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We live in an era that places a premium on both global knowledge and global competition.

Together, these issues make the role of science and technology more critical than ever.

TWAS is addressing the challenges posed by the increasingly seamless interface between science, technology and innovation in a number of ways. First and foremost, the Academy is dedicated to building scientific excellence across the developing world. Indeed, the pursuit of scientific excellence has been TWAS's primary goal since the Academy's inception, and it remains its primary goal today. This dedication is seen not only in the new members that are elected into the Academy each year, but also in our selection of prize winners and the recipients of our research grants and our fellowship awards. I am proud to say that these and other programmes testify to an impressive list of accomplishments for the Academy. But if TWAS is to continue to have a strong impact on science and development in the developing world in the future, then we must strive to do even more.

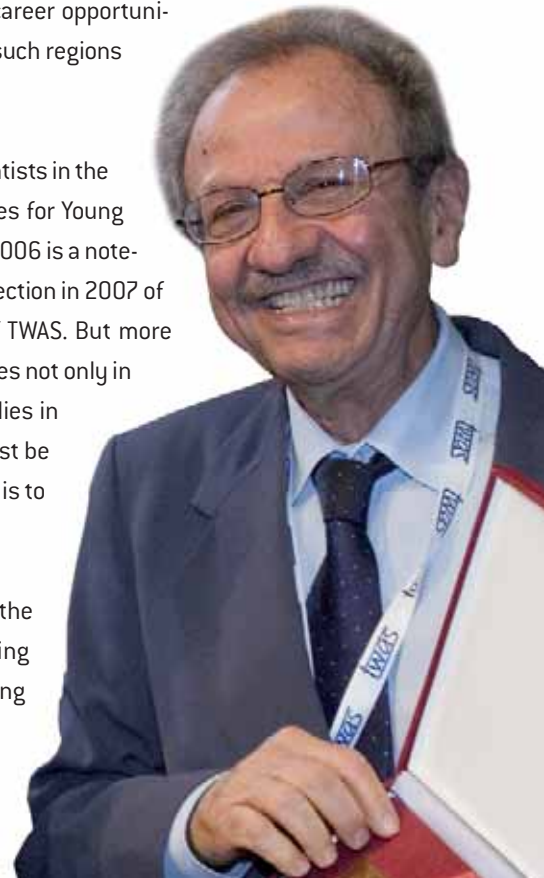
Among the major challenges that lie ahead as we move towards our 25th anniversary in 2008 are:

- To continue to expand our programmes for South-South cooperation, most notably our fellowship programme for postgraduate and postdoctoral training.
- To develop and enhance programmes that address the needs of scientists and scientific institutions that have been left behind. This means, for example, paying special attention to the career opportunities of women scientists and focusing on such regions as sub-Saharan Africa.
- To expand our efforts to help young scientists in the developing world. The Regional Conferences for Young Scientists programme that we initiated in 2006 is a noteworthy beginning in this effort, as is the election in 2007 of 24 Young Affiliate Fellows to the ranks of TWAS. But more needs to be done. The Academy's destiny lies not only in geographical and gender diversity; it also lies in demographic diversity. Youth, in short, must be served if the future of science and society is to be served.
- To position ourselves in the centre of the global world of science that is unfolding before our very eyes. This means working

Foreword

Jacob Palis

President
TWAS



closely not only with our partners in the South but also with our colleagues in the North.

To expand on this last point, science must be promoted as a global enterprise with global benefits. The sense of kinship shared by many developing countries already drives them to pool their efforts, wedded by comparable levels of skill and circumstances. This cooperation has been enhanced by the increasing number of developing countries that have recently experienced rapid growth in scientific competency. These countries now find themselves in a position of effectively cooperating not only with other developing nations with similar levels of scientific capacity, but also with developing countries that, for a number of reasons, have not kept pace with global advances in science and technology. In effect, they are helping to build scientific and technological capacity across the developing world. In such an environment, 'cooperation' replaces 'aid' as the primary driver of development.

Thanks to the universality of science, however, South-South cooperation does not preclude South-North cooperation. In fact, South-South cooperation could well improve the effectiveness of South-North cooperation through the successful creation of trilateral arrangements in which developing countries with less scientific capacity interact with developing countries with greater scientific capacity, especially within the same region. The more scientifically proficient developing countries, in turn, can interact on a more equal footing with developed countries. A variety of critical issues, including climate change, energy research and development, and the curbing of infectious diseases could lend themselves to such an approach – the creation of truly global networks of scientific research.

Solving critical global issues, which impact on every person on the planet, will require scientists in both the South and North to embrace the era of global knowledge and use global competition to spur development in a positive way. Only by working together in an environment that rewards excellence and addresses critical social needs can we hope to improve the well-being of both science and society in the developing world. In a world where knowledge reigns, cooperation and competition are not in conflict. Quite the opposite – they are both part of the same equation for success.

2007: The Year in Review

Mohamed H.A. Hassan

Executive Director

TWAS



It has been another successful year for TWAS. Not only has the Academy recorded increased demand for its core programmes, it has also been busy developing and implementing new programmes.

The standard measure for all TWAS activities has been – and continues to be – excellence. Excellence in the winners of our various prize schemes, excellence in the recipients of our research grants and excellence in the awardees of our South-South Fellowships.

So what does it mean to pursue scientific excellence in 2007 and beyond, and how is the Academy seeking to achieve it?

First, it means continuing to elect the most eminent scientists from the developing world as members of TWAS. The accomplishments of the 45 scientists elected members of the Academy in 2007 speak directly to the Academy's quest for excellence, while their diversity signals TWAS's commitment to the entire developing world. The Academy's 45 new members include outstanding scientists from countries currently under-represented in our 880-strong membership, such as Mongolia, Sudan and Venezuela, as well as – for the first time ever – Oman.

Second, it means both honouring and rewarding the best science in the developing world through prizes and awards. That is why we are so pleased to continue to award the Trieste Science Prize, generously funded by *illycaffè S.p.A.*, which is designed to honour the developing world's top scientists alongside our other awards in eight scientific disciplines and our Prizes to Young Scientists.

Third, it means ensuring that we provide opportunities to recognize the work of young scientists. That is why I am especially pleased to announce that, in 2007, through its five regional offices, the Academy elected its first 24 Young Affiliate Fellows. These excellent scientists, all under the age of 40, come from 21 developing countries. The positive response of TWAS members to the 15 Young Affiliates who attended our 18th General Meeting in Trieste and the mentorship that these young scientists will receive through their links with TWAS will benefit the future of science in developing countries – especially as we aim to have 125 such Young Affiliates on board within five years.

And, fourth, one of the most important functions that TWAS – indeed any science academy – can have is to advise governments on critical issues related to science-based development. That is why we continue to work closely with the Inter-Academy Panel on International Issues (IAP), based in Trieste, especially as the lead academy on its 'Capacity Building for Science Academies' programme (see pages 60-61).

Among the highlights of TWAS's 2007 activities were:

- *South-South Fellowships programme.* A total of 105 South-South Fellowships were awarded, the highest ever annual total, of which 96 were accepted. These Fellowships are provided in collaboration with partner organizations in Brazil, China, India and Pakistan. Together, these initiatives comprise the world's largest South-South Fellowship programme (see pages 38-39 and 65).
- *Grants for Research Units from Science and Technology-lagging Countries.* TWAS's Grants for Research Units in Least Developed Countries (LDCs) programme was launched in 2002. Initially a relatively small programme aimed at just the world's 50 LDCs, with support from the Swedish International Development Cooperation Agency's Department for Research Cooperation (Sida/SAREC), the programme has now been opened up to an additional 27 countries deemed to be lagging behind in their scientific and technological capacities. With more secure funding, TWAS is now able to expand the opportunities provided under this increasingly popular programme (see pages 44-45 and 65).
- *Trieste Science Prize.* On 3 May 2007, TWAS and *illycafé S.p.A.*, the commercial sponsor of the Trieste Science Prize, announced the names of the third round of 'Trieste Laureates': Luis Rafael Herrera-Estrella, Mexico, and Goverdan Mehta, India, in the fields of agricultural and chemical sciences, respectively. The two winners attended a ceremony in Trieste, held during a four-day international science media fair, FEST, in May 2007, and presented their work at the TWAS 18th General Meeting held in Trieste in November 2007 (see pages 20-21).
- *TWAS 18th General Meeting.* The TWAS 18th General Meeting, originally scheduled to be held in Pakistan, was moved to Trieste owing to political uncertainty in Pakistan. The meeting was attended by some 200 scientists from 44 countries. Among the highlights of the meeting were the election of 45 eminent scientists to the Academy, the induction of the first group of TWAS Young Affiliates, and the announcement of the winners of the 2007 TWAS Prizes (see pages 12-17).
- *Increased outreach.* A plenary lecture presented to more than 2,000 delegates attending the annual meeting of the American Association for the Advancement of Science (AAAS) in San Francisco, USA, in February 2007, illustrated the growing gap between such scientifically advanced developing nations as China and countries that are lagging scientifically. The lecture led to requests from two leading international journals, *Science* and *Cell*, for commentaries examining these gaps in scientific capacity and highlighting ways of tackling them. These outreach activities have given the Academy unprecedented visibility among the global scientific community and a far wider audience than it has had in the past.

- *Regional prizes.* In line with TWAS's increased outreach activities and the Academy's dedication to honouring excellence, in 2006, three regional prizes were established, to be awarded on a rotating basis by each of the five TWAS Regional Offices. The winners of the first of these prizes, for the 'Public Understanding and Popularization of Science', were announced during the TWAS 18th General Meeting [see pages 12-17 and 57].
- *Cities, Science and Sustainability.* TWAS teamed up once again with the United Nations Development Programme Special Unit for South-South Cooperation (UNDP-SSC) and the United Nations University - Institute of Advanced Studies (UNU-IAS) to organize the ninth in a series of 'Sharing Innovative Experiences' workshops. This workshop focused on 'Cities, Science and Sustainability'. The 18 case studies presented during the workshop will be published in 2009 [see pages 48-49].
- *Capacity building in the geosciences.* In 2006, TWAS teamed up with FORGEA-International, a geo-mining and environmental training and cooperation centre based in Sardinia, Italy, to organize four workshops, three of which were held in early 2007. In total, the four workshops provided state-of-the-art training for 86 students and middle-level professionals from North Africa, the Middle East, the Balkans and eastern Europe [see pages 49-50].
- *TWAS-UNESCO Associateship scheme.* This programme, which provides scientists in developing countries with opportunities to develop long-term links with more than 100 centres of excellence in the South, is becoming increasingly popular. In 2007, 17 scientists were selected for the award, which allows them to make two visits to their selected host institution during a three-year period. In 2007, 44 associateship awardees visited institutions in nine developing countries [see pages 36-37 and 64].
- *Endowment fund.* During 2007, the TWAS endowment fund passed its initial target of US\$10 million. The fund, which is intended to bring long-term security to TWAS, now has a target of US\$25 million. A campaign to help us attain this goal will be launched in 2008.

This brief overview of TWAS's 2007 activities demonstrates that the Academy continues to advance on a variety of fronts but always with the over-riding aim of encouraging countries in the South to strive towards excellence when developing their indigenous scientific capacity and by directly supporting their efforts.

TWAS's 18th General Meeting was held on the campus of the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy, from 13-14 November 2007. Nearly 200 scientists from 44 countries – the majority of whom were members of TWAS – attended.

TWAS in Trieste



TWAS's 18th General Meeting, originally scheduled to take place in Islamabad, was moved to Trieste due to the political uncertainty and unrest in Pakistan. Plans to change the venue began in September in the face of rising tensions in Pakistan. Conference participants arrived in Trieste in mid-November, less than two weeks after Pervez Musharraf, Pakistan's president, declared a state of emergency.

Highlights of the meeting included:

- The election of 45 new members to the Academy. The class of 2007, which includes scientists from Mongolia, Oman (for the first time ever), Sudan and Venezuela, were chosen from a candidate pool of nearly 200 scientists nominated by current members. "The 2007 candidates," noted C.N.R. Rao, immediate past president of TWAS, "constituted the best pool of candidates that the Academy has ever had to consider. The high level of accomplishment represented by these scientists made the selection process difficult. But it also helped to ensure that those who were chosen were among the most eminent scientists in the developing world and therefore





worthy of this honour.” Among the 45 new members are eight women scientists, marking the largest number of women ever elected to TWAS in a single year. The Academy’s membership now totals 880, representing 90 countries.

- The granting – for the first time in the history of the Academy – of TWAS Young Affiliate status to 24 promising scientists under the age of 40 who live and work in developing countries. Each of TWAS’s regional offices selected up to five Young Affiliates, 15 of whom attended the conference to be welcomed into the TWAS family and to present their research. Topics ranged from innovative applications of forensic DNA analysis in the Philippines to an examination of whether advances in nanotechnology could soon help medical practitioners diagnose diseases in Ethiopia and other nations in sub-Saharan Africa. “Listening to these young scientists explain their research,” noted TWAS president Jacob Palis, “confirms that high-level scientific knowledge is taking hold at universities and research centres throughout the developing world”. The Young Affiliates programme is one of several initiatives that TWAS plans to pursue in the coming years to help ensure that the next generation of scientists in the developing world receives the recognition and support that they need and deserve.
- The presentation of TWAS Prizes to seven eminent scientists from the developing world: in the agricultural sciences: Heong Kong-Luen, International Rice Research Institute, Los Baños, Philippines; in biology: Pedro Leòn-Azofeifa, National Centre for Advanced Technologies, San José, Costa Rica; in chemistry: Che Chi-Ming, University of Hong Kong, China; in the earth sciences: Rengaswamy Ramesh (TWAS Fellow 2007), Physical Research Laboratory, Ahmedabad, India; in



the engineering sciences: Chang Chun-Yen, National Chiao Tung University, Hsinchu, Taiwan, China; in mathematics: Claudio Landim, *Instituto de Matematica Pura and Aplicada*, Rio de Janeiro, Brazil; and in physics: Dipankar Das Sarma (TWAS Fellow 2007), Centre for Advanced Materials, Indian Association for the Cultivation of Science, Kolkata.

