ANNUAL REPORT 2010

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TWAS, the academy of sciences for the developing world, is an autonomous international organization that promotes scientific capacity and excellence in the South.

Founded in 1983 by a group of eminent scientists under the leadership of the late Nobel laureate Abdus Salam of Pakistan, TWAS was officially launched in Trieste, Italy, in 1985, by the secretary-general of the United Nations.

TWAS has nearly 1,000 members from over 90 countries. More than 80% of its members are from developing countries. A 13-member council directs the Academy activities. A secretariat, headed by an executive director, coordinates the programmes. The Academy's secretariat is located on the premises of the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy.

TWAS's administration and finances are overseen by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in accordance with an agreement signed by the two organizations. The Italian government provides a major portion of the Academy's funding.

The main objectives of TWAS are to:

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

To help achieve these objectives, TWAS collaborates with a number of organizations, most notably UNESCO, ICTP and the International Centre for Biotechnology and Genetic Engineering (ICGEB).

ACADEMY OF SCIENCES FOR THE DEVELOPING WORLD

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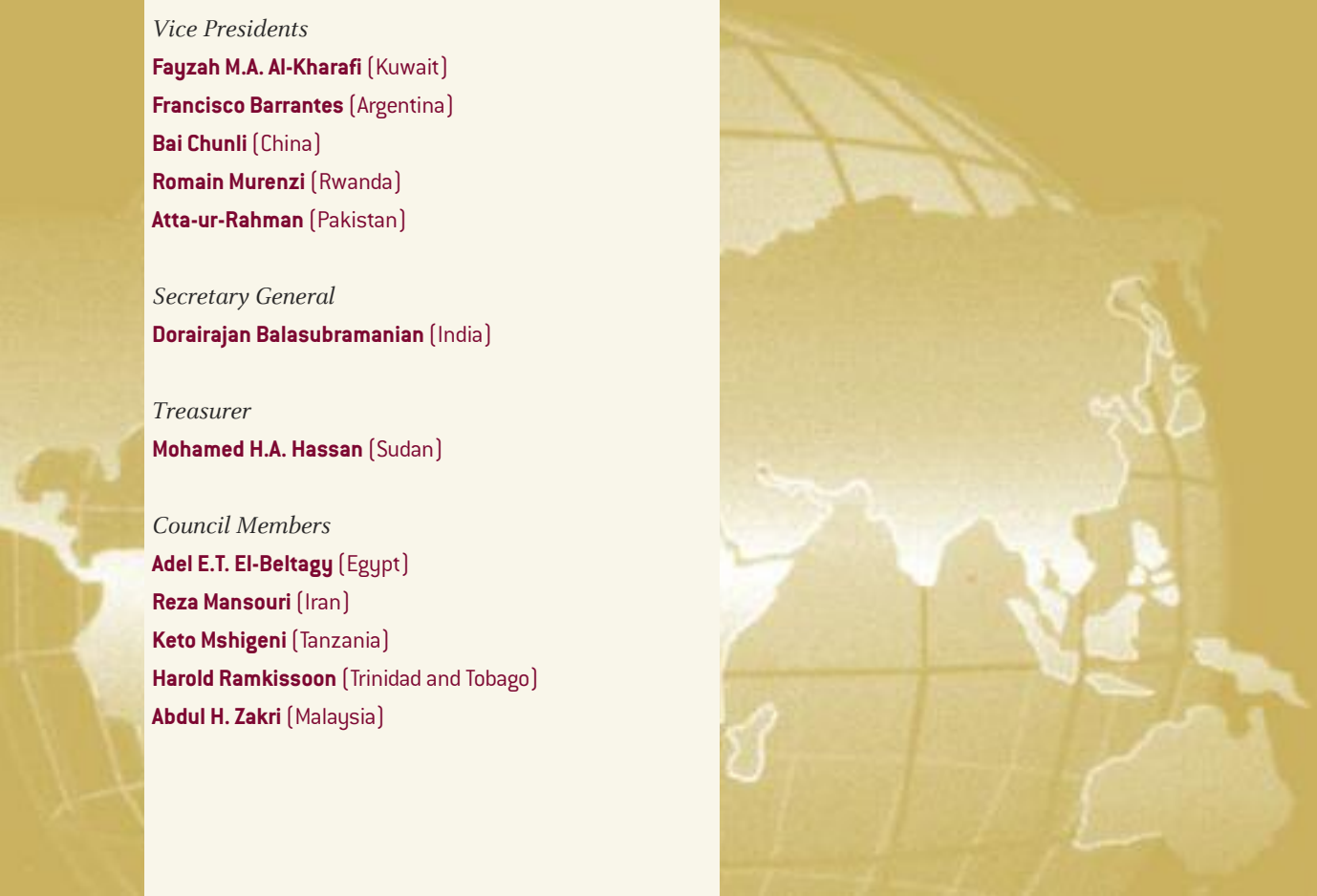

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Foreword

Jacob Palis
President
TWAS

The TWAS 21st General Meeting, held in Hyderabad, India, showcased the enormous progress in science and science-based development that has taken place in India over the past several decades. A broad assessment of the state of TWAS's portfolio of activities carries a similar upbeat message. Yet, TWAS also faces compelling challenges – both old and new.

There is broad acknowledgement that TWAS's fellowship programmes are working well and are growing at a rapid pace, thanks to partnerships with the governments of Brazil, China, India, Kenya, Malaysia, Mexico, Pakistan, and Thailand. There is growing appreciation for the success of TWAS's five regional offices, which are assuming greater responsibility for the Academy's activities, including the selection of TWAS Young Affiliates and the awarding of TWAS regional prizes. There has been progress in reaching the Academy's target of a USD25 million endowment fund even in these difficult economic times. The fund currently has more than USD15 million. And there is continual support from TWAS's major benefactors – the Swedish International Development Agency (Sida), the Kuwait Foundation for Science (KFAS) and, of course, the Italian government, which has served as the Academy's primary funder since TWAS's inception.

In addition, there is an expanding list of partners that now collaborates with TWAS, including illycaffè, Microsoft Research, the International Science, Technology and Innovation Centre for South-South Cooperation (ISTIC), the International Centre of Insect Physiology and Ecology (ICIPE), the African Union, Biovision and Lilly. There is the growing global presence of Trieste-based international organizations that work closely with TWAS – most notably, the Abdus Salam International Centre for Theoretical Physics (ICTP); the Organization for Women in Science for the Developing World (OWSD); IAP, the global network of science academies; and the InterAcademy Medical Panel (IAMP). And there is increasing recognition in both the scientific and economic development communities of the important role that TWAS plays in helping to build scientific and technological capacity in developing countries.

Despite the notable progress that has been made, daunting problems persist. As several recent reports have shown, the welcome increase in scientific prowess in the South, whether measured in terms of the rising number of scientists, publications, patents or the production of science-based goods and delivery of science-based services, has been led largely by emerging economies – notably, Brazil, China, India, Mexico, South Africa and Turkey. While the share of articles published in peer-reviewed international journals by scientists in developing countries rose from 18% in 2003 to 25% in 2007, scientists in just seven countries accounted for more than 80% of these articles. Surveys suggest that there are some 80 countries where science and technology play a very small or virtually no role in the economy. Not surprisingly, these are among the world's poorest countries.

The dream of TWAS, as I have often said, is "to achieve good science in all countries to the benefit of their societies." From this perspective, TWAS still has a great deal of work to do.

The Academy, which has been both a witness and a participant to the enormous changes in global science that have taken place over the past quarter century, is well placed to serve as an important player in efforts to meet the challenges that lie ahead.

What is true for the emerging economies, in many ways, is also true for TWAS. The path to success has been long and arduous. Much progress has been made and there is good reason to believe that much more can be achieved. Yet there is a long way to go and many obstacles to overcome before we reach a level of global success that is our shared goal.

The key to such future progress is no secret. It lies in unwavering national commitment, sustained financial support and the promotion of openness and scientific exchange. This is a formula for success that has served the countries that I mentioned above well over the past several decades and that could provide a useful template for others.

Indeed a growing number of developing countries have been able to chart a path for science-based development. That means developing countries now have a number of models to examine and the ability to choose elements from each model that best suit their circumstances.

When it comes to science and technology, all developing countries are moving ahead. But some countries are moving much faster than others. A primary goal of TWAS over the next several years will be to help accelerate the pace of change in 'scientifically lagging' countries so that a true global community of science can be built for the benefit of all. South-South cooperation will play a key role in this effort.

The long-standing era defined by a North-South gap in scientific capacity is fading and could possibly come to an end in the years ahead. A new era marked by less clearly defined lines of demarcation between scientifically advanced and scientifically lagging countries will hopefully unfold in the not-too-distant future.

Such a paradigm shift will carry profound implications not only for international science but also for international development and diplomacy. TWAS plans to be there every step of the way providing assistance when and where it can and encouraging others to join in efforts to embrace science as a primary tool for building a more prosperous and peaceful world.

The "Years" in Review

Mohamed H.A. Hassan
Executive Director
TWAS

This year will mark the final year of Mohamed H.A. Hassan's tenure as TWAS's executive director. *It is the end of an era for the Academy. Professor Hassan uses the opportunity afforded by his retirement to describe how the Academy has grown over the years and where the major challenges may lie for TWAS in the years ahead.*

As my quarter century of service as TWAS's executive director comes to an end, I often think about my early years: the writing of the statutes for TWAS, the foundation meeting with the Academy's first 42 members in 1983, and the drafting of letters to potential donors.

I remember trying to enlarge the pool of potential candidates for TWAS membership by speaking with newly elected TWAS members about colleagues whom they knew to be outstanding scientists; by reviewing the roster of scientists elected to science academies in the North who came from the developing world; and by identifying prominent scientists who travelled to the International Centre for Theoretical Physics (ICTP) to participate in the Centre's research and training activities in Trieste.

I remember the joy and satisfaction that everyone associated with the Academy felt in 1985 when the Italian government announced that it would provide TWAS with an annual grant of USD1.5 million – a generous contribution that ensured the Academy's long-term survival and that enabled TWAS to launch its research grants, fellowships and prize programmes in earnest.

I remember witnessing similar expressions of pride and enthusiasm in 2004 when the Italian government passed a parliamentary law that transformed the funds that Italy gave to TWAS from a "voluntary" to a "permanent" contribution that would no longer be subject to yearly reviews. I learned about this good news the same day that China's President Hu Jintao spoke to more than 3,000 people attending the opening ceremony of the TWAS 20th anniversary conference in the Great Hall of the People in Beijing. The Italian government's decision to provide TWAS with a permanent source of funding, combined with President Hu's high praise for the accomplishments of TWAS that he presented to such a large and distinguished audience, made this one of the most memorable days in the Academy's history.

I think about other turning points too that may have been less dramatic but no less important to the success of TWAS. I recall, for example, the Academy's decision to focus on South-South collaboration in science at a time when developing countries looked exclusively to the North to build their scientific capacity.

TWAS's emphasis on South-South collaboration may have failed to pay significant dividends in the short term (at the time, there were simply too few scientists and too few scientific institutions of excellence in the developing world to forge meaningful collaborations). Yet, over the long term, TWAS's early call for scientific partnerships and exchanges among developing countries gave the Academy lasting credibility as one of the world's strongest and most forthright "voices for science in the South." This has generated untold benefits not only for TWAS but, more importantly, for science in the developing world.

South-South collaboration in science has both deepened and accelerated over the past two decades as scientific capacity has become stronger in a broad range of fields. The trend has spread across the South, creating fertile ground for fellowships, grants and joint research programmes among developing countries.

Then there's the decision by the governments of Brazil, China and India, in 2004, to collaborate with TWAS in funding fellowships for post-graduate and post-doctorate students from the developing world to study in centres of excellence in their countries. Today, the TWAS South-South fellowship programme, which has since been joined by a number of other countries, including Kenya, Malaysia, Mexico, Pakistan and Thailand, offers more than 300 fellowships each year. It is the largest South-South post-graduate and post-doctoral fellowship programme in the world.

And then there's the family of like-minded institutions that have joined TWAS over the years to make Trieste their home. For example, the Third World Organization for Women in Science (TWOWS, which has recently been renamed the Organization for Women in Science for the Developing World or OWSD). The organization, which was launched with the help of TWAS in 1988 and which the Academy has supported ever since, remained active but largely in a steady state for many years. Recently, OWSD has taken important steps to raise its profile and increase its level of activities. There are now more than 3,000 women scientists who belong to OWSD. That makes it the world's largest organization of women scientists.

There's also IAP, the global network of science academies, which came to Trieste in 2000 and was joined by the InterAcademy Medical Panel (IAMP) in 2005. Both organizations have allowed TWAS to extend its reach from the South to the North. This has helped give the Academy a truly global presence in both science and science policy.

Over the past quarter century, a great deal of progress has undoubtedly been made in building scientific capacity in the developing world. Yet, it is equally true that more work needs to be done if the goal of having "good science in all countries," as TWAS president Jacob Palis likes to say, is to be achieved.

As the 2010 *UNESCO Science Report* noted, the North-South gap in scientific capacity, at least in aggregate terms, is closing. From 2003 to 2007, the share of scientific articles published by scientists from developing countries in peer-reviewed scientific journals has climbed from 18% to 25%. This is undoubtedly welcome news. It speaks to a more equitable world and to a world with a larger, more diverse, scientific pool of expertise.

But a closer look at the statistics reveals a less glowing portrait of the state of science in the developing world. An estimated 80% of the increase in publications in peer-reviewed journals authored by scientists in the South comes from just a handful of countries: Brazil, China, India, Malaysia, Mexico, South Africa and Turkey. China alone is responsible for one-third of the developing world's scientific output.

TWAS, in fact, has identified some 80 developing countries that continue to lag far behind the rest of the world in their scientific capacity and output – so-called "scientifically lagging" countries. Having a collective population of 1.6 billion people, these countries account for less than 1% of the world's scientific publications.

Thus, for all of the progress that has been made, we have, in a sense, traded a North-South divide in science and technology for a South-South divide.

And what is true of science, not surprisingly, is also true of economic development. Again, much attention has been focused on the rapid pace of growth now being experienced by emerging economies. This is indeed welcome news. China's 10% annual growth rate over the past 25 years has lifted some 600 million people out of poverty, marking the most rapid pace of poverty alleviation in the history of humankind. Just last year, China's economy leaped passed Japan to become the world's second largest economy. India, which has experienced annual growth rates ranging from 5% to 10% over the past two decades, now has more than 300 million people who enjoy middle-class income status. The annual per-capita gross domestic product (GDP) in Brazil, meanwhile, climbed from USD8,700 in 2005 to USD11,200 in 2010.

Science and technology have played a prominent role in the economic success of each of these countries, a role well recognized by the political leadership. Brazil now spends more than 1% of its gross domestic product on science and technology; China spends 1.5%; and India about 1%.

But again a closer look reveals a much more complicated picture in which the bright colours of hope are mixed with darker hues of grey. For example, average expenditures on science and technology among sub-Saharan Africa's 48 countries are well below 0.5%. In Burkina Faso, Congo, Lesotho and Zambia, they are lower than 0.1%. Low percentages also prevail in countries with predominantly Muslim populations.

TWAS has always supported efforts to build scientific and technological capacity in developing countries as a necessary prerequisite for improving global social and economic well being. But, at the same time, it has always been keenly aware of the modest contributions it can make to this effort. TWAS, after all, is a small organization with a small staff and limited budget.

The same sense of reality will undoubtedly guide the agenda of the new executive director as he takes over the reigns of the organization. However, I would like to offer some suggestions, many of which have been outlined in the Academy's strategic plan for 2010 - 2014, that could help TWAS remain a key player in global efforts to continue to strengthen scientific capacity in developing countries.

First, I think it is important to decentralize TWAS activities, largely by extending greater responsibility to the Academy's regional offices. The core operating budget for the TWAS secretariat is unlikely to increase in the future. Therefore the regional offices will need to shoulder greater responsibility for the administration of prizes, fellowships and research grants, especially as these efforts continue to expand. This trend has been unfolding for the past several years with the help of the secretariat. Such efforts, moreover, should not be viewed solely as an economic measure. Decentralizing the Academy's activities reflects the growing strength of science in the developing world and the ability of neighbouring countries within the same region to pursue activities that are mutually reinforcing and beneficial.

Second, TWAS should seek to build upon its successful post-graduate fellowship programmes. These programmes currently offer some 300 fellowships each year. However, only half – some 160 fellowships – are actually awarded. It costs the Academy about USD350,000 a year to cover the transportation costs for grant recipients and to administer the programme. This investment, in turn, leverages an estimated USD2.5 million from the host countries to cover tuition, housing and living costs. If the Academy were able to identify worthy candidates for each of the 300 fellowships that are currently available, the costs for TWAS would increase nearly two-fold, reaching USD700,000. For the host countries, the costs would rise to more than USD5 million. There is no doubt that, if we could heighten awareness among students across the developing world, sufficient demand exists for these fellowships.

Third, TWAS should seek to reach its USD25 million target for the Academy's endowment fund. The fund currently stands at USD15 million and has been growing – albeit slowly – largely as a result of the earnings that are being generated by the principal. The Academy should reinvigorate its endowment fund campaign to help ensure that the USD25 million goal is met by 2020. As has been the case since the endowment fund was created in 1993, all contributions should come from developing countries and TWAS members.

