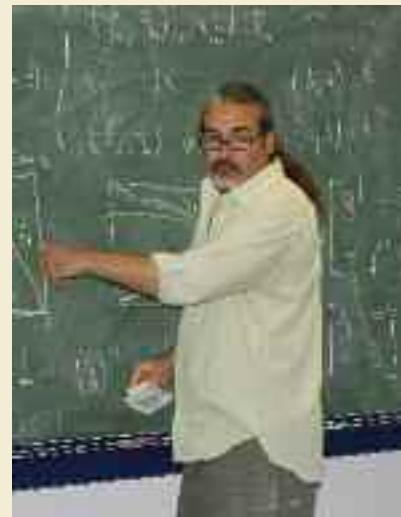


Pujals' research has focused on dynamical systems and, in particular, on attempts to understand the structures related to the presence of robust phenomena, the characterization of universal mechanisms that lead to dramatic changes in dynamical behaviour, and the description of generic properties within all systems.

Together with many collaborators, Pujals directed his efforts on proving and developing a two-fold dichotomy: on the one hand, robust properties of a system imply a particular structure that allows a better comprehension from a topological and statistical point of view; on the other hand, its absence leads to homoclinic bifurcation which works as the universal mechanism that produces qualitative changes in the dynamic.

Following Jacob Palis' conjecture (Pujals completed his PhD in 1996 at IMPA under the supervision of the TWAS president), which provides a paradigm and conceptual framework, Pujals research shows how those problems constitute different perspectives of the same phenomena, obtaining a correspondence between generic dynamical behaviour and the mechanisms that generate them.

Among the honours he has received are the *Unión Matemática de América Latina y el Caribe* (UMALCA) award in mathematics, 2004, and the ICTP Ramanujan Prize for Young Mathematicians from Developing Countries, 2008.



MEDICAL SCIENCES

Ricardo Gazzinelli, Department of Biochemistry and Immunology, Federal University of Minas Gerais, Belo Horizonte, Brazil, won the TWAS Prize in Medical Sciences:

for his seminal work on elucidating molecular and cellular mechanisms by which innate immunity mediates host resistance to infection and diseases caused by intracellular protozoan parasites.



Plasmodium, *Trypanosoma* and other single-celled protozoan parasites are major causes of disease and mortality across the developing world.

Gazzinelli has dedicated his research career to studying the interaction of such protozoan parasites with the host's innate immune response mediated by such host cells as macrophages and dendritic cells.

Specifically, Gazzinelli has investigated the role of parasite-host interaction in the induction and regulation of immune responses and inflammation, as well as the cellular mechanisms involved in host resistance and pathogenesis of disease caused by these parasites.

Of particular note, he has demonstrated that both genomic DNA and glycosphosphatidylinositol (GPI) anchors have pro-inflammatory activity against various life-stage forms of *Trypanosoma cruzi*, *Toxoplasma gondii* and *Plasmodium falciparum*. This work was followed by studies that identified receptors on the host cells (Toll-like receptors 2 and 9) as key innate immune receptors that recognize parasite-derived GPI anchors and DNA. These findings have potential implications in the pathogenesis of Chagas disease and malaria.

Based on these results, Gazzinelli's work has advanced to the development of new technologies for producing vaccines and therapeutic agents against neglected diseases, especially diseases caused by intracellular protozoan parasites. In particular, Gazzinelli is partnering with two private enterprises: a veterinary vaccine producer and a pharmaceutical company. From these collaborations, a recombinant vaccine against the canine visceral leishmaniasis is already on the market, and a product to treat acute malaria episodes is in development.



PHYSICS

Nathan Berkovits, Institute of Theoretical Physics, *Universidade Estadual Paulista*, São Paulo, Brazil, shared the TWAS Prize in Physics:

for his significant contributions to superstring theory and its covariant quantization.

General relativity and quantum mechanics have been the two pillars of theoretical physics for almost 100 years. While general relativity is Einstein's theory of gravity that determines the large-scale structure of the universe, quantum mechanics determines the small-scale structure of atoms. However, there is strong theoretical evidence that the two theories are incompatible and that general relativity breaks down at the subatomic scale where quantum effects become relevant.

The strongest candidate for replacing general relativity with a quantum theory is superstring theory, which postulates that point-like particles should be replaced by one-dimensional strings. There have been various formulations of superstring theory over the last 30 years. During his postdoctoral studies in the United States and United Kingdom (1988 to 1994), Berkovits, for example, developed the 'hybrid formalism' for the superstring. After moving to Brazil in 1994, he developed a more advanced formulation of open superstring field theory that does not suffer from the contact-term problems of previous formulations.

The most recent formulation of superstring theory is the ‘pure spinor formalism’, the only known quantization of the superstring which is manifestly covariant with respect to both spacetime and worldsheet supersymmetry (a worldsheet is a two-dimensional manifold that describes the embedding of the string in spacetime), which has been helpful in reconciling gravity with quantum mechanics and to which Berkovits has made significant contributions.

Gao Hongjun, Institute of Physics, Chinese Academy of Sciences, Beijing, China, shared the TWAS Prize in Physics:

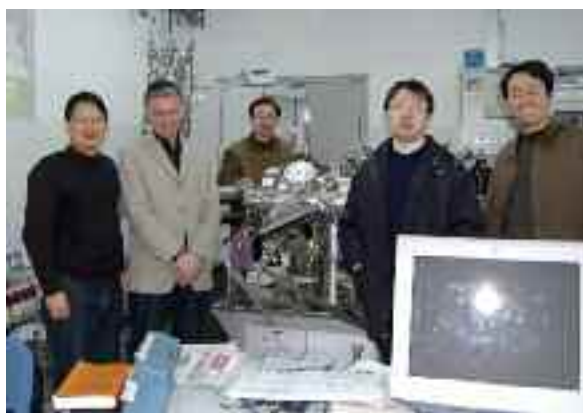
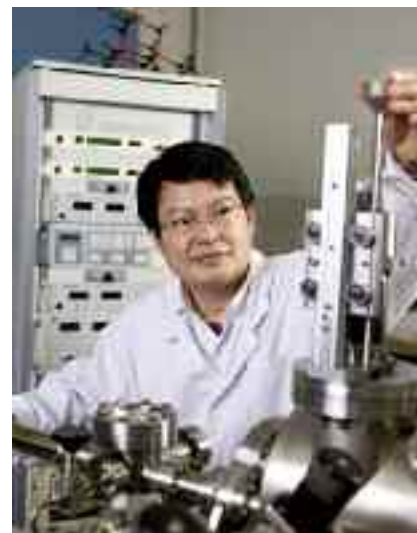
for his basic and significant contributions to the understanding and control of quantum structure formation and its potential application in quantum devices.

Gao has focused his research on functional thin films of organic compounds and their application in ultra-high density data storage. He and co-workers, for example, were the first to demonstrate that information can be written, erased and rewritten on a film of single-molecule thickness.

From 2000, Gao has been investigating the fundamental aspects of nano- and molecular electronics through efforts to visualize, understand and ultimately control quantum structures. Currently, he and his group are looking to derive functions for single atom- or single molecule-scale structures. When it comes to visualizing nano-scale structures, Gao and his colleagues have managed to obtain the world’s highest resolution scanning tunnelling microscopy (STM) image of Si(111)-7x7 – a feature of silicon crystals – that resolved a long-time discrepancy between theoretical and experimental results.

Gao has also developed a new method for synthesizing large scale single layer graphene (carbon sheets) on a variety of metal surfaces. Various analyses indicate that the graphene grows to millimetre dimensions with good long-range order, continuity and crystallinity that makes it potentially useful in quantum dot arrays.

In other work, Gao has succeeded in anchoring rotors formed from single molecules onto fixed points on a gold surface. Each molecular rotor is free to rotate around a well-defined axis, thus providing a proof-of-principle and a significant step towards integrating molecular rotors into nano-machines as potential power or propulsion systems.



TWAS Prizes for Young Scientists in Developing Countries are awarded to scientists no older than 40 years of age. The prizes are given in collaboration with national academies of science, scientific research councils and ministries of science and technology in a number of developing countries. TWAS provides the prize money (up to US\$2,000) while the national organizations select the recipients. Winners are chosen from among each of the major fields of natural science (biology, chemistry, physics and mathematics) on a rotating basis. Prizes are presented by a high-ranking official, such as a government minister, at a special ceremony. Some 45 national organizations are currently participating in the TWAS Prizes for Young Scientists programme. In 2009, prizes were awarded to 27 young scientists in 17 countries.

TWAS Prizes for Young Scientists



PROTEIN INTERACTIONS IN TURKEY

Proteins are both the building blocks of living cells and the driving forces that catalyse cellular chemistry. Interactions between proteins, therefore, are of central importance for virtually every process in a living cell.

Özlem Keskin, Koç University, Istanbul, Turkey, has developed novel tools for analyzing such protein-protein interactions based on such aspects as structural similarities between proteins, evolutionary data and protein interaction networks. She combines these different sources of data with computational models and applies chemical engineering principles to biological systems. In particular, in 2005, she introduced the concept of ‘hot’ regions at protein-protein interfaces, an idea that has opened up the field of protein recognition and binding, in a paper that has been cited more than 100 times.

She also studies the relationships between protein structure, function and dynamics, having been involved in the development of the anisotropic network model (ANM), a simple yet powerful model for the analysis of proteins that uses comparisons of their predicted properties with experimental properties – a model that is being increasingly used in the field.

It is expected that improved knowledge of protein-protein interactions, through such work as Keskin’s, will increase our understanding of diseases, for example, and provide the basis for new therapeutic approaches.