- A symposium, led by Atta-ur-Rahman (TWAS Fellow 1985), head of Pakistan’s Higher Education Commission and former Minister of Science and Technology, on the current state of science and technology in Pakistan.
- A lecture, by Pervez Hoodbhoy, professor of nuclear physics and chair of the physics department at Quaid-i-Azam University, Islamabad, on the state of science education with a focus on the current state of affairs in Pakistan. Hoodbhoy attended the conference to receive the first-ever TWAS-ROCASA (Regional Office for Central and South Asia) award for contributions to the public understanding and popularization of science. The winners of the other regional awards, each of whom received a US\$3,000 cash prize, were also announced at the conference (see page 57).

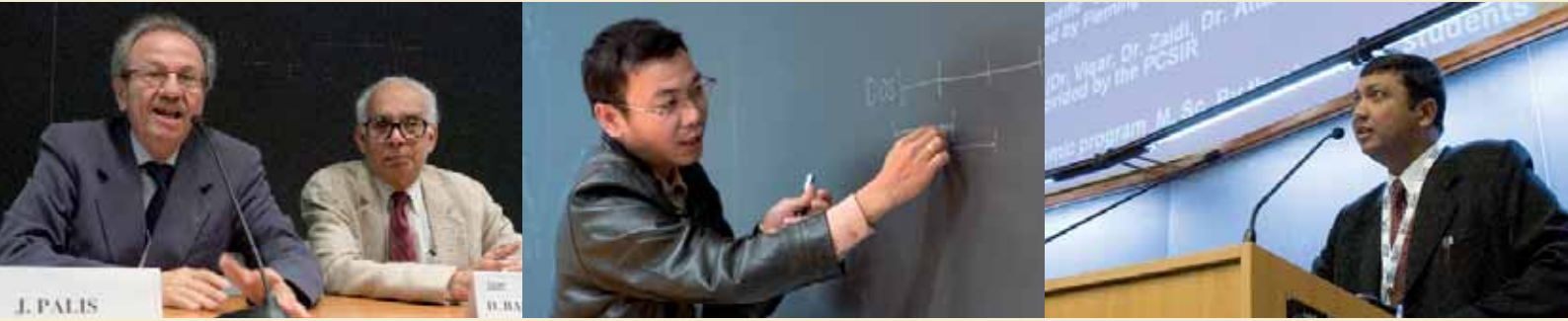


- Presentations by the 2007 Trieste Science Prize winners: Luis Herrera-Estrella (TWAS Fellow 2004), *Laboratorio Nacional de Genómica para la Biodiversidad, Centro de Investigacion y de Estudios Avanzados, Campus Guanajuato, Mexico*, who won in the category of agricultural sciences, and Goverdhan Mehta (TWAS Fellow 1993), Department of Organic Chemistry, Indian Institute of Science, Bangalore, India, who won in the chemical sciences. The Trieste Science Prize is generously funded by the Trieste-based illycaffè S.p.A., one of the world's pre-eminent coffee manufacturers. Ernesto Illy, the patriarch of illycaffè and a gifted scientist and strong supporter of Trieste's scientific institutions, attended the event. Herrera-Estrella spoke about his ground-breaking studies of the soil bacterium, *Agrobacterium tumefaciens*, which led to the development of the first transgenic crops that are now grown on 100 million hectares in 20 different countries. Mehta spoke about the science of organic synthesis, and especially the use of natural products that can serve as platforms for the discovery of new compounds with novel pharmaceutical activities (see pages 20-21).

- A TWAS 2007 Medal Lecture presented by Hernán Chaimovich (TWAS Fellow 2000), *Departamento de Bioquímica, Instituto de Química, Universidade de São Paulo, Brazil*. Chaimovich spoke about molecules with hydrophobic and hydrophilic properties that enable them to associate spontaneously in solvents, including water. "Such molecules," he noted, "can assume diverse shapes ranging from single layers to bubbles to spheres." In addition to the intellectual challenges that these molecules pose for basic science (related to studies of surfaces and complexity), they also hold promise in such areas of applied science as drug delivery and oil extraction.

- The selection of the TWAS Medal Lectures for 2008: José de la Peña (TWAS Fellow 2003), professor, *Instituto de Matemáticas, Universidad Nacional Autónoma de México*; M.R.S. Rao (TWAS Fellow 2002), president, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore; Anwar Nasim (TWAS Fellow 1987), science advisor, OIC Standing Committee on Scientific and Technological Cooperation, Islamabad; and Keto Mshigeni (TWAS Fellow 1987), vice chancellor, Hubert Kairuki Memorial University, Dar es Salaam, Tanzania. The latter two scientists had been selected to deliver Medal Lectures in 2007 but were unable to attend the meeting in Trieste. The Council agreed to move their awards ceremony and presentations to the 2008 General Meeting in Mexico.

- The convening of the first 'exchange' meeting among the coordinators of TWAS's five regional offices, chaired by TWAS president Jacob Palis. Varadachari Krishnan (TWAS Fellow 1996), Hindustan Lever research professor at Jawaharlal Nehru Centre for Advanced Scientific Research, represented the Regional Office for Central and South Asia (TWAS-ROCASA) in Bangalore; Iba Kone, acting executive director, African Academy of Sciences, represented the Regional Office for Sub-Saharan Africa (TWAS-ROSSA) in Nairo-



bi, Kenya; Yonglong Lu, director-general, Bureau of International Cooperation, Chinese Academy of Sciences, represented the Regional Office for East and Southeast Asia and the Pacific (TWAS-ROESEAP) in Beijing; Carlos Aragão de Carvalho, director, Scientific and Technological Funding Agency of the Brazilian Academy of Sciences and professor of physics at *Universidade Federal do Rio de Janeiro*, represented the TWAS Regional Office for Latin America and the Caribbean (TWAS-ROLAC) in Rio de Janeiro; and Mohamed M. El-Faham, director of the Centre of Special Studies and Programmes, *Bibliotheca Alexandrina*, represented the Arab Regional Office (TWAS-ARO) in Alexandria, Egypt. The broad-ranging discussions examined strategies for publicizing TWAS events and activities; procedures for the selection of regional prize winners and Young Affiliates; better ways to identify excellent scientists, especially in nations that are not

well represented in the Academy; efforts to foster closer ties between TWAS regional offices and national chapters through joint activities and programmes; and opportunities for maximizing the communication opportunities afforded by the internet. “The TWAS regional offices are beginning to fulfil their promise as institutions that not only extend the reach of the Academy but also make significant contributions in their own right,” noted TWAS executive director, Mohamed H.A. Hassan.

- The approval by TWAS members of the Academy’s revised statutes and bylaws. Juan Roederer (TWAS Associate Fellow 1991) headed the Academy’s statutes and bylaws committee, which benefitted from the expertise of Albert Koers, an eminent law professor who served as the executive director of the InterAcademy Council (IAC) from 2001 to 2005. The new statutes and bylaws herald the transformation of the Academy from a small institution, where decisions have often been made on an informal *ad hoc* basis, into a large and sophisticated organization requiring a more formal structural framework. Thus, the revised statutes and bylaws will help guide the Academy in the years ahead as the level of its activities and range of operations continue to expand.



Like all previous General Meetings, TWAS members were given the opportunity to express their opinions



and concerns during a two-hour membership meeting. As in previous such meetings, the members had no shortage of ideas and comments on how the Academy might strengthen its activities and programmes.

All those who spoke agreed that the Academy was making an important mark on scientific and technological development in the developing world and that the organization was well positioned to do even more in the future.



Syed Muhammad Qaim (TWAS Fellow 2001), *Institut für Nuklear-chemie, Jülich*, Germany, and Vincent Pryde Titanji (TWAS Fellow 2004), vice chancellor, University of Buea, Cameroon, both expressed admiration for the accomplishments of TWAS. Both, however,

suggested that the Academy should do more to help scientists and scientific institutions in least developed countries (LDCs). Mohamed Hassan agreed that limited funding posed a significant handicap that had affected the Academy's ability to help scientists most in need. He added that the problem would be addressed – and hopefully alleviated to a degree – thanks to the renewal of funding from the Swedish International Development Cooperation Agency (Sida) that will allow the Academy to award more grants to research units at a level of US\$30,000 instead of US\$10,000 (the standard level of funding for individual scientists). The three-year funding extension from Sida will enable TWAS to fund some 20 new research units a year for the next three years in the world's least developed and scientifically lagging countries.

Atta-ur-Rahman (TWAS Fellow 1985), chair of the Commission of Higher Education in Pakistan, noted that a growing number of developing countries were making steady progress in building their scientific and technological capacities, but that significant barriers often remain stubbornly in place when it comes to transforming this expanding knowledge base into products and services that add jobs and wealth to a nation's economy. He suggested that TWAS consider launching a broad-based initiative to support and honour science-based innovation – an initiative that could take place in partnership with such organizations as the Organization of Islamic Conference's Standing Committee on Scientific and Technological Cooperation (COM-STECH) and the United Nations University (UNU). The goal would be to assist and honour those who were successfully overcoming the obstacles impeding the transfer of research findings to the marketplace and would focus on such issues as the protection of intellectual property rights; the development of technology parks and business incubators; and the expansion of private-sector investment in research and development. Other members expressed support for the idea and urged the Academy to consider instituting such measures after undertaking additional studies and exploring potential sources of funding.

Jorge Eduardo Allende (TWAS Fellow 1985), professor, *Instituto de Ciencias Biomédicas*, University of





Chile, inquired whether the Academy could take steps to shield its budget from the devaluation of the dollar, especially considering that, while TWAS's revenues arrived in dollars, most of the organization's staff costs and operational expenses were paid out in Euros. Hassan noted that UNESCO, which manages the Academy's funds, was reviewing its monetary policies because it, too, was concerned about the adverse impact that the dollar's decline was having on the organization's purchasing power. The situation will continue to be monitored and discussed further with UNESCO.

Concluding the proceedings, Palis noted that the stage had been set for a grand 19th General Meeting and 'Silver Jubilee' celebration in Mexico City in 2008. He once again thanked ICTP for agreeing to hold the meeting in Trieste following the decision to move the venue from Islamabad. He also expressed thanks to the staff of the TWAS secretariat for their hard work in organizing the rescheduled event on such short notice.

Palis added that: "Next year will be a special time for the Academy. The 25th anniversary will provide ample

opportunities for both celebration and reflection. Over the past quarter century, we have indeed accomplished a great deal together and we do indeed have a great deal to be proud of. Even so, a great many challenges still lie before us: challenges posed by broad sectors of the scientific community that have yet to share fully in our progress, including young scientists, women scientists and researchers working in least developed and scientifically lagging countries; challenges posed by the growing number of international problems that cannot be addressed without science, such as global warming, food and energy security, and access to safe drinking water; and challenges posed by transferring our scientific knowledge to society to ensure that we do not become honoured but insulated minorities within our own nations. We have both a vested interest and moral obligation," continued Palis, "to seek ways to help distribute the fruits of our labour to our fellow citizens. These are the issues, at the nexus of society and science, that will be the focus of our attention in the years ahead, and these are the issues that will provide the measure of our impact and success as we enter the next quarter century of the Academy's life."



PROGRAMMES

The third set of **Trieste Science Prize** laureates were announced in 2007. This prestigious prize, administered by TWAS and funded by illycaffé S.p.A., the internationally renowned coffee manufacturing company that, like TWAS, has its headquarters in Trieste, Italy, is designed to give international recognition and visibility to outstanding scientific achievements made by scientists living and working in the developing world. The award includes a trophy and a US\$50,000 monetary prize. The two winners – in the fields of agricultural sciences and chemical sciences – attended a ceremony in Trieste, held during a four-day international science media fair, FEST, in May 2007, and presented their work at the TWAS 18th General Meeting held in Trieste in October 2007.

Trieste Science Prize

AGRICULTURAL SCIENCES: LUIS RAFAEL HERRERA-ESTRELLA

The 2007 Trieste Science Prize for Agricultural Sciences was awarded to:

- **Luis Rafael Herrera-Estrella**, director of the National Laboratory for Genomics of Biodiversity and professor of plant genetic engineering at the Centre of Research and Advanced Studies in Irapuato, Mexico.

Luis Rafael Herrera-Estrella helped to pioneer the field of plant molecular biology and genetic engineering. Plant transformation techniques developed by Herrera-Estrella and his colleagues have had a significant impact on the commercial production of genetically modified plants currently grown on more than 100 million hectares worldwide.

Herrera-Estrella's work has largely focused on crop species of economic importance to Latin America, including asparagus, maize and papaya. In addition, his analysis of the molecular mechanisms of toxins, produced by the disease-causing bacterium *Pseudomonas syringae* pv *phaseolicola*, has led





TRISTE SCIENCE PRIZE

to the development of transgenic beans resistant to the disease.

Herrera-Estrella has recently turned his attention to understanding the molecular mechanisms that make it possible for plants to tolerate toxic concentrations of aluminium and, more generally, that enable plants to adapt to nutrient-deficient soils. This is critically important in Latin America, where some 500 million hectares of farmland are deficient in phosphorus, an essential nutrient for healthy plant growth and crop production.

CHEMICAL SCIENCES: GOVERDHAN MEHTA

The 2007 Trieste Science Prize for Chemical Sciences was awarded to:

- **Goverdhan Mehta**, CSIR Bhatnagar fellow and honorary professor at the Department of Organic Chemistry at the Indian Institute of Science in Bangalore, and distinguished research professor at the University of Hyderabad, India.

Mehta is a world-renowned chemist who has made breakthrough contributions in a variety of fields related to organic synthesis.

His wide-ranging interests include the synthesis of biologically significant and architecturally challenging natural products; the design of novel molecules; the study of stereo-electronic effects; and super molecular chemistry. His synthesis techniques have been widely praised for their elegance and originality. Oteliones A and B, for example, currently being tested for their anti-tumour activity, are among the 50 complex and biologically active natural products that Mehta and his group have synthesized.



Mehta's work has led to patents for hybrid drugs for the treatment of cancer that combine the drugs' conventional cytotoxic action with the ability to be 'switched on' in the desired location using light as a stimulus. He and his group have also synthesized carbon compounds that may have potential applications in nanotechnology devices.

Beyond the laboratory, Mehta has made significant contributions to science education and science policy in India and abroad. He is currently president of the International Council for Science (ICSU) in Paris, France, and a member of the Scientific Advisory Committee to the Prime Minister of India.



