4

YEAR 2007
VOL.19 NO.4

twas

TWAS newsletter

NEWSLETTER OF THE ACADEMY OF SCIENCES FOR THE DEVELOPING WORLD

Published with the support of the Kuwait Foundation for the Advancement of Sciences

TWAS PRESIDENT JACOB PALIS OPENED TWAS'S 18TH GENERAL MEETING, HELD AT THE ABDUS SALAM INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS (ICTP) IN TRIESTE, ITALY, NOVEMBER 2007, BY WELCOMING NEARLY 200 SCIENTISTS FROM 44 COUNTRIES TO THE EVENT. IN HIS ADDRESS, PALIS OUTLINED THE ACADEMY'S ACCOMPLISHMENTS TO DATE AND DESCRIBED THE CHALLENGES THAT LIE AHEAD AS TWAS SEEKS TO STRENGTHEN AND EXPAND ITS ACTIVITIES ON THE EVE OF ITS 25TH ANNIVERSARY. EXCERPTS FROM HIS ADDRESS FOLLOW.

Palis Opens General Meeting

I would like to welcome you to the 18th General Assembly of TWAS. It is indeed a pleasure to be with so many friends and colleagues.

It is the Academy's intellectual capacity that makes the organization special to the outside world. But it is our friendship and camaraderie that makes meetings like these special.

I would like to take this opportunity to thank our closest partners: the United Nations Educational, Scientific and Cultural Organization (UNESCO), which has served as our 'parent' organization for nearly 20 years, and the Italian government, which has generously provided crucial funding for our organization since its inception. The global credentials provided by UNESCO and the financial backing provided by the Italian government are two of the primary reasons for our success. TWAS is indeed indebted to both.

I would also like to thank ICTP and its director, K.R. Sreenivasan (TWAS Associate Fellow 1998). Since our inception, ICTP has welcomed TWAS onto its campus and provided a home for our secretariat. We are indeed thankful for the Centre's enduring hospitality, which became evident once again when the director graciously answered our call to move this meeting's venue to Trieste and to have ICTP host the event.

The present meeting was originally scheduled to take place in Islamabad, Pakistan. But the difficult political circumstances there prompted us to discuss the issue with our colleague, Atta-ur-Rahman (TWAS Fellow 1985), head of the Higher Education Commission in Pakistan. Based

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Published quarterly with the support of the Kuwait Foundation for the Advancement of Sciences (KFAS) by TWAS, the academy of sciences for the developing world
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PRINTING
Stella Arti Grafiche, Trieste

on Atta-ur-Rahman's kind understanding of our concern and the rapid response from Sreenivasan inviting us to relocate the meeting to ICTP, we were able to make the change. The hard work and dedication of the TWAS secretariat, under the guidance of our executive director Mohamed H.A. Hassan, allowed us to organize the event in just six weeks. This was no easy task and we are thankful to the Academy's skilled staff for succeeding under such a tight and unforgiving deadline.

We would also like to express our appreciation to our Pakistani colleagues for agreeing to move their session on science and technology in Pakistan from Islamabad to Trieste on such short notice. TWAS views our trip to Islamabad as a postponement, not a cancellation, and we pledge to hold a future meeting of the Academy in Pakistan so that we can witness firsthand the progress in science and technology that has taken place there.

ICTP, the internationally renowned centre of scientific training and research, created by Abdus Salam, is sacred ground for many scientists from the developing world. Indeed many of us owe our success to Salam's ability to transform his vision into reality and to graciously take us along on his journey. ICTP and TWAS represent Salam's two most enduring monuments to his legacy. As a citizen of Pakistan, one of Salam's fondest dreams was to see his native country transformed into a nation of vast scientific and technological capacity – a place where science and technology would serve as the basis of prosperity and well-being for all citizens. Recent progress in scientific and technological capacity building in Pakistan provide us with hope that the dream is being realized.

Given the location of this meeting and given the ominous events that have recently transpired in Pakistan, I think it is appropriate that we call attention to some of Salam's most stirring words: "Scientific heritage," he often said, "is the common heritage of all humankind, one of the unifying forces among the people of this globe."

In these troubled times, when many people have chosen to exploit our differences instead of celebrate our commonalities, it is comforting to note Salam's inspiring words about the role that science can play not only in promoting our material well-being but also in promoting social harmony. The nearly 200 scientists participating in this conference, representing more than 40 countries, are a realization of Salam's compelling vision and a confirmation of TWAS's lofty mission.

The Academy is dedicated to building scientific excellence across the developing world and to promoting science as a global enterprise with global benefits. Indeed, the pursuit of scientific excellence has been TWAS's primary goal since the Academy's inception, and it remains its primary goal today. In seeking to realize this goal, we are striving to fulfil Salam's grandest vision.

Yet, we must also recognize that the circumstances in which TWAS operates have changed dramatically since we began our noble journey nearly a quarter century ago. And that is one of the key reasons for the Academy's success has been its uncanny ability to change with the times.

EXCELLENCE NOW

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

First, it means continuing to elect the most eminent scientists from the developing world as members of TWAS. Yet it also means electing scientists from a diverse set of developing countries. The 44 scientists who are being officially inducted into the Academy in 2007 come from 17 countries, including Iraq, Nepal and Tunisia. Overall, TWAS now has more than 850 members representing more than 90 countries. Their accomplishments speak directly to the Academy's quest for excellence. And their diversity signals the Academy's commitment to the entire developing world.

Second, it means both honouring and rewarding the best science in the developing world through prizes and awards. That is why we are so pleased to have the winners of the 2007 Trieste Science Prize – Luis Herrera-Estrella from Mexico and Goverdhan Mehta from India – with us at the conference. The Trieste Science Prize, which is generously funded by illycaffè whose headquarters are also located here in Trieste, is designed to honour the developing world's top scientists. Let me express my deep appreciation to illycaffè for supporting what has become an internationally renowned prize in just three short years. Ernesto Illy, the patriarch of illycaffè and an accomplished scientist in his own right, has graciously joined us at this ceremony. We welcome both his presence and support.

Third, it means ensuring that we provide opportunities to recognize the work of young scientists. That is why I am especially pleased to note the presentations that will be given by scientists who have been selected as TWAS young affiliates. Their talks will range from applications of nanobiotechnology in Ethiopia to examinations of thin film solar cells in Malaysia. The efforts of these talented young scientists is testimony to the broad range of excellent scientific research currently being pursued across the developing world. It should help raise our confidence that the future is indeed in good hands.

Fourth, one of the most significant, yet neglected, areas of our work has been our ability to engage the public in what we do and to successfully convey to them why it is important. That is why I am happy to note the lecture of Pervez Hoodbhoy, who will speak about science education and the public understanding of science. Hoodbhoy is both an internationally renowned physicist and a well-respected advocate of educational and democratic reform in his home country of Pakistan. These are, I am sure, interesting times for him – perhaps too interesting – and we are happy to have him join us to discuss a topic of such critical concern. Hoodbhoy will be receiving the first-ever TWAS Regional Office for Central and South Asia (ROCASA) Prize for the Public Understanding of Science.

And, fifth, one of the most important functions that TWAS – indeed any science academy – can have is to advise governments on critical issues related to science-based development. That is why I am delighted to acknowledge the presence of Atta-ur-Rahman, head of the Higher Education Commission and former minister of science and technology in Pakistan. Atta-ur-Rahman, the chief architect of Pakistan's successful efforts to boost scientific and technological capacity, will lead a symposium on this critically important topic.

What will transpire over the next two days represents just a sampling of the Academy's broad-ranging activities – all designed to promote scientific excellence and science-based sustainable development in the developing world. There are the TWAS Prizes to Young Scientists in Developing Countries that are awarded in collaboration with national science academies and ministries in the developing world. There are the newly created Regional Conferences for Young Scientists. There are the TWAS Research Grants that are among the most coveted research awards in the South. There are Grants to Research Units in scientifically and technologically lagging countries that are targeted to boost the quality of research among individuals and institutions functioning under trying conditions. There are the TWAS Associateships and Research Professor programmes, both designed to promote South-South and South-North scientific exchange. And there are the TWAS Fellowships for Postgraduate and Postdoctoral Training, the world's largest programme of its kind, which we operate in partnership with Brazil, China, India and Pakistan.

TWAS also works closely with its associated organizations whose secretariats are located here on the Miramare campus in Trieste – the Third World Organization of Women in Science (TWOWS), the InterAcademy Panel (IAP) and the InterAcademy Medical Panel (IAMP).

And we have also launched collaborative projects with our scientific colleagues in Italy. For example, we have entered into a partnership with the International Centre for Genetic Engi-

neering and Biotechnology (ICGEB) to promote research on plant tolerance to abiotic stress. And we have collaborated with Forgea International, a geo-mining and environmental training institution in Sardinia, to organize four workshops dealing with a broad range of environmental issues.

TWAS's national chapters and regional offices extend the Academy's reach, and our extensive publication programme helps to get the word out on what we do both nationally and internationally.

It is, I am proud to say, an impressive list of accomplishments. We are, by many measures, the little institution that accomplishes big things. But if we are to continue to succeed and to have a strong impact on science and development in the developing world in the future – to punch above our weight, so to speak – then we must strive to do even more. Here are some of the major challenges that lie ahead as we move toward our 25th anniversary next year.

First, we must continue to expand our programmes for South-South cooperation, most notably our Fellowship Programme for Postgraduate and Postdoctoral Training.

The fellowship programme, in many ways, represents the future of the Academy and, more importantly, the future of science in the developing world. As a result, we must entice additional countries to join and expand our efforts.

Second, we must continue to develop and enhance programmes that address the needs of scientists and scientific institutions that have been left behind.

This means, for example, securing additional funding for women scientists and it means focusing special attention on such regions as sub-Saharan Africa.

Third, we must continue to expand our efforts to help young scientists in the developing world. The Regional Conferences for Young Scientists is a noteworthy beginning in this effort.

But more needs to be done. The Academy's destiny lies not only in geographical and gender diversity; it also lies in demographic diversity. Youth, in short, must be served if the future of science and society is to be served.

Fourth, we must continue to strengthen the TWAS secretariat to ensure that our internal capacity matches our expanding profile and increasing level of activities.

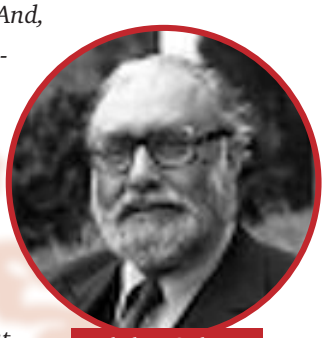
Fifth, we must work aggressively to reach our US$25 million target for the TWAS endowment fund. The Italian government's generosity has enabled us to do great things. With an adequate endowment fund in place we will be able to do even greater things.

And sixth, we must take measures to position ourselves in the centre of the global world of science that is unfolding before our very eyes. This means working closely not only with our

partners in the South but also with our colleagues in the North. We have made great progress in promoting South-South and North-South collaboration at the highest levels of scientific expertise. But again, we can and must do more.

Next year will mark the 25th Anniversary of TWAS. José Morán López (TWAS Fellow 1991 and currently the Academy's treasurer) promises that it will be a gala affair. Silvia Torres-Peimbert (TWAS Fellow 2001), an eminent scientist at the Institute of Astronomy at the University of Mexico, will provide a preliminary look at the Academy's Jubilee celebration at the close of this meeting. We will indeed have a great deal to celebrate. Our efforts over the next year, moreover, will undoubtedly provide even greater proof of the Academy's value to society.

Despite the Academy's success, let us never forget that the tasks that lie before us are, in fact, tasks without end. I say that in a positive way. That's because what we do involves improving the well-being of both science and society in the developing world. And, as the prospects for both science and society improve, so too will the standards by which success is defined.



Abdus Salam

Let me conclude with another enduring quote by our founder Abdus Salam, this one presented on the occasion of the Academy's first meeting, held here in Trieste, in the summer of 1985. The title of the meeting, appropriately enough, was 'South-South and South-North Cooperation in the Sciences.'

"We tend to forget," Salam said, "that it is the science of physics that brought about the modern communications revolution and gave real meaning to the concept of one world and its interdependence.

"We tend to forget," he continued, "that it is the science of medicine that brought about the penicillin revolution.

"We tend to forget it is the sciences of chemistry and genetics that brought about fertilizers and the Green Revolution.

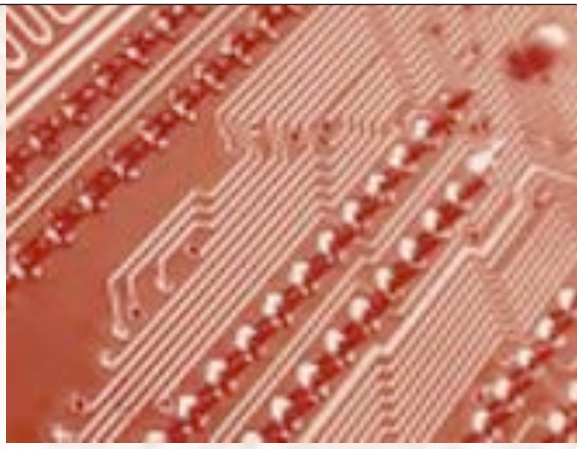
"And we tend to forget that it is to these sciences that the developing world must turn to for resolutions of its present problems."