YOUNG PRIZE WINNERS

Name	Country	Awarding Body	Field
Mohammed Mizapur Rahman	Bangladesh	Bangladesh Academy of Sciences	Physics
Sabita Rezwana Rahman	Bangladesh	Bangladesh Academy of Sciences	Biology
Silvia Restrepo	Colombia	Colombian Academy of Sciences	Biology
Mahmood Sasa Marin	Costa Rica	National Council for Scientific & Technological Research	Biology
Rafael Alfredo Fando Calzada	Cuba	Cuban Academy of Sciences	Biology
Yovani Marrero Ponce	Cuba	Cuban Academy of Sciences	Chemistry
Gregorio Amilcar Sánchez Pérez	Guatemala	Academy of Medical, Physical & Natural Sciences	Agronomy
Ibrahima Sory Diare	Guinea	Ministry of Higher Education & Scientific Research	Biology
Ali Morsali	Islamic Rep. of Iran	Iranian Research Organization for Science & Technology	Chemistry
Namjil Erdenechimeg	Mongolia	Mongolian Academy of Sciences	Biology
Geleghadam Ankhbayar	Mongolia	Mongolian Academy of Sciences	Mathematics
Ripu Mardhan Kunwar	Nepal	Royal Nepal Academy of Science & Technology	Biology/Botany
Krishna Prasad Devkota	Nepal	Royal Nepal Academy of Science & Technology	Organic Chemistry/ Natural Products
Gan Bahadur Bajracharya	Nepal	Royal Nepal Academy of Science & Technology	Organic Chemistry/ Natural Products
Muhammad Idrees	Pakistan	Pakistan Academy of Sciences	Biology
Maricor N. Soriano	Philippines	National Academy of Science & Technology	Physics
Estariethe van Heerden	South Africa	Department of Science & Technology/Academy of Sciences of South Africa	Biochemistry/ Microbiology
Amal Mohammed Wadeasa	Sudan	Sudan Institute for Natural Sciences	Physics
Eltayb Abdellatef	Sudan	Sudan Institute for Natural Sciences	Biology
Nada Kamal Abd Ellatif Bayoumi	Sudan	Sudan Institute for Natural Sciences	Biology
Santi Maensiri	Thailand	National Research Council	Physics
Zehra Özlem Keskin Özkaya	Turkey	Scientific & Technical Research Council	Biology
Shakhlokhon U. Turdikulova	Uzbekistan	Uzbekistan Academy of Sciences	Biology
Uktir A. Rozikov	Uzbekistan	Uzbekistan Academy of Sciences	Mathematics
Usman K. Sapaev	Uzbekistan	Uzbekistan Academy of Sciences	Physics
Jamshid M. Ashurov	Uzbekistan	Uzbekistan Academy of Sciences	Chemistry
Nicholas Midzi	Zimbabwe	Research Council of Zimbabwe	Medical Sciences

FOUR UZBEK WINNERS

The Uzbekistan Academy of Sciences selected winners in four different scientific fields.

Photonic crystals can be compared to semiconductors that modify the behaviour of light photons rather than electrons. Indeed, they are seen as potential replacements for semiconductors as carriers of information, with the potential to increase the speed and band-width of future communication systems. However, harnessing the potential of photonic crystals requires producing crystals with properties tuned to desired characteristics.

Usman Sapaev studies various parametric frequency conversion processes of continuous and pulsed laser sources in non-linear photonic crystals (NPCs). His systematic theoretical approaches mean that NPCs can be used to control multiple-frequency laser field interactions with the exact properties desired.





Molecular biologist Shakhlokhon Turdikulova studies proteins: in particular the role of membrane glycoproteins in polarized cells. Cell polarity – achieved by maintaining an electrical potential difference across a membrane – relies on the asymmetric organization of cellular components and is developed through a series of processes including signalling cascades and membrane trafficking events. It is also a key process in organism development. Turdikulova's studies on two specific enzymes, and the role played by glycosylation – the addition of carbohydrate chains to proteins – have helped our understanding of the mechanisms of developmental diseases caused by abnormalities in protein trafficking and glycosylation and may thus lead to the discovery of new treatments.

In mathematics, Utkir Rozikov was honoured for his work on the theory of Gibbs measures of models of statistical mechanics. In particular, he developed a new method of studying several Gibbs measures of the models on trees and described a complete set of periodic Gibbs measures of such models. In addition, with N. Ganikhodjaev, he gave a construction of a non-linear evolution operator that connects Gibbs measures of the models of statistical mechanics with models of genetics. This result permits the use of thermodynamics in mathematical biology. Rozikov is among the foremost young Uzbek mathematicians. Based on the excellence of his more than 70 publications Rozikov was also selected as a TWAS Young Affiliate in 2007.

In addition to these prize winners in mathematics, physics and biology, Jamshid Ashurov, Institute of Bioorganic Chemistry, was awarded a TWAS Prize for Young Scientists by the Uzbekistan Academy of Sciences in the field of chemistry.

GOING NANO IN THAILAND

In 2001, Santi Maensiri obtained his MPhil from the University of Oxford, United Kingdom, thanks to his studies on the surface mechanical properties of alumina-silicon carbide nanocomposite materials. On completing his degree, he returned to his native Thailand where he is currently associate professor in the department of physics, Khon Kaen University in Khon Kaen, located some 400 kilometres northeast of the capital, Bangkok.

Maensiri's research interests lie in the fabrication, synthesis, physical and biological properties and applications of nanoparticles, nanofibres and thin films. Among other areas, he is attempting to develop diluted magnetic semiconductors and magnetic nanoparticles for medical applications, and electrospun nanofibres of ceramics, polymers and nanocomposites for use in energy-efficient electronic devices as well as for medical and pharmaceutical applications.

He has published more than 70 papers in international journals, more than 50 as first or corresponding author. He has also been awarded a National Research Council of Thailand Innovation Award (2006) and a Young Scientist Award from the Foundation for the Promotion of Science and Technology under the patronage of the king of Thailand (2007). For these reasons, Maensiri was selected by the National Research Council, Thailand, for the national TWAS Prize for Young Scientists in Developing Countries, 2009.

DISEASE DIAGNOSIS FOR PAKISTAN

As in many developing countries, diseases caused by infectious agents and genetic defects are common, but the cost of diagnosis is often prohibitive. The result is that many ailments go unidentified and, thus, untreated.

To address this issue, Pakistan's Ministry of Science and Technology decided to establish a public-sector molecular diagnostic laboratory. In 2000, following his successful MPhil at the University of the Punjab, Lahore, Pakistan, Muhammad Idrees was selected to set up the facility.

Within 6 months he had set up a PCR-based diagnostic service for the detection of infectious diseases at the Centre for Applied Molecular Biology (CAMB) in Lahore and was providing rapid and reliable diagnoses for the most prevalent infectious and genetic diseases in Pakistan. In addition, tests to detect the presence of *Mycobacterium tuberculosis* (the causal agent of tuberculosis), the hepatitis B virus (HBV), the hepatitis C virus (HCV), and to identify the genotype of HCV were estimated to cost one-tenth of price of comparative kits available in the United States.

As a result, CAMB now provides qualitative, quantitative and genotyping diagnoses to patients booked for HBV and HCV infection treatment at 104 sentinel sites around Pakistan. Between September 2006 and July 2008, for example, more than 50,000 tests were carried out free-of-charge for poor patients.

Idrees' work, however, does not only focus on diagnosis. Access to a large number of infections has allowed him to pursue his PhD studies at the University of the Punjab (2000-2005) focusing on the genome variability of HCV. In particular, he has developed a simple, rapid and reliable genotyping system for the most common HCV types found in Pakistan, derived a method for identifying mixed infections in patients, and identified and isolated several novel HCV genotypes from different areas of Pakistan.

Idrees' contributions to science are recorded in some 30 papers in peer-reviewed journals. He also recently spent several months as a postdoctoral researcher at the world-renowned Centers for Disease Control and Prevention (CDC), Atlanta, United States, where he further advanced his research on viral hepatitis.



The TWAS-UNESCO Associateship Scheme operates in collaboration with more than 100 scientific institutions in the South that have been designated 'centres of excellence'. The scheme allows researchers from developing countries, each of whom is appointed for three years, to make two visits to a selected centre to develop and carry out collaborative research. TWAS provides travel support for the associates and contributes towards incidental local expenses, while the host centres cover their living expenses.

In 2009, TWAS awarded 23 new associateships to scientists from 11 countries, including Nepal, a Least Developed Country, while a total of 38 TWAS-UNESCO Associates travelled to host institutions in 10 countries in the South: Argentina, Brazil, China, India, Iran, Jamaica, Pakistan, Peru, Syria and Thailand (see page 66).

Associateship Scheme



ANALYSING STAPLE STARCHES

Cassava plays a major role in the staple diets of some 200 to 300 million people throughout the South, but especially in Africa. However, certain varieties contain toxins in the form of cyanogenic glycosides that also cause a bitter taste.

To counter this bitterness – and avoid the toxic effects – cassava tubers are typically processed by fermentation.

“Fermentation is an important processing method for the crop,” says Adewale Olusegun Obadina. “Fermentation processes can be classified into solid state, that do not involve soaking, from which ‘gari’ is made, and submerged processes that involve soaking in water and are used to make ‘fufu’, for example.” Both fufu and gari are prepared as thick dough-like pastes and typically served with soups and stews.

To better understand the microbiological, physico-chemical and functional properties of the starch and flour in fufu and gari, Obadina, a lecturer in the Department of Food Science and Technology, University of Agriculture, Abeokuta, Nigeria, was awarded a TWAS-UNESCO Associateship. From September to November 2009, he made his first visit under the scheme to the





National Centre for Genetic Engineering and Biotechnology (BIOTEC), Thailand. There he collaborated with Kuakoon Piyachomkwan in BIOTEC's Cassava and Starch Technology Research Unit.

"During the fermentation of fufu and gari," explains Obadina, "lactic acid bacteria, other bacteria and yeast contribute significantly to starch breakdown, acidification, detoxification and flavour development." The identity of these microorganisms, however, is little known and 'starter cultures' vary widely. Part of Obadina's research was to characterize these microorganisms by sampling the fermenting flour at 12-hour intervals, plating out the solution in a series of dilutions, and checking to see how many and what type of organisms grew.

"The microbiological changes that occurred during the processing of fufu and gari were similar," reports Obadina. "Lactic acid bacteria, for example, increased progressively throughout the fermentation period. Yeasts were not isolated within the first 24 hours, but increased rapidly during the remaining period. Moulds, which were present at the beginning of the fermentation, decreased in number and were not isolated after 36 hours of fermentation."

In parallel, the pH of the fermenting tubers during gari production decreased from 6.6 to 4.0 within the first 24 hours and then remained within the range 4.05-4.93 for the following 60 hours – most likely because of the proliferation of lactic acid bacteria.

Obadina also measured the properties of the flours produced by the two fermentation processes, comparing them with flour prepared directly from dried tubers. In particular, he measured the 'pasting' temperature that marks the point of increasing viscosity of the starches in the flour as they are heated in water.

"The time to attain peak viscosity for starch from fufu is considerably lower than that for gari and native starches," confirms Obadina, who also carried out



microscopic analyses of the starch granules from each type of flour.

"We concluded that differences in the functional properties of starch produced from fufu and gari are more likely to be because of the formation of amylose-like fragments caused by enzymatic hydrolysis of amylopectin – a highly-branched polymer of glucose that is one of the main components of starch."

"The results obtained during the first visit will be published in an international journal," says Obadina. "I am grateful to TWAS for this support, which has also led to the development of another research proposal. We aim to confirm our hypothesis about differences in peak viscosity by determining the average granule diameter, solubility and swelling power of each of the starches at 60°C and 85°C. I look forward to my second visit when we will carry out this work."

TWAS's South-South Fellowship Programme provides opportunities for scientists from one developing country to carry out research at an approved institution in another developing country. The programme largely operates in partnership with national scientific institutions in Brazil, China, India, Malaysia, Mexico and Pakistan (see page 67). In addition, TWAS offers Research and Advanced Training fellowships, tenable at centres of excellence in the South (see page 66). All together, TWAS and its partner organizations now offer some 300 fellowships a year, making this programme the largest South-South fellowship scheme in the world. While TWAS administers the programme and covers the travel costs, the programme partners cover local costs such as living expenses and tuition fees.