Fourth, TWAS should strengthen its position as one of the pre-eminent voices for science in the South. To accomplish this goal, the Academy should begin publishing at least one policy brief on a science-based issue of importance to the developing world each year. The briefs should examine these issues from the perspective of scientific communities in the South. In a similar vein, the Academy should continue to encourage the development of the Consortium on Science, Technology and Innovation for the South (COSTIS), which UNESCO has agreed to host in partnership with the Paris office of the G77 + China. COSTIS holds great promise in forging close ties between science policymakers and the scientific community.

Fifth, TWAS should engage in a comprehensive study on how it can best position itself to meet the challenges posed by the rapid – indeed breathtaking – changes now taking place in science and society not only in the developing world but also throughout the entire world.

No organization owes its accomplishments to just one individual or even group of individuals. So it is with TWAS. Whatever contributions the Academy has made to science and society in the developing world have been due to a number of distinct, yet integrated, pillars of strengths to which I owe an enormous debt of gratitude: The Academy's members, the Academy's staff and the Academy's leadership, led by TWAS's remarkable presidents: Abdus Salam, José Vargas, CNR Rao and, currently, Jacob Palis. I am also indebted to the Academy's dedicated staff, many of whom have worked for the Academy as long as I have. As TWAS's executive director, I have been the primary point of contact for the Academy's many partners. But it is the work behind the scenes, done by the staff, which accounts for much of TWAS's success.

Let me conclude by offering my sincere thanks for allowing me to serve such a magnificent organization that has fulfilled so much of its promise, yet promises so much more. It's been the journey of a lifetime that has bestowed rich personal rewards and a sense of satisfaction for which I will be forever grateful.

The TWAS 21st General Meeting, which took place from 19 to 22 October 2010, included more than 350 scientists from over 50 countries. The meeting was held in a conference centre overlooking Hyderabad, the capital of the state of Andhra Pradesh and India's sixth largest city.

TWAS in India

When TWAS held its 13th General Meeting in New Delhi in 2002, India's decade-long efforts to develop a broad-based strategy for science-based development were first gaining traction at home and increasing visibility abroad. At the time, the impact of India's efforts was clearly visible but narrowly confined to select areas in select cities. These special places offered beacons of hope for a better future even as they stood in stark – indeed startling – contrast to their surroundings, which were often cast in dark shadows of poverty and despair.

Upon TWAS's return to India in 2010 for its 21st General Meeting, the country's sweeping progress and shimmering future were on full display, most notably in the ceaseless construction and buoyant optimism that is evident everywhere you look. India, of course, continues to face many challenges. Yet there is now growing confidence – and, more importantly, growing evidence – that these challenges can and will be met.

This was the uplifting atmosphere that surrounded the discussions at the TWAS conference in Hyderabad. In less than a decade, the hints of hope infusing the Academy's conference in New Delhi in 2002 had been transformed into clarion calls heralding a better future not just in India but also throughout the developing world – a future that will be propelled forward by increased knowledge and widespread applications of science and technology.

The highlights of the conference were:

• The opening address by Prime Minister Manmohan Singh in which he lauded the rapid growth of scientific capacity in the South. Until recently, he observed, science and technology "was the preserve of the developed world". But "the barriers to the development and the obstacles to the diffusion of science and knowledge," he noted, "are breaking down." The Minister cautioned, however, that "developing countries should not follow the same path to development as developed countries." Instead, he urged developing countries to devise a "more sustainable way of developing their societies and economies without injuring or destroying the natural beauty of Mother Earth." Such an effort, he asserted, can only be charted by advances in scientific knowledge.

• Brief speeches by representatives of organizations that have graciously supported TWAS, including Immacolata Pannone, scientific expert, the Italian Ministry of Foreign Affairs; Fernando Quevedo, executive director, the Abdus Salam International Centre for Theoretical Physics (ICTP); AnnaKarin Jonsson Norling, policy specialist, the Swedish International Development Agency (Sida); and Anna Illy, daughter of the late Ernesto Illy and vice president of the Ernesto Illy Foundation.

• A ministerial roundtable focusing on scientific collaboration with Africa. The roundtable featured presentations by Shri Prithviraj Chaven, Minister of Science and Technology in India; Naledi Pandor, Minister of Science and Technology in South Africa; H.A.M. Dzinotyiweyi, Minister of Science and Technology in Zimbabwe; Jean-Pierre Ezin, Commissioner of Human Resources, Science and Technology of the African Union; and Carlos Alberto Aragão de Carvalho, president, Brazilian National Council of Scientific and Technological Development (CNPq). The speakers not only conveyed a sense of pride, but also foresaw great promise in the progress in science-based sustainable development now taking place in a growing number of developing countries. In addition, they emphasized the importance of South-South cooperation in science and technology and examined how such collaboration could prove beneficial not just for emerging economies but,

equally important, for the least developed countries (LDCs). The speakers, also noted that many developing countries do not have the critical mass of scientists necessary to address their most pressing social and economic problems on their own. Yet, they maintained that through South-South collaboration they could marshal the knowledge and skills they would need to promote sustainable development within their own countries. Collaborative efforts, the speakers said, would also help to address critical global issues that have been historically neglected by developed countries, including effective treatments for tropical disease, strategies for producing higher crop yields for small landholders who rely on traditional farming practices, and improved programmes for mitigating the risks posed by natural hazards. TWAS, the speakers observed, could serve as an important catalyst in such efforts.

• The election into the Academy of 58 new members from 21 countries: 53 fellows and 5 associate fellows, including scientists from Ethiopia, Lebanon and Senegal. With the election of the class of 2010, TWAS's total membership has reached the 1,000 threshold.

• Conference symposia that ranged from 'Science in India' to 'Agriculture and Food Security' to 'Mitigation and Adaptation to Climate Change'. For the first time, TWAS also held a session on 'science with children', organized by TWAS's immediate past president, C.N.R. Rao, that was attended by some 150 secondary school students.

• The announcement that José Goldemberg, a professor at the Institute of Electronics and Energy at the University of São Paulo and former Federal Secretary of Science and Technology and Federal Secretary of Environment in Brazil, had won the 2010 Ernesto Illy Trieste Science Prize. Goldemberg was honoured "for his contributions to the development and modernization of the use of biomass as a sustainable energy source". The prize, sponsored by the Ernesto Illy Foundation, carries a cash prize of USD100,000. In his speech to the conference participants, Goldemberg offered a strong defense for the cultivation of biofuel crops in such sugar-growing countries as his native Brazil where ethanol now constitutes nearly 20% of the fuel stock for transportation and one-third of the ethanol consumed worldwide. He contended that African countries such as Ghana, Mozambique and Tanzania with similar climates and soil conditions could – and should – replicate Brazil's success in biofuel production. Such initiatives, he said, would generate much-needed income for their economies while helping to curb the world's appetite for fossil fuels.

• Presentations of TWAS 2010 Medal Lectures by Silvia Torres-Peimbert, professor emeritus, *Instituto de Astronomia, Universidad Nacional Autonoma de Mexico*, Mexico City, Mexico, and winner of the 2010 L'Oreal-UNESCO Prize, who spoke about planetary nebulae that eject stellar matter into space, influencing the chemical composition of stars; Habib Firouzabadi, professor of chemistry, College of Sciences, Shiraz University, Iran, who talked about the growing number of organic reactions that have taken place using newly

developed reagents and catalysts created in laboratories in both developed and developing countries; and M.K. Bhan, Secretary to the Government of India, Department of Biotechnology, New Delhi, who examined the health risks posed by zinc deficiencies in developing countries, especially for children.

• Presentations by 2009 TWAS prize winners, including in agricultural sciences: Huey-Lang Yang, distinguished professor at the Center of Biotechnology, National Cheng Kung University, Taiwan; in biology: Lin He, professor at Shanghai Jiao Tong University, China, and Partha P. Majumder, professor of eminence, Human Genetics Unit, Indian Statistical Institute, Kolkata, India; in chemistry: Swapan K. Ghosh, head, Theoretical Chemistry Section, Bhabha Atomic Research Centre, Mumbai, India, and Li-Jun Wan, professor, Institute of Chemistry, Chinese Academy of Sciences, Beijing, China; in earth sciences: Rafael Navarro-González, professor, Laboratory of Plasma Physics and Planetary Studies, Institute of Nuclear Sciences, Autonomous National University of Mexico, Mexico City; in engineering sciences: Liang-Gee Chen, distinguished professor, National Taiwan University, Taipei, China; in mathematics: Enrique Pujals, professor, Institute of Pure and Applied Mathematics (IMPA), Rio de Janeiro, Brazil; in medical sciences: Ricardo Gazzinelli, professor, Department of Biochemistry and Immunology, Federal University of Minas Gerais, Belo Horizonte, Brazil; and in physics: Nathan Berkovits, full professor, Institute of Theoretical Physics, *Universidade Estadual Paulista*, Sao Paulo, Brazil, and Hongjun Gao, deputy director, Institute of Physics, Chinese Academy of Sciences, Beijing, China.

• The announcement of the 2010 TWAS prize winners. The awardees will speak about their research at the next TWAS conference. The winners were in agricultural sciences: Francisco Alfonso Larque-Saavedra, Centre of Scientific Investigation, Merida, Mexico, and Ibrokhim Abdurakhmonov, Center of Genomic Technologies, Academy of Sciences of Uzbekistan; in biology: Satyajit Mayor, National Centre for Biological Sciences, Tata Institute for Fundamental Research, Bangalore, India, and Soo-Chen Cheng, Institute of Molecular Biology, *Academia Sinica*, Taiwan; in chemistry: Dan-China Yang, Department of Chemistry, University of Hong Kong, and Santanu Bhattacharya, Department of Organic Chemistry, Indian Institute of Science, Bangalore, India; in earth sciences: Anil K. Gupta, Department of Geology and Geophysics, Indian Institute of Technology, and Alexander W.A. Kellner, Department of Geology and Paleontology, National Museum, Federal University of Rio de Janeiro, Brazil; in engineering sciences: Vivek Borkar, School of Technology and Computer Science, Tata Institute of Fundamental Research, Mumbai, India, and Edgar Zanotto, Vitreous Materials Laboratory, Federal University of São Carlos, Brazil; in mathematics: Manindra Agrawal, Department of Computer Science and Engineering, Indian Institute of Technology, Kanpur, India, and Carlos Gustavo Tamm de Araujo Moreira, Institute of Pure and Applied Mathematics, Rio de Janeiro, Brazil; in medical sciences: Gabriel Adrian Rabinovich, Institute of Biology and Experimental Medicine, Buenos Aires, Argentina; and in physics: Qi-Kun Xue, Department of Physics, Tsinghua University, Beijing, China.



• Invited lectures by Bengt Norden, professor of chemistry, University of Technology, Gothenburg, Sweden, who spoke about the role that optical spectroscopy can play in enhancing our understanding and applications on nanotechnology in both biological systems and synthetic materials; Luiz Davidovich, professor of physics, *Instituto de Fisica, Universidade Federal do Rio de Janiero*, Brazil, who explored the enormous intellectual challenges that scientists face in seeking to understand the quirky behaviour of subatomic particles operating in the quantum world and the reasons why such understanding may hold the key for unlocking not only the deepest secrets of the fundamental laws of physics but also for advancing such fields as quantum information that could lead to more efficient processing and transmission of information; Raghavendra Gadagkar, INSA S.N. Bose research professor and J.C. Bose National Fellow at the Indian Institute of Science in Bangalore, on the intricate and fascinating systems of the social organization of wasps that exhibit a strong "sense" of loyalty, obedience, resilience, and adaptability; Hong Tao, chief scientist in the Department of Virus Morphology at the Institute for Viral Disease Control and Prevention, Beijing, China, on efforts to develop a novel rotavirus vaccine that would mark an important breakthrough in the treatment of the most common cause of severe dehydrating diarrhoea in infants and children; K. Srinath Reddy, president, Public Health Foundation of India, New Delhi, India, who spoke about the 'vast disparities' in health that exist not just between rich and poor countries but between rich and poor people in all countries. He observed that life expectancy at birth ranges from just over 40 in Lesotho to more than 80 in Japan and that disparities in infant mortality rates range from 160 deaths per 1,000 live births in Afghanistan to 3 per 1,000 live births in Singapore. To reduce these disparities, he called on developing countries to increase the number of medical personnel and to place greater emphasis on primary health care; and Atta-ur-Rahman, coordinator general, COMSTECH, Islamabad, Pakistan, who urged developing countries to turn to knowledge, technology, innovation and enlightened leadership as the primary drivers of sustained economic growth.

• Lectures by the winners of the 2010 TWAS Regional Prizes, focusing on the critical issues of public understanding and popularization of science. The prizes are given by the TWAS regional offices and include a USD3,000 cash award.

Presentations by TWAS young affiliates in the fields of biological and physical science. There were 17 talks in all on topics ranging from malaria control in Nigeria to mitochondrial DNA diversity in Africa to quantum entanglement and molecular self-assembly for new polymer materials. Among the countries represented were Algeria, Botswana, Indonesia, Jamaica and Qatar. In addition, TWAS's regional offices announced the selection of 25 new young affiliates for 2010-14. That brings the total number of TWAS young affiliates to 98.

- For the second consecutive year, events at the TWAS general meeting were the subject of a lively blog and stories posted on the news portal scidev.net. This year the postings were made by journalist T.V. Padma, SciDev.Net's regional coordinator for South Asia. A feature article, examining the state of science in India, written by the TWAS editor, was also carried by SciDev.Net. Twelve news stories were also posted on the TWAS website. The number of visitors to the TWAS website tripled during the conference.
- The official announcement that TWAS's long-standing executive director, Mohamed H.A. Hassan, would be retiring in spring 2011 after having adeptly guided the Academy since its inception more than a quarter century ago (see "The 'Years' in Review", p. 9).

India enjoys a long and rich tradition in science and technology. It's where the concept of zero was created. It's where many of the principles of astronomy were first introduced. It's where the deeply rooted traditions of scholarship and science remained firmly in place despite centuries of poverty and often oppressive rule by foreign powers. And it's where a newly independent India, created in 1947, sought to nurture the country's intellectual and scientific roots despite the enormous social and economic problems that the nation faced. Indeed, over its long history, India has never lost its reverence for learning even in times of despair.

In the past, mathematics, astronomy and geography marked the strengths of India's scholarly and scientific community. More recently, such fields as mining and metallurgy, information and communication technologies, agriculture and climatology, medicine and pharmaceuticals, and nuclear energy and space technology have dominated the country's research agenda. These pursuits have earned India a growing international reputation in science, technology and increasingly innovation.

Ever since India liberalized its economy in 1991, there has been a companion revolution in science and tech-

nology. In fact, the two revolutions – one in economic policies and growth, the other in science and technology capacity building and applications – have complemented and reinforced each other.

Today, India is on a path to becoming a global superpower. The same can be said of science. As Prime Minister Chavan noted just prior to the conference: "India is too big to be straight jacketed into a single policy for science and technology. It has a strong and diverse scientific research community and a growing array of scientific centres of scientific excellence; it has received consistent support from the government regardless of the party in power; and it has enjoyed moderate but steady progress in science-based development, which is increasing at an accelerated pace."

India, the Minister went on to say, "has been patient, optimistic and ethical" in its approach to both science and development, and it has been determined to invest in science and technology in ways designed to benefit all Indians even as it seeks to gain prominence in the international scientific community."

All of those trends and principles were on full display at the TWAS 21st General Assembly – both for the world to see and for others to learn from.

In this sense, India's progress is at once a reflection of the progress in science-based development among an increasing number of developing countries and, at the same time, an inspiration for those developing countries that have yet to fully participate in these encouraging trends.

Indeed India's experience reflects well on the ongoing efforts to build scientific capacity and excellence throughout the developing world and suggests that through continued hard work, commitment and global collaboration, all developing countries can take advantage of expanding applications and advances in science to improve the economic and social well-being of their people.

PROGRAMMES

The **Ernesto Illy Trieste Science Prize**, instituted by illycaffè, TWAS and the Ernesto Illy Foundation, is an annual prize given to a scientist in a developing country or an emerging economy for outstanding contributions to science and scientific innovation. The prize, now in its sixth year, includes a cash award of USD100,000. The 2010 Ernesto Illy Trieste Science Prize, in the field of energy, was given to José Goldemberg, a world-renowned energy expert whose research has focused on biofuels. The awards ceremony took place at the opening session of the TWAS 21st General Meeting in Hyderabad, India, held on 19 October 2010, with Prime Minister Manmohan Singh presiding.

Ernesto Illy Trieste Science Prize

ERNESTOILLY TRIESTESCIENCEPRIZE

SUSTAINABLE ENERGY TECHNOLOGIES

José Goldemberg was honoured "for his contributions to Brazil's biofuels programme and for serving as a leading advocate for the adoption of 'leapfrog' technologies to promote economic development in the developing world. Goldemberg, a professor at the University of São Paulo, is a former Federal Secretary of Science and Technology and Minister of Education.

In a seminal article published in *Science* magazine in 1978, Goldemberg and his colleagues presented compelling scientific evidence showing that biofuels derived from sugarcane could reduce the use of fossil fuels in Brazil while rendering much less harm to the environment.

"At the time," Goldemberg says, "efforts to develop biofuels in Brazil were justified largely on the basis of energy security. Our research demonstrated that biofuels production in Brazil would not only significantly decrease the use of fossil fuels but also help curtail air pollution and greenhouse gas emissions."

Goldemberg's findings bolstered the efforts of the Brazilian government, which had launched a biofuels programme in 1975 in response to the international oil crisis. In the early 1970s, the government's primary goal was to overcome possible supply disruptions from abroad by developing domestic sources of fuel. By verifying biofuel's positive energy balance and adding an environmental dimension to the argument, Goldemberg strengthened support for Brazil's biofuels programme, helping to ensure its long-term viability.