Salam would be delighted to know that the role of the sciences in the developing world has not been forgotten. In fact, it is more prominent now than ever before. ■

Jacob Palis
TWAS President
Trieste, Italy

PUBLICATION OUTREACH

ON 22 OCTOBER 2007, THE *TWAS NEWSLETTER* JOINED A COORDINATED GLOBAL EFFORT TO PUBLISH ARTICLES ON SCIENCE, TECHNOLOGY, PUBLIC HEALTH AND HUMAN DEVELOPMENT DESIGNED TO EXAMINE AND ADVANCE THE MILLENNIUM DEVELOPMENT GOALS.



More than 230 science journals worldwide simultaneously released articles exploring issues related to "poverty and human development". Topics under discussion included food security, the spread of infectious diseases, child and maternal healthcare, the physician brain drain from developing countries and the use of satellite technology to examine and anticipate disease outbreaks.

The project's twin objectives were to raise public awareness and to showcase scientific and policy research on critical global concerns related to poverty and development. The timing of this project coincided with the midway point in United Nations efforts to meet the targets of the Millennium Development Goals (MDGs). The MDGs were unanimously endorsed by the member states of the UN in 2000 as a way to chart progress towards overcoming the most serious obstacles standing in the way of sustainable well-being in the developing world.

The Council of Science Editors (CSE) – formerly known as the Council of Biology Editors – organized the initiative. The John E. Fogarty International Center for Advanced Study and the US National Library of Medicine, both part of the US National Institutes of Health (NIH) in Washington, DC, served as the primary sponsors.

Among the diverse publications participating in the initiative were *African Health Sciences*, *Archives of Iranian Medicine*, *Cell*, *Lancet*, *Journal of Poverty*, *Nature*, *Science*, *Sudanese Journal of Public Health* – and the *TWAS Newsletter*.

Planning for the project began several years ago when the CSE decided that it might be able to make a modest contribution to help advance the MDGs by encouraging science journals around the world to simultaneously examine topics related to poverty and human development. CSE created a 50-member task force, led by Paul Bozuwa, president of Dartmouth University's Journal Services, and Richard Horton, editor-in-chief, *The Lancet*, to move the concept forward.

By signing on to the MDGs, UN member nations pledged to halve extreme poverty and hunger, improve access to safe drinking water by 50 percent, provide universal primary education to all children, promote gender equality, reduce child mortality, improve maternal health and ensure environmental sustainability. The benchmark for measuring progress is 1990. The date for determining whether the targets have been met is 2015. As a result, July 2007 marked the halfway point in efforts to meet the MDGs.

Experts who have analysed trends in health and economic and social well-being in the developing world have concluded that many – indeed most – of the targets will not be met. Yet, it is also true that significant progress has been made on many fronts.

For example, it is likely that the number of people living on less than US$1 a day (the criteria most experts use to define extreme poverty) will be cut in half. Specifically, by 2015, the percentage of people in the developing world living in such dire conditions is expected to decline to 16 percent; in 1990, the figure stood at 32 percent.

Much of the progress in reducing poverty is due to the unprecedented economic growth of China and India, which together account for nearly half of the developing world's population.

Progress in sub-Saharan Africa has been much slower, and experts project the continent will not meet any of the MDGs. It is estimated, for example, that the number of people living in extreme poverty in sub-Saharan Africa fell just five percent between 1999 and 2004, from 46 percent to 41 percent, a pace far too slow to achieve the 2015 target. Sub-Saharan Africa will also fail to meet the MDG of universal primary education, although the percentage of children attending school throughout the region rose from 57 percent in 1999 to 70 percent in 2005.

Proponents of 'The Global Theme Issue on Poverty and Human Development' believed that having a large number of science, medical and economic development journals, including some of the world's most eminent publications published in both the North and the South, examining these issues at the same time would not only create a critical mass of new information and insights, but also capture global attention. Some of the participating journals dedicated an entire issue to the subject. Others published a few papers and still others issued an editorial.

The project, which began with a handful of journals, ultimately grew into the largest publication initiative of its kind. The official launch took place 22 October on the NIH campus in Washington, DC. Elias Z. Zerhouni, director of the NIH, gave the opening address. Fiona Godlee, editor-in-chief,

British Medical Journal (BMJ), also spoke. The 'kickoff' event was designed to promote the initiative as well as to highlight some of the best research that was being published by participating journals.

Biomedical journals successfully sponsored two previous explored these critical issues in such a concentrated period of time.

The organizers hope that this initiative will serve as a precedent for the intensely competitive publishing world, illustrating that working in concert has benefits the pace of progress that will be made in meeting the MDGs.

The *TWAS Newsletter*'s contributions also focused on broad scientific and technological challenges faced by two distinctly different places in the developing world: Brazil, which has made

global theme issues. In January 1996, some 36 journals in 21 countries published more than 200 articles examining emerging and re-emerging global microbial threats. In 1997, nearly 100 journals in 31 countries published a wide range of articles focusing on the theme of ageing.

With 235 journals participating in the Global Theme on Poverty and Human Development, this marked the largest and most ambitious effort to date. Never before had so many scientists, technologists, journalists and researchers both for the fields of inquiry that the journals represent and, more importantly, for the critical societal issues that the publications seek to examine.

The TWAS Public Information Office was delighted to join initiative and used the occasion to put the spotlight on a broad range of articles related to poverty and development previously published in the *TWAS Newsletter.* Among the issues examined were public health and the status of women scientists in the developing world, both of which will have a direct bearing on substantial progress in building its scientific capacity, and the countries of sub-Saharan Africa, which continue to lag behind. ■

For additional information about 'The Global Theme on Poverty and Human Development', see www.councilscienceeditors.org. *To browse the contributions of the TWAS Newsletter to this initiative, see* www.twas.org/CSE.html.

TWAS'S 18TH GENERAL MEETING

THE 18TH GENERAL MEETING OF TWAS WAS HELD FROM 13 TO 14 NOVEMBER 2007 ON THE CAMPUS OF THE ABDUS SALAM INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS (ICTP) IN TRIESTE, ITALY. NEARLY 200 SCIENTISTS FROM 44 COUNTRIES WERE IN ATTENDANCE.

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

The meeting in Trieste was pared down in light of the difficulty of re-organizing the event at a new venue on such short notice. Nevertheless the major elements of the original meeting were kept in place. These included:

- A symposium, led by Atta-ur-Rahman (TWAS Fellow 1985), head of Pakistan's Higher Education Commission and former minister of science and technology, on the current state of science and technology in Pakistan (see pp. 22-28).
- A broad-ranging lecture by Pervez Hoodbhoy, professor of nuclear physics and chair of the physics department at Quaid-i-Azam University, Islamabad, on the state of science education with a focus on the current state of affairs in Pakistan. Hoodbhoy attended the conference to receive the first-ever TWAS-ROCASA (Regional Office for Central and South Asia) award for contributions to the public understanding and popularization of science (see pp. 29-33). The winners of the other regional awards, each of whom will receive a US$3,000 cash prize, were also announced at the conference. These include: in Latin America and the Caribbean: Robert Lent, professor of neurosciences and director of the Institute of Biomedical Sciences, Federal University of Rio de Janeiro; in the Arab region: Adnan Hamoui (TWAS Fellow 1988), editor-in-chief, Arab edition of *Scientific American* and consultant with *Ajman University Journal*; and in Africa: Christina Scott, the first African news editor of the web portal *Science and*

TWAS ENDOWMENT GROWS

The TWAS Endowment Fund, launched in 1993, recently surpassed its initial target of US$10 million thanks to contributions from the governments of Brazil, India, Nigeria, Mexico and Iran. In 2003, the TWAS Council agreed to raise the target to US$15 million. Next year the Academy will renew its appeal for additional contributions by launching a Jubilee Endowment Fund Campaign in conjunction with the Academy's 25th anniversary. The Council has also raised the target to US$25 million.

Development Network (*scidev.net*) and a well-known media and broadcast personality in South Africa who focuses on issues of science and technology on the African continent. Next year's regional prizes, to be announced at the TWAS 19th General Meeting in Mexico City, will be given to individuals who have made significant contributions to the development of science curricula and educational material for school-age children.

- The granting of TWAS Young Affiliate status to promising scientists under the age of 40 who live and work in developing countries. Twenty-four scientists (up to five chosen by each of TWAS's regional offices) were selected for this honour, which, like the regional prizes for the promotion of public understanding and the popularization of science, was being given for the first time in the history of the Academy. Sixteen of the TWAS Young Affiliates attended the conference to be welcomed into the TWAS family and to lecture about their research. Topics ranged from innovative applications of forensic DNA analysis in the Philippines to an examination of whether advances in nanotechnology could soon help medical practitioners diagnose diseases in Ethiopia and other nations in sub-Saharan Africa. "Listening to these young scientists explain their research," noted TWAS president Jacob Palis, "truly confirms that high-level scientific knowledge is taking hold at universities and research centres throughout the developing world". The Young Affiliates programme is one of several initiatives that TWAS plans to pursue in the coming years to help ensure that the next generation of

scientists in the developing world receives the recognition and support that it needs and deserves.

Other highlights at the TWAS 18th General Meeting include:

- The election of 45 new members to the Academy. The class of 2007, which includes scientists from Mongolia, Oman (for the first time ever), Sudan and Venezuela, was chosen from a candidate pool of nearly 200 scientists nominated by current members. "The candidates for 2007," noted C.N.R. Rao, immediate past president of TWAS, "constituted the best pool of candidates that the Academy has ever had to consider. The high level of accomplishment represented by these scientists made the selection process difficult. But it also helped to ensure that those who were chosen were among the most eminent scientists in the developing world and therefore worthy of this honour." Among the 45 new members were eight women scientists. This marks the largest number of women ever elected to TWAS in a single year. The Academy's membership now totals 880, representing 90 countries.
- Official membership certificates were also given to the 44 scientists who had been elected to TWAS in 2006. Some 17 members travelled to Trieste to receive their certificates in person.
- The members gave final approval to the revised Academy statutes and bylaws. Juan Roederer (TWAS Associate Fellow 1991) headed the Academy's statutes and bylaws committee. The committee benefited from the expertise of Albert Koers, an eminent law professor who has taught at the University of Utrecht and Harvard University and who served as the executive director of the InterAcademy Council (IAC) from 2001 to 2005. As Juan Roederer noted: "Approval of the statutes reflects the Academy's transformation from a small institution, where decisions have often been made on an informal *ad hoc* basis, into a large and sophisticated organization requiring a more formal structural framework to operate more smoothly and effectively. These documents should help guide the Academy in the years ahead as the level of its activities and range of operations continue to expand."
- The holding of the first 'exchange' meeting among the coordinators of TWAS's five Regional Offices, chaired by TWAS president Jacob Palis. Varadachari Krishnan (TWAS Fellow 1996), Hindustan Lever research professor at Jawaharlal Nehru Centre for Advanced Scientific Research, represented the Regional Office for Central and South Asia (TWAS-ROCASA) in Bangalore; Iba Kone, acting executive director, African Academy of Sciences, represented the Regional Office for Sub-Saharan Africa (TWAS-ROSSA) in Nairobi, Kenya; Bai Chunli (TWAS Fellow 1997 and currently TWAS vice-president for east and southeast Asia), executive vice-president, Chinese Academy of Sciences, represented the

The Academy's membership now totals 880, representing 90 countries.

Regional Office for East and Southeast Asia and the Pacific (TWAS-ROESEAP) in Beijing; Carlos Aragão de Carvalho, director, Scientific and Technological Funding Agency of the Brazilian Academy of Sciences and professor of physics at the Federal University of Rio de Janeiro, represented the TWAS Regional Office for Latin America and the Caribbean (TWAS-ROLAC) in Rio de Janeiro; and Mohamed M. El-Faham, director of the Centre of Special Studies and Programmes, *Bibliotheca Alexandrina*, represented the Arab Regional Office (TWAS-ARO) in Alexandria, Egypt.

The broad-ranging discussions examined different strategies for publicizing regional events and activities; procedures for the selection of regional prize winners; better ways to identify excellent scientists, especially in nations that are not well represented in the Academy; efforts to foster closer ties between TWAS regional and national offices through joint activities and programmes; and opportunities for maximizing the communication opportunities afforded by the internet. New web portals will soon be up-and-running at each of the regional offices. The portals will operate on an upgraded electronic platform, enabling the regional offices to be easily linked both to one another and to the main TWAS website in Trieste. This will help foster a common 'organizational' image and, more importantly, the rapid exchange of information. TWAS's executive director, Mohamed H.A. Hassan, congratulated the regional coordinators for creating efficient 'can-do' offices that are remarkably free of bureaucracy. "These offices," he noted, "are beginning to fulfil their promise as institutions that not only extend the reach of the Academy but also make significant contributions in their own right." The regional coordinators agreed to schedule annual meetings for the purposes of sharing ideas and discussing issues of mutual concern. The meetings are likely to take place in conjunction with TWAS general meetings.