South-South Fellowships



FROM NEPAL TO NEIGHBOURING INDIA

Established in 1959 on a campus just five kilometres from downtown Kathmandu, Tribhuvan University is the oldest university in Nepal. With more than 250,000 students spread across several campuses – and some 6,000 teaching faculty – it is also ranked as the 22nd largest university in the world.

Nurapati Pantha obtained an MSc from the Central Department of Physics, Tribhuvan University, in 1999, where he is currently an assistant professor. In the meantime, he has also advanced his knowledge in his specialist areas – atmospheric physics and condensed matter physics – by undertaking a second MSc, this time at the Norwegian University of Science and Technology, from where he graduated in 2007.

In 2008, Pantha attended an autumn school on the physics of new materials in Kathmandu where Abhijit Mookerjee from the S.N. Bose National Centre for Basic Sciences (SNBNCBS) at Kolkata, India, gave a series of presentations.

Conversation between Partha and Mookerjee, an expert in computational materials science, inspired Partha to apply for a Research and Advanced Training Fellowship from TWAS. His application was successful, so, in





April 2009, he made the relatively short (600 kilometre) journey to Kolkata.

“At SNBNCBS, I worked on density functional theory and *ab initio*, or ‘first principle’, approaches to study a number of geometrical conformations of small clusters of palladium atoms,” explains Pantha. Palladium is unusual in that, at room temperatures, the metal is able to absorb up to 900 times its own volume of hydrogen. It is also used as a catalyst in hydrogenation and dehydrogenation reactions, as well as for purifying hydrogen gas. Palladium also has potential nano-applications in the detection or storage of hydrogen gas..

Rather than focusing on hydrogen, however, Pantha and Mookerjee undertook some theoretical studies of palladium’s interaction with another gas, nitrogen, in particular the dinitrogen molecules that make up 80% of the air in our atmosphere.

At SNBNCBS, Pantha investigated a number of geometrical conformations of palladium in clusters of two to seven atoms, and analysed how nitrogen was deposited on them. “The aim was to analyse the similarities and differences between the reactivities of surfaces and clusters,” explains Pantha, “and to see if nitrogen-metal interactions along the lines of hydrogen-metal interactions are possible.”

“The most stable geometrical structures and their symmetry carried over during this research work agree well with previous results derived through different *ab initio* techniques,” says Mookerjee. “For example, we have confirmed that dinitrogen does not dissociate when absorbed by palladium clusters.”

“My three-month visit to SNBNCBS has been a milestone in my theoretical understanding and research work in physics,” confirms Pantha. “It has formed a strong background for further work and a research programme on materials science and atmospheric physics back home at Tribhuvan University. Now that the major



mathematical and conceptual parts of the research – on electronic structure calculations – have been completed, I hope to produce a research article soon by exploring this field a little more. During my time at SNBNCBS, I also learned some other research tools that will be useful to me in the future.”

“We hope that, through this TWAS Fellowship for Research and Advanced Training, we have helped in some way to strengthen Tribhuvan University by helping in the professional development of one of its faculty,” concludes Mookerjee. “We also hope that links between SNBNCBS and Tribhuvan University have been strengthened and will allow for the development of future collaborative research projects.”

The **TWAS Research Professors in Least Developed Countries (LDCs)** scheme was launched in 2005. More than 100 TWAS members have since expressed an interest in participating in the programme, which allows them to visit a research institution in an LDC three times during a five-year period for one to three months on each occasion. The areas of expertise of each of these TWAS members has been circulated to more than 1,000 institutions in LDCs so that they can select their preferred expert. Four TWAS Research Professors travelled in 2009 [see page 68], including Abdul Ghaffar of Pakistan, whose experience is highlighted below.

TWAS Research Professors



TRANSFERRING EXPERTISE TO TOGO

Togo is one of the world's Least Developed Countries (LDCs). Pakistan, on the other hand, has a growing scientific community and a rising profile in the world of science. Although both countries are classed as 'developing', a measure of the disparity between them is their respective number of TWAS Fellows: just two from Togo, but 33 from Pakistan.

Through the TWAS Research Professors in Least Developed Countries programme, Abdul Ghaffar, an expert in plant pathology formerly at the Department of Botany, University of Karachi, Pakistan, visited the University of Lomé, Togo, where he was hosted by another TWAS Fellow, plant virologist Yawovi Gumedzoe.

Worldwide, plant pathogens such as fungi, bacteria, viruses and nematodes are major constraints to agricultural production. In the 1850s, for example, the potato blight fungus devastated Irish potato crops, causing famine and mass emigration. In Africa, cassava mosaic virus can reduce yields of cassava – a drought-resistant staple crop – by up to 40%, while nematodes are considered the leading pest of bananas, reducing yields by between 30% and 60% in many countries.

“When I arrived in Togo, in May 2009, I was immediately introduced to the president of the University of Lomé and the director of the Department of Agriculture,” recalls Ghaffar, “and presented them with copies of books and journals on plant pathology from Pakistan.”



Ghaffar then delivered a series of prepared lectures to plant pathology students, focusing on the topical issue of food security, and how studies in plant pathology play an important role in improving agricultural productivity against a background of rising population.

“After covering the types of organisms that cause disease in plants, and the kinds of symptoms they induce, I reviewed a number of examples of plant diseases that had been introduced from one continent to another, such as the potato blight fungus and citrus canker, which was introduced from Japan to Florida and prompted the grubbing up of 15 million trees,” explains Ghaffar.

Among the other activities Ghaffar undertook during his visit to Togo was a workshop where young scientists were provided training on how to write better grant proposals and how to improve their scientific papers so that they had a better chance of being accepted for publication in peer-reviewed journals.

Ghaffar also visited the university’s mycological herbarium, which holds some 2,000 specimens of fungi collected in Togo.

“The herbarium is very cramped and needs more space,” explains Ghaffar. “I also advised that there is a need to create a detailed register of the samples present, including the date and place of collection as well as the name of the collector. I also suggested that a paper or bulletin on the occurrence of fungi on plants in Togo be published, as many of the species represented in the collection may not have previously been reported from the country.”

Ghaffar finished off his visit to Togo by acting as external examiner to Martine Zandjanakou-Tachin, a PhD student at the University of Lomé who was studying the distribution and genetic diversity of *Mycosphaerella* species of banana in Nigeria. The student identified three species of *Mycosphaerella* fungus in Nigeria and, using DNA analyses, a number of variants of each one.



“It was interesting to note that the incidence of the different types varies from year to year and from one agro-ecological zone to another,” adds Ghaffar, who recommended and supported the award of a PhD degree to the candidate.

“Despite the climatic differences between Pakistan and Togo, which obviously affect the agriculture in each area – as well as crop pathogens – I felt my visit was extremely useful to staff and students at the University of Lomé and hope that many of my recommendations will be followed up,” concludes Ghaffar.

His host in Lomé, Gumedzoe, agrees. “Here in Togo we have few resources for research and receive few international-level visitors,” he says. “We are grateful to TWAS for providing this opportunity to our department. The students, in particular, have learned a lot from Professor Ghaffar and it is clear that his enthusiasm for his subject has rubbed off on them. This can only be to the long-term benefit of plant pathology in Togo.”

The **Joint Visiting Scientist Programme** is sponsored by TWAS, the International Council for Science (ICSU), the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the United Nations University Institute for Advanced Studies (UNU/IAS).

The programme aims to provide institutions and research groups in the South, especially those with limited outside contacts, with the opportunity to establish long-term links with internationally-renowned experts, who are often working in the North, to help develop scientific research and teaching capacity in their country. In 2009, TWAS funded five scientists, enabling them to visit institutions in D.R. Congo, Ivory Coast, Mali, Myanmar and Swaziland [see page 68].

North-South Collaboration



BREAKING BARRIERS

Myanmar is the largest country of mainland southeast Asia. Its stagnant economy and political isolation also mean that the country is among the poorest of the region.

The Ayeyarwady River, nearly 2,170 kilometres in length, is Myanmar's longest river, and after the poem penned by the British author, Rudyard Kipling, is sometimes referred to as 'The Road to Mandalay', highlighting its importance as a commercial waterway. Either side of the river are fertile plains, which are home to the majority of the population of Myanmar.

Given the importance of the river to the national economy, it is surprising to learn that it is not the focus of continual study and monitoring.

In fact, staff and students from the Department of Geography at Yangon University, Yangon (formerly Rangoon), typically do not carry out any field studies due to the lack of funds and reliable equipment.

It was into this situation that Shigeko Haruyama from the Graduate School of Bio-resources, Mie University, Tsu City, Japan, entered thanks to support received through the ICSU-TWAS-UNESCO-UNU/IAS Visiting Scientist programme. Haruyama stayed in Myanmar for 14 days, in September and October 2009, hosted by Yangon University's Department of Geography.

"During our first formal meetings, we discussed the programme for education in physical geography and the possibility of a field excursion to the Ayeyarwady River basin with a view to studying its fluvial geomorphology,"



recalls Haruyama. “I also gave a lecture on general fluvial geomorphology for masters’ students.” Fluvial geomorphology considers the effects of the erosion or deposition of sediments on the river bed and surrounding landscape, and Haruyama’s lecture focused on the geomorphology of the most recent, geological era that includes the present day.

“Fortunately, we were able to organize a field visit, so from 22 to 24 September we took the students to the Ayeyarwady River delta to explain several methodologies of fluvial geomorphologic study and to show how to manage analyses in the field,” continues Haruyama. “We also discussed how badly research is needed into recent natural environmental changes in the delta.”

Haruyama believes it is critically important for staff in the Yangon Department of Geography to study such aspects as geomorphology, climatology and vegetation in the field, which is not the case at present because of scarce funds and the fact that all the department’s facilities are old and equipment is either broken or not maintained. “Thus I proposed the project of developing the Department of Geography,” she adds, “and that field study and field science should be essential for all of staff and students studying physical geography.”

Haruyama has also attempted to overcome some of the isolation facing scientists in Myanmar.

“Typically, the university does not have an internet connection and personal computers are kept locked away,” says Haruyama. “If students want to use a computer, they must request permission from the university. Internet facilities are also very limited in the country and when we moved to a remote area such as the river delta, we could not connect to other people.”

Having said this, however, Haruyama also explains that the Myanmar scientists are “hungry for scientific information” and “very keen to travel outside the country to study and to invite researchers to their institution.”



“Therefore, I invited a staff member to present his paper at the Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) ‘East Asian Seas’ international congress in Manila, Philippines, even covering his flight and accommodation from my personal funds. I am also trying to get Yangon staff an invitation to attend the International Geographical Union conference in Tel Aviv, Israel, in July 2010 as I believe attending such a conference would provide good information and academic networking opportunities with the international scientific community.”

Haruyama confirms that very few Yangon University staff, even full professors, have received training abroad and very few scientists from abroad visit Myanmar to give lectures. “Thus the ICSU-TWAS-UNESCO-UNU/IAS Visiting Scientist programme can help promote the educational system in Least Developed Countries such as Myanmar and enhance the scientific methodology and critical scientific thinking of staff,” she says.