Today, Brazil produces 30 billion litres of sugar-based ethanol each year, which replaces 50% of the petrol used in the country. Ethanol production and distribution generates USD30 billion each year in revenues (about 5% of Brazil's gross domestic product) and accounts for one million jobs.

Trained as a physicist at the University of São Paulo, Goldemberg did postgraduate work in Canada and the United States before returning to his alma mater in the mid-1950s, where he earned a PhD and then became a full professor and subsequently rector.

In the early 1990s, he was Brazil's Federal Secretary of Science and Technology and Minister of Education. In 1992, while serving as the interim Federal Secretary of Environment, he was one of Brazil's highest-level representatives at the "Earth Summit" in Rio.

From 2002 to 2006, he served as the Secretary of Environment in São Paulo, Brazil's most populous state and largest producer of biofuels.

In 2000, Goldemberg was named chairman of the board and lead author of the United Nations Development Programme's (UNDP) World Energy Assessment. In 2007, he co-chaired the InterAcademy Council (IAC) study panel responsible for the report, *Lighting the Way: Towards a Sustainable Energy Future*.

Goldemberg has spent a lifetime bridging the world of research and policy, and has long been a passionate advocate of renewable energy. He contends that, by relying on renewable sources of energy, developing countries can 'leapfrog' fossil-fuel-dependent developed countries and "chart a more viable path for sustainable development."

He first outlined this paradigm for economic development in a book, *Energy for a Sustainable World*, which he co-authored with Thomas B. Johannsson, Amulya K.N. Reddy and Robert Williams in 1988. The book helped to redirect discussions on the relationship between energy and economic development, convincing policymakers of the important role that innovative technologies could play in providing environmentally sound supplies of energy to meet the developing world's growing energy needs.

In recent years, he has led scientific discussions concerning biofuels' potential impact on food security and forest and agricultural land. Goldemberg's studies have concluded that only a small amount of additional land will be needed to meet the projected demand for biofuels over the next decade (an estimated 4% of the total 1.5 million hectares available on a global scale).

Together with the development of second-generation technologies and access to marginal pasturelands, he says, there is good reason to believe that "additional lands could be cultivated for biofuels without placing other worthy environmental and land-use goals at risk."

"Biofuels", Goldemberg notes, "were the primary source of energy from the dawn of civilization until the 19th century when their use was eclipsed first by coal and then by oil and gas production." Today, biofuels represent about 10% of primary energy consumption.

"In a world increasingly concerned about future energy supplies and the spectre of global warming, the continued development of biofuels will likely prove an essential ingredient of sustainable economic growth", Goldemberg says.

As the Brazilian experience shows, biofuels can help nations gain prosperity, security and sustained growth without jeopardizing the environment. And, as the pathbreaking research of Goldemberg illustrates, the success of such efforts often depends on the quality and depth of the scientific research that drives and shapes the policy debate.

TWAS Prizes for scientific excellence, awarded annually in the fields of agricultural sciences, biology, chemistry, earth sciences, engineering sciences, mathematics, medical sciences and physics, rank among the highest scientific accolades given to scientists in developing countries. Each prize carries a cash award of USD15,000. This year's prizes, announced during the Academy's 21st General Assembly held in Hyderabad, India, will be presented at the 22nd General Meeting in Trieste, Italy, in November 2011.

TWAS Prizes: Honouring Scientists

AGRICULTURAL SCIENCES

Ibrokhim Yulchievich Abdurakhmonov, Center of Genomic Technologies, Institute of Genetics and Plant Experimental Biology, Academy of Sciences of Uzbekistan, Tashkent, Uzbekistan

For contributions to understanding and utilizing the molecular diversity of the cotton genome

Cotton (*Gossypium* spp) is the world's most important non-food agricultural commodity. In Uzbekistan, cotton is also an important source of national wealth. In fact, Uzbekistan is the world's second largest cotton exporter. Each year, Uzbek farmers cultivate more than one million metric tons of cotton, generating over USD1 billion in export revenues.

But all is not well in the cotton fields. Monoculture has narrowed the genetic base of cultivated cotton, leading to a decline in yield and quantity. This unwelcome trend is a matter of growing concern for farmers, producers and researchers not just in Uzbekistan but also worldwide.

Ibrokhim Y. Abdurakhmonov, founder of one of the most advanced molecular biology and genomics laboratories in central Asia, has pioneered the study of cotton genomics and biotechnology in the region.

Abdurakhmonov's initial research confirmed that Uzbek cotton is at risk due to the repeated use of the same cultivars. Seeking to endow local breeds

with new and more desirable traits, he and his team have applied a technique called RNAi (or RNA interference) to determine the function of specific genes.

Analysis of cotton DNA with modern genomics technologies has enabled him to clone and characterize individual genes and genetic families that control flowering, fiber development and plant resistance to biotic and abiotic stress.

Identifying specific genetic markers marked the first step towards the establishment of a 'bar-coding system' that provides a genetic tag to protect the intellectual property rights of Uzbek breeders and, more generally, Uzbekistan's cotton germplasm collection.

The author of more than 100 peer-reviewed publications and a tireless promoter of training courses aimed at strengthening the scientific community, Abdurakhmonov has expanded his investigations from cotton genomics to cotton proteomics, forging new international collaborations to enhance the state of Uzbeki research and raise the profile of the country's researchers in the global scientific community.

Francisco Alfonso Larqué-Saavedra, Natural Resources Unit, Scientific Research Center of Yucatan, Mérida, Yucatán, México

For pioneering work on the effect of aspirin in plant physiology and the bioproductivity of cultivated plants

More than three decades of research conducted by Francisco Alfonso Larqué-Saavedra has shown that salicylic acid, the principle active ingredient in aspirin, can benefit plants as well as humans. For example, much like aspirin reduces headaches and blood clotting in people, it helps alleviate stress in plants, enhancing bioproductivity of food plants and boosting the flowering of decorative plants. It also promotes rapid rooting. In other words, it could help plants live happier lives, especially under stressful conditions.

Larqué-Saavedra earned his undergraduate and MA degrees at the *Universidad Autónoma de México* and the *Colegio de Postgraduatos* in Mexico

City, and his PhD in plant physiology at London University in the UK. While working on his doctoral thesis, which focused on the study of drought-tolerant maize cultivars, Larqué-Saavedra discovered that salicylic acid could affect the behaviour plant stomata – the small pores on the leaves' surfaces that allow gases to flow in and out.

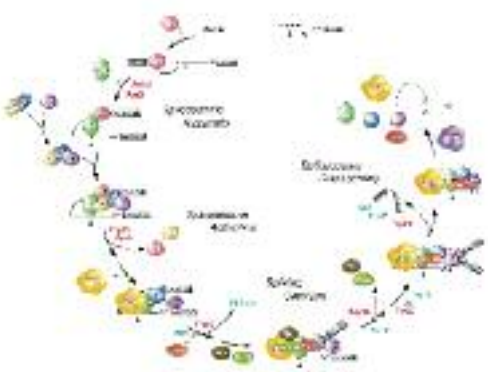
In a series of experiments in which he used aspirin to make mebrane inceptors induce the biosynthesis of the stress hormone abscisic acid (ABA), he found instead that salicylic acid had a marked effect on its own: it closed stomata. As a result, it could possibly serve as an important bioregulator. Larqué-Saavedra's research indicates that the increase in bioproductivity that can be obtained with low concentrations of salicylic acid appears to be mainly due to the positive effect the compound has on augmenting the length and the density of the plant's roots.

Larqué-Saavedra has been honoured with the National Award in Sciences and Arts given by the President of Mexico, the National Award in Food Production, the Food Science and Technology Prize and the Centleot Prize. He is a member of the Science Council Committee of the Mexican Presidency, the Mexican Academy of Sciences and the Mexican Academy of Agricultural Sciences, and founder of the Center of Water Studies in Cancún, Mexico, and the Laboratory of Advanced Molecular Studies Applied to Biology (GEMBIO).

BIOLOGY

Soo-Chen Cheng, Institute of Molecular Biology, Academia Sinica, Tapiei, Taiwan, China

For contributions to understanding the molecular mechanism of pre-RNA splicing



The genetic codes found in DNA cannot produce a working protein unless it is first translated into functional intermediaries called RNAs. As they grow inside a cell, however, RNAs must undergo a remodeling process. Soo-Chen Cheng has spent much of her scientific career seeking to elucidate the mechanism that turns a precursor single-stranded RNA into a functioning protein-generating intermediary.

A native of Taiwan, China, Cheng completed her education at Duke University in the United States, before acquiring a research position at the US National Institutes of Health (NIH). She then moved to the California Institute of Technology, where she helped to develop a yeast model to clarify a

complex process known as RNA splicing that removes unnecessary base strings, called introns, from the RNA precursor, and joins the remaining exons to form a unique string.

Chen and her group at the Institute of Molecular Biology, *Academia Sinica*, in Tapiei, Taiwan, China, where she now works, have identified several protein factors involved in the splicing pathway. In addition, they have described a protein complex that serves as a stabilizer for the so-called spliceosome, the machinery in charge of removing the introns from the pre-mRNA.

The protein complex plays a critical role in RNA maturation. When its functioning is impaired, the protein produced from its sequence is unable to fold and work properly.

Her research results were published in *Science* magazine in 2003. Chen was named a distinguished research fellow at the Institute of Biological Medicine in Singapore the same year.

Satyajit Mayor, National Centre for Biological Sciences, Bangalore, India

For contributions to our understanding of the membrane organization in living cells

Satyajit Mayor has devoted his career to exploring the molecular structure and organization of cell membranes in living cells. Much of his research has focused on elucidating the role of the endocytic process in cellular signalling and developmental programmes in tissue morphogenesis.

The cell surface, in particular, has attracted Mayor's interest for its peculiar properties. The surface resembles a fluid-mosaic where proteins are clustered in an array of biological patterns that confer distinctive properties both to the surface and the cell itself.

One family of proteins – glycolipid-tethered GPI-anchored proteins – that appear as relatively immobile nanoclusters when compared to other more

mobile elements, carry particular importance. Mayor's research, which has shed light on the dynamics behind the formation and breakup of these proteins, has led to a new paradigm for the molecular organization and regulation of the plasma membrane.

Mayor has also contributed to the development of innovative microscopy techniques. Spurred by the research community's need to trace molecular phenomena that have been difficult to spot with traditional techniques, Mayor applied quantitative fluorescence microscopy to endocytosis, a process in which the cell engulfs and then absorbs proteins and chemicals. With the aid of this powerful technique, he has tracked the endocytic pathways of a number of molecules both at the nano and micron scale.

Satyajit Mayor is the author of more than 80 research papers and is a member of the editorial boards of numerous international journals, including *Cell, Molecular Biology of the Cell, Biochemica Biophysica Acta, Journal of Cell Science* and *Biochemical Journal*.

He has been a recipient of such honours as the JC Bose Fellowship and Swarnajayanti Fellowship from India's Department of Science and Technology, and the Shanti Swarop Bhatnagar Award from the Council of Scientific and Industrial Research (CSIR) in India.

CHEMISTRY

Santanu Bhattacharya, Department of Organic Chemistry, Indian Institute of Science, Bangalore, India

For contributions to bioorganic, medicinal and supramolecular chemistry, including molecular design of lipids for gene delivery, DNA recognizing molecules, enzyme inhibitors, micelles, vesicles, low molecular mass gelators and nano-composites

How to cure diseases through chemical sciences has been of central importance to Santanu Bhattacharya since the beginning of his academic career in Kolkata, India. He received a BSc in chemistry and an MSc in organic chemistry from the University of Calcutta, and a PhD at Rutgers University, New Jersey, USA, in bioorganic chemistry, focusing on kinetic differentiation of bilayer surfaces in synthetic functional vesicles.

He was then awarded a postdoctorate fellowship at the Massachusetts Institute of Technology, Massachusetts, USA, where he worked in the laboratory of Nobel Laureate H. Gobind Khorana. His research focused on the biology and chemistry of signal transduction involving membrane

proteins. Bhattacharya subsequently joined the Indian Institute of Science (IISc), Bangalore, as an assistant professor and ultimatley became a full professor.

Bhattacharya has helped develop numerous types of lipid molecules for the structure-function studies in biological membranes and for effective gene transfection; synthesized new G-quadruplex stabilizers and DNA minor groove binders; and developed chemical nucleases to 'footprint' drug/protein molecules bound to specific DNA domains.

He has also synthesized several novel molecular motifs for achieving gelation in specific solvents and developed soft nano-composites from gels laced with metal nanoparticles or carbon nanotubes and related nanomaterials.

Bhattacharya is a fellow of the Indian Academy of Science and the Indian National Science Academy. He has received the Swarnajayanti Fellowship in Biological Sciences and the Shanti Swarup Bhatnagar Award in Chemical Sciences from the Prime Minister of India, has served on numerous academic,

institutional, and governmental committees and panels, and has been a consultant for biotechnology, personal care and pharmaceutical industries.

Yang Dan, Morningside Laboratory for Chemical Biology, Department of Chemistry at the University of Hong Kong, China

For contributions to developing novel synthetic methods and their applications to the syntheses of bioactive natural products and probes for biomedical research

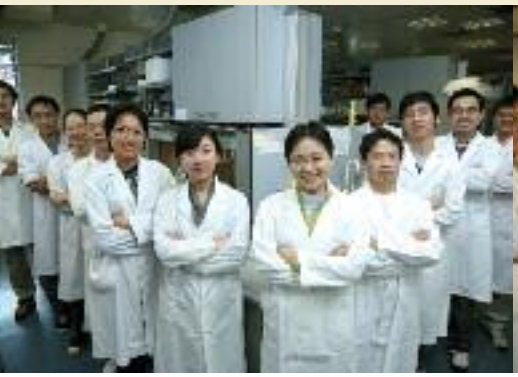
Nature both inspires and informs research. This was precisely the concept at play when Dan Yang sought to isolate and analyze the most active chemical compounds in Chinese medicinal plants. These plants have traditionally been used to treat rheumatoid arthritis, lupus and psoriasis.

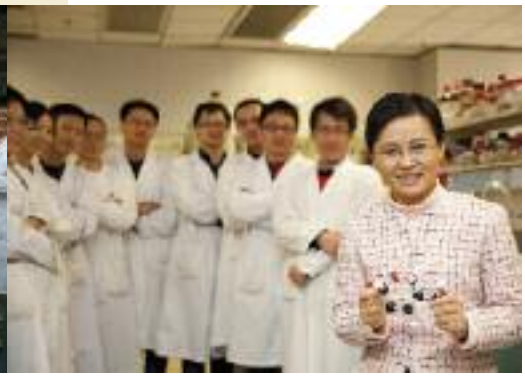
Yang has analyzed the chemical compounds synthesized by *Tripterygium wilfordii* Hook F (also known as the Thunder God vine or, in China, Lei Gong Teng) to uncover a new pathway of oxidation reactions based on the structure of triptolide, a highly active substance in the plant.

Yang's broad research interests encompass organic chemistry, biochemistry and chemical biology. She is skilled at devising innovative methods for the synthesis of bioactive therapeutic products that are critical for drug development.

Yang was educated at Columbia, Princeton and Harvard universities in the United States. After earning her doctorate degree, she joined the University of Hong Kong, where she is now Morningside professor of chemical biology and chair of the Department of Chemistry.

Yang has made original contributions to the new field of organocatalysis, which examines how an organic catalyst can impact the pace and composition of chemical reactions. One catalyst she developed played a key role in the synthesis of a billion-dollar antihypertension drug now manufactured by a Japanese company.





Her research is marked by both the novelty she brings to solutions and the impact of her findings. This not only applies to the field of chemistry, but also to the development of such tools as fluorescent probes to investigate human diseases and the aging process triggered by the production of reactive oxygen species.

MEDICAL SCIENCES

Gabriel Adrián Rabinovich, Laboratory of Immunopathology, Institute of Biology and Experimental Medicine (IBYME), Buenos Aires, Argentina

For contributions on the role of protein-glycan interactions in the control of inflammation and cancer leading to the identification of novel therapeutic drugs

The interface between immunology and glycobiology, a largely unexplored field of research focusing on the structure and biosynthesis of sugar

chains or glycans, is a promising field of study that could shed light on why some tumours escape surveillance by the immune system.

Gabriel Rabinovich, born in Córdoba, Argentina, and educated at the National University of Córdoba, has sought to elucidate the mechanisms of specific cellular processes linked to inflammation and autoimmunity that could shed light on this critical, potentially cancer-related, health challenge.

Rabinovich has examined whether protein-sugar interactions are critical factors in the ability of tumour cells to evade an immune response. He is particularly interested in exploring the role that cell surface glycoproteins may play in regulating the survival of T-cells.

Using both *in vitro* and *in vivo* strategies, Rabinovich and his colleagues are currently focusing their research on the so-called glycome, the full complement of sugars in cells and tissues. Uncovering the mechanisms that guide glycome interactions with other proteins could lead to the development of new anti-inflammatory compounds and anti-cancer drugs.

Rabinovich's research has also shown that galectins are directly involved in cell adhesion, cell migration and even cell death. His laboratory has produced synthetic galectins capable of alleviating chronic inflammation by sustaining the survival of T-cells.

Early in his career, Rabinovich was named the Most Talented Scientist in Latin America. More recently, he received the John Simon Guggenheim Memorial Foundation Award and the Cancer Research Investigator Award.