TWAS's Regional offices are beginning to fulfil their promise.

MURENZI ON BOARD

Romain Murenzi has replaced Lydia Makhubu on the TWAS Council. He will serve as vice-president for Africa for the remainder of the term until 2009. Murenzi, who holds a doctorate in physics from the Catholic University of Louvain in Belgium, is Minister of Science and Technology in Rwanda, where he has served as one of the chief architects of one of the world's most dramatic turnarounds in science-based sustainable development. Makhubu (TWAS Fellow 1988), professor emeritus of chemistry at the University of Swaziland and currently a member of parliament in Swaziland, has served on the TWAS Council since 1997. She was also president of the Trieste-based Third World Organization for Women in Science (TWOWS) from the organization's inception in 1993 until 2005. Makhubu stepped down from the Council for health reasons. Her vast experience, deep knowledge and unstinting commitment to the advancement of science and technology in the developing world and her tireless efforts on behalf of women scientists in the South will be sorely missed. For a profile of Makhubu's career, see "One Woman's Journey", TWAS Newsletter, *2005, vol. 17, no. 3, p. 38.*

- The presentation of TWAS Prizes to seven of the eight eminent scientists from the developing world honoured this year: in the agricultural sciences, Heong Kong-Luen, International Rice Research Institute, Los Baños, Philippines; in biology, Pedro León-Azofeifa, National Centre for Advanced Technologies, San José, Costa Rica; in the earth sciences, Rengaswamy Ramesh (TWAS Fellow 2007), Physical Research Laboratory, Ahmedabad, India; in the engineering sciences, Chang Chun-Yen, National Chiao Tung University, Hsinchu, Taiwan, China; in mathematics, Claudio Landim, Institute of Pure and Applied Mathematics, Rio de Janeiro, Brazil; in chemistry, Che Chi-Ming, University of Hong Kong, China; and in physics, Dipankar Das Sarma (TWAS Fellow 2007), Centre for Advanced Materials, Indian Association for the Cultivation of Science, Kolkata, India. Jacinto Convit, Institute of Biomedicine, Caracas, Venezuela, was awarded the TWAS Prize in the medical sciences *in absentia*.
- Presentations by the Trieste Science Prize winners for 2007: Luis Herrera-Estrella (TWAS Fellow 2004), National Laboratory of Genomics for Biodiversity, Centre of Advanced Research and Studies, Guanajuato Campus, Mexico, who won in the category of agricultural sciences, and Goverdhan Mehta (TWAS Fellow 1993), Department of Organic Chemistry, Indian Institute of Science, Bangalore, India, who won in the chemical sciences. The Trieste Science Prize is generously funded by the Trieste-based illycaffè, one of the world's preeminent coffee manufacturers. Ernesto Illy, the patriarch of illycaffè and a gifted scientist and strong supporter of Trieste's scientific institutions, attended the event. Herrera-Estrella and Mehta had previously spoken about the research that had earned them the Trieste Science Prize, at the international science fair *Fest* in Trieste (see *TWAS Newsletter*, vol. 19, no. 2, pp. 8-17). This time, both gave more scientific lectures to fit the interests of

The discussion focused on how TWAS could move forward even more effectively.

their scientific audience largely comprised of TWAS members. Herrera-Estrella spoke about his path-breaking studies of the soil bacterium, *Agrobacterium tumefaciens*. These efforts, which took place in the 1980s, led to the development of the first transgenic crops. Today such crops, which are grown on 100 million hectares in 20 different countries, play a key role in improving plant resiliency to insects, diseases and herbicides. Mehta spoke about the science of organic synthesis, a field of chemistry that focuses on the creation of diverse molecular architectures. Such efforts often lead to the synthesis of novel molecules that can serve as platforms for the discovery of new drugs, especially drugs for emerging diseases.

- A medal lecture was given by Hernán Chaimovich (TWAS Fellow 2000), Department of Biochemistry, Institute of Chemistry, University of São Paulo, Brazil, who spoke about molecules with hydrophobic and hydrophilic properties that enable them to associate spontaneously in solvents, including water. "Such molecules", Chaimovich noted, "can assume diverse shapes ranging from single layers to spheres". In addition to the intellectual challenges that these molecules pose for basic science (related to studies of surfaces and complexity), they also hold promise in such areas of applied science as drug delivery and oil extraction.
- The selection of TWAS Medal Lectures for 2008: José de la Peña (TWAS Fellow 2003), professor, Institute of Mathematics, National Autonomous University of Mexico; M.R.S. Rao (TWAS Fellow 2002), president, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore; Anwar Nasim (TWAS Fellow 1987), science advisor to the Organization of Islamic Conference's Standing Committee on Scientific and Technological Cooperation (COMSTECH), Islamabad; and Keto Mshigeni (TWAS Fellow 1987), vice-chancellor, Hubert Kairuki Memorial University, Dar es

Salaam, Tanzania. The latter two scientists had been selected to deliver Medal Lectures in 2007 but they were unable to attend the meeting in Trieste. The Council agreed to move their awards ceremony and presentations to the 2008 General Meeting in Mexico.

Like all previous General Meetings, TWAS members were given ample opportunities to express their opinions and concerns, both informally and during a two-hour membership meeting. And, as in all previous General Meetings, the members had no shortage of ideas and comments on how the Academy might strengthen its activities and programmes in the future.

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

The discussion focused on how TWAS could move forward even more effectively. Topics ranged from the impact that the dramatic decline in the value of the dollar was having on the Academy's budget to whether TWAS should create a new category of awards and prizes in support of science-based innovations that are having a direct bearing on economic development in the developing world.

Syed Muhammad Qaim (TWAS Fellow 2001), Institute for Nuclear Chemistry, Jülich, Germany, and Vincent Pryde Titanji (TWAS Fellow 2004), vice chancellor, University of Buea, Cameroon, both expressed admiration for the accomplishments of TWAS. But both suggested that it should do more to help scientists and scientific institutions in least developed countries (LDCs). Mohamed Hassan agreed that limited funding posed a significant handicap which has affected the Academy's ability to help scientists most in need. He added, however, that the problem would be addressed – and hopefully alleviated to a degree – next year, thanks to the renewal of a grant from the Swedish International Development Agency (Sida) that will allow the Academy to award an additional number of research grants at a level of US$30,000 instead of US$10,000 (the latter has been the standard level of funding until now). The three-year grant extension will also enable TWAS to fund some 20 new research units a year for the next three years in least developed and scientifically lagging countries. As a result, Hassan said, the Academy should be able to assist a much larger number of eligible candidates in LDCs and science-poor countries.

Maurizio Iaccarino (TWAS Associate Fellow 1997), former assistant director-general for natural sciences at UNESCO, requested an update on the status of the Consortium on Science, Technology and Innovation in the South (COSTIS), a joint initiative forged between the

international scientific institutions based in Trieste (under the banner of the Trieste System) and the Group of 77, the largest network of member states in the United Nations promoting the interests of developing countries. COSTIS was created at the TWAS 10th General Conference held in Angra dos Reis, Brazil, in September 2006. TWAS president Jacob Palis explained that COSTIS held great potential for advancing science and technology in the developing world. However, efforts to transform the organization from a grand concept into a concrete reality were unfolding more slowly than anticipated. Palis added that he hoped to meet with Ambassador Dumisani Kumalo, South Africa's permanent representative to the UN and the driving force behind the creation of COSTIS, to discuss ways to move COSTIS forward. He stated that he would report back to the membership about the outcome of this meeting.

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

Jorge Eduardo Allende (TWAS Fellow 1985), professor, Institute of Biomedical Sciences, University of Chile, inquired whether the Academy could take steps to shield its budget from the devaluation of the dollar. He observed that while TWAS's funds are held in dollars, most of the organization's staff costs and operational expenses were paid out in Euros. Hassan noted that he and Palis had visited TWAS's parent organization, UNESCO, which manages the Academy's funds. They were told that UNESCO was reviewing its monetary policies because it too was concerned about the adverse impact that the dollar's decline was having on the organization's purchasing power. Hassan noted he would monitor the situation and discuss the matter further with UNESCO.

Next year will mark the 25th anniversary of TWAS

At the closing ceremony of TWAS's 18th General Meeting, Palis noted that the meeting's success (a sentiment expressed by many of the participants) set the stage for an even grander event next year in Mexico City. He once again thanked ICTP for agreeing to hold the meeting in Trieste following the decision to move the venue from Islamabad. He also expressed thanks to the TWAS staff for their hard work in organizing this event on such short notice. Palis added that TWAS planned to hold a General Meeting of the Academy in Pakistan sometime after the Jubilee celebration in Mexico.

"Next year," he noted, "will be a special time for the

MEXICO CITY TO HOST JUBILEE CELEBRATION

The TWAS 19th General Meeting and Jubilee Anniversary Celebration will take place at the Mexican Academy of Sciences in Mexico City from 11-13 November 2008. José Luis Morán López, TWAS treasurer and professor at the Department of Advanced Materials for Modern Technology at the Institute of Science and Technology in San Luis Potosí, Mexico, stated that plans are well underway for the event and he extended a warm invitation to all TWAS members to attend what promises to be a gala affair. Mexico's National Council for Science and Technology and the Ministry of Public Education will generously sponsor the meeting. In addition to the usual prize and medal presentations and talks by next year's group of TWAS Young Affiliates, there will be a series of special Jubilee lectures focusing on issues of critical importance to the future of science. The lectures are to be given by some of the world's most eminent scientists. For example, Nobel Laureates Mario Molina (TWAS Fellow 1996) and Harold Varmus have agreed to speak. There will also be a half-day seminar on the state of science and technology in Mexico and a broad examination of TWAS's past and future as the Academy seeks to build on the success of its first quarter century of existence. For additional information about the TWAS Jubilee Celebration, contact info@twas.org.

Academy. The 25th anniversary will provide ample opportunities for both celebration and reflection. And the Academy," he enthusiastically added, "plans to do both.

"Over the past quarter century, we have indeed accomplished a great deal together," Palis said, "and we do indeed have a great deal to be proud of.

"Yet," he added, "a great many challenges still lie before us: challenges posed by broad sectors of the scientific community that have yet to share fully in our progress, including young scientists, women scientists and researchers working in least developed and scientifically lagging countries. Challenges posed by the growing number of international problems that cannot be addressed without science: global warming, food and energy security, and access to safe drinking water, for example. And challenges posed by transferring our scientific knowledge to society to ensure that we do not become honoured but insulated minorities within our own nations. We have both a vested interest and moral obligation," Palis continued, "to seek ways to help distribute the fruits of our labour to our fellow citizens.

"These are the issues, at the nexus of society and science, that will be the focus of our attention in the years ahead, and these are the issues that will provide the measure of our impact and success as we enter the next quarter century of the Academy's life." ■

TWAS 18TH GENERAL MEETING

Trieste, Italy, 13-14 November 2007

BUILDING CAPACITY IN PAKISTAN

AMID ALL OF THE UNCERTAINTY, TURMOIL AND VIOLENCE THAT HAS GRIPPED PAKISTAN OVER THE PAST SEVERAL YEARS, ONE POSITIVE TREND HAS EMERGED: THE NATION HAS DRAMATICALLY INCREASED ITS INVESTMENT IN HIGHER EDUCATION, SCIENCE AND TECHNOLOGY.

The driving force behind Pakistan's recent effort to build scientific and technological capacity is Atta-ur-Rahman, who currently serves as Federal Minister and Chairman of the Higher Education Commission and Advisor to the Prime Minister on Science and Technology. Atta-ur-Rahman, who is also a TWAS Fellow (1985) and the Academy's Vice-President for Central and South Asia, organized a two-hour high-profile symposium at the TWAS 18th General Meeting held in Trieste, Italy, in November. The symposium, which examined current trends and future directions in science and technology in Pakistan, featured a series of presentations by prominent Pakistani scientists. It also included an opening talk by Atta-ur-Rahman, in which he explored the principles and programmes that are shaping Pakistan's nationwide campaign to build a strong foundation for scientific and technological capacity. Atta-ur-Rahman highlighted the success that the campaign has been achieved to date. The following article is based on his presentation.

Education, science and technology are the great divides in today's world. Differences in scientific and technological capabilities help to explain why rich countries are rich and poor countries are poor. But these same factors are also the great equalizers. Scientific and technological capabilities, in fact, can also serve as vital instruments for overcoming poverty, hunger, disease and other debilitating social and economic ills that often incite conflict and violence both within nations and beyond national borders.

Throughout much of the 20th century and for many centuries before, a nation's prospects for economic development largely depended on its natural resources. Countries richly endowed with natural resources sought to exploit their natural bounty for economic gain; countries poorly endowed in natural resources often sought to acquire these resources from others either through trade or by force.

