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"THEY ARE CAN-DO ORGANIZATIONS THAT ARE HELPING TWAS TO EXPAND ITS REACH AND IMPACT." THAT'S HOW MOHAMED HASSAN, THE ACADEMY'S EXECUTIVE DIRECTOR, DESCRIBED TWAS'S FIVE REGIONAL OFFICES AT THE 18TH GENERAL MEETING HELD IN TRIESTE LAST NOVEMBER.

In the following article, Carlos Alberto Aragão de Carvalho, coordinator for the TWAS Regional Office for Latin America and the Caribbean (TWAS-ROLAC), describes the range of activities that TWAS-ROLAC has pursued since its inception. This marks the first in a series of articles on the TWAS regional offices that will be published in the TWAS Newsletter.

TWAS in the Americas

The creation of the TWAS Regional Office for Latin America and the Caribbean (TWAS-ROLAC) can be traced to a key goal in the Academy's Strategic Plan for 1997-2000, which called for the creation of a series of field offices across the developing world to help decentralize TWAS activities and bring the Academy closer to those it seeks to help.

The real work of TWAS-ROLAC, however, began in June 2004 when TWAS signed a memorandum of understanding with the Brazilian Academy of Sciences (ABC) that led to the establishment of a TWAS-ROLAC secretariat at ABC headquarters in Rio de Janeiro. With a permanent home and an annual grant of US$10,000 from TWAS, TWAS-ROLAC was able to get things off the ground and moving.

One of its first actions was to create a homepage (www.rio.twas.org). The thinking behind this was that the primary goal of TWAS-ROLAC was to foster networking among the nearly 200 TWAS members who live and work in Latin America, and that there would be no better way to advance this goal than to take advantage of the opportunities presented by electronic communications.

The TWAS-ROLAC website, which is constantly being refined and expanded, includes a detailed database on TWAS Fellows in the region, describing their fields of interest and insti-

CONTENTS

TWAS NEWSLETTER
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tutional affiliations; an outline of the office's work plan; wide-ranging information about scientific activities, including upcoming meetings and potential funding opportunities; key links to scientific organizations, including universities, research centres and science academies; and news on science and technology, particularly scientific news pertaining to the region.

Since its creation, TWAS-ROLAC has also devoted a great deal of time and effort to identifying scientists who might be worthy of nomination for TWAS membership and awards. The office is particularly interested in locating scientists from the region's smaller and poorer countries who have done excellent work but who may have been overlooked in the past. It has also sought to publicize TWAS activities and programmes largely through announcements on the website and in e-mails.

The goal is to increase the number of scientists who are aware of the opportunities that TWAS offers. This effort is based on the notion that the more scientists know about the Academy's initiatives, the more likely it is that the Academy will receive applications of high quality – in short, that visibility, at least in the right places, is a prerequisite for excellence. For example, it has been disseminating information about TWAS-CNPq (Brazilian National Research Council) Fellowship Programme. Launched in 2004, the programme, which is funded by the Brazilian government, supports a total of 60 scholarships each year – 30 doctoral and 30 postdoctoral – in all areas of science.

In 2005, the office initiated the first-ever TWAS-ROLAC Prizes for Young Scientists in Latin America and the Caribbean, honouring scientists in the fields of chemistry, earth science and engineering. A jury comprised of four TWAS Fellows from the region vetted the candidate pool and chose the awardees, all of whom were younger than 40 years of age.