PHYSICS

Xue Qi-Kun, Department of Physics, Tsinghua University, Beijing, China

For contributions to the discovery of novel physical properties of metal thin films modulated by quantum size effects

The combination of molecular beam epitaxy (MBE) and scanning tunneling microscope (STM) allows the deposition of thin films and the assembly of nanostructured materials with atomic precision. These techniques, when operated at milli-Kelvin temperatures, also provide spatial resolutions at the atomic level.

Xue Qi-Kun has been utilizing these two techniques for more than a decade. His goals have been to examine fundamental questions

related to material science and condensed matter physics and to uncover important synergies between physics and biology.

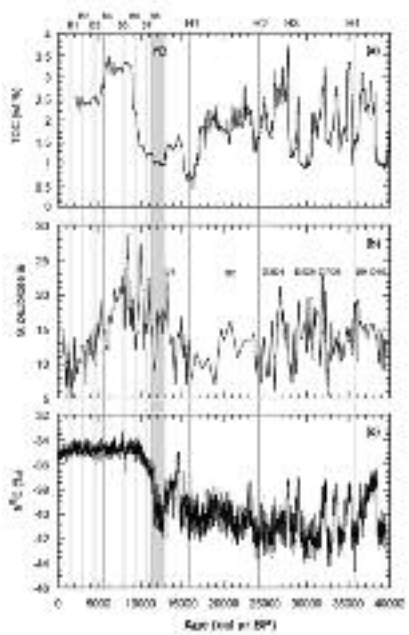
Xue, who directed the State Key Laboratory for Surface Physics at the Institute of Physics (IOP), in the UK, before moving to Tsinghua University's Department of Physics, in China, spent nearly a decade shuttling across continents to conduct research on the atomistic process of molecular beam epitaxy growth of III-V compound semiconductors (GaAs, InAs and GaN) and related heterostructures.

Xue has published more than 270 articles in international peer-reviewed journals. He has also mentored more than 40 doctoral students, testimony to the key role he has played in training the next generation of condensed matter physicists, biophysicists and nanotechnologists in China.

EARTH SCIENCES

Anil K. Gupta, Indian Institute of Technology, Kharagpur, India

For contributions to the understanding of past variability in Indian summer monsoons over multidecadal and centennial time scales



The northwest Indian Ocean is subject to dramatic seasonal changes spurred by the variability of wind and rain associated with the monsoons.

In summer (June to September), strong winds from the southwest cross the northern Indian Ocean to provide moisture to the Indian subcontinent and, more generally, South Asia. In winter (December to February), the winds assume a northeasterly direction and rainfall becomes less frequent and more variable. Summer monsoon rains are critical for the region's food production, water supplies and economy.

Anil K. Gupta has spent the past two decades studying India's summer monsoons by investigating historic field records provided by marine sediments.

Gupta has developed an internationally acclaimed IIT Laboratory for micropalaeontology to reconstruct past monsoons by analysing marine sediments. He has studied the palaeo-oceanography and palaeo-climate of the

deep-sea Indian Ocean through his work with India's Ocean Drilling Programme (ODP), documenting changes in ocean productivity marking the beginning of the Indian monsoon 7.5 to 8.5 million years ago. His research has helped to record the behaviour of monsoons over decades and centuries.

Gupta is a fellow of the Indian Academy of Science, the Indian National Academy of Sciences, the Indian Geophysical Union and the Indian Science Congress. He has received many awards, including India's National Mineral Award, the Birbal Sahni Institute of Palaeobotany's T.M. Harris Medal, and the Mining, Geological and Metallurgical Institute of India's (MGMI) J. Coggin Brown Memorial Medal for Geological Sciences. He has published numerous articles in international journals, including *Nature* and *Science*, and his research has served as the basis of a *National Geographic* documentary on the Indian monsoons.

Alexander Wilhelm Armin Kellner, Federal University of Rio de Janeiro, Department of Geology and Palaeontology, National Museum

For contributions to the study of fossils enhancing scientific understanding of palaeobiodiversity and palaeoecosystems

An explorer by birth and a passionate dinosaur hunter, Alexander W.A. Kellner was born in Lichtenstein and raised in Austria until age four when his family moved to Brazil, where he first displayed a fascination for the lost world of dinosaurs in primary school. Later, as a PhD student at the Federal University of Rio de Janeiro, he published an article reporting the discovery of a new species of pterosaur, an extinct flying reptile found in the Santana deposits in northeastern Brazil. The finding heralded a career characterized by discovery and novel insights.

Several landmark discoveries highlight Kellner's career. While earning his master's degree, Kellner unearthed a previously unknown group of high-flying pterosaurs, prompting new studies on potential links between flowering plants and flying reptiles.

Later, he located a patch of well-preserved fossilized skin that included muscle fibres and blood vessels dating back more than 100 million years. This finding, together with an analysis of a reptile fossil from China's Liaoning deposits, led Kellner to devise a new model characterizing the membrane-like wing of pterosaurs.

Expeditions to some of the world's richest fossil sites in Chile, Iran and Antarctica not only enabled Kellner to identify 44 new species, which included *Nemicolopterus crypticus*, the smallest pterosaur ever found, and *Thalassodromeus sethi*, displaying a large cranial crest that he speculated functioned as a thermostat to help regulate body temperature.

Kellner has also participated in projects designed to help raise public awareness and appreciation for science. For example, he coordinated a national exhibit, 'During the Time of the Dinosaur' and writes a monthly column, "Fossil Hunters", for *Ciencia Hoje On Line*, an initiative sponsored by the Brazilian Society for Scientific Progress.

MATHEMATICS

Manindra Agrawal, N. Rama Rao Professor, Department of Computer Science and Engineering, IIT, Kanpur, India

For discovery of a novel characterization of prime numbers, leading to an efficient way of testing the primality of a number

Prime numbers, which play a pivotal role in number theory, have fascinated mathematicians for ages. But how do we know if a number is a prime number? Manindra Agrawal has been investigating this problem throughout his entire career.

A large number of algorithms have been devised to address the problem of "primality", including a relatively simple algorithm based on the straightforward and irrefutable principle that a prime number can be identified by dividing the given number by all numbers smaller than the given one. This algorithm, however, cannot establish the primality of numbers with more than 50 digits in a reasonable time even when relying on supercomputers.

Agrawal developed the first deterministic polynomial-time algorithm to determine if a given number is prime. By making calculations for prime numbers more efficient, Agrawal in effect placed the identification of prime numbers on a fast track.

Agrawal, a fellow of India's three national science academies and editor of several journals, including *Information and Computation*, *Theory of Computing* and *Theory of Computing Systems*, has also made fundamental contributions to arithmetic complexity theory, which also requires the ability to process a vast number of computations in an efficient manner capable of reducing computer processing time.

Agrawal has won a number of prestigious prizes, including the Humboldt Award, Fulkerson Prize, Gödel Prize, the Abdus Salam International Centre for Theoretical Physics (ICTP) Prize, the Clay Research Award and the Shanti Swarup Bhatnagar Award.

Carlos Gustavo Moreira, Institute for Pure and Applied Mathematics, Rio de Janeiro, Brazil

For contributions to the study of the interplay between fractal geometry and dynamical bifurcations

In 1990, at age 17, Carlos Gustavo Moreira received a gold medal in the International Mathematical Olympiad held in Beijing, China. The same year, he successfully completed an undergraduate course of study at the Federal University of Rio de Janeiro (UFRJ) and a Master's degree at the Institute for Pure and Applied Mathematics (IMPA). His rapid advance in university studies took place while he was still in secondary school. He obtained a PhD at IMPA in 1993 and was subsequently awarded a two-year postdoctoral fellowship at the *Université de Paris-Sud* in 1994. Since 1995, he has been at IMPA, where he is now a full professor.

Moreira's primary contributions to mathematics relate to the study of the interplay between fractal geometry and dynamical bifurcations. His doctoral thesis confirmed the existence of stable intersections of Cantor sets in the context of Poincaré's homoclinic tangencies and their surface bifurcations. With Fields Medal Winner Jean-Christophe Yoccoz, Moreira later discovered that a pair of regular Cantor sets with large fractal dimensions generally have stable intersections.

Moreira has also collaborated with Artur Avila, director of research at *Université Paris Institut de Mathématiques de Jussieu*, on the dynamical behaviour of interval maps having only one critical point – so-called unimodal maps.

Moreira is a member of the Brazilian Academy of Sciences. He has been a TWAS Young Affiliate since 2008. In 2007, he received the TWAS-ROLAC Prize for Young Scientists in Mathematics and the title *Socio de honor* from the Cuban Society for Mathematics and Computation. In 2009, he received the Mathematical Union of Latin

America and the Caribbean (UMALCA) Prize. He heads the Council of the Brazilian Mathematical Society (SBM) and is a member of the Brazilian Commission for Mathematical Olympiads.

ENGINEERING SCIENCES

Vivek Shripad Borkar, School of Technology and Computer Science, Tata Institute of Fundamental Research, Mumbai, India

For contributions to the theory and algorithms for time-averaged control, including situations involving additional constraints, noisy observations and model uncertainty

Vivek Shripad Borkar earned an undergraduate degree in electrical engineering from the Indian Institute of Technology (ITT), Mumbai, a Master's degree in systems and control engineering from Case Western Reserve University in USA, and a PhD degree in electrical engineering and computer science from the University of California at Berkeley, USA. He worked as a visiting scientist in the Division of Applied Mathematics, University of Twente, in The Netherlands, before returning to India where he has held positions at the Tata Institute of Fundamental Research (TIFR) Centre and Indian Institute of Science (IISc) in Bangalore and the TIFR School of Technology and Computer Science in Mumbai, where he is currently a senior professor.

Borkar's research focuses on stochastic control and optimization that has applications to communications and other allied disciplines in electrical engineering. His most significant contribution is related to research on the problem of average cost or 'ergodic' control. Borkar's work expanded the theory by identifying two paradigms that encompass most cases and can be handled analytically: `near-monotone' costs that penalize unstable behaviour and a suitable uniform stability condition.

Borkar has written four books and authored more than 100 articles in peer-reviewed journals. He is a member of the editorial boards of a number of national and international journals, including the *SIAM Journal of Control and Optimization* and *Proceedings of the Indian Academy of Sciences for Engineering Sciences*..

Borkar has won several national and international honours, including the S.S. Bhatnagar Award and the J.C. Bose Fellowship from the government of

India, the Homi Bhabha Fellowship and the P.C. Mahalanobis Medal from the Indian National Science Academy. He is a fellow of the National Academy of Science of India, Indian Academy of Science, Indian National Science Academy, Indian National Academy of Engineers, and the Institute of Electrical and Electronics Engineers. He has also been named a distinguished alumnus of the IIT, Mumbai.

Edgar Dutra Zanotto, Federal University of São Carlo, Brazil

For contributions to the fundamental mechanisms and kinetics of crystal nucleation and growth in glasses and the development of novel glass-ceramics

Edgar Dutra Zanotto's research seeks to forge a close relationship between basic research and technological advances in the fields of glass materials and glass engineering. Zanotto earned undergraduate and Master's degrees in applied physics and material science from the University of Sao Pãulo. After acquiring a doctorate degree in glass engineering at Sheffield University in the UK, he was appointed visiting assistant at the University of Arizona, USA, and then moved to the University of Ferrara in Italy, where he earned a second Master's degree.

Zanotto's research focuses on the crystallization kinetics and properties of glasses and glass-ceramics. In addition to testing and developing glassy materials, he explores such basic science issues as growth and nucleation models in oxide glasses, surface crystallization, glass stability, and processes that control the mechanical and thermal properties of glass.

Zanotto has forged international partnerships with 22 companies and registered 12 patents. He created one of the first Brazilian research centers on vitreous materials and is the founder of a spin-off company (VITROVITA) that develops and produces bioactive glass-ceramics for dental applications.

He is a recipient of the Zachariasen Award, given by the *Journal of Non-Crystalline Solids*, and the Vittorio Gottardi Prize, given by the International Commission on Glass. He was awarded his first TWAS Prize in 2004.

TWAS Prizes for Young Scientists in Developing Countries are awarded to scientists no older than 40. The prizes are given in collaboration with national academies of science, scientific research councils and ministries of science and technology in developing countries. TWAS provides the prize money (up to USD2,000) while the national organizations select the recipients. Winners are chosen from each of the major fields of natural science (biology, chemistry, mathematics and physics) on a rotating basis. High-ranking government officials – for example, Ministers of Science and Technology – present the prizes at a special ceremony. Some 45 national organizations currently participate in the programme. In 2010, 27 young scientists in 17 countries received awards.

TWAS Prizes for Young Scientists

SPIDER WEAVING IN TRINIDAD

Jo-Anne Nina Sewlal was named the winner of the 2010 CAS (Chinese Academy of Sciences)-TWAS Young Scientist Award in zoology. She is the first woman to be honoured.

Sewlal earned a BSc and a MPhil from the University of the West Indies (UWI) where she is expected to complete her PhD this year. Her dissertation focuses on the biodiversity of three orb-weaving spider families in Trinidad and Tobago.

Tropical fauna is poorly documented across the world, including in the Caribbean. This is especially true for invertebrate fauna. Sewlal has broadened the web of knowledge through her research on spiders in the eastern Caribbean. Her findings have not only been featured in the local media, but she has also forged close ties with several nongovernmental organizations in the region. She edits the "Environment TOBAGO" newsletter and writes a weekly column on the environment for *Tobago News*.

Sewlal has published 29 scientific papers and more than 270 popular articles on broad-ranging topics that include biodiversity, systematics, taxonomy, cytogenetics and biogeography. Her writings pay particular attention to fauna in the Caribbean.

She is the author of the *Ecological Studies of Web-Building Spiders: Studies of Four Tropical Species*, based on her Master's thesis. In addition, she is the first recipient of the Greenhall Trust Award, which allowed her to survey

YOUNG PRIZE WINNERS

Name	Country	Awarding Body	Field
Abdullah Shams Bin Tariq	Bangladesh	Bangladesh Academy of Sciences (BAS)	Physical Sciences
Akhter Nasima	Bangladesh	Bangladesh Academy of Sciences (BAS)	Natural Sciences (Nuclear Medicine)
S.M. Abdur Rahman	Bangladesh	Bangladesh Academy of Sciences (BAS)	Biology
Mohammad Musharof Hossain	Bangladesh	Bangladesh Academy of Sciences (BAS)	Biology
Jereson Silva Valencia	Colombia	Academia Colombiana de Ciencias Exactas, Fisicas y Naturales	Physics
Sergio Madrigal Carballo	Costa Rica	Consejo Nacional para Investigaciones Cientificas y Tecnologicas CONICIT	Chemistry
Mohammed Abd El-Hamid Amin Ismail	Egypt	Academy of Scientific Research & Technology (ASRT)	Chemistry
Gabriela Montenegro Bethancourt	Guatemala	Academia de Ciencias Medicas, Fisicas y Naturales de Guatemala	Medical Sciences
Reza Sameni	Islamic Rep. of Iran	Iranian Research Organization for Science & Technology	Computer engineering
Sodbileg Chagdaa	Mongolia	Mongolian Academy of Sciences	Physics
Amgalan Minjigmaa	Mongolia	Mongolian Academy of Sciences	Chemistry
Manoj Tapa	Nepal	Royal Nepal Academy of Science & Technology	Biology
Prasamsa Singh	Nepal	Royal Nepal Academy of Science & Technology	Meteorology
Rabindra Prasad Dhakal	Nepal	Royal Nepal Academy of Science & Technology	Chemistry
Mahendra Maharjan	Nepal	Royal Nepal Academy of Science & Technology	Biology
Syed Munir Hussain Shah	Pakistan	Pakistan Academy of Sciences	Chemistry
Marcellino Gutierrez-Guevara	Panama	Asociación Panameña para el avance de la Ciencia (APANAC)	Chemistry
Eladio Teofilo Ocaña Anaya	Peru	ANCYT - Academia Nacional de Ciencia y Tecnologia	Mathematics
John Donnie A. Ramos	Philippines	National Academy of Science (NAST)	Molecular biology
Neil Darrel Fernandopulle	Sri Lanka	National Science Foundation	Biology
Visith Thongboonkerd	Thailand	National Research Council	Biology (Biomedical Sciences)
Jo-Anne Nina Sewlal	Trinidad & Tobago	Caribbean Academy of Sciences	Zoology
Abdurrahman Muhammed Uludag	Turkey	The Scientific & Technical Research Council of Turkey	Mathematics
Talat A. Akunov	Uzbekistan	Uzbek Academy of Sciences	Physics
Mirabbos I. Hojamberdiev	Uzbekistan	Uzbek Academy of Sciences	Chemistry
Bakhrom A. Omirov	Uzbekistan	Uzbek Academy of Sciences	Mathematics
Nosir E. Shokurov	Uzbekistan	Uzbek Academy of Sciences	Biology

the spider fauna of the Bocas Islands, and is one of the first recipients of the Darwin Scholarship given to 35 persons worldwide for the study of biodiversity and for developing and managing school- and community-based biodiversity monitoring projects and communicating biodiversity issues to the public and decision makers.

BIOLOGY IN BANGLADESH

Nasima Akhter has received the 2010 BAS (Bangladesh Academy of Sciences)-TWAS Prize for Young Scientists in molecular medicine. She has been working as a nuclear medicine physician and sonologist with the Bangladesh Atomic Energy Commission (BAEC) since 1998, where she is currently a senior medical officer at the Center for Nuclear Medicine and Ultrasound on the campus of Dhaka Medical College Hospital.