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\$10,000. Of particular note in 2007 is the prize in agricultural sciences won by Muhammad Arshad, which marks the first TWAS Prize won by a Pakistani scientist since 2000. The TWAS Prizes for 2007 were announced during the TWAS 18th General Meeting held in Trieste, Italy. The prizes will be presented at the TWAS 19th General Meeting and 'Silver Jubilee' celebrations, scheduled to take place in Mexico City, Mexico, in November 2008.

TWAS Prizes: Honouring Scientists



AGRICULTURAL SCIENCES

Muhammad Arshad, Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, Pakistan, won the TWAS Prize in Agricultural Sciences:

for his innovative contributions to the study of plant bio-fertilizers and their potential to improve crop production.

Less than one percent of the soil ecosystem is composed of microbes, yet the members of this tiny biomass carry out a range of dynamic activities, including nutrient cycling, which is critical for healthy plant growth. Although a small proportion of soil microorganisms may be pathogenic and cause diseases such as wilts and root rots, many others are beneficial. "Current agricultural scenarios demand the use of such beneficial bacteria as supplements to chemical fertilizers to guarantee food security on a sustainable basis," says Muhammad Arshad.





As a soil microbiologist, Arshad has focused his research on developing strategies to use beneficial microorganisms for enhancing crop production. In doing so, he has pioneered the concept of utilizing microbially-produced plant growth regulators, or 'bio-fertilizers', to improve crop production in sustainable agricultural systems and has successfully formulated high-quality bio-fertilizers. Using this approach, Arshad has prepared 'Rice Biofert' that contains microbially-derived plant growth promoting substances that has proved effective in farm trials and that is currently being commercialized in Pakistan.

Arshad has also examined ways of converting organic wastes into value-added soil-amendments through enrichment with nutrients, plant growth regulators and beneficial rhizobacteria. The novelty of this approach is that the product is highly effective even when applied to fields at rates far lower than organic wastes are traditionally applied. This environmentally friendly approach is not only useful for the management of organic wastes but also improves soil health, soil water retention properties and crop yields.

In collaboration with the scientists at the University of California, Riverside, USA, Arshad has also developed an effective bioremediation biotechnology for pesticide-polluted soil and water environments that is currently being used by the United States' Environment Protection Agency.



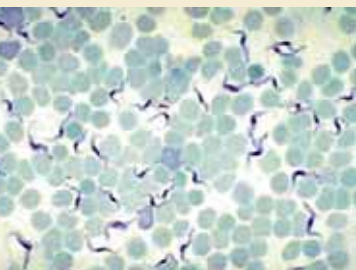
BIOLOGY

Lucia Mendonça Previato, *Instituto de Biofisica Carlos Chagas Filho, Universidade Federal do Rio de Janeiro, Brazil*, won the TWAS Prize in Biology:

for her contributions to the understanding, treatment and prevention of Chagas disease.



Chagas disease affects an estimated 17 million people in Central and South America. It is caused by a protozoan parasite, *Trypanosoma cruzi*, which is transmitted to humans by several species of blood-sucking bugs. Initial symptoms may be no more than local swelling around the bite. However,



the disease may progress – even over as many as 20 years – to damage the heart and digestive system, sometimes proving fatal. Current drug treatments are often toxic and tend to be ineffective, especially against the chronic stage of the disease.

Any parasite that survives within a host for so long must have evolved a mechanism for outwitting the host's immune system. Such an interaction with the host takes place on the surface of the parasite. In efforts to understand the pathogenesis of Chagas disease, Mendonça-Previato studies the structure, biosynthesis and function of glycoconjugates present on the surface of *T. cruzi*.

Sialic acid, often found in animal glycoproteins, plays a significant role in the mediation of many cell-cell and cell-molecule interactions by interacting with surface receptors. Mendonça-Previato and her group discovered a new metabolic route for the incorporation of sialic acid into *T. cruzi* glycoproteins.

Rather than being produced internally by the parasite and 'exported' to the outer surface of the membrane, Mendonça-Previato showed that *T. cruzi* 'scavenges' sialic acid from host sialoglycoconjugates through the action of a *trans*-sialidase enzyme. *Trans*-sialidase was immediately suspected to play a pivotal role in *Trypanosoma*-host interactions, such as parasite attachment to cells and alteration of immune cell function to enhance parasitism.

More recently, Mendonça-Previato and her group have advanced their studies of *T. cruzi* surface *trans*-sialidase, especially its roles in the host immune response and the invasion of host cells by the parasite. Further analyses of the activity of *trans*-sialidase have opened up the possibility of designing novel *trans*-sialidase inhibitors. Other advances made while characterizing many of the unique glycobiology features of *T. cruzi* may lead to significant advances towards the development of chemo- and immuno-therapies not only against *T. cruzi*, but other parasites as well.

CHEMISTRY

Kankan Bhattacharyya, Physical Chemistry Department, Indian Association for the Cultivation of Science, Kolkata, India, won the TWAS Prize in Chemistry:

for his seminal contributions to ultrafast dynamics in organized and biological assemblies.

Early in his research career, Kankan Bhattacharyya showed that acid-base properties at the surface of an aqueous solution differ markedly from the prop-



erties demonstrated within the bulk of the liquid. He has since extended his studies to investigate the properties of solutes and solvents in nano-cavities.

Nano-cavities are found in such structures as micelles, sol-gel matrices and proteins. Through a series of cutting-edge analyses, Bhattacharyya has demonstrated that the properties of liquids confined in such nano-cavities are different from the properties of bulk liquids due to the substantially altered local properties in the nano-cavity and the close proximity of the reactants.

Among Bhattacharyya's most significant discoveries is that water molecules confined in the nanocavity of a protein or other organized assembly such as a micelle may move 100 to 1,000 times slower compared to molecules in bulk water. He also found that the solvation dynamics – the interaction between solutes and solvents – at different sites of a protein are different. The slowness of the water in this biological system is highly beneficial and can protect the protein under adverse conditions.



Using fluorescence resonance energy transfer (FRET), Bhattacharyya has expanded his chemical studies to biological systems. The precise location and nature of the interactions between specific molecular species in living cells is of major interest in many areas of biological research, but investigations are hampered by the limited resolution of the instruments employed to examine these phenomena. By linking FRET with optical microscopy, Bhattacharyya can 'observe' the interactions between two molecules as they approach within several nanometres of each other, a distance sufficiently close for molecular interactions to occur. Using this system, he confirmed that proton transfer in nano-confined systems is substantially slower compared to that in bulk water. These studies have significantly improved our understanding of ultrafast dynamics in biological systems and conclusively prove that chemistry in a nano-confined system is fundamentally different from that in a bulk liquid.

EARTH SCIENCES

Paulo Artaxo, Institute of Physics, University of São Paulo, Brazil, won the TWAS Prize in Earth Sciences:

for his outstanding work in understanding the role of biomass-burning aerosols on cloud processes and the radiation balance in the Amazon Basin.

The Amazon Rainforest covers some 5.5 million square kilometres, 60 per cent of which are located in Brazil. As one of the world’s most pristine environments, the Amazon forest is one of the few remaining areas of land where very low atmospheric aerosol loads can still be found under natural conditions.

Artaxo was one of the first scientists to recognize that natural vegetation plays a major role in the emission of aerosol particles into the atmosphere, and that the forest emits a large amount of cloud condensation nuclei that



help regulate both local precipitation and the global climate. He also discovered that natural aerosol particles are efficient carriers of key nutrients such as phosphorus.

“The intense interaction between the rainforest and the atmosphere involves the emission and deposition of aerosols and trace gases such as volatile organic compounds, ozone, nitrogen oxides, methane and carbon dioxide,” confirms Artaxo.

Since 1985, Artaxo has focused his research on environmental issues in the Amazonian region and, in particular, the impacts of deforestation on climate.

“The natural unperturbed pattern is suffering profound changes with the deforestation of about 20,000 square kilometres of rainforest every year and the emissions associated with biomass burning. The large amount of particles emitted by biomass burning changes the radiation balance, cloud properties and deposition pattern of key nutrients,” says Artaxo. “The impacts extend



over most of South America, influencing air quality and surface radiation balance over a large area.”

Amazonia is also expected to be one of the ecosystems most seriously affected by climate change. “Models indicate that the extent of the forest will be reduced significantly, with a large accompanying loss of carbon to the atmosphere that will intensify the greenhouse effect,” adds Arataxo, who served as a member of the Intergovernmental Panel on Climate Change (IPCC) Working Group 1. The IPCC shared the 2007 Nobel Peace Prize with former US vice president Al Gore for their combined efforts in increasing public understanding and awareness of climate change.

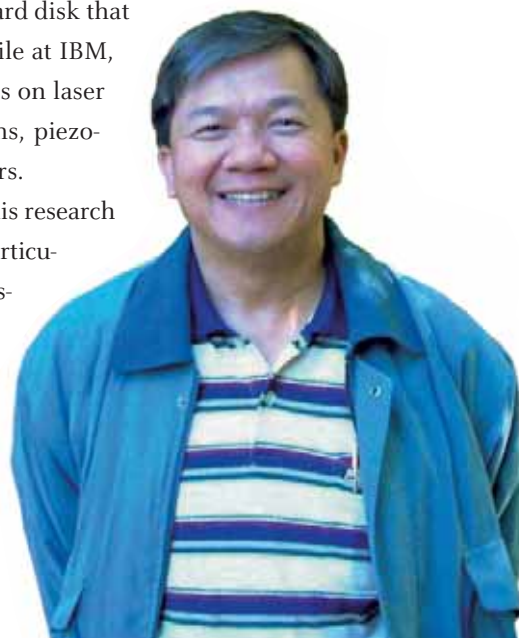
ENGINEERING SCIENCES

Chih-Kung Lee, Institute of Applied Mechanics, National Taiwan University, Taipei, Taiwan, China, won the TWAS Prize in the Engineering Sciences:

for his fundamental contributions to interdisciplinary system research in piezoelectricity, optics, micro electro-mechanical systems, nano-biomechanics and plasmonics.

After receiving his master’s and doctoral degrees from Cornell University, USA, Chih-Kung Lee joined IBM’s Almaden Research Center in San Jose, California, where his research and development spanned interdisciplinary areas related to magnetic disk drives, optoelectronic systems, metrology systems and piezoelectric systems. He was awarded an IBM Outstanding Technical Achievement Award for his work on reducing the thermal track mis-registration of a commercial IBM hard disk that was a profitable commercial product at the time. While at IBM, he also received awards for his inventions and patents on laser encoders, nanometre fly height measurement systems, piezoelectric strain rate gauges and acceleration rate sensors.

In 1994, he returned to Taiwan, where he extended his research on distributed piezoelectric sensors and actuators, particularly in the areas of flexible structure control, shock sensing and sensor development. His interdisciplinary background allows him to create innovative integrated systems based on his knowledge of mechanics, optics, electronics, semiconductors, metrology



and interface systems. His inventions of model sensors and piezoelectric transformers, for example, helped open a new research line in the field of smart structures. To date, Lee's work has been recognized by the award of more than 110 patents, many of which have been successfully transferred to industry.

Lee has also been a driving force in promoting education and public understanding of nanotechnology in Taiwan, particularly through the establishment of a Nano-Bio Micro-Electro-Mechanical Systems (MEMS) group at the National Taiwan University. This group, which includes faculty from various universities as well as experts from Taiwan's Industrial Technology Research Institute and private companies, emphasizes social responsibility as a cornerstone of world-class research. Through Nano-Bio-MEMS, Lee is currently directing his efforts to finding a paradigm to link Taiwan's research in engineering and applied sciences to the next-generation industrial and societal trends.



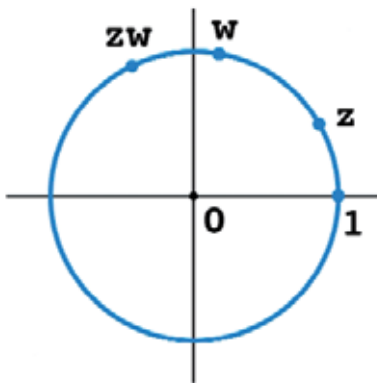
MATHEMATICS

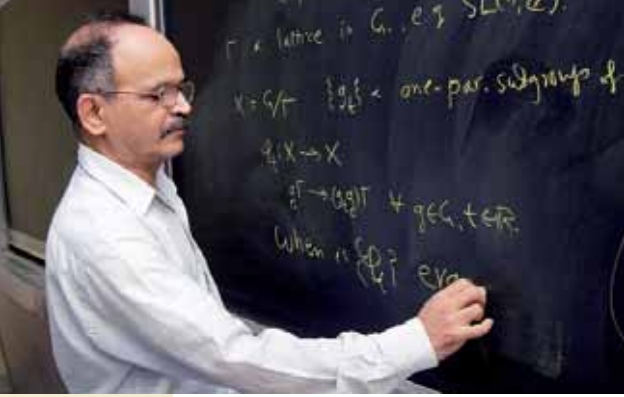
Shrikrishna Dani, School of Mathematics, Tata Institute of Fundamental Research, Mumbai, India, won the TWAS Prize in Mathematics:

for his fundamental contributions to the study of flows on homogeneous spaces of Lie groups and of probability measures on Lie groups.

Shrikrishna Gopalrao Dani joined the Tata Institute of Fundamental Research in 1969 and has been affiliated with the institute ever since.

His contributions to mathematics have been in two main areas. Throughout his career, he has studied ergodic theory and the dynamics of flows on homogeneous spaces of Lie groups and their applications to Diophantine approximation. Lie groups, named after the 19th century Norwegian mathe-





matician, Sophus Lie (1842-1899) represent the best-developed theory of continuous symmetry of mathematical objects

and structures. They provide a natural framework for analysing the continuous symmetries of differential equations, making them indispensable tools for many parts of contemporary mathematics and modern theoretical physics.

Since the 1980s, Dani has also made significant contributions to certain questions on probability measures on Lie groups. His work on the behaviour of orbits of flows on homogeneous spaces, concerning their closure, distribution, recurrence, boundedness and divergence, and his successful efforts to relate these aspects to questions in Diophantine approximation, have had a major impact on the theory. For example, his results on uniform recurrence of the trajectories of unipotent flows played an important role in Ratner's proof of the Raghunathan conjecture. With G.A. Margulis, Dani made notable improvements to Ratner's uniform distribution theorem and deduced a quantitative version of the Oppenheim conjecture.