TWAS offers **Research Grants** of up to US\$15,000 to young scientists of proven ability from developing countries for research projects in the basic sciences, covering the costs of specialized equipment, essential consumable material and scientific literature. Awardees must submit a report of their work to TWAS one year after the last piece of equipment has been bought using the grant money. The following example of TWAS-supported research, therefore, is based on a grant provided in 2007, the final report for which was submitted in 2009. In 2009, 21 TWAS Research Grants were awarded to researchers in some 17 developing countries. Among these, nine grants went to scientists working in seven countries in sub-Saharan Africa, while other grants went to scientists in Bangladesh, Ecuador, Indonesia and Peru (see page 67). The TWAS Research Grants programme is sponsored by the Swedish International Development Cooperation Agency (Sida).

Research Grants for Individuals



INVESTIGATING CAMEROONIAN FRUITS

Antioxidants are found in many plant tissues and are particularly prevalent in fruit. Although they have no nutritional value, they play an important role in maintaining health as they protect cells against the damaging effects of reactive oxygen species. An imbalance between reactive oxygen species and antioxidants leads to oxidative stress, which may lead to cardiovascular and neurodegenerative disorders, diabetes, cancer or obesity. Regular consumption of some fruits has been associated with reduced risk of developing such diseases.

In 2007, Alembert Tchinda Tiabou of the Institute of Medical Research and Medical Plants Studies (MRMP) in Yaoundé, Cameroon, was awarded a TWAS Research Grant to study the antioxidants in five species of fruit indigenous to Cameroon.

“The aim of the project was to identify antioxidant compounds in these fruits that could be used in standardized dietary supplements, or to find evidence to promote the consumption of the fruits for their direct health benefits,” informs Tchinda Tiabou.

Tchinda Tiabou proceeded to make methanol extracts from air-dried fruit samples and separate out the constituent chemicals using thin-layer chromatography (TLC). To identify





the antioxidants present, he used a standard test based on diphenylpicrylhydrazyl (DPPH).

“The DPPH-TLC-guided separation of extracts from *Xylopia parviflora*, which is in the custard apple family, led to the identification of three compounds that were identified by physical, spectrophotometric and spectroscopic methods to be the flavonoids kaempferol 3-O-arabinofuranside, quercetin and (+)-catechin,” explains Tchinda Tiabou. “Two of these compounds showed remarkable antioxidant activity compared to the standard control compound used in these tests, known most simply as BHT.”

Thanks to the TWAS grant, the precise identification of these compounds was made possible through the purchase of a spectrophotometer.

“We also isolated and identified two other antioxidants, sargachromanol and sargaquinoic acid, from *Pycnanthus angolensis* (African or false nutmeg),” adds Tchinda Tiabou. “Unfortunately, when purified, these compounds decomposed before their DPPH activity could be measured. However, we were able to determine that their structures are similar to that of vitamin E, a well-known antioxidant.”

Tchinda Tiabou explains the importance of the TWAS grant to his institution: “Since the economic crisis that hit Cameroon in the 1980s,” he says, “much of our equipment has become unserviceable or obsolete. The spectrophotometer in our medical analysis laboratory, for example, has been out of order for a long time. Researchers in that laboratory, therefore, also use the machine we acquired through the TWAS grant – so multiplying the effectiveness of the award.”

Indeed, the case of Tchinda Tiabou is a perfect example of how TWAS’s different programmes can work

together to build capacity in an institution in a developing country. In 2005, for example, Tchinda Tiabou was awarded a TWAS-UNESCO Associateship (see pages 36-37) to visit the International Centre for Chemical and Biological Sciences (ICCBS), Karachi, Pakistan, to work with TWAS Fellow Iqbal Choudhary. It was while at ICCBS that Tchinda Tiabou honed his skills with the spectrophotometer. Based on this, as well as work at home in his laboratory in Cameroon, Tchinda Tiabou and Choudhary have published two papers together.

“Thanks to TWAS, these experiences are also allowing our institution to undertake its own capacity-building initiative,” says Tchinda Tiabou. “For example, we are now planning to organize practical training sessions for students from the Department of Chemistry at the University of Yaounde, where spectrophotometer facilities are not available.”

One student who has already benefited from the equipment and materials supplied through the TWAS grant is Ngandi Zacharias, whose MSc thesis on the bioactive compounds present in *Zanthoxylum leprieurii*, another tree native to Cameroon, was positively evaluated in 2009.

And the benefits of this particular TWAS Research Grant do not stop there. In 2002, Tchinda Tiabou was one of 275 researchers appointed by Cameroon’s Ministry of Scientific Research and Innovation. Among this cohort of scientists, he is only the second to have been promoted to the grade of *Maitre de Recherches* (senior research officer). In addition, in September 2009, Tchinda Tiabou took up a one-year postdoctoral fellowship at the University of Liege, Belgium, and is convinced that receiving the TWAS grant was a significant factor in both these career-enhancing awards.

The **Research Units in Science- and Technology-lagging Countries** programme, launched by TWAS in 2002, was originally designed to assist small research groups in Least Developed Countries (LDCs) that have accomplished significant results but, because of the difficult conditions under which they work, have yet to realize their full potential. Thanks to support from the Swedish International Development Cooperation Agency (Sida), the programme allows the participation of research units in some 80 countries identified by TWAS as lagging in their science and technology capacity. Each selected research unit receives a grant of up to US\$30,000, which can be renewed on the basis of a positive report and re-application. In 2009, 13 research groups in nine countries were supported, comprising eight new awards and five renewals [see page 67].

Research Grants for Groups



SURVEYING SORGHUM IN ZIMBABWE

Sorghum is the fifth most widely grown cereal crop. In sub-Saharan Africa its ability to withstand drought conditions means that it is a favoured staple crop.

The most widely grown species of sorghum is *Sorghum bicolor*. However, cultivated varieties are susceptible to a number of pests and diseases. An increasingly common way of controlling pests and diseases is genetic modification, whereby a gene from another organism that confers resistance to a specific pest or pathogen is introduced into the crop variety. Much of the world's cotton, for example, now contains the *Bt* gene from a bacterium that makes the cotton resistant to caterpillars and weevil grubs.

Such a mechanism is also being proposed for sorghum, which is often afflicted by stem-boring grubs. However, as is the case for any proposed release of a genetically modified organism, extensive risk assessment studies must be carried out so that any potential harm to either the environment or to people consuming the product are either eliminated or minimized.

"In this case," explains Edias Mwenje, Department of Applied Biology and Biochemistry, National University of Science and Technology (NUST), Bulawayo, Zimbabwe, "sub-Saharan Africa is believed to be the centre of origin of sorghum. Zimbabwe, for example, is home to a number of wild sorghum species – some of which are capable of hybridizing with *S. bicolor* grown in farmers' fields."

In 2007, therefore, Mwenje was awarded a TWAS Grant for Research Units to undertake detailed gene flow studies on sorghum and its wild relatives in Zimbabwe and surrounding countries. “The objective was to understand the ecology, distribution patterns and genetic diversity of wild and weedy sorghum in the region,” says Mwenje. “To this end, baseline data on the herbivorous insects and the extent to which they affect wild sorghum was also collected.”

Following extensive surveys using global information systems (GIS) technology, detailed maps of the distribution of three species of wild sorghum were obtained.

“The results indicate that three species of wild sorghum are prevalent in Zimbabwe,” confirms Mwenje, “*Sorghum arundinaceum*, *S. versicolor* and *S. halepense*. We have shown that these wild varieties are widely distributed in Zimbabwe, especially in cities along roads and riverine places. This is important information for policy makers in order to determine areas in which genetically modified sorghum could be planted.”

Molecular biology studies on the different sorghum samples also confirmed that it is *S. arundinaceum* – sometimes considered a subspecies of the cultivated *S. bicolor* – that most frequently hybridizes with commercial varieties in farmers’ fields.

“Hybrids resulting from crosses between *S. arundinaceum* and commercial varieties are very stable and show hybrid vigour,” informs Mwenje, “manifested through increased height, thicker stems and larger seed compared to the wild relatives.”

If genetically modified sorghum were to be introduced into Zimbabwe, the risk is that these hybrids

could act as a ‘genetic bridge’ between the cultivated types and wild species.

“The fear is that the *Bt* gene, for example, could be introduced into wild sorghum and confer a biological advantage – it would be resistant to leaf-eating insects, for example,” explains Mwenje. “Such a survival trait might confer enhanced fitness outside the agricultural setting, resulting in ecological disruption.”

For these reasons, Mwenje and the members of his team, comprising three BSc students, an MPhil student and two PhD students (all of whom graduated in 2009), sampled plots of wild sorghum for associated insect species.

“The results indicate that diverse species of insect are associated with wild sorghum, including Lepidoptera (moths and butterflies), which include serious pests such as leaf-eaters and stem-boring caterpillars that are the main targets of the often-used *Bt* transgene,” says Mwenje. “We also found predatory species and wasps that parasitize these caterpillars. Any release of *Bt*-sorghum, therefore, could have knock-on effects against these natural bio-control agents.”

As well as providing valuable data that can be fed into a risk-assessment analysis for the potential release of genetically-modified sorghum, the TWAS research grant has also been used wisely to build the research capacity of NUSTS’s Department of Applied Biology and Biochemistry.

“Thanks to the grant and the equipment we were able to purchase,” says Mwenje, “our research unit now comprises five MSc students studying in the broad areas of biotechnology, molecular biology and plant pathology. We also hope to soon start attracting students from other countries in the southern Africa region. We have also received national and regional recognition,” adds Mwenje, “as I have been invited to participate in a national working group for biotechnology projects and the group has been invited to collaborate with Western Cape University in South Africa on sorghum research.”



TWAS – like every organization – needs an effective way of communicating its programmatic activities to its membership and other interested parties. For TWAS, this includes the many international organizations and institutions committed to building scientific capacity in developing countries, as well as government ministries, national research councils and academies of science – a list that is ever-increasing. Within the Academy’s secretariat, such efforts are the responsibility of the Public Information Office.

Public Information



TWAS’s 11th General Conference and 20th General Meeting in Durban, South Africa, in October 2009 saw increased and immediate coverage through the efforts of the TWAS Public Information Office (PIO). A ‘live’ blog that featured commentary on the activities of each day of the meeting was included on the webportal SciDev.Net and the TWAS website and longer news items were added daily to the TWAS website. News releases about the winners of the 2009 TWAS prizes and awards and the Ernesto Illy Trieste Science Prize announced at the Durban meeting were widely distributed to the Italian and international press. In addition, a special edition of the *TWAS Newsletter*, ‘Science in Sub-Saharan Africa: TWAS Newsletter in review’, was produced especially for the conference.

Extending its series *Excellence in Science: Profiles of Research Institutions in Developing Countries*, initially funded by the David and Lucile Packard Foundation, TWAS published and distributed an in-depth profile of the Ifakara Health Institute located in Ifakara, Tanzania. TWAS intends to continue producing these profiles and distributing them as widely as possible.