Akhter graduated from Chittagong University's Sylhet MAG Osmani Medical College in 1995. She joined BAEC as a medical officer and earned

an MPhil in nuclear medicine in 2001 from the Institute of Nuclear Medicine (INM) at Bangabandhu Sheikh Mujib Medical University (BSMMU) in Dhaka. She received a Japan Government Scholarship for doctoral study and obtained a PhD degree in nuclear medicine from Kanazawa University in 2008.

Her research has confirmed the importance of whole-body radionuclide bone scintigraphy in the identification and treatment of cancer. She has assisted in the development of a radiotracer for brain imaging in Alzheimer's patients and found a potential sigma-1 receptor-imaging agent, which served as the basis of the research for her doctoral degree.

While studying in Japan, she published three scientific papers in high-impact international journals (two in *Nuclear Medicine and Biology* and one in the *European Journal of Nuclear Medicine*). In total, she has published 40 papers in national and international journals and two book chapters.

Akhter currently conducts ultrasonographic clinical research on fetal screening in search of congenital anomalies during the first trimester of pregnancy. She is also examining the potential effectiveness of non-radioactive iodine adjunct medication, used in combination with radioiodine therapy, for the treatment of Graves' disease.

ENTANGLEMENT IN COLOMBIA

Jereson Silva-Valencia, recipient of the 2010 Colombia Academy of Sciences-TWAS Prize for Young Scientists in physics, completed his undergraduate degree in physics at the *Universidad del Valle*. His initial research focused on semiconductor heterostructures, particularly the physical properties of nano-structure particles. He conducted an early study of the optical absorption spectra associated with transitions between the valence band and donor impurity band in a GaAs quantum dot.

Enthused about the subject area, Silva-Valencia, while an MSc student, examined the effects of applied magnetic fields on the binding energy and the optical-absorption spectra associated with transitions from the first Landau valence level to a shallow donor-impurity band in GaAs.

In 1997, Silva-Valencia went to Brazil to study at Campinas State University, earning a doctorate in 2001. There, he shifted his research focus to the physical properties of one-dimensional interacting systems with a superlattice-like structure called Luttinger liquid superlattice.

Upon returning to Colombia in 2003, Silva-Valencia created a strongly correlated systems research group. Fifteen students have completed their undergraduate and graduate theses while working with the group.

In collaboration with other researchers, Silva-Valencia has calculated the binding energy of excitons and shallow hydrogenic impurities in spherical quantum dot under isotropic hydrostatic pressure. He has also investigated

the effect of donors' positions inside the cylindrical nanowire superlattice at their ground-state energies.

The entanglement notion in quantum information theory (QIT) has gained great importance due to its relationship with systems studied in condensed matter physics. Silva-Valencia seeks to determine the critical points of such systems as the anisotropic Kondo necklace model, Heisenberg model with Dzyaloshinsky–Moriya interaction, and the ferrimagnetic mixed-spin chain with positive crystal-field anisotropy under an external magnetic field.

CHEMISTRY IN NEPAL

Rabindra Prasad Dhakal, TWAS recipient of the 2010 Royal Academy of Sciences and Technology-Prize for Young Scientists in chemistry, earned a master's degree at Tribhuvan University in Kathmandu, Nepal, in 1993, specializing in organic chemistry. He was subsequently an assistant lecturer at the university. In 2001, he was awarded a fellowship to study bio-organic chemistry under UNESCO's Advanced Research in Chemistry and Chemical Engineering programme. His research focused on isolating candidate anticancer and antibiotic metabolites from microbes. He then went to Saga University in Japan to earn a doctorate degree. Turning to chemical engineering, he focused on synthesizing novel functional organic materials derived from biopolymers.

Dhakal's research has concentrated on cellulose, chitin, chitosan and other biopolymers for conversion into nontoxic adsorbents that can be recycled into the environment. In addition to conventional adsorbents, he studies such macromolecular biopolymers as lipophilic solvent extraction reagents for the recovery of base metals and precious metal ions. The goal is to modify these materials to enhance the capacity of industrial wastes to be absorbed into the environment.

Dhakal recently returned to Nepal where he hopes to use his expertise to address some of his country's acute environmental problems. He also plans to reach out to policymakers and the public to educate his fellow citizens about the adverse impact that toxic metals have on the environment, most notably soil and water. He has assumed lead responsibility for organizing the First National Conference on Bioenergy, to be held in August 2011 under the sponsorship of the Nepal Academy of Science and Technology.

The TWAS-UNESCO Associateship Scheme is conducted in collaboration with more than 100 scientific institutions in the South that have been designated 'centres of excellence'. The scheme enables researchers from developing countries, each of whom is appointed for three years, to make two visits to a selected centre to pursue collaborative research. TWAS provides travel support and contributes to incidental local expenses. Host centres cover living expenses. In 2010, TWAS awarded 31 new associateships to scientists from 18 countries. In total, 46 TWAS-UNESCO associates travelled to institutions in 15 countries in the developing world: Argentina, Botswana, China, Ethiopia, India, Indonesia, Iran, Jamaica, Jordan, Mexico, Pakistan, South Africa, Syria, Taiwan and Thailand.

Associateship Scheme

ASSESSING SOIL QUALITY IN ETHIOPIA

Improving soil quality plays a critical role in raising agricultural productivity. This intricate and reciprocal relationship drives the research agenda of Joshua Olaleka Ogunwole.

Ogunwole studies the biophysical aspects of soil that may be affected by changes in farming practices and alternations in the agricultural landscape in the Ethiopian Highlands of the Blue Nile Basin.

Ogunwole's research, which is designed to enhance agricultural productivity, closely parallels and often crosses paths with the Consultative Group on International Agricultural Research's (CGIAR) Nile Basin Development Challenge Programme on Water and Food (CPWF), which was launched in 2002.

The Ethiopian Highlands are an invaluable source of water and agricultural resources not only for Ethiopia but for the downstream countries of Sudan and Egypt as well. The area enjoys a mean annual rainfall of 900 to 2,500 millimetres and is home to Lake Tana, the source of the headwaters of the Blue Nile. Its watershed is the largest in Ethiopia.

In Sudan, the Blue Nile supplies water to the Roseires and Sennar dams that generate 80% of the country's electricity and help to irrigate the Gezira Plain, an important agricultural region renowned for its production of cotton.

In Egypt, the Blue Nile provides nearly 60% of the water reaching the country and, when combined with the Atbarah River, which also originates

in the Ethiopian Highlands, the figure rises to 90% of the water and more than 95% of transported sediment.

The majority of the people in the region, who derive their livelihoods from farming, are rain-dependent and vulnerable to adverse environmental conditions and poor management practices. Much of the rainwater that feeds into the Blue Nile basin is lost to runoff and not retained as surface or ground water. Compounding these problems are additional environmental threats such as overgrazing, deforestation and improper farming practices that lead to soil erosion, loss of soil fertility, reduced infiltration and changes in runoff patterns. All these factors tend to uphold and, in some cases, aggravate conditions of poverty.

By studying trends at the landscape level (defined by dominant agro-ecological zones and prevailing farming systems), Ogunwole seeks to identify management practices that could strengthen the resilience of rural communities and contribute to poverty reduction through more efficient management practices designed to enhance natural resource regeneration and sustainability.

During his first associateship visit from September to December 2010, Ogunwole conducted a soil quality assessment at the landscape level, studying farmers' agricultural practices and perceptions of the role that soil quality plays in crop yields. He travelled from Zaria, Nigeria, where he is a professor at the Ahmadu Bello University's Institute for Agricultural Research, to Addis Ababa, Ethiopia, where he was hosted by the International Water Management Institute's sub-regional office for East Africa and Nile Basin.

"I have gained a great deal of knowledge and experience from the TWAS Associate Programme", Ogunwole says. "It gave me an opportunity to explore in greater depth methodologies for utilizing landscape approaches to natural resource management. Equally important, it allowed me to examine how these methodologies might play out in practice as part of a larger effort to reduce poverty and generate wealth over the long term."

TWAS's South-South Fellowship Programme provides opportunities for scientists from one developing country to carry out research at an approved institution in another developing country. The programme operates in partnership with a growing number of institutions in the developing world. Collectively, TWAS and its partner organizations now offer some 300 fellowships a year, making this programme one of the largest South-South fellowship schemes in the world. TWAS administers the programme and covers the travel costs. Programme partners cover tuition fees and local living expenses.

South-South Fellowships

FROM UZBEKISTAN TO CHINA

Bahtigul J. Azimova, who earned a PhD in biochemistry from the Institute of Biochemistry at the Uzbekistan Academy of Sciences in Tashkent, Uzbekistan, is currently a junior research associate at the institute, where she studies the role that hormones play in the growth of cancerous cells.

In 2006, Azimova was awarded a fellowship to study at Hanover University in Germany, in the fields of biochemistry and molecular biology. In 2010, she was granted a TWAS postdoctoral fellowship at the Chinese Academy of Sciences' Chengdu Institute of Biology (CIB) to conduct research on the biosynthesis of estrogens.

Estrogen, a compound synthesized endogenously by the body of all vertebrates and some insects, is an essential component in the estrous cycle that regulates the recurring physiologic changes due to the actions of reproductive hormones found in most female placental mammals. The three main naturally occurring estrogens in women are estrone (E1) produced during menopause, estradiol (E2) produced in nonpregnant females and estriol (E3) produced during pregnancy.

Estrogens are also commonly used in some oral contraceptives and estrogen replacement and hormone replacement therapies. The compound displays diverse physiological effects associated with a number of diseases, especially among women. These diseases include breast cancer and osteoporosis.

Azimova and other researchers have identified a natural product compound that can significantly promote *in vitro* and *in vivo* estrogen biosynthesis. They have also shown that the production of estrogen can be mediated through an enzyme called aromatase.

Specifically, Azimova's research focuses on the molecular mechanisms that enable aromatase to influence the production of estrogen through research activities that include: 1) biotin-labeled compounds to purify the natural product compound's targets and immunoprecipitation and demonstrate its direct interaction with aromatase; 2) a molecular-docking method to predict the chemical compound's potential points of interaction and a point-mutagenesis method to locate the regions and amino acids critical for activity; and 3) a combination of immunoprecipitation and mass spectrum techniques to study the post-translational effect of aromatase by the chemical compound.

The TWAS fellowship is enabling Azimova to enhance her understanding of molecular biology, cell biology and genetics and hone her skills in research related to cell culture, purification and DNA. At CAB, Azimova is learning the techniques required for such activities as cell culture, protein quantification, enzyme-linked immunosorbent assay (ELISA), molecular cloning, vector ligation, transfection and extraction, and protein expression in *E.coli*. After gaining experience and access to the facilities and knowledge at CIB, Azimova anticipates that her research will result in a number of publications in peer-reviewed international journals.

Upon returning to Uzbekistan, she plans to share both her findings and experience with her colleagues not only at the institute but also at the Tashkent Medical Academy and the Tashkent Pediatric Medical Institute. She hopes that the knowledge she gains will help advance studies in biosynthesis in her own country and improve scientific understanding of the role that hormones and molecular genetic bases plays in the formation and growth of tumours.

On a more personal note, Azimova comments that "Science helps to unite people from diverse countries and cultures. The TWAS fellowship programme", she adds, "provides young scientists the opportunity to not only advance their careers but to create life-long friendships with colleagues from far-away places."

The TWAS Research Professors in Least Developed Countries (LDCs) scheme was launched in 2005. More than 100 TWAS members have since expressed interest in participating in the programme, which allows them to visit a research institution in an LDC three times during a five-year period for one to three months on each occasion. The areas of expertise of each TWAS member who has expressed interest in the programme have been circulated to more than 1,000 institutions in LDCs so that they can select their preferred expert. Three TWAS research professors took part in the programme in 2010, including Hamet Seydi (TWAS Fellow 1987), whose experience is highlighted below.

TWAS Research Professors

INCREASING THE COUNT OF MATHEMATICIANS

Mathematics in Africa is a challenging profession. Salaries are low. There is little or no funding for research or participation in conferences and workshops. Many universities cannot afford to pay for journal subscriptions. Internet services are far from commonplace and where they do exist they are often unreliable with low bandwith. According to MathSciNet, the number of people with PhDs in mathematics from sub-Saharan Africa was only 1,773 in 2007. For Africa as a whole, it was estimated that there were only 2,702 PhD holders.

The prospects for postdoctoral research, moreover, are not encouraging. An informal survey conducted by the Developing Countries Strategies Group of the International Mathematical Union (IMU) in 2009 showed that North Africa had the highest level of mathematical research output and East Africa had the lowest. From 2000-07, North Africa accounted for approximately 0.9% of the total world research output in mathematics each year. In the same period, East Africa's share was only 0.01%. Central Africa was approximately 0.03%, West Africa was 0.08% and Southern Africa was 0.39%.

Even more worrying is that mathematical research in these three regions largely occurs in only one country per region. In Central Africa, Cameroon produces more than 80% of the total regional publications, Nigeria produces 70%-90% of the publications in West Africa and South Africa produces more

than 90% of publications in Southern Africa. Burkina Faso and Senegal produce almost all of the publications for Francophone West Africa.

TWAS 2010 research professor Hamet Seydi (TWAS Fellow 1987), who hails from Senegal, proposed to address some of these daunting challenges in the field of mathematics in Africa.

Seydi is a distinguished professor in the Department of Mathematics and Computer Sciences in the Faculty of Sciences and Technology at Cheikh Anta Diop University in Dakar, Senegal. As a TWAS research professor, he visited the Université Abdou Moumouni (UAM) in Niamcy, Niger. During his month-long visit, which took place between 19 May and 19 June 2010, Seydi taught a 30-hour course on mathematical logic. He also lectured at a conference on the Jacobian Conjecture at UAM's *Departement de Mathématiques et d'Informatique* and agreed to serve as the supervisor of three PhD students, thus ensuring future interaction with his host institution.

In addition to his teaching and lecturing responsibilities, Seydi outlined the activities and goals of the USA-Europe-Africa Graduate Training in Mathematics and Computer Science Initiative (GTI) to professors and administrators at UAM, including the faculty of the *Departement de Mathématiques et d'Informatique*, the dean of the Faculty of Sciences and the president of the university. The initiative is scheduled to begin next year at UAM. He also spoke to teachers in nearby schools about the challenges posed by teaching mathematics in secondary schools in Africa.

Seydi met with Niger's Minister of Higher Education and Scientific Research to discuss two additional initiatives sponsored by GTI that seek to improve science instruction and learning in Africa. These initiatives consist of a training project in mathematics for high school teachers and an extracurricular course for superior high school graduates designed to better prepare them for their university studies. The Minister agreed to adopt both of these initiatives, which are scheduled to begin in September 2011.

The TWAS Visiting Scientist Programme provides institutions and research groups in developing countries, especially those with limited outside contacts, opportunities to establish long-term links with internationally-renowned experts. The primary goal is to help build scientific research and teaching capacity in the host country. In 2010, TWAS funded four scientists, enabling them to visit institutions in the Democratic Republic of Congo, Myanmar, Nepal and Uruguay. Carlos Santiago Andreo, from Argentina, was among those who participated. He went to Nepal.

North-South Collaboration

COLLABORATION CARRIES PERSONAL BENEFITS

In a growing number of developing countries, problems of food, health and the environment are being addressed by a rapidly increasing use of biotechnology. The field has produced disease- and pest-resistant and stress- and salt-tolerant crops, vitamin-enriched products, including rice and wheat, new antibiotics, vaccines, as well as enzymes and bioremediation agents for the environment. Food security, poverty alleviation, sustainable agriculture and disease reduction and prevention have all benefited from biotechnology developments in recent years.

Unfortunately, research and applications of biotechnology require highly sophisticated and expensive technologies that many developing countries cannot afford. For least developed countries (LDCs) such as Nepal the challenges are even more difficult. Infrastructure and institutional support are lacking.

In December 2008, the Nepal Academy of Science and Technology and the Ministry of Environment, Science and Technology published "A National State-of-the-Art Report on Biotechnology for Nepal", which provided an overview of the situation in the country.

A survey done in conjunction with the report identified some 60 key institutions involved in biotechnology, including fourteen active in plant biotechnology, eight in animal biotechnology, ten in medical biotechnology, six in food and industrial biotechnology, four in environmental biotechnology, twelve in biotechnology education, four in bio-energy and bioconversion technology, and two in biotechnology information.

A basic foundation thus exists for potential advancement in the field of biotechnology. Nevertheless, people have not yet been trained in different disciplines of modern biotechnology. Without a comprehensive training programme or adequate national funding for research and development in this field, the knowledge and skills of researchers will remain inadequate.

The TWAS Visiting Scientist Programme is one way in which biotechnology challenges in Nepal can be addressed. Through collaborative visits, exchanges of knowledge and expertise, the programme can help fill the gaps.

In October 2010, Carlos Santiago Andreo (TWAS Fellow 2005), professor of biochemistry at the *Centro de Estudios Fotosinteticos y Bioquimicos* (CEFOBI) in Rosario, Argentina, travelled to Nepal. He was hosted by the Central Department of Biotechnology at Tribhuvan University in Kathmandu, Nepal.

Andreo spoke to faculty and students about his research on the role that carbon dioxide fixation plays in photosynthesis and the creation of enzymes.

"The TWAS visiting scientist programme", Andreo says, "afforded me an opportunity to engage in collaborative research with colleagues from Nepal. This not only enabled both me and my hosts to forge valuable and rewarding personal relationships, but also helped to strengthen our research capacities and expand our global perspectives."

Andreo also had fruitful discussions with administrators and faculty at Tribhuvan University, focusing on possible future collaboration, including joint research projects and student and faculty exchanges that they hope to begin in 2011.