MEDICAL SCIENCES

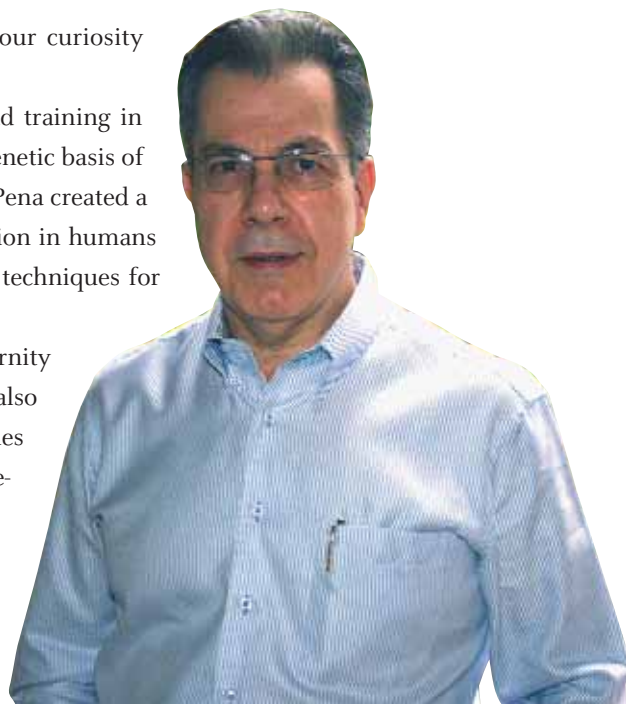
Sergio Danilo Junho Pena, *Departamento de Bioquímica e Imunologia, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil*, won the TWAS Prize in the Medical Sciences:

for his contributions to human and parasite molecular genetics and to the understanding of the formation and structure of the Brazilian population.

Genetic evidence is frequently used to satisfy our curiosity about human origins and population migrations.

Although Sergio Pena's early-career research and training in Canada and the United Kingdom focused on the genetic basis of muscular diseases, on returning to Brazil in 1982, Pena created a laboratory dedicated to the study of genetic variation in humans and helped pioneer the application of DNA-based techniques for the characterization of human genetic diversity.

Pena was also the first to launch DNA-based paternity testing in Brazil, for example. His research group also successfully developed a series of novel techniques for the detection of human mutations that are widely employed in many developing countries.





In 1995, Pena and his group began to use molecular techniques to study the origins and structure of Brazilian populations. They first demonstrated the existence of a remarkable founder effect on the Y-chromosome, which is inherited through the paternal line, of Amerindian populations from North America to Patagonia. These data were later used to show that the most likely origin of Amerindians was Central Siberia.

Pena then turned his attention to the investigation of urban populations in Brazil. His group's comparison of the percentages of Y-chromosome markers with maternally-inherited mitochondrial DNA markers demonstrated significant sex-biased mating in the founding and ongoing history of the Brazilian population, with a predominantly paternal European input and chiefly maternal African and Amerindian contributions. Pena's research has thus contributed to a coherent genetic picture of the evolutionary history of Brazilians, providing an important complement to the narratives derived from social science methodologies.

In 1992, Pena also began genetic research on human parasites, initiating the first formal large-scale DNA sequencing programme in Latin America to study the transcriptome of the parasitic worm, *Schistosoma mansoni*. He has also employed several of the tools developed to study human genome diversity to shed light on the biology of *Trypanosoma cruzi* and the pathogenesis of Chagas disease.

PHYSICS

Jie Zhang, Shanghai Jiao Tong University, China, won the TWAS Prize in Physics:

for his significant contributions to the development of saturated x-ray lasers and our deep understanding of the interaction between high-power lasers and matter.

Jie Zhang obtained his PhD from the Institute of Physics, Chinese Academy of Sciences (CAS), in 1988. He then spent 10 years at the Rutherford Appleton Laboratory, UK, where he and his colleagues from British universities used a specially optimized driver pulse laser configuration to illuminate two opposite-gradient targets to relax the density gradient of plasmas, which had been the obstacle in producing short-wavelength (14-5.8 nanometre) x-ray lasers. Lasers capable of producing such beams are sought-after as this region of the spectrum provides the best contrast



between carbon-based biological structures and water, enabling images of living structures to be obtained.

Zhang returned to China in 1999 to join the Institute of Physics, CAS. Despite initial difficulties, he teamed up with a group of young returnee scientists and raised enough funds to build powerful laser systems, advanced target chambers and sophisticated diagnostic equipments. These efforts led to research that has increased our understanding of the processes responsible for the generation and propagation of high-energy fast electrons in laser-plasma interactions. These investigations are related to so-called 'inertial confinement fusion', which could produce energy released through the fusion of the nuclei of deuterium and tritium (isotopes of hydrogen). One of the ways currently being tested to achieve this involves compressing the target fusion fuel with powerful laser beams and then igniting the compressed fusion fuel with high-energy fast electrons generated by another high-power laser beam through a cone of gold to provide the 'fast ignition' required to generate the



fusion – rather like a spark plug is used in a car engine to ignite the petrol. The contributions of Zhang and his team have enhanced our understanding of the process of the generation and propagation of high-energy fast electrons in laser-plasma interactions, which are of critical importance in the fast ignition process.

TWAS Prizes for Young Scientists in Developing Countries are awarded to scientists under 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 2007, prizes were awarded to 43 young scientists in 25 countries.

TWAS Prizes for Young Scientists



SUPPORTING FARMING SYSTEMS

After obtaining his BSc at the University of Fort Hare and MSc in crop science at the University of Natal, South Africa, Albert Modi travelled to the United States to study for his PhD at Ohio State University, earning his doctorate in crop science in 1999. Upon his return to South Africa in late 1999, Modi began his university research career as a senior lecturer at the University of Natal. He also began conducting studies on the physiology of cotyledonal cracking in green beans.

The cotyledons of seeds such as beans typically become the first leaves of the germinated seedling. As such, they form the plant's first efforts to produce energy from sunlight via photosynthesis and thus provide a spur to subsequent plant growth and development. Under certain environmental conditions, the cotyledons can crack, reducing their photosynthetic capacity – which can have significant effects on the eventual yield of a bean crop.

Modi has shown that cracking can be controlled by treating seeds with calcium and controlling the rate at which water is imbibed during germination.



YOUNG PRIZE WINNERS

Name	Country	Awarding Body	Field
Md. Shahdat Hossain	Bangladesh	Bangladesh Academy of Sciences	Biochemistry
Md. Khariul Islam	Bangladesh	Bangladesh Academy of Sciences	Physical Sciences
Guy Aymard Degla	Benin	Benin Centre for Scientific & Technical Research	Mathematics
Gonzalo Marcelo Ramirez Avila	Bolivia	<i>Academia Nacional de Ciencias de Bolivia</i>	Physical Sciences
Luiz Alvaro Garitano-Zavala	Bolivia	<i>Academia Nacional de Ciencias de Bolivia</i>	Biology
Victor Manuel, Sarria	Colombia	<i>Academia Colombiana de Ciencias Exactas, Fisicas y Naturales</i>	Chemistry
Daniel A. Barragán-Ramírez	Colombia	<i>Academia Colombiana de Ciencias Exactas, Fisicas y Naturales</i>	Chemistry
Mabis Montero Villalobos	Costa Rica	<i>Consejo Nacional para Investigaciones Cientificas y Tecnologicas</i>	Chemical Sciences
Eric Alfaro Martinez	Costa Rica	<i>Consejo Nacional para Investigaciones Cientificas y Tecnologicas</i>	Physics
Tania Crombet Ramos	Cuba	Academy of Sciences of Cuba	Biology
Luiz Javier Gonzalez Lopez	Cuba	Academy of Sciences of Cuba	Chemistry
Randall Manuel Lou Meda	Guatemala	<i>Academia de Ciencias Medicas, Fisicas y Naturales de Guatemala</i>	Medical Sciences
Alfa Lamine Sylla	Guinea	Ministry of Higher Education and Scientific Research (MESRS)	Mathematics
Hamid Sarbazi-Azad	Iran, Isl. Rep.	Iranian Research Organization for Science & Technology (IROST)	Computer Engineering
Mohsen Alishahiha	Iran, Isl. Rep.	Iranian Research Organization for Science & Technology (IROST)	Physics
Francis Wanjala Nyongesa	Kenya	Kenya National Academy of Sciences	Physics
Elnura Hudaibergenova	Kyrgyzstan	National Academy of the Kyrgyz Republic	Chemistry
Lyudmila V. Serikova	Kyrgyzstan	National Academy of the Kyrgyz Republic	Chemistry
Daud Kassam	Malawi	National Research Council of Malawi	Agricultural Sciences
Indree Tuvshintogtokh	Mongolia	Mongolian Academy of Sciences	Biology
Lkhamsuren Altangerel	Mongolia	Mongolian Academy of Sciences	Mathematics
Rosemary Shrestha	Nepal	Nepal Academy of Science & Technology	Biological Sciences
Chinta Mani Pokhrel	Nepal	Nepal Academy of Science & Technology	Mathematics
Narayan Prasad Adhikari	Nepal	Nepal Academy of Science & Technology	Physics
Surya Kant Kalauni	Nepal	Nepal Academy of Science & Technology	Natural Product Chemistry
Muhammad Sabieh Anwar	Pakistan	Pakistan Academy of Sciences	Physics
Jaeson Santos Calla Choque	Peru	<i>Academia Nacional de Ciencia y Tecnologia (ANCYT)</i>	Biology
Drexel H. Camacho	Philippines	National Academy of Science (NAST)	Chemical Sciences
Albert Theminkosi Modi	South Africa	Department of Science & Technology of the Republic of South Africa and the Academy of Science of South Africa (ASSAf)	Agricultural Sciences
Udagedaralage Asanka Dilup Jayasinghe	Sri Lanka	National Science Foundation	Biology
Sumaya Ahmed Zaki-Eldeen Hamdan	Sudan	Sudan Institute for Natural Sciences	Biology
Elssfah Mohammed Elawad Fadol	Sudan	Sudan Institute for Natural Sciences	Physics
Elamin Mohammed Saeed Ali	Sudan	Sudan Institute for Natural Sciences	Mathematics
Mohammed Awad Ali Khalid	Sudan	Sudan Institute for Natural Sciences	Chemistry
Khaled Haddad	Syria	Supreme Council of Science	Physics
Tirayut Vilaivan	Thailand	National Research Council	Chemistry
Bahtiyar Özgür Sarioglu	Turkey	Scientific & Technical Research Council of Turkey (TUBITAK)	Physics
Enock Matovu	Uganda	Uganda National Council for Science and Technology	Medical Sciences (Veterinary)
John H. Muyonga	Uganda	Uganda National Council for Science and Technology	Agricultural Sciences
Kanbarali Turgunov	Uzbekistan	Uzbekistan Academy of Sciences	Chemistry
Mirshod Ermamatov	Uzbekistan	Uzbekistan Academy of Sciences	Physics
Gayrat Muratov	Uzbekistan	Uzbekistan Academy of Sciences	Biology
Aleksandr Serebryanskiy	Uzbekistan	Uzbekistan Academy of Sciences	Physics

However, too much calcium, showed Modi, can reduce the percentage of seeds that germinate.

Modi has also extended his laboratory research to local farming communities. In particular, in 2001, he created the Ezemvelo Farmers Organization (EFO) in the province of Kwazulu-Natal, the first South African farmer group to grow certified organic crops. About 200 farmers are now involved in this scheme. From this beginning, Modi has continued to promote small-scale organic farming and on-farm research on traditional agricultural practices. In 2006, for example, he initiated another collaborative project on the dynamics of homestead agriculture and organic farming in partnership with colleagues in South Africa and the Netherlands.

For these reasons, Modi was awarded a TWAS Prize for Young Scientists by the South African government's Department of Science and Technology, which authorizes the South African Academy of Sciences to run the programme.

ADDING VALUE TO FISH

Lake Victoria is the largest freshwater lake in Africa. The lake's fish provide a valuable source of high protein food for the local people and a valuable export commodity for the three neighbouring countries, Kenya, Tanzania and Uganda. Among the species caught for export, the most important is the Nile perch, which can grow up to 2 metres in length.

Research on Nile perch post-harvest biochemistry has contributed to the understanding of the best way to ensure the quality of the products. Such products include not only the meat, but also others typically regarded as processing by-products such as skins, belly flaps and trimmings.

John Muyonga, department of food science and technology, University of Makerere, Uganda, has spearheaded research that has demonstrated that Nile perch processing by-products are good sources of high quality collagen, gelatin and omega 3-rich oil. Collagen is used in medicine to treat burns and other skin problems and is also found in some cosmetics. It can also be converted into gelatin, which is a common food additive. Omega-3 fatty acid is another food additive that has proven health benefits.

Through this work on the post-harvest biochemistry and biomaterial extraction of Nile perch, Muyonga has developed ways that can contribute to improving the quality and economic value of Nile perch, especially through these so-called by-products – processes that are likely to lead to commercial



activities that will eventually, it is hoped, contribute to the socio-economic development of the country.

For these reasons, Muyonga was awarded a TWAS Prize for Young Scientists by the Uganda National Council for Science and Technology.

The prize was shared with Enock Matovu, faculty of veterinary medicine, Makerere University, who was honoured for his research on the molecular mechanisms of drug resistance to African trypanosomes, the parasites that cause sleeping sickness in human and the wasting disease, *ngana*, in cattle.

CLIMATE STUDIES IN COSTA RICA

Eric J. Alfaro Martínez, school of physics, University of Costa Rica, is an atmospheric physicist. Specifically, his research revolves around understanding and predicting climate system variability.

“Some regional climate variability,” says Alfaro Martínez, “is the consequence of non-seasonal changes, but is more associated with



inter-annual and decadal variability in the surrounding oceans and their interaction with the overlying atmosphere.