In June, TWAS and IAP co-organized a conference on ‘Afghanistan and its Geographical Context: Development of a Regional Network of Cultural and Scientific Cooperation’ with the Italian Ministry of Foreign Affairs during the G8 Foreign Ministers’ Meeting in Trieste, Italy. Another special ‘TWAS Newsletter ... in review’ was produced on this occasion. It featured 15 newsletter articles written over the past 10 years that have focused on science



in the Islamic world. A booklet entitled 'TWAS Promoting Collaboration' and an 'Abstracts of Presentations' booklet were also produced for the conference. The workshop was covered by both local and national media.

The PIO also participated in the World Science Forum, hosted by the Hungarian Academy of Sciences in Budapest in November. TWAS executive director Mohamed Hassan's speech at the Ministerial Roundtable session concerned the historic shift towards the increasing production of scientific knowledge in the developing world. A summary of the speech was posted on the TWAS website. TWAS also participated in the 'Berlin7', an international open access conference held at the *Université Panthéon-Sorbonnes* in Paris in December and posted an interview with Zhang Xiaolin, executive director of the Chinese Academy of Sciences' National Science Library, on the TWAS website.

In February, the United States-based SEED magazine published an article by Mohamed Hassan entitled 'New Partnerships Could Represent a Tipping Point in Developing African Science: Breaking the Legacy'. In March, an interview with Hassan was featured on the UNESCO portal as part of the UNESCO Future Forum that was held on 2 March in Paris to reflect on the current global financial and economic crisis. In June, the PIO helped arrange for media coverage of the 'IAP Statement on Ocean Acidification' that asserted corrosion of coral reefs and dramatic changes in ocean biodiversity will have significant implications for food production and the livelihoods of millions of people. In July, the PIO helped to launch the NASAC statement on 'Brain Drain in Africa' to the G8+5 Summit in L'Aquila, Italy. In October, a feature article was published on 'The state of

South African Science' on SciDev.Net. It discussed the challenges of science and technology in South Africa, which include realigning scientific capacity to serve the black majority, tackling brain drain and ensuring scientific research benefits the poor.

The flagship publication of the Academy is the *TWAS Newsletter*, which is published four times a year. The *TWAS Newsletter* – with a print-run of 2,500 copies distributed worldwide – is generously supported by the Kuwait Foundation for the Advancement of Sciences (KFAS). Its magazine-like format provides a timely and effective way of keeping TWAS members, as well as colleagues and partners in other international organizations, up to date with the work of the Academy and its affiliated organizations, TWOWS, IAP, IAMP and COSTIS (see pages 60-63).

The *TWAS Year Book 2009*, containing short biographies of all TWAS Fellows and Associate Fellows, was published in August 2009 and distributed to all members. The *Year Book* continues to serve as an important source of information for the Fellows themselves as well as those who are interested in the Academy's membership.

TWAS also produces a two-page *e-Bulletin*, issued three times in 2009 and the *IAP Bulletin* every three months. Each were disseminated widely and made available on the websites of the respective organizations.

In addition to its ongoing responsibilities, the PIO also maintains the Academy's website, provides editorial and technical assistance for the websites of the Academy's associated organizations, and prepares booklets, leaflets, brochures and posters detailing the activities of TWAS and its partner organizations.



Partnerships



BIOTECH COLLABORATION

Two programmes aimed at supporting biotechnology research networks overlapped in 2009.

The three-year TWAS-International Centre for Genetic Engineering and Biotechnology (ICGEB) Joint Programme in Biotechnology provided funding to networks of two to four institutions to carry out research and training activities on tolerance to abiotic stress in plants. In each case, one of the partner institutions had to be in a least developed country (LDC) or other science- and technology-lagging country (S&TLC) and a significant part of the allocated funds had to go towards training young scientists from these institutions at other, more advanced institutions within the network. In 2009, the third and final annual allocation of funding was provided to the selected networks. Representatives of each research network also attended a workshop at the United Nations Food and Agriculture Organization (FAO) in Rome, Italy, in June, where results were shared and discussed with members of other supported networks.

Following a Memorandum of Understanding signed in 2008, TWAS and ICGEB joined forces with the United Nations Educational, Scientific and Cultural Organization's International Basic Sciences Programme (UNESCO/IBSP) to fund a three-year 'Joint Project on Capacity Building in Basic Molecular Biology'. Again, the project is aimed at the creation of networks involving institutions from S&TLCs, but in this case the focus is on research on biotic

stresses (i.e., pests and pathogens) of crop plants and domestic animals.

Following a successful call for letters of intent, principal investigators of the 14 projects deemed the most promising were invited to a workshop in Santiago, Chile, on 1-2 October 2009. There, participants were provided with overviews of the state-of-the-art in biotic stress research from international experts and received advice on how to strengthen their research proposals. All principal investigators attending the workshop were then invited to submit full-length proposals by the end of the year, of which five will be selected for funding.

EUROAFRICA-ICT

The two-year EuroAfriCa-ICT project, funded through the European Union's (EU) Seventh Framework Programme (FP7), sees TWAS linking up with a number of institutions in Europe, sub-Saharan Africa and the Caribbean. The project, which began in 2008, aimed at increasing the number of scientists from sub-Saharan Africa and the Caribbean carrying out research in information and communication technology (ICT) that become involved in EU-funded research programmes.

The flagship event of 2009 was the First Euro-Africa Cooperation Forum on ICT Research, held in Brussels, Belgium, on 24-25 March. More than 320 participants from some 50 countries – including both policy-makers and ICT researchers in the public and private sectors – attended the event to discuss the development of collaborative projects. The two-day event was organized by the European Commission Directorate General, Information Society and Media (DG INFSO) with the



support of the African Union Commission (AUC) and the EuroAfriCa-ICT project, with a significant contribution from TWAS.

The EuroAfriCa-ICT consortium members also organized information workshops (three were held in 2009, in Benin, Jamaica and Rwanda), and a 'concertation' meeting held in Brussels, Belgium, in October. In addition, the EuroAfriCa-ICT team provided a number of web-based support activities such as an on-line ICT community, a partner search database and regional help-desks. Funding was also secured for the continuation of the project for a further two years (2010-2011).

For additional information on EuroAfriCa-ICT, visit: www.euroafrica-ict.org.

PHYSICS COLLABORATION

In July 2009, TWAS and the Abdus Salam International Centre for Theoretical Physics (ICTP) signed a memorandum of understanding that commits the two organizations to work more closely together. To date, although the TWAS secretariat has been generously hosted by ICTP since the inception of the Academy in 1983, the number of collaborative programmes has been limited.

This has now changed, and joint projects and programmes are under way. In November 2009, for example, TWAS teamed up with ICTP's Aeronomy and Radiopropagation Laboratory and other partners to support a workshop on the science and application of global navigation satellite systems. The workshop was hosted by the National Universities Commission in Abuja, Nigeria, and some 25 professors and lecturers from 12 Nigerian universities attended. TWAS and ICTP have also agreed to contribute to an African PhD programme on geohazards being run by the Institute of Geophysics, Space Science and Astronomy, Department of Physics, Addis Ababa University, Ethiopia. In addition, TWAS will support a number of ICTP diploma students and fellowships, as well as sponsoring various networks in specific areas of mathematics and physics.



MICROSOFT SUPPORT FOR AFRICA

In 2009, TWAS entered into a three-way agreement with Microsoft Research, UK, and the African Academy of Sciences (AAS) to coordinate two programmes designed to promote computer science research in Africa: an awards programme for young African computer scientist, and support for computer science workshops and meetings in Africa.

The first round of TWAS-AAS-Microsoft awards for young computer scientists in Africa were presented at a TWAS Regional Conference for Young Scientists in Nairobi, Kenya, in December 2009. The winners, from three different African countries – each of whom received Euro 7,000, Euro 5,000 of which is earmarked for further research – were:

- Youcef Bentoutou, *Centres de Techniques Spatiales*, Arzew, Algeria.
- Omar Fakh Hamad, Department of Electrical and Computer Systems Engineering, University of Dar es Salaam, Tanzania.



- Tshilidzi Marwala, Research Chair in System Engineering, Department of Science and Technology, South Africa.

PERMIT

The EU-Turkey funded project, PERMIT (Promote Education and Reciprocal Understanding through Multi-cultural Integrated Teaching), was completed in 2009. This 18-month project brought together young teachers from various backgrounds in Turkey (both state schools and private schools) with other teachers from Italy and Slovenia with the aim of introducing them

and their students to European culture (and the European teachers and students to Turkish culture) through a series of workshops designed around the development of exemplar teaching materials on multi-cultural themes.

Although the project embraced all subject areas, including the arts and humanities, TWAS ensured a scientific element by selecting young

Turkish science teachers. Çigdem Kagitçibasi (TWAS Fellow 2006), Koc University, Turkey – an expert in cross-cultural psychology – participated in the project’s scientific steering committee that is evaluating the results of the project as the exemplar materials developed were trialled in classroom situations.

TWAS’s PERMIT project partners include the University of Venice Ca’Foscari, Italy; the University of Primorska, Koper, Slovenia; and Yildiz Technical University, Istanbul, Turkey.

The project ended with a conference in Istanbul on 27 October where the successes of the project were analysed and participating students from the three countries presented their views on the classroom projects they had undertaken.



TWAS-COMSTECH GRANTS

In June 2009, TWAS and the Organization of Islamic Conference (OIC) Standing Committee on Scientific and Technological Cooperation (COMSTECH) signed a memorandum of understanding whereby the two organizations agreed to co-finance a Joint Research Grants programme. Through the new programme, research grants of up to US\$15,000 are made available to scientists under the age of 40 working in OIC member states. Awards are available in the fields of earth sciences, engineering sciences, information technology and computer sciences, materials science including nanotechnology, pharmaceutical sciences and renewable energy.

In response to the first call for proposals, TWAS and COMSTECH provided grants to 19 young scientists in 10 countries: Albania, Algeria, Bangladesh, Egypt, Iraq, Malaysia, Pakistan, Senegal, Sudan and Tunisia.

CAPACITY BUILDING WORKSHOPS

Following on from a series of four training courses on 'Capacity building in environmental related issues in the field of geo-mining' held in 2006 and 2007, TWAS continued its partnership with Forgea International, a geo-mining and environmental training and cooperation centre based in Sardinia, Italy. With funding from the Italian government's Ministry of Foreign Affairs, TWAS and Forgea International organized a further three training courses, one of which was held in 2008.



The two remaining training courses were held in March and May 2009 and focused on 'Bioremediation and phytoremediation techniques for the reclamation of mine sites' and 'Remote-sensing and other environment-related issues'. The courses featured 22 invited participants from 14 target countries (mainly North Africa and the Middle East) and 21 participants from 11 countries, respectively.

For additional information on Forgea International, visit: www.forgeainternational.org.