In the final decades of the 20th century, however, it became increasingly clear that knowledge (and particularly scientific and technological knowledge), not natural resources, had become the primary force propelling both national economic well-being and global economics.

Such trends have been accelerating during the first decade of the 21st century. Today, few nations in either the developed and developing worlds would fail to acknowledge the importance of science, technology and innovation as cornerstones of their future social and economic well-being. Indeed no nation is likely to progress without developing broad scientific and technological capabilities. Countries that think otherwise are destined to remain marginalized in the globalized world in which we live, making it difficult for their people to live secure and peaceful lives marked by material and social well-being.

With more than 160 million people, Pakistan is the sixth most populous nation.

SERVING YOUTH

With more than 160 million people, Pakistan is the world's sixth most populous nation. And with more than 50 percent of its population younger than 19, it is also home to one of the world's most youthful populations. Herein lies not just a challenge but also an opportunity.

That is why Pakistan has devised a broad approach to educational reform – one that emphasizes fundamental change throughout all levels of education from primary schools to university and post-graduate training.

In primary schools, there is a need to focus on basic education and to do so in ways that emphasize teaching excellence and inquiry-based learning. At the university level, there is a need to provide students with the best teachers and best equipment possible and to assure access to the most current literature and ideas in their fields.

Since 2002, Pakistan has made a concerted effort to improve its universities and research centres and to strengthen the links between institutions of higher education and the larger society, especially for the purposes of promoting innovation and creating national wealth.

In terms of higher education, the major challenges in Pakistan lie in access, quality and relevance. Historically, only a small percentage of students of university age in Pakistan has attended universities. In 2000 the percentage stood at just 2.5 percent.

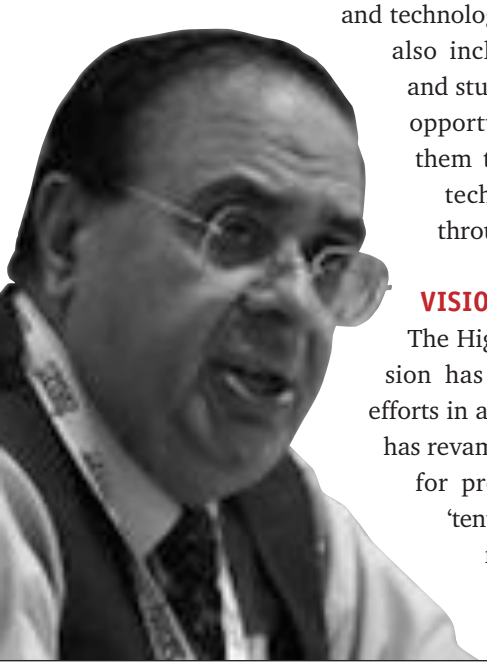
The small percentage of Pakistani youth attending universities had by no means translated into high-quality instruction or learning. In fact, the opposite was true. Pakistan's universities have long suffered from

poorly trained and poorly paid faculty; poorly equipped and poorly maintained classrooms and laboratories; and poor governance and administration that have made it difficult, if not impossible, to address major challenges effectively. Indeed universities in Pakistan have often operated as 'institutional islands' harbouring goals and responsibilities that were largely isolated from national needs.

The plan of action that was developed and implemented over the past five years by the Higher Education Commission focused on the following key areas: faculty development; greater opportunities for students to attend universities; improved environments for learning; the promotion of research excellence; and encouraging faculty and students to explore issues of national relevance.

To advance this agenda, the Higher Education Commission has aggressively sought to expand the nation's training and research capabilities, especially by fostering the development of new information and communication technologies. It has also sought to promote and reward good university governance and administration and to devise a rigorous system of quality assurance focusing on standards, assessment and accreditation.

The ultimate goal is to create an attractive and rewarding environment for teaching, learning and research that draws the nation's 'best and brightest' into education, especially in fields related to science and technology. Increasingly, the goal also includes providing faculty and students with attractive job opportunities that encourage them to pursue scientific and technological challenges throughout their careers.



VISION TO PRACTICE

The Higher Education Commission has sought to advance its efforts in a variety of ways. First, it has revamped the salary structure for professors. Under a new 'tenure track' system, salaries for the nation's most productive professors can reach US$5,000 a month. That is more than five times the salaries earned by cabinet ministers.

The system is based on the overriding principle that performance determines pay. A committee of international experts working at top universities and research institutes in the developed world oversees the evaluation process. The primary task of the committee is to assess the quality of research and teaching of their colleagues in Pakistan. The government has also instituted a 75 percent tax waiver for university professors that allows them to keep a large portion of their salaries (the maximum tax payable by academics is 5 percent).

Under the foreign faculty-hiring programme, more than 500 scientists and professors have been lured to Pakistan. The majority are native-born scientists who have been living abroad most of their lives and now finally see reason to return. Others are non-Pakistanis who have been enticed to move to Pakistan by the good salaries and a strong sense that things are moving in a

positive direction. One unique feature of this programme is the effort to cluster faculty in similar fields in the same institution to create a critical mass of expertise. For example, more than 40 mathematicians, mostly from Eastern Europe, are now at the Government College University of Lahore. They have created a solid intellectual base in a few short years, helping the university to strengthen its capacity for teaching and research and to rapidly gain credibility both in Pakistan and abroad.

Good salaries, of course, are essential to attract and keep talented individuals. But good working conditions are necessary too. State-of-the-art centralized laboratories created in 20 locations now provide analytical testing services to all scientists. The government, following recommendations of the Higher Education Commission, has increased research funding by 2,400 percent over the past five years, bringing the total amount of public funding for research to more than US$1 billion.

Pakistan has increased research funding by 2,400 percent over the past five years.

Agency for International Development (USAID) and the Pakistani government. Between 2006 and 2010, more than 600 Pakistani students will attend top-ranked universities in the United States as Fulbright Scholars, receiving master's and PhD level training. An additional 500 Pakistani students will travel to Australia under the Australia-Pakistan Fellowship Programme.

Pakistan has also established an indigenous PhD programme that has allowed more than 2,000 additional students to enroll in doctoral programmes at Pakistani universities. The initiative has helped to raise total PhD enrolment to 8,000. It is important to note that 70 percent of the students enrolled in the indigenous PhD programmes are women. To attract the brightest into higher education, the Higher Education Commission has also launched a US$600 million indigenous scholarship programme for undergraduate study.

The selection process in all of these programmes is competitive and transparent. The goal is to broaden

Pakistan is not just trying to jumpstart teaching and research capabilities in universities. It has also pursued a fast-track strategy to broaden learning opportunities for the nation's large college-age population. The Higher Education Commission, for example, has launched a US$1 billion foreign scholarship programme that enables some 2,000 students each year to enroll cost-free in universities, mostly in Europe. Pakistani students are also the largest recipients of US Fulbright Scholarships, under a programme jointly funded by the US

student access to higher education without undermining the quest for excellence. In effect, we are seeking to democratize quality education by creating opportunities for as many meritorious students as possible. Many PhD students attending Pakistani universities, moreover, now have an opportunity to study abroad through 'sandwich' programmes that require them to enroll and earn their degrees at home yet spend a good deal of time – in many cases, two years or more – in a foreign institution. For example, Pakistani universities have nurtured

'sandwich' programmes with more than 50 universities in the United Kingdom.

LEAP-FROGGING AHEAD

Efforts to reform Pakistan's system of higher education focus on such conventional measures as salary increases, improved job prospects, a greater number of scholarships and increased opportunities for travel and exchange. Nevertheless advances in information and communication technologies provide a new tool for accelerating the pace of change in ways that were unimaginable just a decade ago.

Advances in ICTs provide a new tool for accelerating the pace of change.

Pakistan has devised an information technology (IT) strategy that not only focuses on expanding broad bandwidth capacity across the nation but also on nurturing a cyber-rich environment that stimulates learning and creativity. To move this strategy forward, the government has passed enabling legislation to facilitate computer access and has fostered programmes that provide services to citizens so that they too can benefit from such efforts. Nearly 97 percent of the population has access to the internet. Bandwidth costs for two megabits per second of capacity have been reduced from US$87,000 per month in 2000 to US$900 per month today.

Between 2000 and 2006, the number of Pakistani cities and towns with access to the internet skyrocketed from 30 to nearly 2,400, following a decade-long period of stagnation in which many other nations became full-fledged participants in the information and communications revolution. Not surprisingly, during the same period the number of internet users in Pakistan also grew dramatically from 130,000 to more than 12 million.

Yet the growth of internet use pales before the phenomenal growth in the use of cell phones. In 2000, Pakistan had just 300,000 phones. Today it has 65 million. It is the fastest pace of growth in the world and it continues to accelerate. This welcome trend was made possible by sharp declines in telephone rates, increasing competition among private companies and the introduction of a 'Calling Party Pays' strategy that allows individuals to receive telephone calls without incurring any charges. If observers think that electronic communications have not dramatically altered daily communications – and social interaction – in Pakistan, all they need to do is call one of the ever-growing number of Pakistan's avid cell phone users and ask.

Advances in information and communication technologies have also had a dramatic impact on universities in Pakistan. For example, the Pakistan Education and Research Network (PERN), a fibre-optic internet system with broad bandwidth connection, currently links some 60 universities, serving as an information highway that helps to promote data exchange and collaborative research. At the same time, it serves as a platform for a nationwide distance learning programme and a digital library service available to all universities. To facilitate research collaboration and the exchange of information, especially between Pakistan and US scientists,

PERN is now being connected to the United States via a high-speed network. Research between Pakistan and US scientists is also being promoted through an annual US$5.5 million collaborative research fund. Some 40 collaborative research projects have been funded over the past five years.

In many developing countries, including Pakistan, access to the most recent editions of journals has been a chronic problem, particularly for faculty and students in departments of science and technology. Now, thanks to the advent of the digital library, which was launched in 2005, more than 23,000 full-text journals, including back volumes, are available to students and faculty free-of-charge. Extensive use has been made of this service. More than 1.2 million articles were downloaded in 2006, a figure that has risen substantially in 2007 (the final tally will be available in mid-2008).

Pakistan's national e-books programme, launched in September 2007, provides access to more than 40,000 textbooks and monographs that are produced by some 220 publishers worldwide. Faculty and students in public universities enjoy free access to this data (private universities pay concessionary rates). The books can be downloaded and searched via keywords.

Beyond the world of electronic books and articles, in November 2001 Pakistan also launched a virtual university, which now offers four-year undergraduate degrees in 15 different disciplines. Programme content is delivered on four digital channels broadcast by PAKSAT-1, Pakistan's first educational satellite, launched in 2002. Two recording studios, both in Lahore, have also been built.

All of this has not only expanded learning opportunities in Pakistan's major cities but has also laid a foundation for high quality training in the most remote corners of the nation – an initiative that has been bolstered by a video-lecturing programme. More than 4,000 lectures offered by top professors from leading universities in the United States, Europe and Japan are being transmitted and made easily accessible on CDs. A Massachusetts Institute for Technology (MIT) mirror website has also been created to provide access to open source materials and lecture notes from more than 900 MIT courses.

Efforts to promote public universities through government investments and collaboration with foreign institutions of higher education are essential. But to accelerate the pace of change it is also necessary to solicit the help of the private sector. That is why Pakistan's government has launched a matching grants programme with private institutions and proposed initiatives for the sharing of faculty salaries. The government has also agreed to extend long-term leases for buildings and property and has made it possible for private institutions to gain access to research funding as part of a larger effort to build a strong university system within Pakistan over the next decade.

The government is not content to just foster knowledge. It would also like to devise strategies that promote knowledge-based innovation and entrepreneurship. It hopes to do so by opening up effective channels for financing the creation of technology parks and business incubators and for providing venture capital for promising but financially risky projects that could result in high returns on the investment. The government has

also created national commissions in such advanced fields as biotechnology and nanotechnology that are seeking to devise pathways for moving research findings from the laboratory to the marketplace.

NORTH TO SOUTH

Finally, the Higher Education Commission has recently forged partnerships with universities in Asia and Europe designed to establish a world class consortium – the University of Engineering, Science and Technology Pakistan (UESTP) initiative. The goal is to establish university campuses in Pakistan that bear the name of eminent institutions and that draw directly on the talent of these institutions to gain rapid credibility and skills for Pakistani students, faculty and administrators.

The landscape for higher education in Pakistan is being rapidly transformed.

The programme will work like this. Pakistan has agreed to spend up to US$650 million to cover the full costs of building and staffing the campuses. Administrators and faculty from partnering universities will be invited – indeed encouraged by high salaries and first-class working conditions – to come to Pakistan to work at these nascent institutions. Austria, China, France, Germany and Italy have agreed to participate in the first phase of the programme. Japan, South Korea and Sweden are being signed up for the second phase. More countries are thinking about joining.

During the initiative's first 10 years, at least 75 percent of university administrators and faculty will come from the partnering universities. Their primary job will be to manage the universities and to teach Pakistani students. But they will also be responsible for training Pakistani administrators and professors so that the latter can assume full responsibility for the universities over time. Each university will have a large technology park in which foreign industries will set up regional research and development centres.