ROLAC THE STAFF

Carlos Alberto Aragão de Carvalho (TWAS Fellow 2002), professor of physics, Federal University of Rio de Janeiro, has headed the TWAS-ROLAC Office since its inception in 2004. Gabriella de Mello (gfmello@abc.org.br) was appointed the first staff member of the office in 2004. Thanks to the generosity of TWAS and the Brazilian Academy of Sciences (ABC), she spent one year at the TWAS secretariat in Trieste in 2006 learning about the full range of the Academy's activities and operations. In 2006, Kenya Carvalho (kenya@abc.org.br) and Kley Maya (kley@abc.org.br) joined the TWAS-ROLAC staff, allowing de Mello to assume responsibility as ABC's liaison with the TWAS secretariat. The TWAS-ROLAC Consulting Board is comprised of TWAS Fellows from diverse geographical areas within the region and diverse fields of science. The board, which meets once a year, helps to formulate work plans and spread the word about the regional office's activities. Current board members include Alberto Giesecke (earth science, Regional Centre for Seismology for South America (CERESIS), Peru), Carlos Augusto di Prisco (mathematics, Venezuelan Institute of Scientific Research (IVIC), Venezuela), Francisco Barrantes (biophysics, the National Scientific and Technical Research Council (CONICET), Argentina), Manuel Limonta (medical science, the National Institute of Haematology and Immunology, Cuba), and Silvia Peimbert (astrophysics, Institute of Astronomy, National Autonomous University of Mexico (UNAM), Mexico).

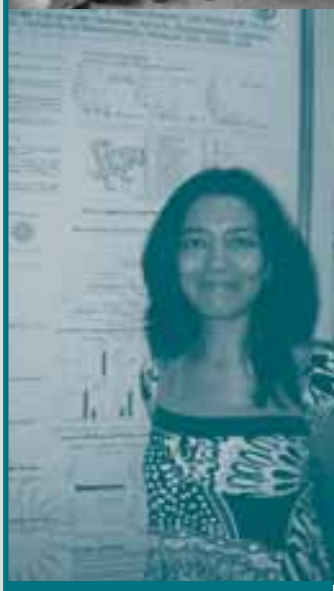
The recipients, each of whom received US$2,000, were honoured at the Third Brazilian National Conference on Science, Technology, and Innovation. The conference, held in November 2005, also provided an opportunity for members of the TWAS-ROLAC consultative board to discuss the state of international scientific exchange programmes in their countries.

Participants agreed that scientific exchange within the region was increasing and that steps should be taken to accelerate and expand this trend. They also agreed that TWAS-ROLAC is well positioned to play a central role in this effort. The success of this meeting led to another conference on a similar topic, held in January 2007 and co-sponsored by ABC and TWAS-ROLAC. The conference, 'Brazilian Science and Scientific Collaboration with Latin America and the Caribbean', provided TWAS regional fellows with an opportunity to explore the status of science and technology in their countries and to discuss what steps should be taken to increase scientific collaboration in the region.

The signature event for TWAS-ROLAC, in its brief history, was the First Regional Conference of Young Scientists (RCYS), 'Promoting Life Sciences for Sustainable Development', which took place at the TWAS 10th General Conference in Angra dos Reis, Brazil, in September 2006.

The conference aimed to bring together a group of talented young scientists from across the region, who were pursuing research careers in the biological sciences, to share their knowledge and experience. Participants were asked to present their research findings both to each other and to leading senior scientists who were attending the TWAS General Conference.

Some 28 young scientists, chosen from seven countries in the region, participated. Fourteen gave presentations and another fourteen displayed posters. Scientists in attendance, including many TWAS Fellows, acknowledged the high level of scientific discussion that took place. As Jacob Palis, president of TWAS, noted: "The excellence of the research presented by the young scientists



TWAS-ROLAC YOUNG SCIENTIST PRIZE

Awardees 2005

- *Luís Eduardo Juanicó (engineering), Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Argentina.*
- *Jorge Luís Chau (earth science), Radio Observatory of Jicamarca, Geophysical Institute, Peru.*
- *Nora Mariel Marder (chemistry), Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Instituto de Química y Físico-Química Biologicas, Argentina.*

Awardees 2007

- *Anamaria Camargo Aranha (medical science), Ludwig Institute for Cancer Research, São Paulo, Brazil.*
- *Carlos Gustavo Moreira (mathematics), National Institute for Pure and Applied Mathematics (IMPA), Brazil.*
- *Juan Larraín (biological science), Faculty of Biological Sciences, Pontifícal Catholic University of Chile, Chile.*
- *Marcelo Knobel (physics), Institute of Physics "Gleb Wataghin," State University of Campinas (UNICAMP), Brazil.*