“Such variations can impact on the human population,” continues Alfaro Martínez. “For example, they can cause extreme events such as droughts that limit available water resources for agriculture, power generation, human consumption and recreation.” Alfaro Martínez’s work has also focused on other natural disasters, such as the annual variation in the number of hurricanes that have affected Costa Rica and Central America.

“A better understanding of the climate system can help us to deal with such extreme events by providing the information we need to select appropriate contingency mechanisms,” adds Alfaro Martínez. “Policy-makers, for example, can use this information in areas of environmental planning and protection, especially those related to the more resource-poor, and therefore more vulnerable, sectors of society.”

For these reasons, Martínez was awarded the TWAS Prize for Young Scientists by Costa Rica’s *Consejo Nacional para Investigaciones Científicas y Tecnológicas*.

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 their subsistence costs, while the host centres cover their living expenses.

In 2007, TWAS awarded 17 new associateships to scientists from seven countries, including Cameroon, Cuba and Iran, while a total of 44 TWAS-UNESCO Associates from 16 countries, including Kenya, Uzbekistan and Yemen, travelled to host institutions in nine countries in the South.

The TWAS-UNESCO Associateship Scheme is kindly supported by the OPEC Fund for International Development (OFID).

Associateship Scheme

COLLABORATING ACROSS CONTINENTS

Ram Kishore and A.K. Mishra, two renowned experts in the field of condensed matter physics, have been working together and publishing papers for a number of years. The fact that Kishore is based at the *Instituto Nacional de Pesquisas Espaciais*, São José dos Campos, Brazil, and Mishra at the Institute of Mathematical Sciences (IMSc), half a world away in Chennai, India, has not hindered their collaboration.

Together, the two scientists have made important contributions to the physics of orthofermions.

Fermions, characterized by their half-spins (as opposed to bosons that have integer-value spins), include such particles as protons and electrons. Pauli's exclusion principle states that no two identical fermions can occupy the same quantum state simultaneously. Formulated by Wolfgang Pauli in 1925, this principle has become one of the most fundamental principles in physics, underpinning many of the characteristic properties of matter, from its large-scale stability to the similarities of atomic properties highlighted by the arrangement of elements in the periodic table.

The quantum state of a fermion is defined by both its orbital state and its spin state. Put simply, the exclusion principle confirms that, if two fermions share the same orbital state, they must have different spin states.

Kishore and Mishra have focused their theoretical work on the behaviour of orthofermions, which obey an even more exclusive exclusion principle.



Kishore first met Mishra in 2000 at IMSc in Chennai and the pair quickly discovered their mutual interests in problems relating to orthofermions. Indeed, their early collaboration led to the publication of a paper in 2004 in the renowned journal, *Physica A*, on orthofermion statistics. Since then, thanks to the TWAS-UNESCO Associateship Scheme, Kishore has visited Mishra at his institute in Chennai on three occasions. He was first awarded a TWAS-UNESCO Associateship in 2004, through which he made two three-month visits. In 2006, his application for the renewal of the Associateship award for an additional three years was approved, allowing him to make an additional two trips to India. The first of these was undertaken between June and September 2007.

“During this visit,” informs Kishore, “we were able to develop a second quantization theory for orthofermions, combining two earlier algebraic expressions into a single equation. This task is essential for modelling a system in the presence of a magnetic field.”

Although the two scientists have advanced the theory of orthofermions through statistical models and algebraic expressions, their work also has potential practical applications. During his visits to India, for example, Kishore has taken the time to visit Ajay, department of physics, G.B. Pant University, Pantnagar, some 2,500 kilometres from Chennai. Together, Kishore and Ajay established a collaborative research programme on strongly correlated electron systems, especially relating to the properties of high-temperature superconductors.

The connection between the two research areas is that the more exclusive exclusion principle of orthofermions means that two orthofermions cannot be in the same orbital state even if their spin states are different. It is proposed that this defining characteristic of orthofermions is somehow responsible for the superconducting properties of certain compounds under high temperatures.

Poor telecommunications infrastructure and the lack of resources to attend major conferences often combine to exclude many talented scientists from developing countries from the mainstream of global research –



much as two orthofermions are excluded from the same orbital state. Despite their geographical separation, it could be said that Kishore and Mishra – thanks to the TWAS-UNESCO Associateship Scheme – have developed a ‘strongly correlated system’ that enables them to work together and to produce excellent research results.

“Without the assistance of TWAS through its Associate Scheme, we would never have been able to accomplish as much together,” confirms Kishore of his collaboration with Mishra. “The programme is extremely useful for helping developing world scientists to establish collaborative research programmes with other institutions in the South.”

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. For the past few years, the programme has operated in partnership with (CNPq), Brazil, the Chinese Academy of Sciences (CAS), the Council of Scientific and Industrial Research (CSIR), India, and the Department of Biotechnology (DBT) of the government of India. In 2007, agreements signed with the National Centre of Excellence in Molecular Biology (CEMB) and the International Centre for Chemical and Biological Sciences (ICCBS) in Pakistan and the Indian Association for the Cultivation of Science (IACS) helped to expand the programme. While TWAS administers the programme and covers the travel costs, the national agencies cover local costs such as living expenses and tuition fees. In 2007, for the first time, TWAS awarded more than 100 fellowships (see page 65).

South-South Fellowships

INSECTICIDE SIDE-EFFECTS

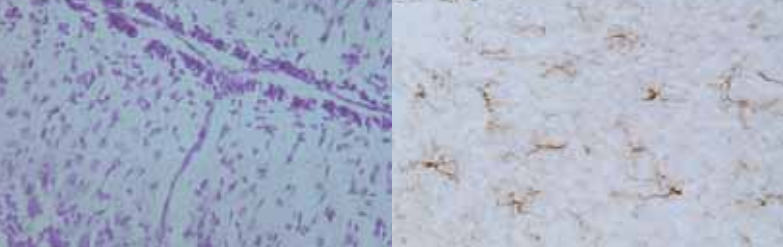
If left unchecked, insect pests can mean the difference between an adequate harvest and hunger for many farmers in developing countries. Insects also transmit deadly tropical diseases such as malaria and sleeping sickness. It is no surprise, therefore, that insecticides are widely used to limit the damage to crops and the spread of diseases caused by insects.

The combination of heat and ignorance of safety measures, however, means that farmers often do not wear the recommended protective gear, such as overalls and a mask, when carrying out spraying operations. All too often, this leads to exposure to the insecticide.

Deltamethrin, which is derived from the relatively harmless natural plant product, permethrin, is an insecticide that is used against a wide range of insect pests. It is estimated that about 70 percent of people in Nigeria use one type of pesticide or another, most of which contain deltamethrin, in the war against mosquitoes and malaria.

Although the toxic effects of deltamethrin on humans are generally lower than for other insecticides, exposure to deltamethrin may still cause both chronic and acute toxicity. The chemical acts on the nervous system of both





insects and mammals. In insects, it causes irreversible damage. In humans, reported symptoms include irritation of the skin and eyes, prickling sensations, headaches, numbness, nausea and fatigue. In severe cases, muscle twitching and even death due to respiratory failure have been recorded.

To study these neurotoxic effects – in rats rather than people – Udu Ada Ibiam, department of biochemistry and biotechnology, Ebonyi State University, Nigeria, was awarded a TWAS-Department of Biotechnology (DBT) postdoctoral fellowship. In August 2007, he travelled to Jiwaji University, Gwalior, some 320 kilometres south of Delhi in India. There, under the supervision of Ishan Patro in the School of Studies in Neuroscience, he received training in how to prepare and analyse thin sections of tissues as well as a range of other biochemical and biotechnological techniques.

“My aim was to understand the responses of glial cells to prenatal exposure to deltamethrin in rats,” explains Ibiam. “Glial cells are important. While do not transmit nerve impulses, they form an essential part of the brain and nervous system. Interactions between nerve cells and glial cells are fundamental to brain function,” he adds.

To achieve this, Ibiam learned how to determine the oestrus cycle of female rats in order to obtain pregnancies timed to specific intervals. He then dosed the pregnant rats with deltamethrin and attempted to observe gliosis in the embryos at different stages of development. “Gliosis is defined as the production of a dense fibrous network of glial and nerve cells that becomes a degenerative lesion,” informs Ibiam. “Once you know what you are looking for, it is relatively easy to spot such affected tissues in well-prepared histological samples.”

By observing and analyzing the gliosis caused by deltamethrin, Ibiam hoped to be able to determine the



possibility of using his tests as a biomarker for neurotoxicity caused by the insecticide.

Ibiam’s results clearly show a range of deleterious effects caused by pre-natal treatment of rats with deltamethrin. For example, total body weight, brain weight and liver weight were all reduced in treated rat pups compared to the untreated control group. In addition, both the brain and liver contained lower than normal levels of protein, implying that the organs were being poisoned. Such results were backed up by Ibiam’s histological analyses, which confirmed that there were differences in the development of the cerebellum and glial cells in treated pups.

“I now want to test the effects of some mosquito insecticides used in Nigeria on developing rat foetuses,” says Ibiam. “Many such insecticides are commonly used in homes, even by pregnant women.”

The **TWAS Research Professors in Least Developed Countries (LDCs)** scheme was launched in 2005. More than 90 TWAS members have since expressed an interest in participating in the programme, which would allow 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. To date TWAS has appointed 10 members as TWAS Research Professors and supported the travels of five. Two TWAS Research Professors travelled in 2007 (see page 66), including Elly Sabiiti of Uganda, whose experience is highlighted below.

TWAS Research Professors



HELPFUL NEIGHBOUR

Rwanda, a small land-locked country in central Africa, is home to some 8.5 million people – and some 1.3 million cattle. Because the human population of Rwanda is expected to increase to 16 million by 2020, there is an urgent need to increase agricultural production.

“Currently, however,” says Elly Sabiiti, “Rwanda’s cattle are largely reared by small-scale farmers with limited land and feed resources.”

Sabiiti, a professor of agricultural sciences at Makerere University, Uganda, was appointed a TWAS Research Professor in 2006 and, in April 2007, travelled to the National University of Rwanda (NUR) to assist the Department of Animal Production in reviewing its curricula and building capacity in doctorate-level research and training.

Founded in 1963, NUR has nine faculties or schools. The Faculty of Agriculture itself is divided into four departments: animal production, crop production, soil sciences and agricultural economics and agribusiness. Sabiiti was appointed to work with the deputy dean of the Faculty of Agriculture, Juvénal Kanani.

“The livestock sector provides a major contribution to the economy of Rwanda,” explains Sabiiti, “yet the department of animal production has





only one permanent PhD on its staff. Indeed, the Faculty of Agriculture currently has no PhD training programmes and only one master's programme, in agroforestry and soil management. There is therefore a critical need to develop training courses and trained research personnel."

During his one-month visit, Sabiiti also evaluated the livestock production systems and the research situation beyond the NUR campus.

"The faculty provided funds and a vehicle that helped make my field visits a success," says Sabiiti. "I was able to meet with other scientists, key government officials and farmers practicing different kinds of livestock production techniques."

Among the livestock rearing methods being practiced in Rwanda are mixed farms, where farmers integrate crop and livestock production, and zero-grazing. In this case, cattle are confined while the fodder, typically elephant grass, is brought in from elsewhere.

"Livestock production is increasing in peri-urban areas using zero-grazing, especially for milk, which has a ready market in the cities," observes Sabiiti. "But there is a serious shortage of fodder. More research is needed to develop alternative feeding packages."

Sabiiti's field visits also took him to the Rwanda Agricultural Research Institute, where he was surprised to find just a few researchers trained to the bachelor degree level and limited capacity to carry out any meaningful research.

"The field visits served a second purpose," adds Sabiiti. "As we spent a lot of time together, I was able to train Kanani on how to observe and identify problems faced by farmers and on what kind of research he could formulate to address these challenges. By meeting key policy makers, he was also able to identify the



priority areas for inclusion in the curriculum and for research.

"During my month in Rwanda, one major objective was accomplished – to forge links with scientists there. The process is now moving on to build PhD training opportunities through research and collaboration."

Indeed, the first steps of this process have already been taken. Kanani, Sabiiti's host at NUR, visited the Faculty of Agriculture at Makerere University in October 2007 where he has been accepted for PhD training. During his studies, Kanani will evaluate feed crop and brewing byproducts and *Tithonia diversiflora* (Mexican sunflower) as alternative low-cost feed supplements for goat milk and meat production in Rwanda.

"Rwanda has just joined the East African Community," concludes Sabiiti. This means that the National University of Rwanda will likely become a member of the Inter University Council for East Africa and allow for better collaboration. Thanks to TWAS, however, we have already been able to open research and training links between our two universities and begin the process of building human capacity."

TWAS offers Research Grants of up to US\$10,000 to scientists from developing countries of proven ability for research projects in the basic sciences. Awardees must submit a report of their work to TWAS one year after the last piece of equipment has been bought. The following example of TWAS-supported research, therefore, is based on a grant provided in 2004, the final report for which was submitted in 2007. In 2007, 46 TWAS Research Grants of up to US\$10,000 each were awarded to researchers in some 21 developing countries. Among these, 16 grants went to scientists working in nine countries in sub-Saharan Africa and another five grants went to scientists in two least developed countries in Asia (Bangladesh and Nepal). The TWAS Research Grants programme is sponsored by the Swedish International Development Cooperation Agency's Department for Research Cooperation (Sida/SAREC).

Research Grants for Individuals



POWER FROM POLYMERS

In Ethiopia, traditional biomass fuels such as wood, charcoal, crop residues and cattle dung provide the main sources of energy. However, the intensive use of such energy sources has been implicated in the country's problems associated with soil degradation, desertification and drought.

Covering more than one million square kilometres and lying just ten degrees north of the equator, there is at least one renewable energy resource that Ethiopia possesses in abundance – solar energy.

“Some nongovernmental organizations have imported solar panels for use in cooking, refrigeration and pumping water,” says Yohannes Teketel, department of chemistry, University of Addis Ababa. “These devices have demonstrated the promising potential of using solar power to meet the energy demands of the rural population, especially in areas where conventional hydropower cannot be installed.”

Current commercial solar panels have conversion efficiencies of 16 to 20 percent. The problem is that the solar conversion technology, based on inorganic compounds such as silicon, is expensive and relatively inefficient. One solution is to develop solar energy conversion devices based on organic technology.