"My hope", says Andreo, "is that my visit will mark the beginning of long-term collaboration between my own institution and Tribhuvan University's Central Department of Biotechnology. The programme is designed to help the recipient institution build its scientific capacity. But the effort also has untold benefits for those who visit these institutions. I know this is true from my own experience in Nepal. I would urge other TWAS members to take advantage of this unique and unforgettable opportunity for personal and professional growth."

TWAS Research Grants Programme in basic sciences for individual researchers – supported by the Swedish International Development Cooperation Agency (sida) – provides up to USD15,000 to young scientists to support projects in the basic sciences. The grant covers the costs of specialized equipment, essential consumable material and scientific literature. In 2010, 24 TWAS Research Grants were awarded in 14 countries. Among these, 10 grants went to scientists in sub-Saharan Africa. Grants were also given to scientists in Azerbaijan, Colombia, the Democratic People's Republic of Korea, Nepal, Uzbekistan and Vietnam. The following example of TWAS-supported research focuses on the work of Coralia Osorio Roa, in Colombia, who has examined the molecular basis for the distinctive aroma of guava.

Research Grants for Individuals

Guava, a tropical fruit native to Central and South America, is also grown in tropical and sub-tropical regions in Africa and Southeast Asia. It is not only a nutritious source of food, but also plays an important role in traditional medicine, aiding in the treatment of a diverse set of ailments, including dysentery and fevers. Recent research suggests that the plant's molecular extracts could have therapeutic value for combating cancer, bacterial infections and inflammation.

For Coralia Osorio Roa, who received a TWAS Research Grant in 2008, the allure of guava has resided in its pleasant aroma. Learning more about what makes guava smell the way it does has served as the centrepiece of her research.

There are more than 100 species of guava, all related to the myrtle family in the genus *Psidium*. Each of these species conveys a pungent citrus-like smell that often hints of lemon or grapefruit. Roa, an associate professor at the National University of Colombia specializing in food chemistry, has sought to identify the molecular compounds responsible for the distinctive aromatic 'notes' that characterize the plant.

"Over the past several decades,' she explains, "there have been numerous studies examining guava volatiles that have led to the identification of nearly 400 structural compounds."

The focus, however, has been on the compounds' potential contribution to the treatment of disease. "Little attention," Roa says, "has been paid to the contribution that the compounds make to guava's pleasant aroma."

What Roa has done is to apply the systematic approach to molecular compound identification developed by the German Research Center for Food Chemistry to identify guava's key aroma compounds.

Several varieties of guava are successfully grown in Roa's home country of Columbia. The species vary in size, shape and flesh colour. Both pink- and red-fleshed guava (*Regional roja*) have recently been studied to identify their aromatic molecules.

As a result, Roa decided to examine white-fleshed guava (*Regional bianca*). To better manage the study sample, she focused on white-fleshed guava grown in Puente Nacional township, located in the Department of Santander, in northeastern Columbia.

With the help of equipment purchased with the TWAS grant, including a molecular pump and a turbo pump controller, Roa and her colleagues identified 21 odour-active compounds. The highest flavour-dilution notes consisted of floral, honey-like aromas. In addition, there were significant mixed-measures of grassy, metallic, sweet caramel and fruity aromatic notes. All of these aromas, with high flavour-dilution factors, had also been detected in red-fleshed guava.

When placed in water-based concentrations for additional study, the results show nine odorants to be the most important aroma compounds in Colombian white-fleshed guava. These compounds include: (Z)-3-hexenal, 3-sulfanyl-1-hexanol, 4-hydroxy-2.5 dimethyl-3(2H)-furanone, trans-4.5-epoxy-(E)-2-decenal, cinnamyl alcohol and 4-methoxy-2.5-dimethyl3(2H).

The key finding is that white-fleshed guava contain the same key aroma compounds as red- and pink-fleshed guava. Any differences in smell are likely due to differences in the quantities of the compound and not to the kind of compounds that were involved. This is important because white-fleshed guava has been the poor cousin of the guava family, gaining far less acceptance among consumers.

All guava, despite their different colours, carry the same appearance. They are a gnarly, oval-shaped fruit that many find tasty but unattractive. Now thanks to Roa's research, we know they have roughly the same aromatic molecular components. Such an insight could open the way for white-fleshed guava to join their red- and pink-fleshed relatives on fruit stands as a popular consumer item rich in vitamin C, carotenoids and fibre.

The **TWAS Research Grants Programme in Basic Sciences for Research Units in S&T-lagging Countries**, launched by TWAS in 2002, is designed to assist small research groups in Least Developed Countries (LDCs). Although these groups have conducted important research with significant results, the difficult conditions under which they work have prevented them from realizing their full potential. With support from the Swedish International Development Cooperation Agency (Sida), this programme provides research units in some 80 countries, which TWAS has identified as lagging in their science and technology capacity, with an opportunity to reach their full potential. Each selected research unit receives a grant of up to USD30,000 that can be renewed two additional times on the basis of a positive report and re-application. In 2010, thirteen research groups in eight countries were supported. There were eleven new awards and two renewals.

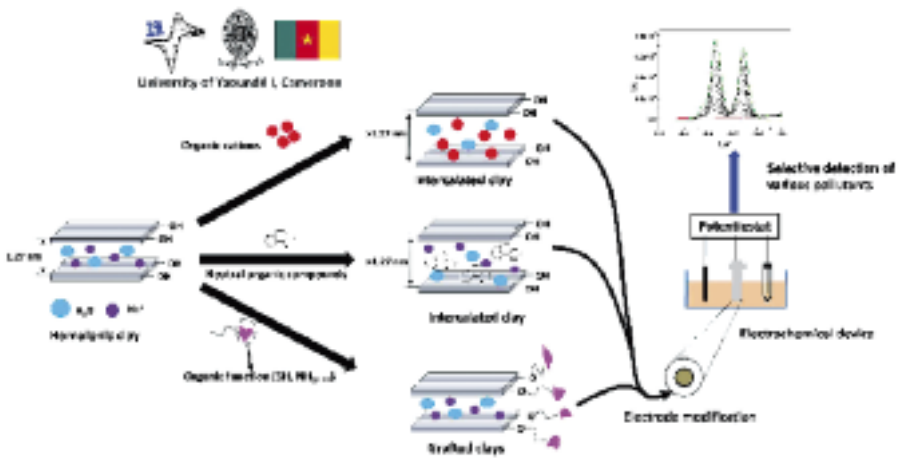
Research Grants for Groups

PROTECTING THE ENVIRONMENT IN CAMEROON

Like many developing countries, Cameroon faces a broad range of environmental, social and public health issues, including the loss of natural habitat and biodiversity, poaching and illegal hunting, soil degradation and desertification, tainted fish and overfishing, the spread of infectious diseases, pollution, and limited access to safe drinking water.

And, as is the case in many developing countries, these issues are closely linked to the challenging economic conditions that Cameroon faces.

Take the challenges posed by access to safe drinking water. About 80% of Cameroon's urban residents have access to safe drinking water. That figure drops to 40% for rural residents. Both inorganic (heavy metals) and organic pollutants (dyes, dioxins and pesticides) contaminate Cameroon's surface



waterways and groundwater, adversely impacting not only public health but also wildlife and the environment.

Having already conducted promising research while working under severe financial constraints and difficult working conditions, the Laboratory of Analytical Chemistry in the Department of Inorganic Chemistry, under the Faculty of Science at the University of Yaoundé in Yaoundé, Cameroon, in 2008 received a TWAS Research Grant in Basic Sciences for Research Units in S&T-lagging countries to find better ways to control and treat water in Cameroon. The grant was renewed in 2009.

The main objective of the laboratory, which operates under the direction of research unit leader Emmanuel Ngameni, is to examine how natural adsorbents, laced throughout Cameroon's clay-baked soils, can aid in the 'take-up' of inorganic and organic pollutants. The effort hopes to lay a strong scientific basis for devising cost effective strategies to address the country's soil and water contamination problems.

The laboratory, for example, has designed and built electro-chemical sensors (modified electrodes) that act as warming devices capable of rapidly and precisely evaluating the level of pollution in wastewater. In addition, electro-coagulation units, also designed and built by the laboratory, have been tested and successfully used to treat industrial wastewater at factory sites across the country. The laboratory has also developed advanced nano-hybrid materials that have shown promise in the detection and treatment of soil and water pollution.

The TWAS grant supported research that led to five scientific papers published in such international peer-reviewed journals as the *Journal of Hazardous Materials, Journal of Electroanalytical Chemistry*, *Talanta* and *Chemistry of Materials*. Three of these papers have been published since the renewal of the grant in April 2009. The papers presented the following research findings to the international scientific community: a study of the removal of paraquat from aqueous solution by biosorption on Ayous (Triplochiton schleroxylon) sawdust; characterization of lapachol in artificial organic-film membrane; electrochemical analysis of methylparathion pesticide by a Gemini surfactant-intercalated clay-modified electrode; Mercury removal from water by electro-coagulation using aluminum and iron electrode; and one-step preparation of thiol-functionalized porous clay heterostructures.

Other benefits derived from the grant include a solid track record of accomplishment that led to the promotion of one of the unit's young scientists, Ignas Kenfack Tonle, to the rank of associate professor. In addition, the unit's research leader, Emmanuel Ngameni, was awarded the prize of "the best presentation by a TWAS Research Unit" at the 11th General Conference of TWAS in Durban, South Africa, in October 2009.

The unit's international reputation was also strengthened through the appointment of Ngameni as a referee in several peer-reviewed international journals, the participation by laboratory members in international conferences with financial support from various sources, and laboratory improvements through the purchase of chemicals and scientific equipment.

Like all organizations, **TWAS must effectively communicate its activities to its members and other interested parties**. The Academy's audience includes the international organizations that are committed to building scientific capacity in developing countries, as well as national ministries, research councils and science academies. The goal is not only to highlight the Academy's excellent work but, more importantly, to advance the Academy's long-standing goal to build scientific capacity in all developing countries. Within the Academy's secretariat, the Academy's communication efforts are the responsibility of the Public Information Office (PIO).

Public Information

The two major focal points of TWAS's PIO in 2010 were the expanded use of the web to publish news stories about the Academy (a total 53 news releases were published during the year) and much broader coverage of TWAS in the Italian press (a total of 80 stories about TWAS were published in Italy's print, broadcast and electronic media). TWAS and its partner organizations also continue to receive broad coverage in the international science media, especially in *Nature, Science* and SciDev.Net (the web portal sponsored by *Nature, Science* and TWAS). In addition, TWAS continues to interact with other media outlets such as *New Scientist, Physics World, Physics Today* and the *World of Science* (UNESCO's science sector flagship publication). TWAS has also taken increasing advantage of the electronic media by publishing with such electronic news services as *Eureka, Galileo* and *Public Service Review*.

TWAS's 21st General Assembly, which took place in Hyderabad, India, in November 2010, provided an excellent opportunity for TWAS to gain global media coverage, focusing on the role that the Academy plays in building scientific capacity in the developing world. The web portal SciDev.Net once again presented a 'live' blog highlighting the events of each day of the meeting, and the TWAS PIO prepared daily news stories for the Academy's website and subsequently prepared a lengthy feature article on the conference for the *TWAS Newsletter*. Stories about the winner of the Ernesto Illy Trieste Science Prize and the 2010 TWAS Prize winners received extensive press coverage, especially in the international science media.

The PIO prepared and submitted the nomination for the Antonio Feltrinelli Prize, which is sometimes referred to as Italy's Nobel Prize. In winning the prize under a special category "for exceptional enterprise of high moral and humanitarian value," TWAS was awarded €250,000 and received extensive coverage in the Italian media both when the prize was announced in June and when the official awards ceremony took place at the *Accademia Nazionale dei Lincei* in November in Rome.

Extending its series 'Excellence in Science: Profiles of Research Institutions in Developing Countries', initially funded by the David and Lucille Packard Foundation, TWAS published and distributed an in-depth profile of the South African Institute of Aquatic Biology (SAIAB) in Grahamstown, South Africa, and the National Agricultural Research Laboratories (NARL) in Kawanda, Uganda. It also forged a new partnership with the Commission on Science and Technology for Sustainable Development in the South (COMSATS) and Science Initiative Group (SIG) at the Institute for Advanced Studies, which ensure the publication of additional volumes in 2011.

The PIO participated in the IAP general assembly and international conference on biodiversity, held in London, and prepared news releases and a lengthy feature article about the event for the *TWAS Newsletter*. The PIO officer made a formal presentation at UNESCO's international meeting on biodiversity held in Paris and UNESCO subsequently published the text of the presentation. The PIO also organized a session on biodiversity at the European Science Open Forum (ESOF) in Turin, Italy. The event received extensive coverage in the Italian press, including news articles in *La Stampa* and *Sole 24 Ore*, two of Italy's leading newspapers. The PIO organized a session at the AAAS annual meeting, held in San Diego, California, USA, devoted to the role of science academies in society, and the PIO officer spoke at a conference session on science, technology and innovation in the Arab region. The PIO was also involved in a session at the TWAS-BioVision.Nxt conference, held in Alexandria, Egypt, devoted to scientific publishing and prepared a feature on the event for the *TWAS Newsletter*. The PIO organized press coverage for the TWAS-IAP conference on the role of academies in promoting regional cooperation in science, technology and innovation in the Balkans. It prepared news releases for the press and the TWAS website, and drafted a feature article for the *TWAS Newsletter*. The event received extensive coverage in the Italian media, including three television news segments.

The *TWAS Newsletter*, generously supported by the Kuwait Foundation for the Advancement of Sciences (KFAS), is the Academy's flagship publication. It is published four times a year and has a print run 2,500 copies. Its magazine-like format provides a timely and effective way of keeping members, as well as colleagues and partners in other international organizations and the science media, up to date with the work of its affiliated organizations, OWSD, IAP and IAMP.

The TWAS Year Book, containing brief biographies of all TWAS Fellows and Associate Fellows, was published in August 2010. The *Year Book* serves as an important and valuable source of information for TWAS members as well as those who are interested in knowing more about those who have been elected to the Academy.

TWAS also produces a two-page *e-Bulletin*, which was issued three times in 2010, and the *IAP Bulletin*, which was issued four times in 2010. Each edition of the bulletin was widely disseminated and made available on the websites of the respective organizations.

In addition to its ongoing responsibilities, the PIO 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 describing the activities of TWAS and its partners organizations.

Over the course of the past decade, TWAS has forged a number of partneships with a diverse group of organizations that are designed to extend the reach of the Academy in ways that help it achieve its goals through collaboration.

Partnerships

PHYSICS COLLABORATION

In July 2009, TWAS and the Abdus Salam International Centre for Theoretical Physics (ICTP) signed a memorandum of understanding that commits the two organizations to work more closely together.

Under the agreement, TWAS has teamed up with ICTP's Aeronomy and Radiopropagation Laboratory and other partners to support a series of workshops on the science and application of global navigation satellite systems. In addition, TWAS has supported two Iraqi scientists under the ICTP Training and Research in Italian Laboratories (TRIL) programme; five young scientists from science- and technology-lagging countries (Benin, Ethiopia, Mongolia, Togo and Uzbekistan) to carry out part of their PhD programmes at institutions in Trieste and the surrounding area under the ICTP Sandwich Training Educational Programme (STEP); and has sponsored networks in condensed matter physics and partial differential equations in Asia and Africa.

BIOTECH COLLABORATION

Following a memorandum of understanding signed in 2008, TWAS and the International Centre for Genetic Engineering and Biotechnology (ICGEB) joined forces with the United Nations Educational, Scientific and Cultural Organization's International Basic Sciences Programme (UNESCO/IBSP) to fund a three-year 'Joint Project on Capacity Building in Basic Molecular Biology'.

As with a previous TWAS-ICGEB programme, the aim is to create networks of institutions from developing and developed countries, this time with a focus on research on biotic stresses (*i.e.*, pests and pathogens) of crop plants and domestic animals.

Five networks have been selected for funding with lead institutions in Cuba, Kenya, Peru and South Africa (two). Partner laboratories are located in such countries as Brazil, Pakistan, Sudan, Switzerland, Tanzania and Uganda. Topics range from efforts to identify the vector and pathogen genotypes of Napier Grass Stunting Disease, a problem across much of East Africa, to the development of vaccines for tick-borne diseases of domestic animals in the New World.

EUROAFRICA-ICT

The two-year EuroAfriCa-ICT project, funded through the European Union's (EU) Seventh Framework Programme (FP7), which saw TWAS link up with a number of institutions in Europe, sub-Saharan Africa and the Caribbean, ended in early 2010. It was superseded by the EuroAfrica-ICT.org project, which will focus mainly on Africa and run until December 2011.

Both projects are aimed at increasing the number of scientists from sub-Saharan Africa carrying out research in information and communication technology (ICT) that become involved in EU-funded research programmes.

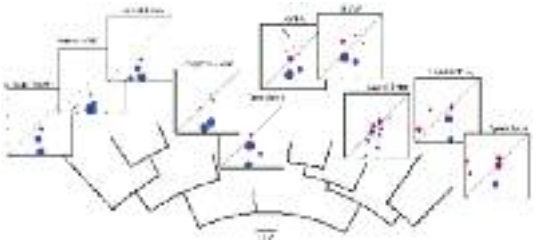
Two flagship events were organized in 2010. The Second Euro-Africa Cooperation Forum on ICT Research was held in Addis Ababa, Ethiopia, on 4 February, while the Third Euro-Africa Cooperation Forum on ICT Research was held in Helsinki, Finland, on 7-8 December 2010 as part of a '2010 Euro-Africa Week on ICT Research and e-Infrastructures. Both events attracted more than 300 participants, including high-level politicians from the host countries, the African Union and the European Union.