PUBLIC UNDERSTANDING AND POPULARIZATION OF SCIENCE PRIZE 2007

- *Roberto Lent, professor of neurosciences and director, Institute of Biomedical Sciences, Federal University of Rio de Janeiro, Brazil.*

TWAS YOUNG AFFILIATES 2007

- *Anamaria Camargo Aranha (structural, cell and molecular biology), Ludwig Institute for Cancer Research, São Paulo, Brazil.*
- *Ernesto Lupercio Lara (mathematics), Centre for Research and Advanced Studies of the National Polytechnic Institute (CINVESTAV), Mexico.*
- *Gabriel Rabinovich (structural, cell and molecular biology), Division of Immunology, National University of Córdoba, Argentina.*
- *Juan Larraín (structural, cell and molecular biology), Faculty of Biological Sciences, Pontifical Catholic University of Chile, Chile.*
- *Marcelo Knobel (physics), Institute of Physics "Gleb Wataghin," State University of Campinas (UNICAMP), Brazil.*

and their enthusiasm for their work provided a valuable addition to the proceedings." Another benefit of the conference was the opportunity it provided these young scientists to meet and share not only their knowledge but their experiences.

The success of the first editions of TWAS-ROLAC prizes and conferences for young scientists has laid the groundwork for each of these activities to become annual events.

For example, the second round of TWAS-ROLAC Prizes for Young Scientists, in the fields of mathematics, physics, biological science and medical science, was held in May 2007. From among the nominations received, four young scientists were chosen by a four-person panel comprised of TWAS Fellows. As in the first year, each winner received US$2,000. The awards ceremony took place at the annual meeting of ABC in Rio de Janeiro, where the winners were also asked to present their work.

Meanwhile, in December 2007, TWAS-ROLAC organized the Second RCYS at ABC. The conference focused on astronomy, chemistry, computer science, mathematics and physics. About 30 scientists participated in the event.

The Third RCYS is scheduled to take place in Rio de Janeiro in December 2008. The conference will focus on the fields of agricultural, engineering and the medical sciences.

Over the past year, the range of activities pursued by TWAS-ROLAC, with the help of TWAS, has expanded even further. Following a request from the TWAS secretariat, TWAS-ROLAC called upon a five-member jury to select five young scientists to become TWAS Young Affiliates. The new affiliated category of membership in the Academy, granted to promising young scientists under 40, will provide such privileges to grantees as financial support to attend TWAS General Meetings. Affiliate membership status will last for five years.

Prompted by the TWAS secretariat, TWAS-ROLAC also named a three-member jury to select the first-ever recipient of the Public Understanding and Popularization of Science Prize. The recipient Roberto Lent, professor of neurosciences and director of the Institute of Biomedicine at the Federal Uni-

versity of Rio de Janeiro, received a US$3,000 prize. The prize in public understanding and popularization, which will rotate with prizes for science education and science institutional building, will be awarded once every three years.

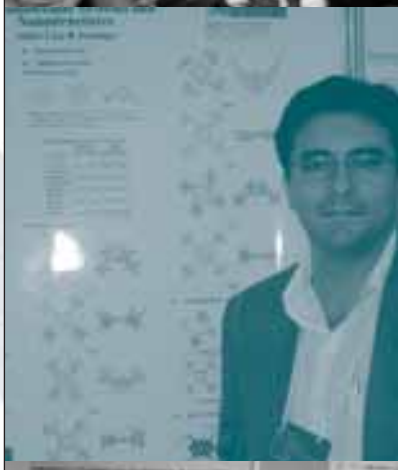
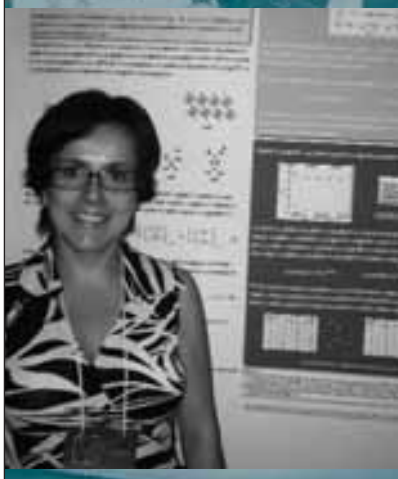
We are proud of the accelerated progress we have made in developing a full range of activities that are proving beneficial both to the scientific community in Latin America and the Caribbean region and to TWAS. We are hopeful, moreover, that we have laid a strong foundation for a more active and effective agenda in the years ahead. As a result, we have every expectation of fulfilling the promise and trust that TWAS and ABC have instilled in us as part of our shared commitment to help advance science, technology and innovation across the region. ■