“Polymer-based solar cells are becoming potential alternatives to conventional inorganic solar cells. Even so, the best organic polymers analysed so far have efficiencies of about five percent,” explains Teketel, who is using a TWAS Research Grant to synthesize conducting polymers and copolymers electrochemically and then characterize their photoactive properties.

“Because they are flexible, however, they can open up new fields of application. Another advantage is the low cost of the cells, which makes them ideal candidates for the energy markets in developing countries,” he adds.

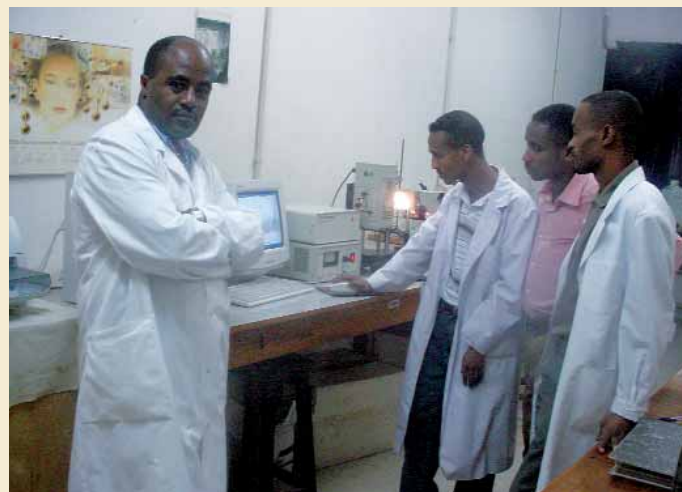
Using equipment and materials provided through the TWAS grant, Teketel has manufactured a number of photoactive electrodes coated with various semi-conducting polymers such as poly(3-hexylthiophene)- or P3HT for short – and poly[2-methoxy-5-(2'-ethylhexyloxy)-1,4-phenylenevinylene] – or MEH-PPV for short – and mixture of either P3HT or MEH-PPV with a fullerene (a spherical array of 60 carbon atoms, C_{60}).

By varying the intensity and spectrum of light hitting the electrodes, Teketel was able to measure the current-voltage responses of the various polymer combinations using a computer-controlled electrochemical analyzer.

“Our results demonstrated that devices in which the photoactive electrode consisted of P3HT/ C_{60} or MEH-PPV/ C_{60} showed improved energy conversion characteristics compared to electrodes that consisted of P3HT or MEH-PPV alone,” says Teketel. “The several-fold enhancement probably derives from the heterojunctions created between the MEH-PPV polymers and the fullerenes that help the effective conversion of light to electricity.”

Based on the work carried out in his laboratory in Ethiopia, Teketel and his group have published some ten papers in reputable international publications.

“The fundamental and basic research that we are doing is contributing to the development of research



work on solar energy devices being carried out elsewhere,” adds Teketel. “With the help of funding from TWAS – this is our second TWAS grant – and other sources, seven master’s students and two PhD students have already completed their studies. In addition, three PhD students are currently working in the lab and using the equipment supplied through the TWAS research grant.

The conversion efficiencies of the devices being built and tested in Teketel’s laboratory may still have some way to go before they can compete with similar devices being developed in other laboratories, but nothing will be achieved without trained personnel and state-of-the-art equipment. It is this type of capacity building that, thanks to TWAS, Teketel has been able to undertake in his laboratory.

If Teketel and his team can continue to increase the efficiency of the solar devices they are designing and testing, then TWAS will have played a significant part in developing not only a renewable source of clean energy, but perhaps also a small part in the economic development of Ethiopia.

TWAS currently supports 17 Research Units in Science- and Technology-lagging Countries.

This programme, launched by the Academy in 2002, was originally designed to assist small research groups in the 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's Department for Research Cooperation (Sida/SAREC), the programme has now been expanded and made available to research units not only in the 50 LDCs, but to research units in some 77 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, renewable for three years, to strengthen its activities. In 2007, 17 research groups in 13 countries were supported, comprising 11 recent awards, five renewals and one ongoing.

Research Grants for Groups

NANO-APPLICATIONS IN MALI

Increasing access to safe drinking water is one of the Millennium Development Goals. In Mali, however, the goal of reducing by half the proportion of people without sustainable access to safe drinking water is a long way from being realized. Indeed, only 5 percent of the population currently has access to safe drinking water.

“In Mali,” says Adama Tolofoudye, the recipient of a TWAS Research Unit grant, “drinking-water infrastructure has a limited terrestrial coverage and its compliance with World Health Organization standards is highly inadequate.”

Tolofoudye, based at the *Faculté des Sciences et Techniques de Bamako* (FAST), is using the grant provided by TWAS to implement research activities aimed at improving water quality by combining two modern technologies – nanofiltration and solar photovoltaic energy. As well as designing a prototype system for providing safe drinking water, he also aims to use the grant to develop a core of trained researchers at FAST that can provide local expertise in developing efficient water treatment systems.

After initial delays between ordering and receiving the necessary equipment, the group has now installed a photovoltaics-powered bench-scale





nanofiltration system in the chemistry department at FAST. The time spent waiting for the component parts to arrive was not wasted, however, as the laboratory was also able to purchase a miniaturized filtration unit with commercial nanofilter membranes that were suitable for training a graduate student, Amadou Maiga, in operation procedures and data interpretation. Such efforts were assisted by Abdoulaye Doucouré, a native of France of Malian descent working as a research manager for a private company in the United States a specialist in filtration, purification and separation. He visited Mali in 2004 as a consultant to Tolofoudye's team after receiving a grant from the Transfer of Knowledge through Expatriate Nationals (TOKTEN) scheme of the United Nations Educational, Cultural and Scientific Organization (UNESCO). He will return to further assist FAST staff in implementing their TWAS Research Units project having been appointed to the TWAS Visiting Scientists programme (see page 66) in 2007.

Nanofiltration membranes are able to remove species dissolved in water that are between 0.1 and 1.0 nanometre in diameter, including salts, heavy metal ions and small organic molecules. However, forcing untreated water directly through such membranes would quickly clog them, making them ineffective. Tolofoudye and his colleagues, therefore, have been analysing certain local materials for use as 'pre-filters' that would remove particles suspended in the water such as bacteria, dispersed colloids and larger organic molecules.

"Among the materials we have investigated," explains Tolofoudye, "are two types of local clay and pyrolyzed coconut shells."

The next step is to challenge five commercial nanofilters with 'synthetic' water – a carefully controlled mixture containing known concentrations of 'contami-

nants', and then to test the best-performing membranes with 'raw' water taken directly from the Niger River in Bamako.

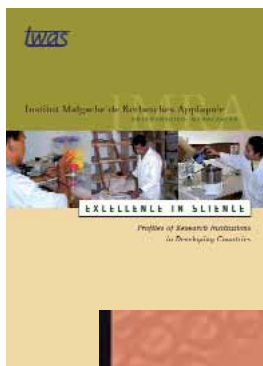
"The next area we intend to develop using the TWAS grant," says Tolofoudye, "is to compare capacitive deionization (CDI) with conventional filtration technologies and link it with solar photovoltaics." This will be achieved in collaboration with a Canadian company. "With CDI," adds Tolofoudye, "it is critical to remove uncharged species with a pre-filter. This can be done using a column filled with activated carbon and again we have been investigating locally-available materials such as pyrolyzed cotton straw."

Initially awarded in 2004, FAST's TWAS Research Unit grant has been extended for an additional three years. This long-term support is now helping Tolofoudye and the head of the chemistry department at FAST, Lassina Sidibé, plan ahead. They now aim to enrol five graduate students in their laboratory in an effort to consolidate local expertise in the strategic field of water purification and ultimately to create a strong research platform in the FAST chemistry department that will focus on water treatment processes and hybrid solar power/filtration systems.

"We hope that, with support from TWAS and from dedicated consultants such as Abdoulaye Doucouré, we can transform this project into a viable research programme that can fully benefit talented students in Mali. We also hope to help Mali reach its goal of providing safe drinking water to the majority of its population," adds Tolofoudye. "By using Mali's abundant solar energy resource to create what is currently a scarce resource in the country – safe drinking water – we believe this project will contribute significantly to Mali's socio-economic development."

TWAS – like all international organizations – needs an effective way of communicating its programmatic activities to its membership and other interested parties. In the case of 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



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 associated organizations, TWOWS, IAP, IAMP and COSTIS (see pages 58-61).

On 22 October 2007, more than 230 science journals worldwide simultaneously published articles exploring issues related to “poverty and human development”. The *TWAS Newsletter* was part of this coordinated effort designed to examine and advance the Millennium Development Goals (MDGs). The collection of newsletter articles focused on such issues as public health and the status of women in the developing world. Articles also examined broad scientific and technological issues in two distinctly different places in the developing world: Brazil, which has made substantial progress in building its scientific capacity, and Africa, which continues to lag behind. The initiative, organized by the Council of Science Editors (CSE), marked the largest ever publication initiative of its kind.

The *TWAS Year Book 2007*, which has been redesigned into a more eye-catching format, contains short biographies of all TWAS Fellows and Associate Fellows. It was published in August 2007 and distributed to all members.

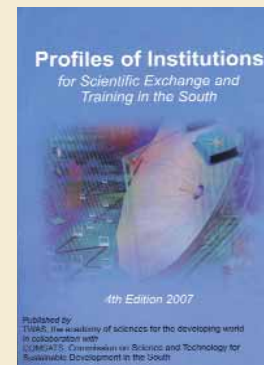
In addition, the fourth edition of *Profiles of Institutions for Scientific Exchange and Training in the South* was published in October 2007 in collaboration with the Pakistan-based Commission on Science and Technology for Sustainable Development in the South (COMSATS). This latest edition, which comes with a searchable CD, contains details of 485 research institutions from 65 developing countries.

The third *TWAS Research Updates*, featuring articles on neuroscience in Brazil and geosciences in central Africa, was also published in 2007. *TWAS Research Updates* highlights research being carried out by scientists in the South and brings their work to the notice of a wider audience, including decision makers.

In 2007, TWAS published the first three volumes of a five-volume series highlighting successful scientific institutions in the developing world, *Excellence in Science: Profiles of Research Institutions in Developing Countries*. The project, funded by the David and Lucile Packard Foundation, examines the factors that have helped to build and sustain these research institutions – in India, Madagascar and Tunisia – so that their diverse case histories can be replicated elsewhere.

In a plenary lecture to more than 2,000 delegates attending the annual meeting of the American Association for the Advancement of Science (AAAS) in San Francisco, United States, on 18 February 2007, TWAS executive director, Mohamed Hassan, illustrated the growing gap between such scientifically advanced developing nations as China and other countries that are scientifically less privileged, mainly in sub-Saharan Africa. “Contradictory trends,” said Hassan, “are opening up a serious divide among developing countries that is compounding the scientific and technological divide that continues to exist between the developed and developing world. This is particularly the case in sub-Saharan Africa, the region of the world that can least afford to be science-poor.”

The success of the AAAS lecture led to requests from two leading international journals, *Science* and *Cell*, for commentaries examining these gaps in scientific and technological capacity and highlighting ways of tack-



ling them. Together, these outreach activities have combined to give the Academy unprecedented visibility among the global scientific community and a far broader audience than the Academy has had in the past.

As a result of the 2004 TWNSO workshop on medicinal plants, a network of South-based researchers was created. Members are provided with updated information on topical issues through the distribution of an e-newsletter. Apart from this newsletter, TWAS also produces a two-page *Fellowships Bulletin*, issued twice in 2007, the *IAP Bulletin* every three months and the *IAMP Newsletter*, also issued twice in 2007, all of which are disseminated widely and made available on the websites of the respective associated organizations.

In addition to its ongoing responsibilities, the TWAS Public Information Office 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



CITIES, SCIENCE AND SUSTAINABILITY

In 2007, for the first time in history, more than half of the world's population was living in cities. Currently, one million people across the globe migrate to cities each week. And most

of this growth of urban centres is occurring in the developing world. Indeed, sub-Saharan Africa is the world's most rapidly urbanizing region.

These statistics highlight the urgent need to address such sustainability issues as access to safe drinking water and sanitation, access to healthcare and adequate housing, traffic regulation and air pollution, to name just a few.

In response, TWAS partnered with the United Nations Development Programme's Special Unit for South-South Cooperation (UNDP-SSC) and the United Nations University - Institute of Advanced Studies (UNU-IAS), based in Japan, to sponsor a workshop on 'Cities, Science and Sustainability'. The event, held in Trieste, Italy, on 20-22 September 2007, brought together 31 scientists and other development workers from 19 countries in the South. During the workshop, 18 case studies were presented, each highlighting a successful project carried out in a city in a developing country. In addition, the workshop featured four special presentations, including one from Hans van Ginkel (TWAS Associate Fellow 2005), who spoke on 'Towards Sustainable Urban Futures: Urbanization in an Era of Globalization and Environmental Change'.



As with other UNDP-SSC-sponsored workshops, the case studies presented at the meeting will be published in the *Sharing Innovative Experiences* series and made available on the internet (see tcdc.undp.org/widenew/sharingsearch.asp) and distributed free of charge throughout the South.

CAPACITY BUILDING WORKSHOPS

In 2006, TWAS teamed up with FORGEA-International, a geo-mining and environmental training and cooperation centre based in Sardinia, Italy, to run four workshops. The first of these workshops, on the theme of ‘Capacity Building in Environment-related Issues in Geo-mining and Coastal Zone Management’ was held in late 2006, while the three others were held in early 2007. These included two courses on ‘Capacity Building in Environment-related Issues: Recovery and Recycling of Construction Materials’ held on 22 January - 2 February and on 19-30 March, and a second course on geo-mining and coastal zone management held on 26 February - 9 March.

In total, the four workshops, held at the *Università per il Sulcis Iglesiente*, in Monteponi, near Iglesias, Sardinia, provided state-of-the-art training for 86 students and middle-level professionals from North Africa, the Middle East, the Balkans and eastern Europe.