Students, in turn, will receive their degrees from the partnering universities, ensuring that their education is first-class and that they are able to obtain the credentials that they need to secure good jobs both in Pakistan and abroad.

The first of these universities is scheduled to open in autumn 2008. When fully operational, an estimated 7,000 Pakistani students will be enrolled on an annual basis.

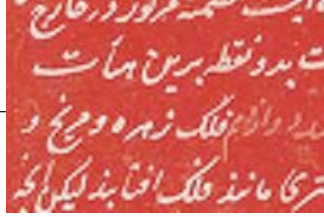
A CHANGING LANDSCAPE

The landscape for higher education in Pakistan is now being rapidly transformed. The twin challenges of access and excellence are being met. We are moving fast. Whether we can sustain such forward motion remains to be seen. But we will not fail from a lack of effort and commitment.

A recent World Bank report has called the developments in higher education in Pakistan "a silent revolution". All this would not have been possible without the support of President Pervez Musharraf, who has overseen a 60-fold increase in the budget of science and technology and a 20-fold increase in the budget for higher education over the past 7 years.

The next step is to transform these subterranean trends into a visible part of the social and economic landscape, making them not so much obscure and novel features of society but clearly recognized aspects of what we do and who we are. It is the only way to ensure that Pakistan becomes a full-fledged member of the global knowledge society. Both Pakistan and the rest of the world have a stake in our success. ■

Atta-ur-Rahman
(TWAS Fellow 1985 and Vice-President)
Federal Minister/Chairman
Higher Education Commission
Advisor to Prime Minister on Science & Technology
Islamabad, Pakistan



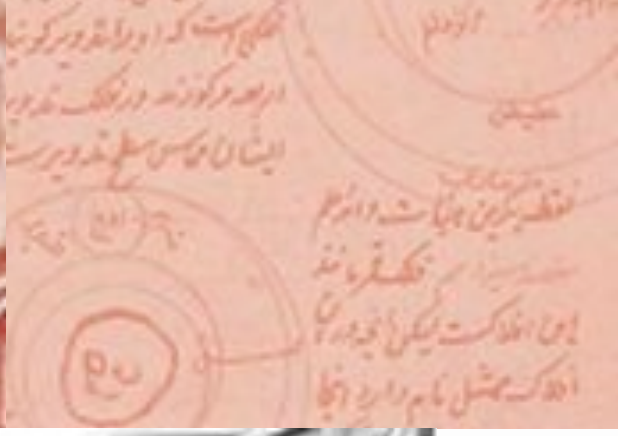
FIGHTING FUNDAMENTALISM WITH SCIENCE

PERVEZ HOODBHOY WAS AWARDED THE FIRST REGIONAL PRIZE FOR PUBLIC UNDERSTANDING OF SCIENCE BY TWAS-ROCASA. DURING TWAS'S 18TH GENERAL MEETING, HE REVIEWED PAKISTAN'S RECENT GROWTH IN SCIENCE AND TECHNOLOGY AND SUGGESTED WAYS FORWARD FOR A MORE OPEN AND INQUIRING SOCIETY IN HIS NATIVE COUNTRY.

Pakistan is a nation of vast contrasts and troubling contradictions. While the nation has experienced a dramatic increase in spending for science and technology over the past five years, accompanied by growing enrolment in universities and an expanding middle class, some 50 percent of the population remains illiterate. Equally important, the nation is experiencing a strong surge in Islamic fundamentalism and a rising tide of violence and political instability. Pervez Hoodbhoy, a professor of physics at the Quaid-e-Azam University in Islamabad and an outspoken critic of the government's strategy for building scientific and technological capacity, describes what he believes needs to be done to nurture a scientifically literate society that cherishes free and open inquiry and appreciates the wondrous and endless challenges posed by science. For Hoodbhoy, the answer lies in changing the nation's mindset and creating a less authoritarian and more equitable relationship between students and teachers.

We owe the modern world to science. That is why science is taught in schools. The prosperity of nations and individuals is contingent upon our ability to understand, apply, monitor and, when necessary, control science. Take the products of science away and we would return to the dark days of our ancestors when a child at birth was more likely to die than live.

There is another excellent reason to study science. Far from being a cold and soulless collection of facts, it is a delicate and beautiful human pursuit imbued with principles that are amazingly simple and precise. At the same time, scientific principles are incredibly powerful



and universal. Exactly the same laws explain why the universe is expanding, stars shine, the sky is blue, human hearts beat and birds fly. Science engages the imagination and fascinates endlessly.

But science is more than gadgets and processes. It is even more than a beautiful and elegant description of nature. Fundamentally, science provides a way to comprehend reality that enables truth to be approached incrementally through a rigorous step-by-step process. Science, moreover, insists on relentless questioning and testing of assumptions, using both logic and empirical verification. This makes science the weapon of choice for combatting the madness of fundamentalism that is now sweeping the globe.

C.N.R Rao, immediate past president of TWAS, lost a nephew in the World Trade Center attack on 11 September 2001. But he preferred not to interpret the terrorist attack as solely to do with the Islamic world. Instead he wrote,

> *I am convinced that whenever and wherever fundamentalism dominates, blind faith clouds objective and rational thinking. When such forces take hold, they create a mindset that allows people to do unusual – indeed sometimes unspeakable – things.*

This is precisely right. But fundamentalism needs to be carefully defined. As I understand it, fundamentalism is a delusional state of mind – an extreme form of hubris – in which an individual is convinced that his or her belief system has the right answers to every possible question concerning human existence.

Even when fundamentalists pretend to engage in a dialogue with those who think differently, they never let go of their blind convictions. The defining characteristics of fundamentalists – religious or secular – are a complete absence of self-doubt, unconditional acceptance of dogma, rejection or marginalization of alternative ways of looking at the world and a desire to inflict punishment on those who deviate from the perceived true path.

Science is an antidote for every kind of dogma and fundamentalism. Consequently, it is deeply feared by the orthodox.

To appreciate this, let us revisit the epic trial of Galileo. It was not a question of cosmology or physics that worked the papacy into a hangman's frenzy. The church could not really have cared whether the sun goes around the earth or vice versa. Crucially important, however, was that the word of god stood in danger of being shown up. If, heaven forbid, the Earth actually encircled the sun, the Bible would be proven wrong, suggesting that its authors would have flunked freshman physics.

This would have placed into jeopardy the entire text of the Bible, including all miracles. All the glorious stories of Joshua and Gideon – which good Christians must accept without question – would have been placed in

doubt. Science, which nags constantly for empirical proof and obsessively asks for reasons, was simply too annoying – and threatening – to be tolerated or even ignored by the 17th century Catholic church.

In more recent times, archaeological science repudiates the fanatics of the Vishwa Hindu Parishad who, in 1992, instigated bloody riots in India after pulling down a 400-year-old Babri mosque, claiming that the god Ram had been born in a temple that had once existed in the same place. Molecular biology and genetic science have made nonsense of creationism and intelligent design, cherished by Christian fundamentalists in the United States who continue to mount a relentless campaign to have school curricula include their faith-based views of how the Earth and its living organisms came to be.

IN PAKISTAN

Pakistan regularly features in the news these days because of growing fundamentalism and a militant Taliban movement that has seized administrative control of some parts of the country. How is it doing in science in the face of these difficulties? Splendidly well, says the government of Pakistan.

Indeed spending on higher education and science has increased by about 15 times over the past five years, and the number of universities has nearly doubled.

A large delegation of scientists, headed by Atta-ur-Rahman, Pakistan's charismatic chemist and chairman of the Higher Education Commission, travelled to Trieste in November 2007 to hold a special symposium on the state of science and technology in Pakistan at the TWAS 18th General Meeting. This was just one of a number of venues where Pakistani scientists, led by Atta-ur-Rahman, have discussed the progress that has taken place.

The claims made in Trieste were many: research activity has vastly increased and research publications from Pakistan have risen by 300 percent as a result of new financial incentives; nine new engineering universities with Asian and European teaching faculty are in the process of being established; mathematics is emerging as a strong discipline in Pakistan; more than 3,000 Pakistani students have been sent overseas for higher degrees; PhDs produced annually from Pakistani universities will soon approach the spectacular figure of 1,500; and so on.

One wishes that all the above indicators signified genuine progress in science and mathematics. But I am afraid that this is not the case. Indeed science in Pakistan continues to languish despite the vast investment that has taken place.

Indeed genuine science in Pakistan – which must be distinguished from publishing papers of dubious quality – has shrunk, not grown, over the last 30 years. With more than 160 million people, Pakistan has fewer than 10 physicists who enjoy an international reputation (all but a couple are over 50 years of age) and still fewer mathematicians. (This excludes the few dozen foreign mathematicians, many from Romania, who have been employed on short-term contracts at a mathematics centre in Lahore.)

Huge per-paper monetary rewards have boosted publication rates enormously. But this increase

Science is an antidote for every kind of dogma and fundamentalism.

has come at the cost of an explosive growth in plagiarism, publication of trivial results and falsified data, and a flood of slightly different versions of the same paper in different journals. A review of international databases shows that other scientists rarely cite papers published by Pakistani scientists.

In short, the government's campaign to increase the number of publications has largely been a paper exercise that has helped to raise the income of some professors who know how to play the game. But it has had scant impact on science either within Pakistan or elsewhere.

THINKING MATTERS

It is not my intent here to make a point-by-point refutation of the official claims rendered by Pakistani officials. The more important question is: Even with a sizeable budget and strong affirmations of the need for encouraging scientific growth, why is Pakistan's performance so undistinguished?

As in many other developing countries, the dead hand of tradition blocks progress. The Pakistani educational system, shaped by traditional social and cultural values, discourages questioning and stresses obedience.

Tyranny of the teacher lies at the core. In Urdu we say that the teacher is not just a teacher, he is your father. Since a father is all-wise, he dare not be questioned. Instead of experiencing science as a personally fulfilling quest for understanding, students memorize an arbitrary set of rules and an endless number of facts under the watchful eyes of despotic teachers. X is true and Y is false because that is what the textbook says. (I grind my teeth whenever a master's student in my university class gives me this argument; but this is the inevitable consequence of authoritarianism.) The mindset needed for authentic science is alien to the educational environment of schools, colleges, and universities in countries such as Pakistan.

The Pakistani educational system discourages questioning and stresses obedience.

How can countries that remain mired in such a thought-deadening process of education develop a true scientific mindset?

The first thing that must be stated is that to begin the effort in colleges and universities is to begin too late. Change must be instituted at the primary school level. Good science pedagogy requires deliberate inculcation of the spirit of healthy questioning in the classroom among five- and 10-year-old children not just 20 year-old young adults.

Correct attitudes start developing naturally when students encounter questions that engage their mind rather than test their memory. For this, it is important to begin with tangible things. One does not need a doctorate in cognitive studies to know that young people learn best when they deal with visual, auditory, tactile, and kinesthetic objects. As their experience grows, they learn to understand abstract concepts, manipulate symbols, reason logically, solve theorems and generalize. These abilities are destroyed, or left woefully undeveloped, by rote memorization.

It should therefore be normal practice for teachers to raise such questions as: How do we know and learn? What is important to measure? How can we confirm our measurements and conclusions? What evidence has been brought to bear on the question? How can we make sense out of the results? Is there a counter explanation, or perhaps a simpler one? The aim should be to get students into the habit of posing such questions and then framing answers.

Bad science teaching in Pakistani schools and widespread scientific illiteracy has made the siren of unreason ever more sonorous and attractive. In older times, only the ignorant and illiterate accepted the idiocy of the aamils, pirs, mullahs and assorted soothsayers and charlatans. Today, however, college graduates and the rich and powerful, calmly accept – indeed embrace – such nonsense as high wisdom that guides their thinking and values.

Good science education can help change this. In fact, the demons of superstition and narrow-mindedness can only be chased away by those who know and understand the spirit of science.

Though difficult, the situation in Pakistan is by no means hopeless. Let me give one personal example that shows that, bucking the mind-deadening 'education' in schools, Pakistani kids are still curious. Inspired by the world-renowned scientist Carl Sagan of *Cosmos* fame, some time ago I created and presented a series of popular science programmes for Pakistani television. The response was phenomenal. I received thousands of letters of support, many from young students living in remote villages. Dozens of young people personally came to my department to thank me. I even had an unannounced visit by the entire student body from a remote village school in southern Punjab!

Science cuts across every boundary – cultural, political, social and even psychological. The only way to get a handle on many of today's conflicts is to enable people to learn to think more scientifically and to encourage them to move away from the various fundamentalisms derived from religion, nationalism and other exclusivist ideologies that create impenetrable, yet false, boundaries between me and you and us and them.