The EuroAfrica-ICT.org consortium members also organized an awareness workshop on 3-4 November 2010 in Mauritius, and a 'concertation' meeting in Brussels, Belgium, in June. In addition, consortium members provide a number of web-based support activities such as an on-line ICT community, a partner search database and regional help-desks.

For additional information, see: *www.euroafrica-ict.org.*

MICROSOFT SUPPORT FOR AFRICA

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



The winners of the second round of TWAS-AAS-Microsoft awards for young computer scientists in Africa – from three different African countries – were:

- **Fayçal Djeffal**, Department of Electronics, Faculty of Technology, at the University of Batna, Batna, Algeria.
- **Konrad Scheffler**, Computer Science Division, Department of Mathematical Sciences, Matieland, South Africa.
- **Moustafa Youssef**, Department of Computer Science and Engineering, Egypt-Japan University of Science and Technology (E-JUST), Alexandria, Egypt.

Each winner receives €7,000, €5,000 of which is earmarked for further research.

In addition, computer science meetings were supported in Cameroon, Ethiopia, Mali, South Africa, Uganda and Zambia.

TWAS-COMSTECH GRANTS

In June 2009, TWAS and the Organization of Islamic Conference (OIC) Standing Committee on Scientific and Technological Cooperation (COMSTECH) signed a memorandum of understanding whereby the two organizations agreed to co-finance a Joint Research Grants programme. Research grants of up to USD15,000 are given to scientists under the age of 40 working in OIC member states. Awards are available in the fields of earth sciences, engineering sciences, information technology and computer sciences, and materials science, including nanotechnology, pharmaceutical sciences and renewable energy.

In response to the second call for proposals, in 2010 TWAS and COMSTECH provided grants to 22 young scientists in 11 countries: Algeria, Bangladesh, Mali, Jordan, Lebanon, Palestinian Authority, I.R. Iran, Malaysia, Nigeria, Pakistan and Turkey.

SCIENCE ENTREPRENEURS IN THE SOUTH

TWAS and the Malaysia-based International Science, Technology and Innovation Centre for South-South Cooperation (ISTIC), which operates under the auspices of UNESCO, launched a search for the best examples of how research in science and technology has led to new products, processes and services.

Following a successful call for applications, the authors of 17 case studies were invited to attend a workshop in Penang, Malaysia, on 6-7 September.

During the workshop, a high-level international committee judged the presentations and selected the best three studies to receive the first ever 'ISTIC-TWAS Entrepreneurship Awards'. The three winners were:

- **Rahmah Noordin**, *Universiti Sains Malaysia*, Penang, Malaysia.
- **Philippe Rasoanaivo** (TWAS Fellow, 2005), *Institut Malgache de Recherches Appliquées*, Madagascar.
- **Hipolito Ortiz Laurel**, *Postgraduate College*, Montecillo, Mexico.

Descriptions of all the selected case studies are currently being edited for publication.

SOUTH-NORTH OPPORTUNITIES

In collaboration with the German Research Foundation (DFG), TWAS launched its first South-North fellowship programme. The programme is open to postdoctoral scientists from sub-Saharan Africa (except South Africa) who received their PhD degree within the last five years.

The ten successful candidates – from Cameroon (2), Nigeria (5), Sudan (2) and Uganda (1) – were supported to undertake two-to-three month research visits at their selected host institute in Germany with the idea that this will lead to more long-term collaborations between the African scientists and their German counterparts. As with the TWAS South-South fellowships programme, TWAS provides travel and visa support, while all expenses in Germany are covered by DFG.

GOVERNING SOLAR RADIATION

Against a background of little to no progress among the international community on an agreement to cut greenhouse gas emissions, the world's scientific community is beginning to discuss and analyse alternative ways of reducing global temperatures in the event that climate change creates severe impacts, including reducing the amount of sunlight that reaches the Earth's surface – so-called solar radiation management.

To date, experiments have been limited to computer simulations and some small-scale field trials are being considered – but should there be international oversight over such experiments or larger experiments if they are proposed? And if so, by whom and how would such oversight be governed?

To tackle these questions, TWAS has joined with the UK's Royal Society and the United States-based Environmental Defense Fund in co-convening the Solar Radiation Management Governance Initiative (SRMGI) to explore different governance options. To ensure representation from the developing world, a number of TWAS Fellows have taken part in the SRMGI steering and working group, which has debated the issues and is developing a document (due for publication in 2011) that aims to open up the discussions to a much wider audience.

For additional information, see: *www.srmgi.org*.

SUPPORT FOR SCIENTIFIC MEETINGS

In 2010, TWAS provided support for 21 scientific meetings in 16 developing countries. Among the meetings were:

- International Conference on Pure and Applied Chemistry (ICPAC-2010): Chemistry for Sustainable Development, Réduit, Mauritius, 26-30 July 2010.
- XIII International Congress of Acarology, Recife, Brazil, 23-27 August 2010.
- International Conference on the Biology of the Most Ancestral Lineages of Flowering Plants, Serena, Chile, 4-10 October 2010.
- 10th International Symposium on Protein Structure Function Relationship, Karachi, Pakistan, 11-15 October 2010.
- International Congress on Mycorrhizal Symbiosis: Ecosystems & Environment in Mediterranean Areas, Marrakech, Morocco, 11-13 October 2010.
- 11th International Chemistry Conference in Africa (11ICCA) on the Role of Chemistry in the Development of Africa, Sohag, Egypt, 20-23 November 2010.
- International Conference on Alternative and Renewable Sources of Energy, Beirut, Lebanon, 24-27 November 2010.
- International Conference on Ecosystem Conservation and Sustainable Development (ECO-CASD 2010), Ambo, Ethiopia, December 2010.

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

Regional Offices

TWAS REGIONAL OFFICE FOR EAST AND SOUTHEAST ASIA AND THE PACIFIC

Headquarters: Chinese Academy of Sciences (CAS), Beijing, China

In 2010, the TWAS Regional Office for East and Southeast Asia and the Pacific (TWAS-ROESEAP) organized two major regional meetings.

On 16-21 August in Beijing, the 'Frontier in Water and Sanitation: A Workshop for Water Engineers and Scientists from Developing Countries' took place at the CAS Research Centre for Eco-Environmental Sciences (RCEES). The workshop, which provided a platform for the exchange of knowledge and experiences for water engineers and researchers in developing countries, consisted of lectures, roundtable discussions and technical visits. More than 50 water engineers and researchers attended from China, Ethiopia, Ghana, India, Kenya, Laos, Malaysia, Mongolia, Nepal, Nigeria, Pakistan, the Philippines, Sri Lanka, Thailand, Tunisia and Vietnam.

On 17-20 November, TWAS-ROESEAP again teamed up with the World Meteorological Organization (WMO) to organize the 9th CAS-TWAS-WMO

International Workshop, this time on 'Climate and Environmental Change: Challenges for Developing Countries'. The meeting focused on the observation, analysis and prediction of global and regional climate and environment changes, along with the impacts of climate change and adaptation policies for economic development and human well-being in developing countries. More than 80 participants from China and other developing countries attended.

TWAS-ROESEAP actively supports the CAS-TWAS Fellowship Programme and the TWAS-UNESCO Associateship Scheme. In 2009, 47 students and scientists from 17 developing countries were awarded CAS-TWAS postgraduate (17), postdoctoral (16) and visiting scholar (14) fellowships. The recipients travelled to China in 2010 to take up their fellowships in CAS institutes. In addition, TWAS-UNESCO associateship awardees from India, DPR Korea, Nigeria and Pakistan travelled to their selected CAS centres of excellence to develop cooperative research programmes. TWAS-ROESEAP and current TWAS members in the region also ensured that many outstanding scientists were nominated as potential TWAS members or potential TWAS Prize winners.

TWAS-ROESEAP was closely involved in the organization of the TWOWS 4th General Assembly and International Conference: 'Women Scientists in a Changing World', which was held in Beijing, China, on 27-30 June 2010. More than 700 women scientists from 55 countries – the majority from developing countries – attended the event. For more information, see page 68.

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

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

In 2010, the TWAS Regional Office for Sub-Saharan Africa (TWAS-ROSSA) began preparations for the Fifth TWAS-ROSSA Young Scientists Conference, scheduled for February 2011 on the theme 'Exchanging

Knowledge on Climate Change Impacts and Vulnerability in Africa: The Role of Networking'.

During the meeting, awards will be presented to the winners of the various prize schemes organized by TWAS-ROSSA and AAS, including the TWAS Regional Prize for the public understanding and popularization of science, the TWAS-AAS-Microsoft Awards for Young African Computer Scientists, and TWAS Regional Young Scientist Prize. In 2010, the latter award focused on applied medical sciences. The winner was Harriet Mpairwe from the Uganda Virus Research Institute, Entebbe, Uganda.

TWAS-ROSSA continued its efforts towards strengthening the capacity of TWAS National Chapters in Africa. This year, chapters in Ghana, Senegal, South Africa and Uganda received funding from the Regional Office.

TWAS-ROSSA also supports the publication of the multidisciplinary peer-reviewed journal *Discovery and Innovation*, which provides a vehicle for African scientists to publish their results and to keep informed about scientific developments on the continent. Four issues are published annually.

- *coordinator: Berhanu Abegaz (TWAS Fellow 1998)*
- *email: aas@aasciences.org*
- *website: www.nairobi.twas.org*

TWAS ARAB REGIONAL OFFICE

Headquarters: Bibliotheca Alexandrina, Alexandria, Egypt

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

The main event organized by TWAS-ARO in 2010 was TWAS/BioVision.NXT. The meeting was held within the framework of the biennial international conference, BioVisionAlexandria 2010, on 11-15 April.

The theme of the TWAS/BVA.NXT 2010 meeting was 'Publishing Scientific Papers in the Developing World'. Almost 100 young researchers (below the age of 35) from 29 developing countries participated in the event. TWAS covered the travel costs for many of the participants from developing countries. Eminent speakers from various publishing houses also participated in the event, which gave the young scientists the opportunity to meet distinguished scientists, as well as editors and reviewers from several prestigious scientific journals with whom they shared their views regarding the obstacles they face when publishing their research and ways to overcome them. During the conference, the young scientists also participated in 'Coffee With' sessions where they were able to speak informally with Nobel Laureates and other eminent scientists.

Other meetings held by TWAS-ARO during 2010 were:

- 'Guidelines for Researchers Workshop', held on 27-30 September, organized in collaboration with the German Academic Exchange Service (DAAD), Elsevier and the

Bibliotheca Alexandrina legal department. Some 40 young scientists from the Arab region attended.

- 'Biorobotics Workshop', held on 12-14 December, co-organized with the Egypt-Japan University of Science and Technology (E-JUST), which introduced the science of biorobotics and artificial intelligence to 25 interested young researchers from the Arab region.
- TWAS-ARO 6th Annual Meeting, held on 22-23 December, which focused on 'Linking research institutions, universities and industry in the Arab world' and featured a series of lectures by TWAS members from the region.

Also in December, a public lecture on 'Beating Cancer Cells to Death with Gold Nanoparticles in More than One Way', which shed light on the latest findings and techniques using gold-nanoparticles to treat cancer, was delivered by Mostafa El-Sayed, School of Chemistry and Biochemistry, Georgia Institute of Technology, USA. Some 800 people attended.

The winner of the Young Arab Scientist prize in the field of 'Biodiversity conservation and informatics' was announced on 23 December 2010 during the TWAS-ARO 6th Annual Meeting. The prize was awarded to Ramy Karam Aziz, Faculty of Pharmacy, Cairo University, Egypt, and an adjunct faculty member at San Diego State University, San Diego, United States.

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

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

The main activity organized by the TWAS Regional Office for Central and South Asia (TWAS-ROCASA) in 2010 was the 'Conclave of Afro-Asia Young Scientists: A Meeting of Concerned Young Scientists'. The event, held at JNCASR, Bangalore, on 11-13 February, focused on 'Energy, Climate and Development'. Some 80 young scientists from 20 countries participated in the meeting, which concluded with a 'Declaration of the Conclave' from the young scientists themselves.

TWAS-ROCASA also runs the TWAS-JNCASR Summer

Research Fellowship Joint Programme, aimed at encouraging young undergraduate students to visit renowned institutions in India. In 2010, three students from the region were selected to participate.

TWAS-ROCASA, in cooperation with the Centre for International Cooperation in Science (CICS) Fellowship Programme, also provided assistance to five young scientists (three from Nigeria, one from Bangladesh and one from Myanmar) to spend time at a laboratory in India.

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

TWAS-ROCASA was also an active collaborator in the organization of the TWAS 21st General Meeting held in Hyderabad during October 2010 (see pages 14-21).

- *coordinator: Varadachari Krishnan (TWAS Fellow 1996)*
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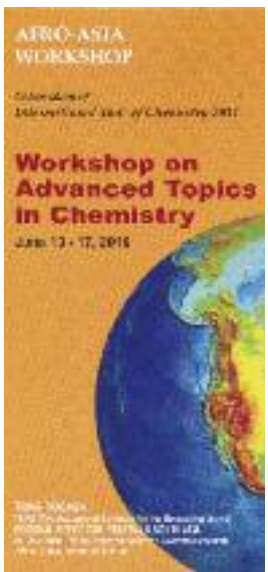

TWAS REGIONAL OFFICE FOR LATIN AMERICA AND THE CARIBBEAN

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

The 2010 TWAS-ROLAC Prizes for Young Scientists were awarded to Robson Monteiro, Institute of Medical Biochemistry, Federal University of Rio de Janeiro, Brazil, in biological sciences, and to Alessandro Garcia, Informatics Department, Pontifical Catholic University of Rio de Janeiro, Brazil, in engineering sciences. The prizes, each worth USD2,000, were presented during the '8th TWAS-ROLAC Young Scientists Conference', which was linked with the conference '*Avanços e Perspectivas da Ciência no Brasil, América Latina e Caribe*', that took place at the Brazilian Academy of Sciences in Rio de Janeiro on 29 November - 2 December 2010.

In May 2010, the 7th TWAS-ROLAC Young Scientists Conference, also held in Rio de Janeiro, featured scientific presentations by 20 young scientists from the

region, including the 2010 TWAS Young Affiliates. TWAS-ROLAC assistance to national chapters in the region included the hosting of a meeting of the Brazil chapter, as well as providing financial support to chapters in Cuba, Jamaica and Trinidad and Tobago. A meeting of the TWAS-ROLAC executive council also took place during the 8th TWAS-ROLAC Young Scientists Conference.

As part of the events organized to celebrate the German Year in Brazil, TWAS-ROLAC held a series of public lectures on 'Tertiary Education' during November 2010, all of which were well attended.

The TWAS-ROLAC webpage was updated to make it more functional and more effective in distributing all the information relevant for TWAS Fellows and the scientific community in the region.

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

REGIONAL PRIZES

In 2006, TWAS established three regional prizes of USD3,000 each that are awarded annually on a rotating basis. In 2010, the Regional Prizes for 'Public Understanding and Popularization of Science' were awarded to:

- TWAS-ARO: Elias Baydoun (TWAS Fellow 1998), Biology Department, American University of Beirut, Beirut, Lebanon.
- TWAS-ROCASA: Arvind Gupta, Children's Science Centre, Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune, India.
- TWAS-ROLAC: Guillermo Chong, *Departamento de Geociencias*, Universidad Católica del Norte, Antofagsta, Chile.
- TWAS-ROSSA: Felix Konotey-Ahulu, University of Cape Coast, Ghana.
- TWAS-ROESEAP: Mahaletchumy Arujanan, Malaysian Biotechnology Information Centre (MABIC), Monash University, Malaysia, and Queena N. Lee-Chua, Departments of Mathematics and Psychology, Ateneo de Manila University, Philippines (shared prize, each receiving USD2,000).

YOUNG AFFILIATES

Since 2007, each TWAS Regional Office has selected up to five Young Affiliates (who must be excellent young scientists aged 40 or below). In 2010, the following 25 young scientists were selected following a nomination process that involves the TWAS Fellows in each region:

YOUNG AFFILIATES

TWAS-ARO	TWAS-ROCASA	TWAS-ROLAC	TWAS-ROSSA	TWAS-ROESEAP
Youcef Bentoutou, Algeria	Muhammed Kamruzzaman, Bangladesh	Yraima Cordeiro, Brazil	Ishmael B. Masesane, Botswana	Li Yin, China
Amal Shendi Nada, Egypt	Gopal Balasubramaniam, India	Rogerio Panizzutti, Brazil	Chukwuocha Uchechukwu Madukaku, Nigeria	Ismunandar, Indonesia
Talal Al-Azemi, Kuwait	M. Jayakannan, India	Mauricio Calderon, Chile	Peter Okafor, Nigeria	Chin-Ping Tan, Malaysia
Ahmad Al-Salman, Oman	Krishna Prasad Devkota, Nepal	Jaime Costales Cordero, Ecuador	Christine Steenkamp, South Africa	Maricor N. Soriano, Philippines
Kefi Ben Atig Rym, Tunisia	Raza Shah, Pakistan	Marvadeen Singh-Wilmot, Jamaica	Jeninah Karungi-Tumutegyereize, Uganda	Santi Maensiri, Thailand

TWAS hosts the secretariats of three international organizations dedicated to serving the needs of science and scientists in the developing world and promoting scientific capacity as an essential component of sustainable economic development. Highlights of the 2009 activities of these organizations follow.