SUPPORT FOR SCIENTIFIC MEETINGS

In 2009, TWAS provided support for 18 scientific meetings in 16 developing countries. Among the meetings supported were:

- Sixth International Conference on Mycorrhizas (ICOM6): Beyond the Roots, 9-14 August 2009, Belo Horizonte, Brazil;
- International Conference on Sustainable Water, 25-28 August 2009, Nairobi, Kenya;
- Second Ibero-American School of Astrobiology: Origins from the Big Bang to Civilizations, 7-13 September 2009, Montevideo, Uruguay;
- IV International Symposium on Biochemistry and Molecular Biology, 12 - 16 October 2009, Havana, Cuba;
- DIVERSITAS Second Open Science Conference: Biodiversity and Society: Understanding Connections, Adapting to Change, 13-16 October 2009, Cape Town, South Africa;
- Fourth Conference of Latin American and Caribbean Women in Exact Sciences and Life Sciences: Science-Women 2009, 14-16 October 2009, Guatemala City, Guatemala;
- International Society of Computational Biology and African Society of Bioinformatics and Computational Biology (ISCB Africa ASCBC) Joint Conference on Bioinformatics of Infectious Diseases, 30 November to 2 December 2009, Bamako, Mali.

The strength of an organization such as TWAS depends on providing information to scientists throughout the developing world. The scientific excellence of the Academy's new members, the fellowships awarded and the research programmes funded depend on the Academy reaching the maximum number of candidates and then selecting the best. To help with this exercise, TWAS has established a suite of regional offices throughout the South. Among the activities shared by the five Regional Offices are the identification and nomination of scientists for TWAS membership, TWAS Prizes and TWAS Regional Prizes, the selection of TWAS Young Affiliates, the organization of Regional Conferences for Young Scientists, and awareness-raising of TWAS activities among scientists in the respective region.

Regional Offices



TWAS REGIONAL OFFICE FOR EAST AND SOUTHEAST ASIA AND THE PACIFIC Headquarters: Chinese Academy of Sciences (CAS), Beijing, China

In 2009, the TWAS Regional Office for East and Southeast Asia and the Pacific (TWAS-ROESEAP) again teamed up with the World Meteorological Organization (WMO) to organize the 8th CAS-TWAS-WMO International Workshop, this time on 'Mineral Aerosols and their Impacts on Climate and Environment'. The event, held in Lanzhou, Gansu Province, China, on 17-19 August, attracted more than 50 participants, including scientists from Australia, China, France, Germany, India, Italy, Japan, Malaysia, Nepal, the Netherlands, Pakistan, South Korea, Thailand, Vietnam, the United States and the United Kingdom.

On 8 October 2009, TWAS-ROESEAP also organized the Fifth Meeting of Chinese TWAS Fellows in Beijing. The meeting, the purpose of which was to promote close cooperation in the region under the TWAS strategic plan, was





attended by more than 100 TWAS Fellows. Indeed, TWAS-ROSEAP actively supports the CAS-TWAS fellowship programme and the TWAS-UNESCO associateship scheme. In 2009, 48 scientists from developing countries other than China were awarded CAS-TWAS postgraduate, postdoctoral or visiting scholar fellowships and four associateship awardees carried out cooperative research in CAS institutes. In addition, under an agreement signed with the Third World Organization of Women in Science (TWOWS) in 2008, three young women scientists from Nigeria and another from Yemen are being hosted in China.

TWAS-ROSEAP also participated in the organization of the TWAS Regional Conference for Young Scientists on 'Food, Health and Fuel: Plants for the Future', held in Selangor, Malaysia, on 2-5 November. In addition, a training course on 'High and New Technology of Biology and Medicine for Developing Countries' was held from 1 July to 22 September 2009 at CAS Institute of Biophysics, Beijing, with the objective of strengthening exchange and cooperation. The 26 participants came from 10 developing countries.

- *coordinator: Chunli Bai (TWAS Fellow 1997)*
- *email: sqfu@cashq.ac.cn*
- *website: www.beijing.twas.org*

TWAS REGIONAL OFFICE FOR SUB-SAHARAN AFRICA
Headquarters: African Academy of Sciences (AAS),
Nairobi, Kenya

In 2009, the TWAS Regional Office for Sub-Saharan Africa (TWAS-ROSSA) organized the Fourth TWAS-ROSSA Young Scientists Conference, which took place on 7-9 December 2009 on the theme 'S&T Enterprises in Africa'. The event took stock of available entrepreneurial opportunities for science and technology in Africa while focusing on the application of research and innovation in tackling societal challenges.

TWAS-ROSSA continued its efforts towards strengthening the capacity of TWAS National Chapters in Africa. This year, the Zimbabwe Chapter based at the Scientific and Industrial Research and Development Centre, Harare, was awarded US\$3,000 for its activities.

Another activity supported through TWAS-ROSSA is the publication of the peer-reviewed, multidisciplinary



and indexed journal, *Discovery and Innovation*, which provides a vehicle for African scientists to publish their results and to keep informed about scientific developments on the continent. Four issues are published annually.

- coordinator: Tom Egwang (TWAS Fellow 1997)
- email: aas@aasciences.org
- website: www.nairobi.twas.org

TWAS ARAB REGIONAL OFFICE

Headquarters: Bibliotheca Alexandrina, Alexandria, Egypt

The TWAS Arab Regional Office (TWAS-ARO) is linked closely with the *Bibliotheca Alexandrina's* Centre for Special Studies and Programmes (CSSP).

The main event organized by TWAS-ARO in 2009 was TWAS/BioVision.Nxt. The meeting was held within the framework of the biennial international conference, Bio-Vision, in Lyon, France, on 7-11 March. TWAS-ARO supported the participation of 32 young scientists from 10 African and Arab countries. The group of young scientists actively participated in several 'Coffee With' sessions,

when they had the opportunity to meet Nobel laureates, leaders of industry, and heads of major international institutions and non-governmental organizations.

The TWAS-ARO fifth annual meeting took place at the *Bibliotheca Alexandrina* on 21-22 December, and was attended by 16 TWAS Fellows from the Arab region together with four Young Affiliates and 62 other participants. The main topic of discussion was the 'Science Supercourse: A new tool for knowledge dissemination in the Arab Region'. During the meeting, the winner of the Young Arab Scientist prize in the field of 'Biology and new life sciences' was announced: Walid M. El-Sharoud (Egypt).





In 2009, three guest lecturers presented TWAS-ARO public lectures: in March, Mostafa El Sayed, director of the Laser Dynamic Laboratory, Georgia Institute of Technology, USA, spoke on ‘Nanotechnology and its application in medicine’; in July, Ahmed Zewail (TWAS Fellow 1989), Linus Pauling Chair, California Institute of Technology, USA, spoke on ‘A journey to the future’; and in October, Miguel Nicolelis, professor of neurobiology, Biomedical Engineering and Psychological and Brain Sciences and co-director, Center for Neuroengineering, Duke University Medical Center, USA, spoke on ‘Biorobotics’.

- *coordinator: Ismael Serageldin (TWAS Fellow 2001)*
- *email: twas.aro@bibalex.org*
- *website: www.bibalex.org/TWASARO*

**TWAS REGIONAL OFFICE FOR CENTRAL AND SOUTH ASIA
Headquarters: Jawaharlal Nehru Centre for Advanced
Scientific Research (JNCASR), Bangalore, India**

The main event organized by TWAS Regional Office for Central and South Asia (TWAS-ROCASA) in 2009 was the Young Scientists of Asia Conclave, ‘Pressing Prob-



lems of Humankind: Energy & Climate’. Billed as a ‘conference of concerned young scientists’, the meeting was hosted by the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) in Bangalore on 15-17 January 2009, and was attended by more than 100 young scientists from 15 countries. An edited volume of the proceedings has been published.

TWAS-ROCASA also runs the TWAS-JNCASR Summer Research Fellowship Joint Programme, aimed at encouraging young undergraduate students to visit



renowned institutions in India. In 2009, four students from the region were selected to participate.

The Regional Office also updated the regional directory of TWAS Fellows that features the biographical and contact details of Academy members in the region.

- *coordinator: Varadachari Krishnan (TWAS Fellow 1996)*
- *email: twasrocasa@jncasr.ac.in*
- *website: www.bangalore.twas.org*

TWAS REGIONAL OFFICE FOR LATIN AMERICA AND THE CARIBBEAN

Headquarters: Brazilian Academy of Sciences (ABC), Rio de Janeiro, Brazil

The 2009 TWAS-ROLAC Prizes for young scientists were awarded to: Ernesto Lupercio (Mexico) for mathematics; Rodrigo Capaz (Brazil), for physics; Pierre Mothe Esteves (Brazil) for chemistry; and Maurício Calderon Nettle (Chile) for earth and space sciences. The prizes, each worth US\$2,000, were presented during the Fifth TWAS-ROLAC Young Scientists Conference held on 4-6 May 2009, which focused on the same themes: mathematics, physics, chemistry and earth and space sciences.

Later in the year, in December, the Sixth TWAS-ROLAC Young Scientists Conference was also held at the headquarters of the Brazilian Academy of Sciences in Rio de Janeiro.

TWAS-ROLAC also helped organize the Latin America and the Caribbean edition of a series of three IAP/TWAS workshops on climate change. Coordinated by Pedro Leite da Silva Dias, the workshop, which took place in Itaipava, Brazil, on 9-10 July 2009, aimed at informing national negotiators of climate-change issues prior to the United Nations Climate Change Conference scheduled for December 2009 in Copenhagen.

- *coordinator: Carlos A. Araújo de Carvalho (TWAS Fellow 2002)*
- *email: contact@twas-rolac.org*
- *website: www.twas-rolac.org*

REGIONAL PRIZES

In 2006, TWAS instigated three regional prizes of US\$3,000 each that are awarded annually on a rotating basis. In 2009, the Regional Prizes for 'Building scientific institutions' were awarded to:



- **TWAS-ARO:** Adnan Badran (TWAS Fellow, 1991), professor and president, Petra University, Amman, Jordan, and president, Arab Academy of Science.
- **TWAS-ROCASA:** Atta-ur-Rahman (TWAS Fellow, 1985), coordinator-general, COMSTECH, and president, Network of Academies of Sciences in OIC (Organization of Islamic Conference) Countries (NASIC).
- **TWAS-ROLAC:** Luiz Bevilacqua (TWAS Fellow, 2002), emeritus professor, Federal University of Rio de Janeiro (UFRJ), Graduate School of Engineering, Brazil.
- **TWAS-ROSSA:** Venansius Baryamureeba, professor

and dean, Faculty of Computing and IT, Makerere University, Kampala, Uganda.

- **TWAS-ROESEAP:** Wu Cheng-Wen, National Yang-Ming University, Taiwan, China.