Maurizio Iaccarino (TWAS Associate Fellow 1997), scientific coordinator for the series of workshops, says: “The ultimate aim of these workshops is to help build a critical mass of trained personnel in the target countries who can implement environmentally-friendly procedures for extracting, using and recycling mineral resources. What makes these workshops different, is



that they not only include sessions taught by the lecturers but that the participants also present their own case studies and so learn from one another. This is critical, as it helps the participants gain a wider understanding of the challenges and the solutions in developing-country conditions. It also helps participants to broaden their networks of contacts in their own areas of expertise.”

The project, sponsored by the Italian Ministry of Foreign Affairs, ended with a high-level forum on 16-17 November 2007, also held in Sardinia. The forum was attended by some 138 participants and involved 25 speakers, including Famiano Crucianelli, undersecretary of state, Italian Ministry of Foreign Affairs; Minister Renzo Rosso, responsible for multilateral cooperation at the Italian Ministry of Foreign Affairs; and Giuseppina





Crescimanno, head of science section, UNESCO-Venice. Geology professors from Germany, Greece, Iraq, Italy, Spain and Turkey also presented short overviews of their work and voiced their appreciation of the training workshops and other TWAS activities. The forum provided a good opportunity to present TWAS and its activities to a large audience of local, regional and national government officials, as well as scientists from various target countries.



For additional information on FORGEA-International, visit: forgea.atspace.com.

BIOTECH COLLABORATION

Launched in late 2005, the TWAS-International Centre for Genetic Engineering and Biotechnology (ICGEB) joint programme on tolerance to abiotic stress in plants is now in full swing.

The programme is designed to create small research networks, each composed of two to four institutions, one

of which must be in a least developed country (LDC) or other science- and technology-lagging country (S&TLC). In 2007, the five selected networks received the first instalment of their three-year funding. Among the conditions of the grant award are that most of the money must be spent in the participating LDC or S&TLC and that young researchers in these countries must receive training, preferably by allowing them to visit the participating laboratories in the more scientifically advanced countries.

Among the proposals selected were those headed by:

- Andres Zurita Silva, Centre for Advanced Studies in Arid Zones, *Universidad de la Serena*, Chile, working on ‘Tolerance strategies of *Quinoa* plants under salt stress’ with collaborators from Argentina, Mali and Italy;
- Konstantin Skryabin, Centre “Bioengineering”, Russian Academy of Sciences, Moscow, Russia, working on ‘Use of bacterial H⁺ pyrophosphatases for the development of salt-tolerant plants’ with a collaborator from Uzbekistan;
- Jennifer Thomson, Department of Molecular and Cell Biology, University of Cape Town, South Africa, work-

ing on 'The development of maize and other crops tolerant to abiotic stresses' with collaborators from Kenya and Zimbabwe;

- Khaled Masmoudi, *Centre de Biotechnologie de Sfax*, Tunisia, working on 'Over-expression of genes encoding ion transport proteins as a strategy to improve salt- and drought-tolerance in wheat' with collaborators from Ghana and Syria; and
- Sabina Vidal Macchi, *Laboratorio de Biología Molecular Vegetal, Universidad de la República Iguá*, Montevideo, Uruguay, working on 'The identification of key genes involved in salt and osmotic stress tolerance in model plants' with collaborators from Argentina, Nicaragua and Hungary.

For additional information on ICGEB, visit: www.icgeb.org.

SUPPORT FOR SCIENTIFIC MEETINGS

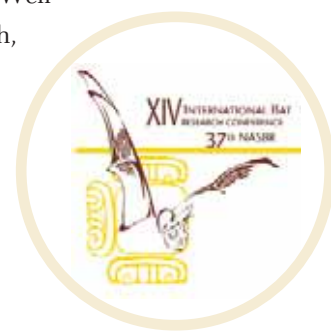
In 2007, TWAS provided support for 23 scientific meetings in 15 countries. Among the meetings supported were:

- The Asian New and Renewable Energy Technology Symposium, ANRET 2007, Ulaanbaatar, Mongolia, 7-9 July 2007;
- International Research Conference on Biodiversity and the Sustainable Management of Natural Resources, Kigali, Rwanda, 23-24 July 2007;
- International Workshop on Renewable Energy for Sustainable Development in Africa, Nsukka, Nigeria, 22-24 July 2007;
- 17th International Congress of Arachnology, Sao Paulo, Brazil, 5-10 August 2007;
- *II Congreso Latinoamericano de Estudiantes de Microbiología y Parasitología*, Lima, Peru, 12-17 August 2007;



CHEMRAWN XII
THE ROLE OF CHEMISTRY IN SUSTAINABLE AGRICULTURE AND HUMAN WELLBEING IN AFRICA

- International Workshop on Women for Science, Beijing, China, 16-17 August 2007;
- XIV International Bat Research Conference (IBRC) and 37th North American Symposium on Bat Research (NASBR), Merida, Mexico, 19-23 August 2007;
- 8th African Crop Science Society Conference, El-Minia, Egypt, 27-31 October 2007;
- International Workshop on Infrared Spectroscopy Applied to Biological and Biomimetic Systems (from the Isolated Molecule to the Cell), Buenos Aires, Argentina, 5-7 November 2007; and
- CHEMRAWN XII – The Role of Chemistry in Sustainable Agriculture and Human Well-being in Africa, Stellenbosch, South Africa, 2-5 December 2007.



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 Young Affiliate membership, TWAS Prizes and TWAS Regional Prizes, 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

The TWAS Regional Office for East and Southeast Asia and the Pacific (TWAS-ROESEAP) held an international workshop on ‘Women for Science’ on 16-17 August 2007. Partners in this event included CAS and the Third World Organization for Women in Science (TWOWS), as well as the Chinese Academy of Engineering, the China Association for Science and Technology, and the All China Women’s Federation. The workshop was attended by 70 women scientists from 18 countries.

In mid-October, the Regional Office teamed up with the World Meteorological Organization (WMO) to host the Sixth CAS-TWAS-WMO Forum, this time on the ‘Design of the Earth System Dynamic Model’. The meeting, held in Beijing, was attended by more than 100 participants, including scientists from Australia, China, France, Germany, India, Italy, Japan, Malaysia,





the Netherlands, Pakistan, South Korea, Thailand, UK, USA and Vietnam.

On 8 November 2007 in Beijing, TWAS-ROESEAP also organized the Fourth Meeting of Chinese TWAS Fellows. The meeting was attended by more than 70 Academy members from across China. The aim of the meeting was to promote the activities and strategy of TWAS in China. Indeed, TWAS-ROESEAP is active in the TWAS-CAS South-South Fellowship programme and the TWAS-UNESCO Associateship Scheme at Centres of Excellence in the South.

In addition, two issues of newsletters and a document related to China-TWAS cooperation in Chinese, both in paper and electronic format, were published and distributed, as well as a Regional Office newsletter in English.

- *coordinator: Chunli Bai (TWAS Fellow 1997)*
- *email: beijing@twas.org, 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 2007, the TWAS Regional Office for Sub-Saharan Africa (TWAS-ROSSA) organized two public lectures. The first, which commemorated the fourth anniversary of the late Thomas Risely Odhiambo (TWAS Founding Fellow), took place on 14 September 2007 in collaboration with Maseno University, Kenya. The lecture, presented by Bethwell A. Ogot, professor emeritus history, Maseno University, and chancellor, Moi University, Kenya, was entitled: ‘Who, if anyone, owns the past? Reflections on the meaning of public history’. The second public lecture was presented by Salif Diop, United Nations Environment Programme, Senegal, on: ‘Key



challenges and priorities for achieving the Millennium Development Goals on water and sanitation’.

The Second TWAS-ROSSA Regional Conference for Young Scientists took place on 3-6 December 2007. The theme of the conference was ‘Mentoring Young Scientists for the Innovative Application of Research and Development in Africa’. The meeting was attended by 65 participants, including researchers, lecturers, students, policy-makers and civil society representatives from 23 countries. The conference provided young and senior scientists with a platform to take stock of advances in the application of research and development in Africa, as well as to exchange ideas and map the way forward for innovative networking mechanisms among scientists within the region.

TWAS-ROSSA also strives to support the activities of TWAS National Chapters in Africa by providing funds

to one such chapter each year. The Ghana Chapter received capacity building support during 2006-2007, while the Zimbabwe Chapter is receiving support during 2007-2008.

TWAS-ROSSA, in partnership with the African Academy of Sciences (AAS), also published the regular four issues a year of the peer-reviewed, multidisciplinary and indexed journal, *Discovery and Innovation*.

With the increase in TWAS-ROSSA activities, an e-newsletter is now produced biannually, in June and December. TWAS-ROSSA also has a website embedded on the AAS website that helps enhance the visibility of TWAS and the Regional Office.

- coordinator: Iba Kone (acting director, AAS)
- 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). During 2007, TWAS-ARO organized three workshops at the *Bibliotheca Alexandrina*. The first, on nanotechnology, was held on 2-3 September and was attended by 90 participants. The ten sessions featured lectures by five eminent speakers, including C.N.R. Rao, TWAS's immediate past president.

A 'School on Algebraic Approach to Differential Equations: *Ecole Mathématique*' was held on 12-25 November, co-organized by TWAS's hosts in Trieste, the Abdus Salam International Centre for Theoretical Physics (ICTP). Finally, on 8-13 December, a six-day bioinformatics workshop on 'Computer Methods in Molecular Biology' aimed to create bridges of interaction between biologists, biochemists and computer science engineers by exposing them to real cutting edge molecular biology and computational techniques.

TWAS-ARO also continued its policy of promoting the public awareness of science through two public lectures. First, Mostafa El-Sayed, director, Laser Dynamic Laboratory, Georgia Institute of Technology, USA, presented a talk on 'Small is Different: The properties of material as its size is reduced to the nanometre scale', on 4 September, which was attended by more than 60 people. The following day, a lecture for publishers, 'Elsevier's View on Scientific Publishing' presented by Carl Schwarz, director, International Publishing Development, Elsevier – the world's leading publisher of science and health information – attracted more than 40 people.





Then, on 23-24 October, TWAS-ARO and the *Bibliotheca Alexandrina* hosted a conference on 'Women in Science'. The large number of participants heard presentations from more than 50 eminent invited speakers.

Among the Regional Office's other activities are the addition of a TWAS-ARO section to the CSSP electronic newsletter, the maintenance of the TWAS-ARO website, which is used to announce conferences, lectures and workshops, and the ongoing development of a directory/database of Arab scientists who are active in the Arab region.

- coordinator: *Ismael Serageldin (TWAS Fellow 2001)*
- email: alexandria@twas.org, secretariat@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 TWAS Regional Office for Central and South Asia (TWAS-ROCASA) has established a new joint programme, the TWAS-JNCASR Summer Research Fellowship Programme (SRFP), aimed at promoting and encouraging undergraduate students in the region to visit renowned institutions in India. Five students were selected in 2007: one from Azerbaijan, one from Bangladesh, two from Iran and one from Sri Lanka.

The Regional Office also published a 'Directory of Fellows' that features the biographical and contact details of TWAS Fellows in the region.

The Regional Office also issued periodical press releases highlighting TWAS events and announcements, for example in *Current Science*, the journal of the Indian Academy of Sciences.

- coordinator: *Varadachari Krishnan (TWAS Fellow 1996)*
- email: bangalore@twas.org, 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

In 2007, the TWAS Regional Office for Latin America and the Caribbean (TWAS-ROLAC) appointed five regional TWAS Fellows to a consultative scientific council that oversees nominations for TWAS Young Affiliate membership and the TWAS Regional Prize. In addition, the five members of this committee presented overviews of science in their countries and on scientific cooperation with other countries in Latin America at a conference organized by ABC in Rio de Janeiro on 'Science in Brazil and Latin American and Brazil/Latin American and Caribbean Scientific Cooperation'. The conference was held on 24-26 January 2007.

TWAS-ROLAC also awarded its second Young Scientist Prizes in 2007. The prize of US\$2,000 was awarded to young scientists working in the biological sciences, mathematics, neurosciences and physics.



In December 2007, the Second Regional Conference for Young Scientists, this time focusing on chemistry, mathematics and physics, was held. Some 27 young scientists from the region attended.

TWAS-ROLAC is also active in contacting TWAS Fellows in the region and seeking nominations for TWAS membership and awards, has updated the Regional Office's homepage, and supports TWAS and the Brazilian National Council for Scientific and Technological Development (CNPq) in the implementation of the TWAS-CNPq South-South Fellowships programme.

- 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 2007, the Regional Prizes for the Public Understanding and Promotion of Science were awarded to:

- TWAS-ARO: Adnan Hamoui (TWAS Fellow 1988), Kuwait Foundation for the Advancement of Sciences and editor-in-chief, Arab edition of *Scientific American*.
- TWAS-ROCASA: Pervez Hoodbhoy, professor of nuclear physics and chair of the physics department at Quaid-i-Azam University, Islamabad, Pakistan.
- TWAS-ROLAC: Roberto Lent, professor of neurosciences and director of the Institute of Biomedical Sciences, Federal University of Rio de Janeiro, Brazil
- TWAS-ROSSA: Christina Scott, a freelance science writer and the first African news editor of the web portal *Science and Development Network (SciDev.Net)*.



At its headquarters in Trieste, Italy, TWAS now 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 2007 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.

TWOWS's flagship post-graduate fellowship programme, sponsored by the Swedish International Development Agency's (Sida) Department for Research Cooperation (SAREC), for young women scientists from sub-Saharan Africa and least developed countries was launched in 1998 and continues to grow. In 2007, 203 applications were received from 26 countries, of which 21 from 14 countries were selected.

Another two young women scientists completed their higher degrees in 2007, bringing the total since the programme began to 70.

In 2007, Sida-SAREC also renewed its funding for next three years, although the new guidelines mean that awards will be restricted to candidates seeking higher degrees in the basic sciences (biology, chemistry, mathematics and physics).

Among TWOWS's other 2007 activities was a 'Workshop on Women for Science' co-organized by the Chinese Academy of Sciences (CAS) and held in Beijing, China, on 16-17 August. Scholars from more than a dozen developing countries addressed issues concerning women in science and technology, including scientific careers for women, how to attract women into scientific careers, factors behind the success of women scientists and how to encourage the understanding and use of scientific knowledge by women in rural areas.

This meeting followed the meeting of the TWOWS executive board, which, among other decisions, approved the organization's Strategic Plan for 2007-2010. The Strategic Plan is now being circulated to potential donors. During the meeting, Fang Xin (TWOWS vice president for the Asia and Pacific region) officially announced that China had agreed to host the next TWOWS Fourth General Assembly and International Conference.