The message of science is that we are one human family. The process of science proves that the only way to effectively deliver this message is through clear and rational thinking that has been nurtured through good education and challenging and rewarding experience. Money counts in achieving this humanistic goal. But mindsets count even more. ■

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TWAS, THE ACADEMY OF SCIENCES FOR THE DEVELOPING WORLD, IS A UNESCO-AFFILIATED ORGANIZATION HEADQUARTERED IN TRIESTE, ITALY. THE ACADEMY RECEIVES THE MAJORITY OF ITS ADMINISTRATIVE FUNDS FROM GENEROUS CONTRIBUTIONS PROVIDED BY THE ITALIAN GOVERNMENT. TWAS'S MANDATE FOCUSES ON HONOURING SCIENTIFIC ACCOMPLISHMENT AND BUILDING SCIENTIFIC CAPACITY IN THE DEVELOPING WORLD. OVER THE PAST DECADE, IT HAS BECOME INCREASINGLY CONCERNED WITH APPLYING SCIENTIFIC AND TECHNOLOGICAL CAPABILITIES TO ECONOMIC DEVELOPMENT CHALLENGES.

SCIENCE FOR DEVELOPMENT

In September 2006, Jacob Palis was elected the fourth president of TWAS. In assuming the TWAS presidency, Palis is following in the footsteps of three other eminent scientists from the South: Abdus Salam (the organization's founding president), José Israel Vargas and C.N.R. Rao. Each of these scientists not only made their mark in the international scientific community but also dedicated a good portion of their careers to advancing the cause of science in the developing world.

Palis received his undergraduate degree in engineering from the Federal University of Rio de Janeiro (UFRJ) and his masters and doctorate degrees in mathematics from the University of California in Berkeley, USA. Between 1993 and 2003, he directed the Institute of Pure and Applied Mathematics (IMPA), Brazil's leading research centre for the study of mathematics. He also served as president of the International Mathematical Union from 1999-2002, headed the Scientific Council of the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy, from 2003 to 2005, and was vice-president of the International Council for Science (ICSU) from 1996-1999.

A renowned international expert in the fields of dynamical systems and differential equations, Palis has received numerous awards, most notably the Brazilian Order of Merit, the Interamerican Prize for Science (Bernardo Houssay Prize) and the Trieste Science Prize. He has also received honorary degrees from universities in Brazil, Chile, Cuba, Peru and the United Kingdom and has been elected to science academies in Latin America, France, Norway, Russia and the United States.

The editor of the TWAS Newsletter *recently conducted an email interview with Palis in which he outlined both his hopes and future plans for TWAS. Excerpts follow.*

What do you think are the most critical challenges facing the developing world in its efforts to promote science-based development?

All levels of government – federal, regional and local – must be made aware that indigenous scientific and technological knowledge are core elements of social and economic development. Awareness, however, is not sufficient; it's action that counts. That's why all levels of government must pursue strategies for science-based development that not only promote aggregate economic growth but that also benefit all segments of society.

These factors, of course, have played a critical role in policy discussions in the past – among both rich and poor countries. However, we now live in an era that places a premium on both global knowledge and global competition. That makes the role of science and technology more critical than ever.

I don't want to sound too grandiose. But the main challenges faced by TWAS today are challenges common to all humanity: how to devise and sustain broad based strategies for growth based on indigenous systems of science, technology and innovation, and how to ensure that such strategies benefit as many people as possible.

Another big challenge, closely related to the challenge cited above, is how to substantially increase the participation of women in science. Greater female involvement in science will help ensure that the global scientific community is drawing on the largest pool of talent possible. It will also help shift the focus of science to issues more directly related to critical social and economic needs.

What is TWAS doing to address these challenges?

TWAS has worked hard to identify the best scientists in the developing world and to elect them as members of the Academy. Earning membership in TWAS has become highly competitive. Five years ago, the Academy received some 100 nominations. Last year, it received more than 200 nominations.

Being elected a member of TWAS is a distinct honour. It not only provides a platform for boosting a scientist's standing within the scientific community, but it also helps to enhance a scientist's visibility within the larger society.

In developing countries without merit-based science academies (and there are many in sub-Saharan Africa), election to TWAS serves another important function. By casting a spotlight on a nation's most eminent scientists, it helps to identify scientists who can be called upon during the earliest stages of an academy's development. That's one reason TWAS has diligently sought nominations not only from developing countries with growing scientific capabilities (Brazil, China and India, for example), but also from poor developing countries with lagging scientific capabilities.

If I were asked to cite just one example of how TWAS is addressing the challenges of science-based developed in the developing world, I would cite the election of prominent scientists to the Academy itself. The more than 850 members who are now members of TWAS are at the front-line of our overall efforts to build scientific and technological capacity in developing countries.

Beyond our roster of Academy members, I think one of TWAS's most significant programmes is the South-South fellowship programme that we operate in partnership with the governments of Brazil, China, and India and, most recently, Pakistan. The programme is open to young scientists from developing countries who are pursuing doctoral degrees and postdoctoral studies in a wide range of scientific disciplines. TWAS pays the cost of travel and provides a small stipend; local universities and research centres hosting the students cover the cost of food and lodging. More importantly, these institutions open their classrooms and laboratories to participating students.

This programme is one of the largest and most effective programmes for South-South cooperation in science. With more than 200 fellowships available each year, it represents an unmatched channel for collaboration between more scientifically proficient and less scientifically proficient developing countries. Indeed the programme now provides a beacon of hope for rapidly advancing scientific capacity across the developing world.

TWAS also oversees a research grants programme largely for young and mid-career scientists in the developing world and visiting scientist programmes that foster South-South and South-North scientific exchanges. The Academy has worked closely with other international organizations, including UNESCO, the United Nations Institute for Advanced Studies (UNU-IAS) and the International Council for Science (ICSU), to advance these efforts. In 2002, under the leadership of my predecessor, C.N.R. Rao, the Academy launched a programme that targeted funds for scientific groups and research centres in sub-Saharan African and least developed countries (LDCs). The programme, which offers annual grants of up to US$30,000 for three consecutive years, has since been expanded to include other scientifically and technologically lagging countries. It is designed to provide significant resources to research groups and institutions in very poor developing countries that are doing excellent work under trying conditions. Our hope is that these funds will allow the groups and institutions to continue their good work and, in fact, ultimately enable them to reach new levels of accomplishment and impact.

The Academy also provides small sums of money to help fund scientific meetings in the developing world and holds a large general assembly once every two to three years that is attended by several hundred high-level scientists, science administrators and public officials. These gatherings, which are supported almost entirely by the host country, have become signature events in assessing the state of science in the developing world. Brazil, China, India, Iran, Kuwait and Senegal are among the countries that have hosted Academy assemblies. The next one, which will also mark the 25th anniversary of TWAS, will take place in Mexico in autumn 2008.

The Academy also supports scientific capacity efforts at the regional level, largely through regional offices in Brazil, China, Egypt, India and Kenya. A key focus of the regional offices is the organization of symposia for young scientists who have displayed much promise in their fields of research. The TWAS secretariat in Trieste has recently established a new affiliated category of membership for young scientists that will permit those who are selected to be associated with the

Academy for a five-year period. It's part of our larger campaign to encourage university students to pursue careers in science.

Finally, I would like to mention that TWAS provides administrative support for several other international scientific institutions that share the Academy's interest in scientific capacity building and science-based development. These organizations include the InterAcademy Panel (IAP), a global network of merit-based science academies and the InterAcademy Medical Panel (IAMP), a global network of medical academies or medical divisions within science academies. We are particularly proud of our support for and affiliation with the Third World Organization for Women in Science (TWOWS). With more than 3,200 members, TWOWS is the world's largest organization of women scientists. Its fellowship programme for young women scientists from sub-Saharan Africa and the LDCs, which is funded by the Swedish International Development Agency (Sida), is helping young women scientists earn advanced degrees in a broad range of scientific fields.

I think that it is also worth mentioning the recent creation of the Consortium on Science Technology and Innovation for the South (COSTIS), which was launched in September 2006 at the TWAS General Meeting in Brazil. COSTIS is a joint initiative of the Group of 77, the largest advocacy group in the United Nations for issues of concern to the developing world, and the international scientific organizations located in Trieste, led by TWAS. While it has yet to take full shape, the core of COSTIS' mandate calls for addressing the critical challenge I mentioned earlier: the need for every nation to build sufficient scientific and technological capacity in order to successfully pursue science-based development. This is indeed a worthy goal in a world where the ability of a nation to compete on the global stage increasingly depends on the ability to acquire, assess and utilize scientific and technological knowledge.

South-South cooperation has emerged as a cornerstone of scientific capacity building in the developing world. What are the benefits of such efforts?

Developing countries share many of the same development challenges and harbour many of the same hopes for improving the well-being of their citizenry through effective applications of science and technology to address critical social and economic needs. At the same time, because many developing countries have cultural and historical bonds and similar scientific aspirations, they find it easier to join in efforts as equals, both to provide appropriate training for scientists and to engage in projects that promote science-based development. All of these factors have made me a staunch supporter of South-South scientific and technological cooperation.

This sense of kinship, wedded by comparable skill levels and circumstances, has been enhanced by the increasing number of developing countries that have recently experienced rapid growth in scientific competency. These countries now find themselves in a position to effectively cooperate not only with other developing nations at similar levels of scientific competency, but also with developing countries that, for any number of reasons, have not kept pace with global advances in science and technology. In such an environment, 'cooperation' replaces 'aid' as the primary driver of development.

Cooperation makes it more likely that all participants are active in planning and implementing the programme. It also means that the lines of distinction between those who give and those who receive – between benefactor and beneficiary – are not likely to be as bright as they have been in the past. Simply put, a strategy based largely on South-South cooperation lays the groundwork for going very far together. That, in turn, means that we may be able to achieve much progress in a brief period.

Science is universal. For this reason, South-South cooperation does not in any way preclude South-North cooperation. In fact, South-South cooperation could well improve the effectiveness of South-North cooperation through the successful creation of trilateral arrangements in which developing countries with less scientific capacity interact with developing countries with greater scientific capacity, especially in the same region. The more scientifically proficient developing countries, in turn, can interact with developed countries. A variety of critical issues, for example, climate change, energy research and development, and curbing the spread of infectious disease, could lend themselves to such an approach, creating truly global networks of scientific research where players contribute what they can and then benefit from the findings and applications that are likely to take place as a result of such efforts.

You have been a key player in the transformation of Brazil's scientific enterprise. What accounts for the success of the reforms? What can other developing countries learn from the experience?

Science in Brazil is rapidly growing but its roots are not very deep. Brazil's most prominent universities – the University of São Paulo and the University of Brazil in Rio de Janeiro – were created in the first half of the 20th century. The nation's main national agencies for the promotion of scientific research and training – notably, the National Scientific Council (CNPq) and the Coordination for the Upgrading of University Professors (CAPES) – were launched in the early 1950s. The nation's scientific enterprise is decades, not centuries, old.

The pace of change, in fact, only began to accelerate rapidly in the 1960s. That's when the National Bank for Development decided to invest 2 percent of its annual budget on science and technology and the Ministry of Education began to build a comprehensive and innovative national framework for postgraduate studies with the goal of increasing both the number and quality of master's and doctorate degrees.

These efforts have reaped enormous benefits, creating an impact over time that is now easy to see. Brazil's scientific and technological communities are much stronger and more diverse and the nation's scientific and technological infrastructure has improved enormously. Perhaps most importantly, as the value of science and technology to society has become increasingly obvious, so too has the government's commitment.

I believe that there is great deal to learn from Brazil's experience, as well as from the experience of other developing countries that have made enormous strides in building and applying scientific and technological capacity to development. If such experiences are shared in meaningful and effective ways, it could mean that relatively less developed countries will be able to rapidly build their own scientific capacity.

The critical challenge that remains in Brazil is to spread scientific excellence beyond São Paulo, Rio de Janeiro and other major urban centres to such less privileged regions as the Amazon, the Northeast and the Centre West, and to encourage greater interaction between the research community, especially universities, and the private sector.

What will be the major focal points of concern during your tenure as TWAS president?
The range and depth of TWAS's activities have expanded tremendously over the past several years. One of the major challenges that the Academy faces today is to consolidate the gains it has made. This means strengthening our internal organization to ensure that we effectively fulfil our commitments. Part of this effort will focus on increasing the Academy's endowment fund, which now exceeds US$10 million but that we hope will reach US$25 million over the next several years. Another part of this effort involves locating and securing our own headquarters.

But that doesn't mean TWAS will be resting on its laurels. The Academy, as always, will be eager to take on new challenges. In addition to strengthening our commitment to South-South cooperation and to providing assistance to young scientists, we are particularly keen to expand our reach in three critical areas: building scientific capacity in LDCs, especially in sub-Saharan Africa and among nations with predominantly Muslim populations; serving as a durable bridge between scientific communities in the South and North; and increasing both educational and employment opportunities for women scientists.