YOUNG AFFILIATES

Each year, each TWAS Regional Office selects up to five Young Affiliates (who must be excellent scientists aged 40 or below). In 2009, the following 25 young scientists were selected following a nomination and selection process that involves the TWAS Fellows in each region:

YOUNG AFFILIATES

TWAS-ARO	TWAS-ROCASA	TWAS-ROLAC	TWAS-ROSSA	TWAS-ROESEAP
Maher A.E.K. Ahmed, Egypt	Farooq Anwar, Pakistan	Irasema Alcántara-Ayala, Mexico	Lawrence N. Kazembe, Malawi	Christian Cumagun, Philippines
Mohamed Al-Lawati, Oman	Orhan Aydin, Turkey	Jose Luis Badano, Uruguay	Thokozani Majazi, South Africa	Che Alex Ma, Taiwan, China
Michel Bariche, Lebanon	Subhabrata Chakrabarti, India	Alexis Kalergis, Chile	John H. Muyonga, Uganda	Ho Hai Phung, Vietnam
Asaad Khalid, Sudan	Sadig Hamidov, Azerbaijan	Stevens Rehen, Brazil	Bernard Slippers, South Africa	Xiaohui Qiu, China
Hamad Mohammad Al-Matar, Kuwait	Halka Siriwardana, Sri Lanka	Stephen Patrick Walborn, Brazil	Emmanuel Iyayi Unuabonah, Nigeria	Subramaniam Ramesh, Malaysia

At its headquarters in Trieste, Italy, TWAS hosts the secretariats of four other international organizations dedicated to serving the needs of science and scientists in the developing world and promoting indigenous scientific capacity as a fundamental component of sustainable economic development. Highlights of the 2009 activities of these organizations follow.

The TWAS Family



THIRD WORLD ORGANIZATION FOR WOMEN IN SCIENCE (TWOWS)

With more than 3,000 members, TWOWS is the largest organization of women scientists in the world.

The third TWOWS executive board meeting was held in Trieste, Italy, in March 2009, hosted by TWAS. Executive board members reviewed national and regional activities, including the TWOWS Fourth General Assembly and International Conference, which will be hosted by the Chinese Academy of Sciences (CAS) in June 2010 in Beijing, China. The TWOWS Strategic Plan, the TWAS-TWOWS Advisory Panel on Women in Science, and the launch of the first TWOWS awards for young women scientists were also discussed.

The TWAS-TWOWS Advisory Panel held its first meeting at the TWAS General Conference in Durban in October 2009, at which it presented a series of recommendations to the TWAS General Assembly aimed at increasing the participation of women scientists in TWAS activities. Recommendations included increasing the representation of women scientists on TWAS selection and nomination committees, and encouraging young women scientists to participate in TWAS regional conferences.

TWOWS's flagship postgraduate fellowship programme for young women scientists from sub-Saharan Africa and Least Developed Countries, sponsored by the Swedish International Cooperation Development Agency (Sida), was launched in 1998 and continues to grow. In 2009, 128 eligible applications were received from 22 countries, of which 29 were selected from 13



Source: World Economic Forum

countries. Under the fellowship, ten young women scientists completed their postgraduate studies in 2009 – from Bangladesh, Cameroon, Kenya (2), Malawi, Myanmar, Nigeria (2), Yemen and Zimbabwe – bringing the total since the programme began to 83. The graduates carried out their studies under the fellowship in six host countries – Ethiopia, Malaysia, Pakistan, Senegal, South Africa and Sri Lanka.

TWOWS-related meetings were also organized by several executive board members in Bolivia, Egypt, India, Nigeria and Yemen.

For additional information about TWOWS, see www.twows.org or contact info@twows.org.

INTERACADEMY PANEL ON INTERNATIONAL ISSUES (IAP)

IAP, an association of the world's merit-based academies of science, currently coordinates programmes devoted to capacity building for science academies. New programmes, led by member academies or by regional networks, funded in 2009 include topics such as science education, genetically modified organisms in Africa, safe drinking water and reviewing science funding landscapes.

IAP membership reached 103 at the close of 2009: the Academy of Sciences of Afghanistan, the Academy of Science of Mozambique and the Nicaraguan Academy of Sciences being the newest members to join IAP.

In January 2009, IAP and the InterAcademy Council (IAC) organized a second joint session of their respective governing bodies in Amsterdam, the Netherlands, in line with a memorandum of understanding (MoU) signed in 2008 by the two organizations. Through this MoU, IAP provides funds to its regional networks to hold workshops aimed at implementing the recommendations of IAC studies. In 2009, IAP facilitated

three such workshops: the Mexican Academy of Sciences hosted the IANAS 'Women for Science Symposium', 20-21 April 2009; the NASAC-TWOWS-TWAS Workshop on 'Women for Science In Africa', took place from 26-27 November 2009, in Nairobi, Kenya; and the NASIC International Conference on 'Gender Participation in the Development of Science', 14-15 November 2009, was held in Dhaka, Bangladesh.

In September 2009, the IAP executive committee met in Tokyo, Japan, where IAP's programmatic agenda for 2010 was adopted. Based on a competitive and rigorous review process, eleven proposals were selected for activities to run in 2010 including four on water issues, one on science communication, two on science education, one on young scientists and gender issues, one on policy advice issues, and two on energy.

In addition, IAP's flagship programme, 'Capacity Building for Science Academies', which pays particular attention to building the capacity of science academies in developing countries, continues to be led by TWAS. A key objective of the programme is to strengthen the role of academies in providing advice to governments on issues of national and global concern through the IAP regional networks. The academies of Albania, Tanzania and Sudan also received funding support for developing and strengthening their infrastructure and network connectivity. In addition, the ongoing 'Digital Knowledge Resources and Infrastructure in Developing Countries' programme received further funding in 2009.

Also in 2009, IAP strengthened its activities in partnership with other organizations. For example, the Council of Canadian Academies brought together participants from around the world for a workshop on 'Best Practices in Advisory Roles and Fellowship Appointments', which took place in Trieste on 12-13



Source: World Economic Forum

February 2009. The workshop was attended by 60 participants from 43 countries. This event was inspired by a collective desire to provide a forum for academies to share successes and challenges, and look for opportunities for mutually beneficial international collaborations on issues such as engaging decision-makers through advisory processes, performing science-based assessments, the process of appointing fellows and outreach to society.

In addition, IAP and IAC joined the European Climate Foundation and TWAS in holding a series of 'briefing-plus-discussion' workshops to prepare delegates for their participation in the global climate change summit in Copenhagen, Denmark, in December 2009, where delegates were seeking to forge a new protocol as a follow-up to the Kyoto Protocol due to expire in 2012. Each workshop aimed to brief delegates on the current state of scientific knowledge on climate change, and on options for mitigating and adapting to its impact. For more information, see 'Regional Offices' (page 58).

IAP provided support for the IAP/TWAS conference on 'Afghanistan and its geographical context: development

of a regional network of cultural and scientific cooperation', organized in collaboration with the Italian Ministry of Foreign Affairs. The event was held in Trieste on 26 June 2009, as a run-up to the G8 Summit in L'Aquila, Italy. Representatives from academies of science in Afghanistan, India, Italy, Pakistan and Turkey were present.

The second IAP Young Scientists Conference took place from 10-12 September 2009 in Dalian, China, in conjunction with the World Economic Forum's 'Annual Meeting of New Champions', drawing on the success of the pilot venture held in Tianjin in 2008. Sixty young scientists, including TWAS nominees Negussie W. Beyene (Tanzania) and Santiago Ron (Ecuador), were selected to participate in sessions on science education and research priorities for promoting innovation. Seven young scientists who participated in the pilot venture in 2008 returned as 'young mentors', including TWAS Young Affiliate Hiba Salah El Din Mohamed (Sudan).

Two IAP statements were released in 2009. Seventy member academies signed the 'Statement on Ocean Acidification'. The statement was released on 1 June 2009, and called on world leaders to recognize the threat posed to oceans by rising levels of atmospheric carbon dioxide. On 16 December 2009, as global leaders met at the United Nations Climate Change Conference to negotiate and agree the framework for a new international climate change agreement in Copenhagen, Denmark, IAP released its 'Statement on Tropical Forests and Climate Change' signed by 54 academies. The signatories from around the globe cautioned that deforestation must be addressed immediately if the target of an 80% reduction in atmospheric carbon dioxide is to be met by 2050.

For additional information about IAP, see www.interacademies.net or contact iap@twas.org.



INTERACADEMY MEDICAL PANEL (IAMP)

IAMP membership currently comprises 65 medical academies and science academies with medical divisions that are committed to improving health and health-related research worldwide.

The IAMP executive committee held its annual meeting on 24 September 2009 at the secretariat in Trieste. At the meeting, a new draft of the IAMP statutes and rules of procedure was approved for circulation and endorsement by the IAMP membership. A draft memorandum of understanding between IAMP and IAP was discussed and sent to the IAP co-chairs for review. The executive committee hopes that a standing agreement for the funding of health-related projects can be signed between the two organizations. In the meantime, IAP continues to support the costs of the IAMP secretariat. The Akademi Sains Malaysia proposed to host the IAMP Scientific Meeting and General Assembly in Kuala Lumpur, Malaysia, in June 2010 and the generous offer was accepted by the IAMP co-chairs and executive committee members. The theme of the conference will be 'Global Collaboration for Local Health Action'. Election of a new co-chair and renewal of the executive committee will take place on that occasion. The general assembly will also consider applications for new members.

For additional information on IAMP, see www.iamp-online.org or contact iamp@twas.org.

CONSORTIUM ON SCIENCE, TECHNOLOGY AND INNOVATION FOR THE SOUTH (COSTIS)

On 4 November 2009, TWAS joined the Group of 77 and UNESCO in announcing the official launch of COSTIS, an international organization designed to bring policymakers and scientists closer together to improve the prospects for sustainable economic growth in the developing world.

The launch took place at a ceremony held at the Hungarian Academy of Sciences and was attended by representatives from more than 50 government agencies and international organizations, including 25 ministers of science and technology from the developing world. Davidson L. Hepburn, president of UNESCO's General Conference and the Bahamas' permanent delegate to UNESCO; Walter Erdelen, head of UNESCO's Natural Sciences Sector; and Jacob Palis, TWAS president, shared the podium to welcome the arrival of COSTIS.

In a message sent to the participants, Abdalmahmood Abdalhaleem Mohamed, chair of the Group of 77 and Sudan's permanent representative to the United Nations in New York, noted that "the G77 is confident that COSTIS will play an instrumental role in making science, technology and innovation an integral part of the development process in the South."

A major goal of COSTIS will be to provide a platform for officials from both policy and funding institutions, most notably ministries of science and technology and research councils, to interact with eminent scientists and technologists to forge effective national and regional strategies for science-based development. COSTIS membership currently includes some 90 institutions, including 25 ministries of science and technology and 35 science academies from the South. COSTIS will also seek to promote South-South and South-North collaboration in science and technology, with a focus on initiatives that help fuel economic development and address critical social needs.

Representatives of the G77, TWAS and UNESCO are currently serving on a steering committee that is responsible for finalizing COSTIS' statutes and bylaws. The interim COSTIS secretariat is hosted by TWAS in Trieste.

For additional information about COSTIS, see www.twaso.org or contact costis@twas.org.