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

INTERACADEMY PANEL ON INTERNATIONAL ISSUES (IAP)

IAP, an umbrella organization for the world's merit-based academies of science, currently coordinates programmes devoted to capacity building for science academies, women and child health issues, science education, water resource management, biosecurity, access to scientific information and natural disaster mitigation.

Following IAP's 5th General Assembly in Alexandria, Egypt, in December 2006, IAP changed its way of funding its programmes away from appointing a particular academy to lead the scheme. Under the new regulations, IAP invites proposals from member academies, groups of academies, or regional networks of academies that are then assessed by a peer review committee.

Also following the meeting in Egypt, the first meeting of the newly elected IAP executive committee was host-



ed by TWAS in February 2007, and the second was hosted by the Australian Academy of Science in September 2007 in Canberra.

During this meeting, the Montenegrin Academy of Sciences and Arts, the Mauritius Academy of Science and Technology and the Sudanese National Academy of Science were accepted as IAP members. The Network of Academies of Science in OIC (Organization of Islamic Conference) Countries (NASIC) also joined IAP as an observer, bringing IAP membership to 97.

IAP's scientific programmatic agenda for 2008 was also adopted at the meeting in Australia. Based on the new competitive review process, the following proposals will receive funding:

Scientific Communication for Young Scientists: InterAcademy Medical Panel (IAMP).

Promoting Access To and Use of Digital Knowledge Resources and Infrastructures: Focus on Countries with Developing and Transitional Economies: US National Academies of Science.

Regional Science Education Programme in Asia and Pacific: Association of Academies of Sciences in Asia



(AASA) and Federation of Asian Scientific Academies (FASAS).

Regional Programme on Science Education: Inter-American Network of Academies of Science (IANAS).

Promoting Best Practices In Science Education In Sub-Saharan Africa: Uganda National Academy of Science and the Network of African Science Academies (NASAC).

Bridging Water Research and Management: Enhancing Global Capacity: Brazilian Academy of Sciences.

Biosecurity: Royal Netherlands Academy of Arts and Sciences (KNAW).

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, will continue 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.

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

INTERACADEMY MEDICAL PANEL (IAMP)

IAMP membership currently comprises 64 medical academies and science academies with medical divisions that are committed to improving health worldwide.

In April 2007, the IAMP executive committee met in Trieste to begin drafting a Strategic Action Plan for use in seeking funding for IAMP and its programmes. The Strategic Action Plan was finalized and printed by the end of the year and is now being circulated to potential donors.

Concerning IAMP's programme on 'Emerging Infections', the Chinese Academy of Engineering hosted a

workshop in Shanghai on 10-16 June 2007. The workshop was attended by 37 participants from 10 countries. A follow-up report highlighted matters of health policy that require further consideration and action by policy makers, and identified areas where more research is required.

In addition, eight academies involved in the programme on 'Reducing Perinatal Mortality', led by Jan Lindsten of the Royal Swedish Academy of Sciences, attended a workshop in Trieste on 14-15 December. Academy representatives learned how a needs assessment study in Tanzania was carried out and are using



this experience to design their own national needs assessment study plans. Meanwhile, donors are coming forward to implement the strategy outlined in the Tanzanian study.

Evidence of the high regard in which IAMP is held – and the potential the network has for instigating improvements in healthcare in developing countries – was forthcoming at the end of the year. On 27 December 2007, the Italian government signed into law an additional annual contribution to TWAS of €500,000 specifically to support IAMP activities.

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)

COSTIS was derived from the Third World Network of Scientific Organizations (TWNISO), created by TWAS in 1988, following a decision by the TWNISO General Assembly and the political backing of the foreign ministers of the Group of 77 (G77) in 2006. With its membership of ministries of science and technology, nation-

al research foundations, national research councils, academies of science and science-based private-sector institutions, COSTIS aims to build on and enhance TWNISO's efforts at promoting science and technology for sustainable development to governments in the South.

In particular, COSTIS aims to promote science-based development through the integration of science, technology and innovation into national economic development plans; to encourage interaction among existing centres of scientific excellence in the developing world; and to support the creation of new international centres of excellence, especially in critical areas of science-based development related to energy, environment and economic development.

Full details of the operational activities of COSTIS are being established by a high-level task force that met twice in 2007 to discuss such issues as the COSTIS statutes and start-up programmatic activities.

The interim COSTIS secretariat is hosted by TWAS in Trieste.

For additional information about COSTIS, see costis.g77.org or contact costis@twas.org.





A P P E N D I C E S

2007 in Figures

In 2007, under the **TWAS-UNESCO Associateship Scheme**, TWAS appointed 17 developing-world scientists as associates for a three-year period, including scientists from Cameroon, Cuba and Iran. In addition, 44 associates travelled to carry out collaborative research at research institutions in nine countries in the South: Argentina, Botswana, Brazil, China, India, Iran, Pakistan, Thailand and Vietnam. The TWAS-UNESCO Associateship Scheme is kindly supported by the OPEC Fund for International Development (OFID).

Geographical area	Awarded	Hosted
Africa and Arab region	19	3
Asia and Pacific region	18	23
Latin America and the Caribbean	7	18
TOTAL	44	44

In 2007, TWAS provided **support for 23 Scientific Meetings** in 15 developing countries. Supported meetings covered a range of disciplines, from arachnology and advanced materials to renewable energies, the sustainable use of natural resources and natural product chemistry.

Geographical Area	TOTAL
Africa and Arab region	6
Asia and Pacific region	7
Latin America and the Caribbean	10
TOTAL	23

In 2007, 16 developing-world scientists from 10 countries, including four least developed countries (LDCs), received **TWAS Fellowships for Research and Advanced Training**. These were hosted by institutions in 10 countries: Benin, Brazil, China, India, Kenya, Malaysia, Mexico, Pakistan, Taiwan-China and Tunisia.

Geographical area	Awarded	Hosted
Africa and Arab region	10	3
Asia and Pacific region	2	10
Latin America and the Caribbean	4	3
TOTAL	16	16

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, and the S.N. Bose National Centre for Basic Sciences and the Indian Association for the Cultivation of Science (IACS), India; and the National Centre of Excellence in Molecular Biology (CEMB) and the International Centre for Chemical and Biological Sciences (ICCBS) in Pakistan. In 2007, TWAS received a total of 170 fellowship applications, of which 105 were awarded – the highest number yet – and 96 were accepted.

Co-sponsoring organization	Postgraduate fellowship		Postdoctoral fellowship		Visiting scholar	
	Awarded	Accepted	Awarded	Accepted	Awarded	Accepted
CNPq, Brazil	16	13	7	6	-	-
CAS, China	16	15	12	12	15	15
CSIR*, India	10	8	13	13	-	-
DBT, India	1	1	4	4	-	-
IACS, India	0	0	0	0	-	-
S.N. Bose, India	1	0	0	0	-	-
CEMB, Pakistan	1	0	0	0	-	-
ICCBS, Pakistan	3	3	6	6	-	-
TOTAL	48	40	42	41	15	15

* Data for CSIR includes applications received in 2006 and 2007.

In 2007, 46 **TWAS Research Grants** of up to US\$10,000 each were awarded to researchers in some 21 developing countries. Among these, 16 grants went to scientists working in nine countries in sub-Saharan Africa and another five grants went to scientists in two least developed countries in Asia (Bangladesh and Nepal). The TWAS Research Grants programme is kindly supported by the Department for Research Cooperation of the Swedish International Development Cooperation Agency (Sida/SAREC).

Geographical area	Biology	Chemistry	Mathematics	Physics	TOTAL
Africa and Arab region	7	3	2	4	16
Asia and Pacific region	5	2	3	4	14
Latin America and the Caribbean	8	3	0	5	16
TOTAL	20	8	5	13	46

In 2007, 17 **TWAS Research Units** were funded in 13 science and technology-lagging countries (S&TLCs) with grants of up to US\$30,000 each. Of these, 11 were first-time awards. The TWAS Research Units in S&TLCs programme is kindly funded by Sida/SAREC.

Geographical area	Biology	Chemistry	Mathematics	Physics	TOTAL
Africa and Arab region	6	5	0	1	12
Asia and Pacific region	1	3	0	0	4
Latin America and the Caribbean	1	0	0	0	1
TOTAL	8	8	0	1	17

The TWAS Research Professors in Least Developed Countries (LDCs) programme was launched in 2005. In 2007, two TWAS members visited their respective host institution.

TWAS Fellow	Country of residence	Field of expertise	Host institution in LDC	Year of appointment
Elly N. Sabiiti	Uganda	Agricultural sciences	National University of Rwanda, Butare, Rwanda	2006
Edemariam Tsega	Canada	Medical sciences	Gondar College of Medical Sciences, University of Gondar, Ethiopia	2005

The ICSU-TWAS-UNESCO-UNU/IAS Visiting Scientist Programme is a joint 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 Studies (UNU/IAS). It enables eminent scientists from developing and developed countries to visit institutions and research groups in developing countries. In 2007, four scientists travelled to their selected host institution, three of whom were appointed in 2006 and another who was one of six scientists appointed in 2007.

TWAS Fellow	Country of residence	Field of expertise	Host institution	Year of appointment
Brian Kerry	U.K.	Agricultural sciences	Department of Zoology, Aligarh Muslim University, Aligarh, India	2006
Manuel Limonta	Cuba	Health sciences	Hubert Kairuki Memorial University, Dar es Salaam, Tanzania	2006
Akier Assanta Mafu	Canada	Food sciences	Institute of Applied Techniques in Food Processing, Kimbese City, Bas-Congo, Congo D.R.	2006
Pierluigi Bonora	Italy	Chemical sciences	Faculty of Sciences and Techniques, University Cheikh Anta Diop, Dakar, Senegal	2007

FINANCE

The total amount of funds received for activities in 2007 was US\$3,007,908. The main contributions were: the Ministry of Foreign Affairs, Italy (US\$2,066,662); the Department for Research Cooperation (SAREC) of the Swedish International Development Cooperation (Sida) (US\$791,313); *illycafé*, Trieste (US\$100,000); and the Kuwait Foundation for the Advancement of Sciences (KFAS) (US\$49,980).

At 31 December 2007, the TWAS Endowment Fund stood at US\$10,617,227, while the target was increased from US\$15 million to US\$25. Donations during 2007 totalled US\$352,402, including US\$218,584 from Brazil, US\$25,064 from Iran, US\$80,000 from Nigeria, US\$25,000 from the *Consejo Nacional de Ciencia y Tecnología* (CONACYT), Mexico, and other small contributions amounting to US\$3,754. Interest in 2007 totalled US\$714,663.

TWAS FINANCIAL STATUS REPORT FOR 2007 (IN US\$)

INCOME ¹	Received	Total
Ministry of Foreign Affairs, Italy	2,066,662	
Department for Research Cooperation (SAREC) of the Swedish International Development Agency (Sida)	791,313	
illycaffè, Trieste	99,953	
Kuwait Foundation for the Advancement of Sciences (KFAS)	49,980	
		3,007,908
Previous year balance brought forward		1,595,604
Previous year adjustment		236,449
Interest income on Research Grants funds		195,826
Interest income on other funds		714,663
Miscellaneous income		17,025
		5,767,475

EXPENDITURE	A Budgeted	B Disbursed	C Commitments	D (B + C) Total Expenditure	E (A - D) Budget Available
A) Awards and Prizes					
a) Trieste Science Prize	100,000	100,000		100,000	-
b) TWAS Prizes	80,000		80,000	80,000	
c) Prizes for Young Scientists	40,000	46,000	6,000	52,000	(12,000)
<i>Sub-Total for [1]</i>	220,000	146,000	86,000	232,000	(12,000)
B) Research Grants and Spare Parts					
a) Research Grants	800,000	444,271	426,723	870,994	(70,994)
b) Spare Parts	10,000				10,000
<i>Sub-Total for [2]</i>	810,000	444,271	426,723	870,994	(60,994)
C) Associateships and Fellowships					
a) Fellowship Programmes	400,000	20,155	370,357	390,512	9,488
b) Associateship & Professorship Programmes	220,000	35,471	74,928	110,399	109,601
<i>Sub-Total for [3]</i>	620,000	55,626	445,285	500,911	119,089
D) Meetings					
a) Council and General Meeting	100,000	59,164	90,837	150,001	(50,001)
b) Scientific Meetings in the South	70,000	2,948	38,000	40,948	29,052
<i>Sub-Total for [4]</i>	170,000	62,112	128,837	190,949	(20,949)
E) Publications					
	220,000	246,040	16,604	262,644	(42,644)
F) Joint Projects					
a) Regional Offices	125,000	27,500	17,500	45,000	80,000
b) TWNSO/COSTIS	50,000	86,563	11,051	97,614	(47,614)
c) TWOWS	70,000	6,102		6,102	63,898
d) TWAS-ICGEB Joint Plant Biotechnology Programme	50,000	52,632		52,632	(2,632)
e) Packard Foundation Project	40,000	14,074	22,876	36,950	3,050
f) Joint Visiting Scientist Programme	30,000	4,244	15,191	19,435	10,565
g) UNU project	8,000	5,646		5,646	2,354
<i>Sub-Total for [6]</i>	373,000	196,761	66,618	263,379	109,621
G) Operational Expenditure					
a) Staff Costs	900,000	1,033,939	1,755	1,035,694	(135,694)
b) Communications	70,000	44,938		44,938	25,062
c) Travel	45,000	49,626		49,626	(4,626)
d) Library, office and other supplies	90,000	43,631	3,903	47,534	42,466
e) Other general operating expenses	35,000	17,663	593	18,256	16,744
<i>Sub-Total for [7]</i>	1,140,000	1,189,797	6,251	1,196,048	(56,048)
Total	3,553,000	2,340,607	1,176,318	3,516,925	36,075
<i>Operational balance (Total income minus total budget)</i>					2,250,550
<i>Less: interest income on other funds transferred to Endowment Fund</i>					714,663
Excess (shortfall) of income over expenditure					
(Total income minus total expenditure under column D)					1,535,887

¹ 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.

TWAS Annual Report 2007

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