Next year, TWAS will celebrate its 25th anniversary in Mexico City. It promises to be a fantastic affair, where we will, of course, pay tribute to those who have so successfully guided the Academy over the years, especially Abdus Salam, José Israel Vargas and C.N.R. Rao. We also plan to recognize the invaluable contributions that others have made to our success: the Italian government, which has generously supported TWAS since its inception; the foundations that have sponsored our programmatic activities; the international scientific institutions that have worked closely with us; and the dedication of our individual members and the Academy's staff, who have served as the primary source of our strength and resilience.

We all have reason to be proud of the progress that has been made in building scientific capacity in the developing world over the past quarter century. But we all recognize that much more work needs to be done.

As I mentioned at the beginning of our conversation, every nation deserves to have its own scientific and technological capacity and every nation must be able to use that capacity in ways that improve the well being of its people. TWAS, in collaboration with many others, intends to continue to advance this worthy effort in the years ahead. Our tactics will undoubtedly change to meet the changing circumstances of the world in which we live. But our goals will remain as consistent as ever. ■

An abbreviated version of this interview was published in A World of Science*, UNESCO, 2008 Vol. 6, No. 1, pp. 14-15.*

CITIES, SCIENCE AND SUSTAINABILITY

THIS YEAR WILL MARK A MILESTONE IN THE GLOBAL MIGRATION OF PEOPLE. FOR THE FIRST TIME IN HUMAN HISTORY, MORE THAN 50 PERCENT OF THE WORLD'S POPULATION WILL LIVE IN CITIES. AN INTERNATIONAL WORKSHOP HELD IN TRIESTE IN SEPTEMBER 2007 EXAMINED BROAD-RANGING STRATEGIES FOR MAKING CITIES IN THE DEVELOPING WORLD MORE SUSTAINABLE.

Humanity's past resided on farms and in rural villages. But humanity's future will unfold in urban settings. Effectively addressing the complexity of issues associated with unprecedented and unrelenting urban growth will be among the most fundamental challenges of our time. That was the focus of the workshop on 'Cities, Science and Sustainability' held in Trieste, Italy, from 20 to 22 September 2007. More than 20 people from countries throughout the South participated in the event which was co-sponsored by TWAS, the United Nations Development Programme's Special Unit for South-South Cooperation (UNDP/SSC) and the United Nations University's Institute for Advanced Studies (UNU/IAS).

In 1900, some 220 million people, or 13 percent of the world's population, lived in cities. A century later, the figure stood at 2.8 billion people, or nearly 47 percent of the world's population.

Currently, one million people across the globe migrate to cities weekly. If current trends continue, and there is no reason to believe that they won't, by 2050 an estimated 6 billion people, or more than two-thirds of humanity, will reside in cities.

A century ago, only 16 cities were home to more than one million people and most of these cities were located in developed countries. Today, there are 400 cities with at least one million people and 75 percent of these cities are in developing countries.

Fifty years ago, cities of 10 million people or more – so-called megacities – were virtually nonexistent. Today, there are 16 such urban conglomerations, most of which are in the developing world. Mexico City's population stands at more than 18 million. Bombay and São Paulo at more than 17 million. Karachi 15. Lagos 13. Buenos Aires 12.

Large cities may capture the public's attention but most people live in small- and medium-sized cities. Indeed more than half of all city dwellers live in cities with less than 500,000 inhabitants and nearly a quarter live in cities with populations between one and five million.

Beyond the overall global pace of urban growth, what's also significant is that most of this growth is taking place in the developing world.

One million people across the globe migrate to cities weekly.

Sub-Saharan Africa is the world's most rapidly urbanizing region. At the current annual rate of urban growth of more than 4.5 percent a year, it is estimated that by 2030 the urban population of Africa will reach 750 million. That's larger than the current population of Europe. Africa, however, is not alone. The urban population of Asia is expected to more than double from 1.3 billion to 2.64 billion and the urban population of Latin American and the Caribbean is expected to rise almost as dramatically from 394 million to 609 million. Demographers predict that by 2030 more than 60 percent of the population of developing countries will be living in cities.

Never before have so many people migrated so rapidly. Never before have so many poor people in poor countries been so mobile.

Jobs may lure people to cities but it's science and technology that make it possible for people to reside in cities and that enable cities to serve as magnets for growth. That's true whether we are talking about 19th century textile factories or 21st century call centres.

History tells us that cities are places where innovation flourishes and where problems often become opportunities.

This was certainly the case in the developed world where, over the course of two centuries, cities devised effective systems for managing water, waste and transportation despite their rising populations. Growth, of course, did not occur without crises but crises were largely overcome. There is no doubt that the quality of life for the majority of citizens in London, New York City and Tokyo, with all of the risks, worries and inconveniences that modern urban living brings, is better today than it was in the 19th century and that people today are living longer and healthier lives.

There is reason to believe that the same arc of progress will take place in cities in the developing world. Yet there is also cause for concern. That's because the circumstances found in the developing world today are not the same as those found during the explosive period of urban development that took place in the developed world a century or two ago: The pace of urban growth in the developing world is infinitely faster, the resource base is smaller, and the institutions designed to respond to these challenges are often not as strong. Moreover,

many of today's 'borderless' global challenges – global warming, for example – suggest that cities may not be in control of their own destiny regardless of how effective their policies may be at the local and regional levels.

Urban centres may be focal points of innovation. But they are also places where poor people tend to live. United Nations Habitat estimates that between one-quarter and one-half of the population in many cities in developing countries live in informal or illegal settlements. Will our planet of gleaming steel-and-glass cities also be a planet of tar-papered slums and shantytowns? Nearly three out of four urban dwellers in sub-Saharan Africa – and nearly one out of three urban dwellers worldwide – live in conditions marked by inadequate access to safe drinking water, poor sanitation, deplorable housing and insecure land tenure. Wise policies will be instrumental in solving these problems. But so will effective applications of science and technology.

The workshop on 'Cities, Science and Sustainability' was designed to explore how cities in the developing world are coping with the challenges posed by the unprecedented pace of urbanization. The case studies, exploring issues ranging from water and waste management, to transportation and air pollution, to housing and liveability, and to training and communication, examined the ways in which science and technology are being used to improve the lives of the growing numbers of people who call the city their home.

One-quarter to one-half of the population in many cities in developing countries live in informal or illegal settlements.

The ultimate aim of the workshop was not just to present ideas but also to share experiences. It marked the latest instalment of a series of workshops that have been organized over the past decade by TWAS, in cooperation with the UNDP/SSC and more recently, the UNU/IAS. As in the past, the presentations featured in this workshop will provide the basis for a book to be published by the UNDP/SSC and made freely available on the internet.

By bringing together researchers and practitioners, the workshop organizers hope to facilitate the exchange of experience and information in ways that will help participants refine and expand their knowledge for dealing with issues of critical importance to their communities and, in this case, their cities. It is also our hope that the subsequent publication will fulfil our larger goal of bringing innovative experiences in applications of science and technology to a wider audience of scientists, development specialists and decision-makers.

The developing world will face many critical issues in the years ahead: challenges related to poverty, education, public health, energy and the environment. The question of 'where' to live has largely been settled. There is little doubt that the vast majority of people in the years ahead will live in cities. But the question of 'how' to live in cities remains unanswered and it's the 'how' that will largely determine whether we are able to chart a successful path to a sustainable future. ■

For additional information about TWAS-UNDP/SCC-UNU/IAS's sharing innovative experiences series, see tcdc.undp.org.
For additional information about the 'Cities, Science and Sustainability' workshop, contact info@twas.org.

THE METROBUS IN MEXICO CITY

As cities in developing countries continue to grow and their economies and use of energy continue to expand, they are increasingly facing serious and potentially debilitating environmental problems. This is particularly true when it comes to rising levels of air pollution, which not only place public health at risk but also threaten to impede future economic growth. In the following article, Claudia Sheinbaum, a researcher at the National Autonomous University of Mexico, Institute of Engineering, and the former Mexico City Minister of Environment, describes the development of Mexico City's Bus Rapid Transportation (BRT) system, an initiative that seeks to make bus travel more convenient while reducing the amount of pollutants emitted into the atmosphere. The article is based on Sheinbaum's presentation at the TWAS-United Nations Development Programme's Special Unit for South-South Cooperation (UNDP/SSC)-United Nations University's Institute for Advanced Studies (UNDP/IAS) Workshop on 'Cities, Science and Sustainability', held in Trieste, Italy, in September 2007.

Mexico City's metropolitan area (MCMA) is home to nearly 20 million people, about one out of every five Mexicans. That makes it the world's second largest urban metropolitan area. Only Tokyo's metropolitan area, with a population exceeding 30 million, is larger.

But size is just one measure of the MCMA's national importance. The metropolitan area, for example, generates more than a third of Mexico's annual gross domestic product.

It would be naïve, however, to assume that the jobs and wealth have come cost free. Pollution, particularly pollution generated by the area's cars, buses and trucks, is also present in abundance.

Beginning in the early 1990s, excessive levels of tropospheric ozone, carbon monoxide, air-borne lead particles and sulfur dioxide prompted the government to introduce measures to curb air pollution. These measures included the introduction of cleaner-burning fuels, mandatory catalytic converters, semi-annual vehicle inspections, and 'car-less' days to encourage public transportation.

In 2006, the government stated that four of the seven air pollutants being monitored – carbon dioxide, sulfur dioxide, nitrogen oxide and air-borne lead particles – were 'under control'. It also acknowledged that the three other monitored pollutants – ozone, particulate matter of less than 10 micrometres (PM_{10}) and particulate matter of less than 2.5 micrometres ($PM_{2.5}$) – remained at unhealthy levels. It is important to note, however, that emission reductions took place even among these pollutants. For example, the number of days each year when ozone levels failed to meet recommended heath standards fell from 341 in 1991 to 214 in 2006. The decline in PM_{10} was even more dramatic. That has not been the case for $PM_{2.5}$, where levels have remained stubbornly high. Nevertheless it is fair to say that the government's air pollution control measures have had a positive impact on the lives and health of millions of Mexicans.

PROBLEMS PERSIST

Experts have pointed to automobiles and micro- and mini-buses as key sources of air pollution. That was the conclusion of a series of studies conducted by Mario Molina (Nobel Laureate Chemistry 1995 and TWAS Fellow 1996) in the late 1990s, which confirmed government studies that showed internal combustion engines were responsible for 75 percent of the air pollution in

the MCMA. Other independent studies concurred with this estimate. All observers, moreover, agreed that greater improvements in air quality would require not only stringent regulations but also a more efficient public transportation system that would attract more people and leave a much lighter footprint on the environment.

Estimates developed in 2005 showed that some 3.5 million motor vehicles circulated on MCMA roads and highways, and that nearly 3 million, or 90 percent, of the vehicles were private automobiles. Despite this large number, automobiles were found to be responsible for just 20 percent of all daily trips. Micro- and mini-buses, in contrast, were found to account for nearly 60 percent of the total number of daily trips, making these buses the MCMA's most important source of transportation.

Another significant source of transportation is the Metro or underground, which carries some 4.5 million passengers each day. That is nearly 15 percent of all daily trips. The Metro is undoubtedly a viable environmentally friendly form of transportation. But it is expensive, requiring an annual subsidy of some US$300 million.

In light of these circumstances, a decade-long question faced by MCMA public officials has been this: What additional measures should be taken to improve the area's traffic congestion and air quality?

GET ON THE BUS

One answer resided in the creation of a Bus Rapid Transportation (BRT) system, an alternative system of bus transport developed in Curitiba, Brazil, in the early 1970s, where it currently carries more than two million passengers a day in this city of six million people. (Bogotá, Colombia, has also developed a successful BRT system.) The system consists of buses designed with large doorways (comparable to trains), dedicated bus lanes, boarding platforms, prepaid fares and zone-based (instead of single entry) fees pegged to the distance that is travelled.

With US$9.5 million in funding derived from the Global Environment Facility (GEF), the government of Japan and the Shell Foundation, in 2002 Mexico City launched the 'Introduction of Climate-Friendly Measures in the Transport Sector in the Mexico Valley Metropolitan Area'. The Metrobus, which was given this name to convey its kinship to the train-based Metro, was placed at the centre of this initiative.

Two years later, *Avenida Insurgentes*, one of the city's principal north-south thoroughfares, which intersects with other major roads and several underground stations, was chosen as the site of the Metrobus project. Construction commenced in January 2005. Eighteen months later, Metrobus began operations. The initiative required a capital investment of some US$70 million, supplied by the Mexican government. The money was used for land acquisitions, station and terminal construction, the development of a computerized ticket system and the purchase of new buses.

Metrobus is not just an innovative transportation strategy for moving people, but it also operates under innovative institutional arrangements that decentralize responsibilities for its operation, regulation and collection of fees. A new independent entity, the *Corredor Insurgentes Sociedad Anónima* (CISA), oversees such day-to-day functions as the hiring and training of personnel and the setting of bus schedules. The company currently employs 220 people, including 160 drivers. At

the same time, a new government agency, authorized by the mayor, shoulders regulatory responsibility for Metrobus, and a private bank manages the system's finances, including the collection of fares.