A P P E N D I C E S

2009 in Figures

In 2009, under the **TWAS-UNESCO Associateship Scheme**, TWAS appointed 23 developing-world scientists from 11 countries, including Cuba, Nepal, Nigeria and Uzbekistan, as associates. In addition, 38 associates travelled to carry out collaborative research at scientific institutions in 10 countries in the South: Argentina, Brazil, China, India, Iran, Jamaica, Pakistan, Peru, Syria and Thailand. The TWAS-UNESCO Associateship Scheme is kindly supported by the OPEC Fund for International Development (OFID).

Geographical area	Awarded	Hosted
Africa and Arab region	10	2
Asia and Pacific region	10	18
Latin America and the Caribbean	3	3
TOTAL	23	23

In 2009, TWAS provided up to US\$5,000 to support 18 **Scientific Meetings** in 16 developing countries. Supported meetings covered a range of disciplines, from bioinformatics of infectious diseases, to chemistry for food security and sustainable development, and integrated coastal zone management.

Geographical area	TOTAL
Africa and Arab region	10
Asia and Pacific region	2
Latin America and the Caribbean	6
TOTAL	18

In 2009, 21 developing-world scientists from eight countries, including six Least Developed Countries (LDCs), received **TWAS Fellowships for Research and Advanced Training**. These were hosted by institutions in 14 countries: Botswana, Cameroon, Chile, China, Congo Rep., India, Madagascar, Malaysia, Mexico, Pakistan, South Africa, Thailand, Uruguay and Zambia.

Geographical area	Awarded	Accepted	Hosted
Africa and Arab region	15	14	7
Asia and Pacific region	2	2	9
Latin America and the Caribbean	5	5	5
TOTAL	22	21	21

TWAS's **South-South Fellowships** are awarded in collaboration with partner organizations in a number of developing countries, including the National Council for Scientific and Technological Development (CNPq), Brazil; the Chinese Academy of Sciences (CAS), China; the Council for Scientific and Industrial Research (CSIR) and Department of Biotechnology (DBT) of the Government of India, the S.N. Bose National Centre for Basic Sciences and the Indian Association for the Cultivation of Science (IACS), India; the *Universiti Sains Malaysia* (USM), Malaysia; the National Science and Technology Council (CONACyT), Mexico; and the National Centre of Excellence in Molecular Biology (CEMB) and the International Centre for Chemical and Biological Sciences (ICCBS) in Pakistan.

In 2009, TWAS awarded a total of 145 fellowship applications, of which 139 were accepted – the highest number yet.

Programme partner	Postgraduate fellowship		Postdoctoral fellowship		Visiting scholar	
	Awarded	Accepted	Awarded	Accepted	Awarded	Accepted
CNPq, Brazil	32	29	7	6	-	-
CAS, China	16	16	18	18	14	14
CSIR, India	7	6	8	8	-	-
DBT, India	3	3	1	1	-	-
IACS, India	0	0	0	0	-	-
S.N. Bose, India	0	0	0	0	-	-
USM, Malaysia	10	10	10	9	4	4
CONACyT, Mexico	0	0	2	2	-	-
CEMB, Pakistan	2	2	0	0	-	-
ICCBS, Pakistan	9	9	4	4	-	-
TOTAL	79	75	48	46	18	18

In 2009, 21 **TWAS Research Grants** of up to US\$15,000 each were awarded to individual researchers in some 17 developing countries. Among these, nine grants went to scientists working in seven countries in sub-Saharan Africa. Other grants went to scientists in Bangladesh, Ecuador, Indonesia and Peru.

Geographical area	Biology	Chemistry	Mathematics	Physics	TOTAL
Africa and Arab region	5	2	0	2	9
Asia and Pacific region	1	2	0	1	4
Latin America and the Caribbean	3	3	0	2	8
TOTAL	9	7	0	5	21

In 2009, 13 **TWAS Research Units** were funded in nine science and technology-lagging countries (from a list of 80 eligible countries) with grants of up to US\$30,000 each. Of these, eight were first-time awards and five were renewals.

Geographical area	Biology	Chemistry	Mathematics	Physics	TOTAL
Africa and Arab region	2	3	0	3	8
Asia and Pacific region	1	3	0	0	4
Latin America and the Caribbean	1	0	0	0	1
TOTAL	4	6	0	3	13

The **TWAS Research Professors in Least Developed Countries** (LDCs) programme was launched in 2005. In

2009, four TWAS members visited their respective host institution.

TWAS Fellow	Country of residence	Field of expertise	Host institution in LDC	Year of appointment
Abdul Ghaffar	Pakistan	Agricultural Sciences	<i>Ecole Supérieure d'Agronomie, Université de Lomé, Togo</i>	2009
Berhanu Molla Abegaz	Botswana	Chemical Sciences	Department of Chemistry, Addis Ababa University, Ethiopia	2005
Hamet Seydi	Senegal	Mathematical Sciences	Faculty of Sciences, University of Abdou Moumouni, Niamey, Niger	2008
Kalyan Bidhan Sinha	India	Mathematical Sciences	International Chair in Mathematical Physics and Applications ICMPA-UNESCO Chair Cotonou, Benin	2009

The **Joint Visiting Scientist Programme** is an initiative of TWAS, the International Council for Science (ICSU), the United Nations Educational, Cultural and Scientific Organization (UNESCO) and the United Nations University Institute for Advanced Study (UNU/IAS). It enables

eminent scientists from developing and developed countries to visit institutions and research groups in developing countries. In 2009, five scientists travelled to their selected host institution.

Visiting scientist	Country of residence	Field of expertise	Host institution	Year of appointment
Akier Assanta Mafu	Canada	Food processing and safety	Institute of Applied Techniques in Food Processing, Kimbese City, D.R. Congo	2009
Abdoulaye Doucoure	USA	Chemistry (water filtration and purification technologies)	<i>Faculté des Sciences and Techniques (FAST) de Bamako, Mali</i>	2009
Shigeiko Haruyama	Japan	Physical geography	Department of Geography, University of Yangon, Yangon, Myanmar	2009
Habauka Majority Kwaambwa	Botswana	Colloidal chemistry	Chemistry Department, University of Swaziland, Kwaluseni, Swaziland	2009
Fabien Solmon	France	Atmospheric chemistry and climate interactions	<i>Université de Cocody, Abidjan, Ivory Coast</i>	2009

The TWAS Secretariat

Executive Director's Office

Mohamed H.A. Hassan
Executive Director

Sandra Ravalico
Helen Martin

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Patricia Presiren
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Third World Organization for Women in Science (TWOWS)

Leena Mungapen
Sara Dalafi

InterAcademy Panel on International Issues (IAP)

Joanna Lacey

InterAcademy Medical Panel (IAMP)

Muthoni Kareithi

*For specific contact details,
see www.twas.org/contact-us/contacts*

Financial Report 2009

FINANCE

The total amount of funds received for activities in 2009 was US\$3,126,577. The main contributions were: the Ministry of Foreign Affairs, Italy (US\$2,108,837); the Swedish International Development Cooperation Agency (Sida) (US\$704,973); *illycafé*, Trieste (US\$99,970) and the Kuwait Foundation for the Advancement of Sciences (KFAS) (US\$59,952).

In addition, it is estimated that partner organizations in the TWAS South-South Fellowships programme (see pages 38-39 and 67) contributed some US\$2 million in local (host country) expenses.

At 31 December 2009, the TWAS Endowment Fund stood at US\$12,025,738, with the target set at US\$25 million. Donations during 2009 totalled US\$383,935, including US\$200,000 from the Ministry of Science and Technology, Brazil, US\$139,155 from the *Consejo Nacional de Ciencia y Tecnologia* (CONACYT), Mexico, US\$ 26,247 from Academia Sinica, Taiwan, China, plus other small contributions amounting to US\$18,533. Interest in 2009 totalled US\$247,848.

TWAS FINANCIAL REPORT 2009 (IN USD)¹
INCOME²

Balance	1,912,371
1) Ministry of Foreign Affairs, Italy	2,108,837
2) Swedish International Development Cooperation Agency (Sida)	704,973
3) illycaffè, Trieste	99,970
4) Kuwait Foundation for the Advancement of Sciences (KFAS)	59,952
5) COMSTEC, Pakistan	39,957
6) European Climate Foundation, the Netherlands	39,326
7) EuroAfrica-ICT (EU FP7), Belgium	37,856
9) EU / Government of Turkey	6,777
10) SPIDER, Sweden	6,376
11) CNR Rao, India	5,000
12) Other small contributions	17,553
13) Prior year adjustment	251,413
14) Interest income	62,978
15) Miscellaneous income	22,555
	5,375,894

EXPENDITURE

	Budgeted	Spent
1) Prizes		
1.1) Trieste Science Prize	110,000	105,677
1.2) TWAS Prizes and Medals	130,000	112,777
1.3) Prizes for Young Scientists	50,000	34,000
1.4) CNR Rao Prize	5,000	5,000
<i>Sub-Total for (1)</i>	295,000	257,454
2) Research Grants	1,000,000	432,775
3) Fellowships, Associateships and Professorships		
3.1) Fellowship Programmes	725,000	596,394
3.2) Associateship & Professorship Programmes	250,000	140,323
<i>Sub-Total for (3)</i>	975,000	736,717 ³
4) Meetings		
4.1) Council and General Meetings	200,000	183,699 ⁴
4.2) Officers and Steering Committee Meetings and Meetings in Trieste	30,000	125,859
4.3) Scientific Meetings in the South	100,000	63,188
<i>Sub-Total for (4)</i>	330,000	372,746
5) Publications	300,000	331,595
6) Joint Projects		
6.1) TWAS Regional Offices	450,000	437,266
6.2) TWAS-AAS-Microsoft Project	130,000	46,665
6.3) TWAS/COMSTEC Research Grant	200,000	200,024
6.4) EuroAfrica-ICT Project	50,000	34,052
6.5) TWOWS	20,000	49,456
6.6) TWAS-ICGEB Project	50,000	63,400
6.7) TWAS-ICGEB-UNESCO Project	50,000	38,000
6.8) ICSU-TWAS-UNESCO Project	60,000	14,249
6.9) TWAS-PERMIT EU Project	8,000	7,889
6.10) TWAS-ICTP Projects	400,000	200,000
<i>Sub-Total for (6)</i>	1,418,000	1,091,001
7) Operational Expenses		
7.1) Staff costs	1,000,000	1,053,402
7.2) Communications	70,000	76,834
7.3) Travel	40,000	61,448
7.4) Library, office and other supplies	20,000	27,050
7.5) Other general operating expenses	30,000	38,933
<i>Sub-Total for (7)</i>	1,160,000	1,257,667
Total	5,478,000	4,479,955
Excess (shortfall) of income over expenditure		895,939

Audited by UNESCO

¹ As at 31 December 2009

² For presentation purposes, all contributions are expressed in US dollars and have been converted using the UN official rate of exchange valid at the time the contributions were received.

³ Estimated local costs to be covered by host countries: US\$ 2,000,000

⁴ Estimated local costs covered by host country: US\$ 500,000

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