The TWAS Family

ORGANIZATION FOR WOMEN IN SCIENCE FOR THE DEVELOPING WORLD (OWSD)

With nearly 3,400 members, OWSD is one of the largest organizations of women scientists in the world.

The OWSD Fourth General Assembly was held in Beijing, China, in June 2010. The assembly was preceded by an international conference, 'Women Scientists in a Changing World', organized in cooperation with the Chinese Academy of Sciences. More than 600 women scientists from 55 countries attended. Xi Jinping, vice president of the People's Republic of China, gave the opening address.

The OWSD Prizes for Young Women Scientists, sponsored by the Elsevier Foundation, were expanded to cover three disciplines in each region – biology, chemistry and physics/mathematics. In total, there were 12 prize winners. Each received USD5,000.

The General Assembly also voted to change the organization's name and acronym from the Third World Organization for Women in Science (TWOWS) to the Organization for Women in Science for the Developing World (OWSD).

OWSD's flagship postgraduate fellowship programme for young women scientists from sub-Saharan Africa and the Least Developed Countries, sponsored by the Swedish International Cooperation Development Agency (Sida) and launched in 1998, continues to grow. In 2010, 191 applications

from 25 countries were received and 31 were selected. In addition, 14 young women scientists completed their postgraduate studies.

In January 2010, the first GenderInSITE workshop was held at the UNESCO secretariat in Paris with support from Sida. GenderInSITE is a joint initiative of OWSD, the UN Commission on Science and Technology for Development and TWAS. Some 30 participants from international agencies, science organizations and academies, and civil society attended.

The purpose of GenderinSITE is to promote the role of women in science, technology and innovation (STI) and to analyze how STI can help improve women's lives and livelihoods. Following the workshop, a series of papers and surveys were commissioned in different regions to identify key gender issues affecting national and regional STI policies and programmes.

OWSD collaborates with IAP, the global network of science academies, largely through the IAP Women for Science Programme. OWSD is also a member of INAS's Women for Science Working Group and has partnered with NASAC to develop an initiative for women in science with academies in sub-Saharan Africa.

For more information about OWSD, see *www.owsdw.org* or contact *info@twows.org*.

IAP, THE GLOBAL NETWORK OF SCIENCE ACADEMIES

IAP, the global network of science academies, focuses on coordinating programmes for capacity building among the world's merit-based science academies.

With the election of the Lebanese Academy of Sciences in 2010, IAP's membership has reached 104.

In January 2010, IAP held its triennial General Assembly and an international conference on biodiversity in London. The events, hosted by the Royal Society, coincided with the celebration of the Society's 350th anniversary. The international conference, which marked the inaugural event of the International Year of Biodiversity, provided an opportunity for science academy members and policy officials to discuss issues associated with the conservation and sustainable use of biodiversity. David Miliband, then UK Foreign Secretary on Science and International Cooperation, gave the keynote address. Participants issued a communiqué on biodiversity, circulated widely to organi-

zations that included UNESCO and the Convention on Biological Diversity (CBD).

At the General Assembly, IAP members elected Mohamed H.A. Hassan, former president of the African Academy of Sciences and TWAS executive director, as co-chair from a developing country. He succeeds Chen Zhu, Minister of Health for China, who completed his six-year term. Hassan will serve with Howard Alper, who was re-elected to another three-year term as co-chair from a developed country. A new executive committee (EC) was also elected. The first

meeting of the newly elected EC was hosted by the Royal Netherlands Academy of Arts and Sciences in Amsterdam, in March 2010. At the meeting, the EC drafted an action plan, agreeing to a number of recommendations based on the following themes and goals:

IAP's programmatic agenda: As in previous years, the annual call for proposals from IAP members was issued in March. Thirty-eight proposals were received and sent for review. More than 50 reviewers were involved in the process. In November 2010, the EC met in Santiago, Chile, where IAP's programmatic agenda for 2011 was adopted. Fifteen proposals were selected. Topics included water supply and management, gender in science, science communication, energy and biosecurity.

Capacity building. As the lead academy for IAP capacity building programmes, TWAS awarded funding to five regional networks: NASAC, NASIC, AASA, CCC and IANAS. This programme pays special attention to building scientific capacity in developing countries. A key objective is to strengthen the role of academies in providing advice to governments on issues of national and global importance.

Throughout 2010, IAP funded and facilitated a number of activities organized by IAP members and the regional networks. These activities included:

- A joint IAP/IAC workshop, 'Inventing a Better Future: A Strategy for Building Regional Capacities in Science and Technology', organized by IANAS and hosted by the Brazilian Academy of Sciences, in Brasília, 21-23 July 2010.
- IAP regional workshop, 'Science Academies in Central and Southern Asia and their Role in Society', organized by the Turkish Academy of Sciences in Istanbul, 1-2 September 2010.
- A joint TWAS-IAP workshop, 'The Role of Academies in Promoting Regional Cooperation in STI in the Balkans', in Trieste, 9-10 September 2010.
- A joint IAP/IAC international seminar, 'Alternate Sources of Energy: Prospects and Options', organized by NASIC and hosted by the Pakistan Academy of Sciences in Islamabad, 14-15 October 2010.
- At a plenary session of the TWOWS General Assembly in Beijing in June 2010, IAP co-chairs presented the results of the joint IAP/IAC regional workshops on women for science. Following one of the regional workshop, IANAS established a Women for Science Working Group to advise IANAS and its member academies on ways to foster a climate that is more welcoming to women and to raise awareness among academies concerning gender issues encountered by women scientists.
- The third IAP Young Scientists Conference took place in September 2010 in Tianjin, China, in conjunction with the World Economic Forum's 'Annual Meeting of New Champions'. Following a call for nominations in February 2010, 126 nominations from 51 IAP member academies were reviewed. The committee

selected 58 young scientists from 36 countries, including 7 young scientists who returned to the conference to serve as "Young Scientist Mentors". In addition, six young scientists, nominated by the Chinese Academy of Sciences, attended as observers. Following the Conference, IAP Young Scientist Awards (USD10,000 each) were given to four participants who had established a research-business partnership with an entrepreneur they had met at the forum.

In 2010, IAP provided the Global Young Academy (GYA), which had been established the previous year, with startup funds. IAP member, *Leopoldina* in Germany, agreed to host the fledgling organization's secretariat.

Responding to a request by UN Secretary General Ban Ki-moon and IPCC Chair Rajendra K. Pachauri to the InterAcademy Council (IAC) to conduct an independent review of the Intergovernmental Panel on Climate Change (IPCC) processes and procedures, IAP members were invited to submit nominations for the review panel. The final IAC report, published August 2010, received extensive media coverage.

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

INTERACADEMY MEDICAL PANEL (IAMP)

IAMP membership currently comprises 69 medical academies and science academies with medical divisions that are committed to improving health and health-related research worldwide.

IAMP's General Assembly was held in June 2010 at *Akademi Sains Malaysia* in Kuala Lumpur. At the meeting, Jo Ivey Boufford, foreign secretary of the Institute of Medicine and president of the New York Academy of Medicine, USA, was elected IAMP co-chair from a developed country; Lai-Meng Looi, senior professor of pathology at the University of Malaya (UM) and senior consultant histopathologist to its Medical Centrem, in Malaysia, was subsequently elected by electronic vote, representing developing countries. A new executive committee (EC) was also elected.

Applications for membership from five academies were approved, bringing IAMP's membership to 69. The General Assembly also approved the statutes and rules of procedure that had been previously circulated to the membership.

In August, the membership endorsed a statement on the health of mothers and children previously drafted by the G8 Academies. The statement was launched at the UN Summit on the Millennium Development Goals in September 2010.

Another statement on the potential health benefits derived from climate change mitigation, drafted by IAMP working group and endorsed by a majority of members, was released at the UN Framework Convention on Climate Change (UNFCCC) in Cancun, Mexico, in November 2010.

Discussions at an EC meeting, held in conjunction with the World Health Summit in Berlin in October, focused principally on projects aimed at earning recognition for the organization to boost fundraising efforts. A proposal was received to organize a leadership training meeting in conjunction with the next World Health Summit for Young Physician Leaders. The need for an efficient communications strategy was underlined, and IAMP was invited to discuss the possibility of becoming the thematic network of health within IAP.

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

iamp
the interacademy medical panel

APPENDICES

2010 in Figures

In 2010, under the **TWAS-UNESCO Associateship Scheme**, TWAS appointed 31 developing-world scientists from 18 countries as associates. In addition, 46 associates carried out collaborative research at scientific institutions in 15 countries in the South: Argentina, Botswana, China, Ethiopia, India, Indonesia, Iran, Jamaica, Jordan, Mexico, Pakistan, South Africa, Syria, Taiwan and Thailand. The TWAS-UNESCO Associateship Scheme is supported by the OPEC Fund for International Development (OFID).

Geographical area	Awarded	Hosted
Africa and Arab region	20	6
Asia and Pacific region	10	21
Latin America and the Caribbean	1	4
TOTAL	*31*	*31*

In 2010, TWAS provided up to USD5,000 to support 21 **Scientific Meetings** in 16 developing countries. The meetings covered a range of disciplines, from bioinformatics of infectious diseases, to chemistry for food security and sustainable development, and integrated coastal zone management.

Geographical area	*TOTAL*
Africa and Arab region	12
Asia and Pacific region	3
Latin America and the Caribbean	6
TOTAL	*21*

In addition, 20 developing-world scientists from 14 countries, including four least developed countries (LDCs), received **TWAS Fellowships for Research and Advanced Training**. These were hosted by institutions in 12 countries: Argentina, Brazil, Cameroon, China, Congo, India, Jordan, Kuwait, Malaysia, South Africa, Taiwan, and Thailand.

Geographical area	Awarded	Hosted
Africa and Arab region	13	*7*
Asia and Pacific region	*7*	10
Latin America and the Caribbean	0	3
TOTAL	*20*	*20*

In 2010, TWAS awarded a total of 160 fellowship applications (including postgraduate, postdoctoral, visiting scholar fellowships, and research and advanced training fellowships), of which 152 were accepted.

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

Programme partner	Postgraduate fellowship		Postdoctoral fellowship		Visiting scholar	
	Awarded	Accepted	Awarded	Accepted	Awarded	Accepted
CNPq, Brazil	20	19	10	9	-	-
CAS, China	20	20	15	14	15	15
CSIR, India	6	6	2	2	-	-
DBT, India	7	5	5	5	-	-
IACS, India	1	1	0	0	-	-
S.N. Bose, India	3	2	0	0	-	-
USM, Malaysia	10	9	10	10	3	3
CONACyT, Mexico	1	0	4	4	-	-
CEMB, Pakistan	0	0	0	0	-	-
ICCBS, Pakistan	5	5	2	2	-	-
BIOTEC, Thailand	-	-	1	1		
ICIPE, Kenya	0	0	0	0	0	0
TOTAL	*73*	*67*	*49*	*47*	*18*	*18*

In 2010, 24 **TWAS Research Grants** of up to USD15,000 each were awarded to individual researchers in some 14 developing countries. Among these, 10 grants went to scientists working in seven countries in sub-Saharan Africa. Other grants went to scientists in Azerbaijan, Bangladesh, Indonesia, Korea DPR, Nepal, Uzbekistan and Vietnam.

Geographical area	Biology	Chemistry	Mathematics	Physics	*TOTAL*
Africa and Arab region	4	4	1	1	*10*
Asia and Pacific region	3	2	4	5	*14*
TOTAL	*7*	*6*	*5*	*6*	*24*

In 2010, 13 **TWAS Research Units** were funded in eight science and technology-lagging countries (from a list of 80 eligible countries) with grants of up to USD30,000 each. Of these, 11 were first-time awards and 2 were renewals.

Geographical area	Biology	Chemistry	Mathematics	Physics	*TOTAL*
Africa and Arab region	2	1	0	0	*3*
Asia and Pacific region	4	2	0	4	*10*
TOTAL	*6*	*3*	*0*	*4*	*13*

The **TWAS Research Professors in Least Developed Countries** (LDCs) programme was launched in 2005. In 2010, three research professors visited their respective host institutions.

TWAS Fellow	Country of residence	Field of expertise	Host institution in LDC	Year of appointment
Ahmed Abdullah Azad	Australia	Structural, Cell and Molecular Biology	BRAC University, Dhaka, Bangladesh	2005
Mahouton Norbert Hounkonnou	Benin	Physics	Department of Physics, University of Zambia, Lusaka, Zambia	2006
Hamet Seydi	Senegal	Mathematical Sciences	Faculty of Sciences, University of Abdou Moumouni, Niamey, Niger	2008

The **Joint Visiting Scientist Programme** is an initiative of TWAS, the International Council for Science (ICSU), the United Nations Educational, Cultural and Scientific Organization (UNESCO) and the United Nations University Institute for Advanced Study (UNU/IAS). It enables eminent scientists from developing and developed countries to visit institutions and research groups in developing countries. In 2010, four scientists travelled to their selected host institution.

Visiting scientist	Country of residence	Field of expertise	Host institution	Year of appointment
Carlos Santiago Andreo	Argentina	Plant biotechnology	Central Department of Biotechnology, Tribhuvan University, Kirtipur, Kathmandu, Nepal	2010
Akier Assanta Mafu	Canada	Food safety processing	Institute of Applied Techniques in Food Processing, Kimbese-City, Bas-Congo, Democratic Republic of Congo	2010
Shigeko Haruyama	Japan	Physical geography	University of Yangoon, Faculty of Science, Department of Geography, Yangon, Myanmar	2010
Laszlo Szabados	Hungary	Plant molecular biology; plant genetics; stress physiology; plant biotechnology	Faculty of Science, University of the Republic, Montevideo, Uruguay	2010

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Joanna Lacey

InterAcademy Medical Panel (IAMP)
Muthoni Kareithi

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

Financial Report 2010

FINANCE

The total amount of funds received for activities in 2010 was USD3,410,802. The main contributions were: the Ministry of Foreign Affairs, Italy (USD2,086,145); the Swedish International Development Cooperation Agency (Sida) (USD728,173); *illycaffè*, Trieste (USD99,955) and the Kuwait Foundation for the Advancement of Sciences (KFAS) (USD49,972).

In addition, it is estimated that partner organizations in the TWAS South-South Fellowships programme contributed some USD2 million in local (host country) expenses.

As of 31 December 2010, the TWAS Endowment Fund stood at USD12,180,417, with the target set at USD25 million. Donations in 2010 totalled USD101,744, including USD39,136 from the Ministry of Science and Technology, Iran; USD25,000 from the *Consejo Nacional de Ciencia y Tecnologia* (CONACYT), Mexico; USD28,860 from Academia Sinica, Taiwan, China; plus other small contributions amounting to USD8,748. Interest in 2010 totalled USD52,935.

TWAS FINANCIAL REPORT 2010 (IN USD)

INCOME[1]	
Balance	895,939
1) Ministry of Foreign Affairs, Italy	2,086,145
2) Swedish International Development Cooperation (Sida)	728,173
3) Accademia Nazionale dei Lincei, Italy	255,101
4) illycaffè, Trieste	99,955
5) COMSTECH, Pakistan	59,925
6) Microsoft Research Ltd, UK	63,459
7) Kuwait Foundation for the Advancement of Sciences (KFAS)	49,972
8) EuroAfrica-ICT (EC), Belgium	64,895
9) Other small contributions	3,177
10) Prior year adjustment	575,651
11) Interest income	11,265
12) Miscellaneous income	(28,243)
	4,865,414

EXPENDITURE	**Spent**
1) Prizes	
1.1) Trieste Science Prize	113,721
1.2) TWAS Prizes and Medals	125,811
1.3) Prizes for Young Scientists	33,000
Sub-Total for (1)	272,532
2) Research Grants	553,075
3) Fellowships, Associateships and Professorships[2]	
3.1) Fellowship Programmes	468,115
3.2) Associateship & Professorship Programmes	168,373
Sub-Total for (3)	636,488
4) Meetings	
4.1) Council and General Meetings[3]	55,461
4.2) Officers and Steering Committee Meetings and Meetings in Trieste	56,738
4.3) Scientific Meetings in the South	67,762
Sub-Total for (4)	179,961
5) Publications	314,840
6) Joint Projects	
6.1) TWAS Regional Offices	409,000
6.2) TWAS-AAS-Microsoft Project	72,488
6.3) TWAS/COMSTECH Research Grant	194,750
6.4) EuroAfrica-ICT Project	90,238
6.5) OWSD	126,319
6.6) TWAS-ICGEB-UNESCO Project	50,000
6.7) ICSU-TWAS-UNESCO Project	16,426
6.8) TWAS – ICTP Projects	264,692
6.9) AU – TWAS Young Scientists National Award	30,000
6.10) ISTIC – TWAS Project	22,616
Sub-Total for (6)	1,276,529
7) Operational Expenses	
7.1) Staff Costs	1,213,347
7.2) ICTP Services	129,745[4]
7.3) Communications	41,426
7.4) Travels	10,698
7.5) Library, office and other supplies	25,142
7.6) Other general operating expenses	23,725
Sub-Total for (7)	1,444,083
Total	4,677,508
Excess (shortfall) of income over expenditure	187,906

Audited by UNESCO

[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.*
[2] *Estimated local costs to be covered by host countries: US$ 2,000,000*
[3] *Estimated local costs covered by host country: US$ 500,000*
[4] *ICTP services for two years (2009 and 2010)*

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- the Kuwait Foundation for the Advancement of Sciences (KFAS)
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- Elsevier Foundation
- COMSTECH, Pakistan
- the European Union, Seventh Framework Programme (FP7)

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