The system operates along a 20-kilometre corridor. There are two terminals and 36 stations, about one station every 450 metres. More than 100 diesel-fuelled buses capable of carrying 150 passengers each (replacements for the 360 micro- and mini-buses that had previously plied *Avenida Insurgentes*), serve as the backbone of the system. They are equipped with three broad, left-sided doors. Otherwise they resemble conventional buses. Diesel engines were chosen because of initial cost-savings and access to fuel. The engines, however, can be easily converted to run on ultra-low sulfur diesel if and when this fuel becomes readily available.

The Metrobus system moves 250,000 passengers, on average, every weekday. It takes about an hour for each bus to complete its route. That is roughly half the time that it took micro- and mini-buses in the past. A single fare is 3.5 pesos (US$0.33), which is not only a reasonable price to pay but also covers the system's operation and maintenance costs, including the financial payments for the buses.

ENVIRONMENTAL IMPACTS

Construction of the Metrobus on *Avenida Insurgentes* required the removal of 1700 trees, largely to clear space for building the 30 plus stations and two terminals. Planners compensated for the adverse environmental impact caused by the felling of trees by planting more than 10,000 saplings across the Mexican metropolitan area and by creating green spaces.

The positive impact of Metrobus on MCMA's air quality is undeniable. Passengers on the Metrobus represented just 1 percent of all bus passengers in the area. Yet it has resulted in significant reductions in air pollutants, including more than 70,000 tons of carbon dioxide and four tons of PM_{10}. Levels of sulfur dioxide, carbon monoxide, nitrogen oxides, volatile organic compounds and ammonia have also been sharply curtailed.

NEXT STOPS

Success has led the MCMA to begin devising plans for expanding the route on *Avenida Insurgentes* and for building 10 additional Metrobus lines on other major avenues in the metropolitan area. Seven additional cities in Mexico, moreover, have expressed interest in developing similar systems. BRT's low investment costs, long-term economic viability, and positive impact on traffic congestion and air quality have made BRT an increasingly attractive transportation option not just in Mexico but around the globe. Surveys show that some 50 cities worldwide have launched, or will soon launch, BRT projects.

The benefits of Metrobus reach across many constituencies. For users, it offers safer and faster travel. For government, it provides an option for mass transit that is considerably cheaper to build than rail alternatives and that promises to generate sufficient revenues to pay for itself. For transport companies, it provides a profitable business model. For bus drivers, it creates the prospects for a more stable source of income replete with healthcare, vacation and pension benefits. And for society, it provides an effective programme for curbing air pollution and greenhouse gas emissions.

As the World Resources Institute 2006 report, *Sustainable Mobility: Metrobus*, *Welcome Aboard,* observes: "It is easy to see how Metrobus has gradually won the financial and political support of multiple actors, as well as the appreciation of the passengers and the public. It can transport 6,000 passengers per hour in each direction at less than a tenth of the initial costs of an equivalent metro system", and over the long haul its "fare covers the operation and maintenance costs of the system, including finance payments on the buses."

All of these factors, the report observes, make "BRT a genuinely sustainable transportation system. Not only does it provide better service with less pollution than conventional buses, it also keeps city finances healthy, without incurring the deficit that metros (undergrounds) tend to cause". ■

Claudia Sheinbaum
Institute of Engineering
National Autonomous University of Mexico
Mexico City, Mexico

DEL PINO ELECTED TO US NAS

• **Eugenia Del Pino** (TWAS Fellow 1989) has been inducted into the US National Academy of Sciences as a foreign associate. An internationally renowned molecular biologist, Del Pino is a professor of biological sciences at the Pontifical Catholic University of Ecuador (PUCE) in Quito. She is also an honorary foreign member of the American Society of Ichthyologists and Herpetologists, a member of the Latin American Academy of Sciences and an honorary foreign member of the American Academy of Arts and Sciences.

Eugenia Del Pino

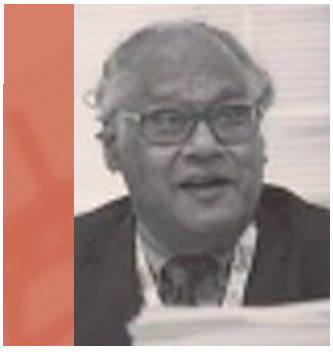
QAIM HONOURED

• **Syed Muhammad Qaim** (TWAS Fellow 2001), deputy director, Institute of Nuclear Chemical Research, Jülich, Germany, and professor at the University of Cologne, has been awarded honorary doctorate degrees from Debrecen University, Hungary, and Yorker International University (the latter is an international university with branches in Managua, Nicaragua, Milan, Italy and New York City, USA). Qaim, who was educated in the UK and Germany, is an internationally renowned nuclear chemist who has studied radiochemical data and techniques and examined fundamental aspects of nuclear reactions and nuclear spectroscopy. He has been previously honoured by the Hungarian Physical Society, Pergamon Press and the Pakistani government. Qaim is a member of the Pakistan Academy of Sciences and the Islamic World Academy of Sciences.

Syed Muhammad Qaim

HONORARY DOCTORATES

• **C.N.R. Rao**, TWAS founding fellow and immediate past president, has received honorary doctorate degrees from the University of Oxford, UK, and Northwestern University, USA. He has also been named a Distinguished Research Professor at the University of Cambridge and declared Laureate of the Khwarizmi International Award by the government of Iran.

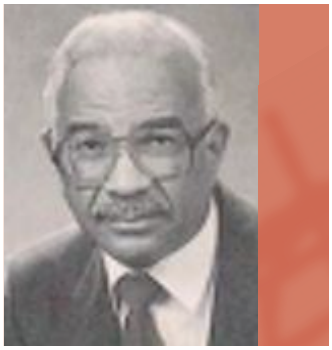


C.N.R. Rao

HASSAN A MAST FELLOW

• **Mohamed H.A. Hassan** (TWAS Fellow 1985), TWAS executive director, has been made an honorary fellow of the Mauritius Academy of Science and Technology (MAST). The induction ceremony will take place later this year. Hassan is also a member of the African Academy of Sciences, the Islamic World Academy of Sciences, *Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, *Académie Royale des Sciences d'Outre-Mer*, Belgium and the Pakistan Academy of Sciences.

Mohamed H.A. Hassan



Gerald Cecil Lalor

CARICOM AWARD

• **Gerald Cecil Lalor** (TWAS Fellow 1987), director general of the International Centre for Environmental and Nuclear Sciences (ICENS), University of the West Indies, in Kingston, Jamaica, has been given the 2007 Caribbean Community and Common Market (CARICOM) Science Award. He was honoured for his contributions to the field of chemistry and for serving a key role

in the development of science and technology in the Caribbean. Caribbean Money Market Brokers Limited (CMMB) sponsor the award.

TATE MEDAL TO YU LU

• **Yu Lu** (TWAS Fellow 1990), research fellow at the Institute of Theoretical Physics, Chinese Academy of Sciences, and former head of the Condensed Matter Section at the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy, has been awarded the 2007 American Institute of Physics' Tate Medal. Yu Lu is being recognized for his contributions in forging close ties among condensed matter physicists across the globe, for his support of young scientists, for organizing world-class international conferences, and for his international leadership in theoretical physics.

Yu Lu

MSOLLA APPOINTED MINISTER

• **Peter M. Msolla** (TWAS Fellow 1989), an expert in the epidemiology and treatment of bovine parasitic diseases, has been appointed Tanzania's Minister for Agriculture and Food Security. He was previously the Minister of Higher Education, Science and Technology. Msolla has also served as professor of veterinary medicine and deputy vice

Peter M. Msolla

chancellor of Sokoine University of Agriculture in Morogoro, Tanzania, a district veterinary officer in Sumbawanga, a regional veterinary officer in the Mbeya Region and chair of the Tanzania Veterinary Association.

IN MEMORIAM

• **Abdul Razzak Kaddoura** (TWAS Fellow 1985) from Syria has passed away at the age of 78. Kaddoura, who received a PhD in high energy physics from Bristol University, UK, served as deputy general director of UNESCO from 1976 to 1988. He held several key posts both in government and academia in Syria, including rector at the University of Damascus. Kaddoura was a member of the Arabic Language Assembly in Damascus, the Saudi Arabian National Centre for Science and Technology and the awards committee of the King Faisal International Prize in Science.

Abdul Razzak Kaddoura

• **Tu Guang-zhi** (TWAS Fellow 1993) from China has passed away at the age of 88. He obtained his BSc from Southwest United University in Kunmin, China, and his PhD from the University of Minnesota, USA.

Tu Guang-zhi

Upon his return to China, he successfully pioneered the development of the field of geochemistry in China and served as the deputy director of the Institute of Geochemistry at the Chinese Academy of Sciences (CAS). For his work, he was awarded the First and Second Prizes by the National Natural Science Awarding Committee and was made an honourary fellow of the Geological Society of America and an academician of CAS.

WHAT'S TWAS?

TWAS, THE ACADEMY OF SCIENCES FOR THE DEVELOPING WORLD, IS AN AUTONOMOUS INTERNATIONAL ORGANIZATION THAT PROMOTES SCIENTIFIC CAPACITY AND EXCELLENCE IN THE SOUTH. FOUNDED AS THE THIRD WORLD ACADEMY OF SCIENCES BY A GROUP OF EMINENT SCIENTISTS UNDER THE LEADERSHIP OF THE LATE NOBEL LAUREATE ABDUS SALAM OF PAKISTAN IN 1983, TWAS WAS OFFICIALLY LAUNCHED IN TRIESTE, ITALY, IN 1985, BY THE SECRETARY GENERAL OF THE UNITED NATIONS.

TWAS has more than 850 members from 90 countries, 73 of which are developing countries. A 13-member Council is responsible for supervising all Academy affairs. It is assisted in the administration and coordination of programmes by a secretariat, headed by an Executive Director and located on the premises of the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy. The United Nations Educational, Scientific and Cultural Organization (UNESCO) is responsible for the administration of TWAS funds and staff. A major portion of TWAS funding is provided by the Ministry of Foreign Affairs of Italy.

The main objectives of TWAS are to:

- Recognize, support and promote excellence in scientific research in the South.
- Provide promising scientists in the South with research facilities necessary for the advancement of their work.
- Facilitate contacts between individual scientists and institutions in the South.
- Encourage South-North cooperation between individuals and centres of science and scholarship.

In 1988, TWAS facilitated the establishment of the Third World Network of Scientific Organizations (TWNSO), a non-governmental alliance of some 150 scientific organizations in the South. In September 2006, the foreign ministers of the Group of 77 and China endorsed the transformation of TWNSO into the Consortium on Science, Technology and Innovation for the South (COSTIS). COSTIS's goals are to help build political and scientific leadership in the South and to promote sustainable development through broad-based South-South and South-North partnerships in science and technology. **costis.g77.org**

TWAS also played a key role in the establishment of the Third World Organization for Women in Science (TWOWS), which was officially launched in Cairo in 1993. TWOWS has a membership of more than 2,500 women scientists from 87 developing countries. Its main objectives are to promote research, provide training, and strengthen the role of women scientists in decision-making and development processes in the South. The secretariat of TWOWS is hosted and assisted by TWAS. **www.twows.org**

Since May 2000, TWAS has been providing the secretariat for the InterAcademy Panel on International Issues (IAP), a global network of 98 science academies worldwide established in 1993, whose primary goal is to help member academies work together to inform citizens and advise decision-makers on the scientific aspects of critical global issues. **www.interacademies.net/iap**

The secretariat of the InterAcademy Medical Panel (IAMP), a global network of 65 medical academies and medical divisions within science and engineering academies, relocated to Trieste in May 2004 from Washington, DC, USA. IAMP and its member academies are committed to improving health worldwide, especially in developing countries.

www.iamp-online.org

WANT TO KNOW MORE?

TWAS and its affiliated organizations offer scientists in the South a variety of grants and fellowships. To find out more about these opportunities, check out the TWAS website:
www.twas.org

FELLOWSHIPS

Want to spend some time at a research institution in another developing country? Investigate the fellowships and associateships programmes:
www.twas.org/Exchange.html
TWOWS offers postgraduate fellowships to women from least developed countries (LDCs) and other countries in sub-Saharan Africa:
www.twows.org/postgrad.html

GRANTS

Are you a scientist seeking funding for your research project? Then take a look at the TWAS Research Grants scheme:
www.twas.org/mtm/RG_form.html
Is your research group seeking additional funds? See if it is eligible to apply under the TWAS Research Units in Least Developed Countries programme:
www.twas.org/mtm/research_units.html

EQUIPMENT

But that's not all TWAS has to offer. For instance, do you need a minor spare part for your laboratory equipment – no big deal, really – but you just can't get it anywhere locally? TWAS can help:
www.twas.org/mtm/SP_form.html

TRAVEL

Would you like to invite an eminent scholar to your institution, but need funding for his/her travel? Check out the Visiting Scientist Programme:
www.twas.org/hg/vis_sci.html

CONFERENCES

Are you organizing a scientific conference and would like to involve young scientists from the region? You may find the help you need here:
www.twas.org/mtm/SM_form.html