Carlos Alberto Aragão de Carvalho
Coordinator for TWAS-ROLAC,
Rio de Janeiro, Brazil

OTHER OFFICES, OTHER REGIONS

TWAS has created five offices. In addition to TWAS-ROLAC, they are:

- *TWAS Regional Office for East and South-East Asia and the Pacific (TWAS-ROESEAP) at the Chinese Academy of Sciences in Beijing, China.*
- *TWAS Regional Office for Central and South Asia (TWAS-ROCASA) at the Jawaharlal Nehru Centre for Advanced Scientific Research in Bangalore, India.*
- *TWAS Arab Regional Office (TWAS-ARO) at the* Bibliotheca Alexandrina *in Alexandria, Egypt.*
- *TWAS Regional Office for Sub-Saharan Africa (TWAS-ROSSA) at the African Academy of Sciences in Nairobi, Kenya.*

COLLABORATION BEGINS AT HOME

SOUTH-SOUTH COLLABORATION IN SCIENTIFIC RESEARCH, A DREAM OF THOSE WHO FOUNDED TWAS A QUARTER OF A CENTURY AGO, IS BECOMING A REALITY.

As the Academy's founders knew, it is not collaboration *per se* that poses the most critical challenge. Rather, it is the quality of science that ultimately determines whether a country can participate in – and fully benefit from – international collaboration, especially in frontier science and technology.

If a country is to avoid the fate of being a junior partner in such endeavours, high-level competence in scientific research at the national level must precede collaboration at the international level.

Let me offer some statistics that indicate the scope of the challenge. The developed world is responsible for about 78 percent of global output in scientific publications. The remaining 22 percent originate from the developing world.

A careful examination of these figures, however, leads to this startling conclusion: The gap in scientific publications between developed and developing countries pales before the gap that has emerged in the South.

Three developing countries account for nearly half of the developing world's contribution to global scientific publications: China (6.6 percent), India (2.2 percent) and Brazil (1.5 percent). Africa's total contribution is just 1.4 percent. Just two countries – South Africa and Egypt – account for more than half of the continent's share.

So what can be done to lay the groundwork for scientific capacity within countries that can then serve as a basis for more meaningful collaborative research among countries?

First, each country that finds itself seriously handicapped by inadequate scientific capacity (TWAS estimates that some 80 countries fit this category) must create at least one competent research university

TWAS Newsletter, Vol. 20 No. 2, 2008




that is widely viewed as an international centre of excellence.

According to the 2007 Shanghai Jiao Tong University ranking of world universities, Africa has only five universities among the world's top 500 universities. Four are in South Africa (the Universities of Cape Town, Witwatersrand, KwaZulu-Natal and Pretoria), and one is in Egypt (the University of Cairo). The 56 member states of the Organisation of the Islamic Conference (OIC) have just two universities among the top 500 universities. In addition to the University of Cairo, there is Istanbul University.

Universities with international standing are critical for setting national standards for quality in education and research, attracting and training scientific talent, and curbing the brain drain. The latter is a crucial consideration. More scientists from sub-Saharan Africa currently live and work in the United States than live and work in their native countries. These scientists are more likely to collaborate with colleagues in the North than with colleagues at home. The truth is that it is difficult – if not impossible – to develop collaborative research projects when a nation's best scientists are living and working elsewhere.

Second, each country must also invest more in its entire university system. While establishing at least one university of international excellence is important, it is not enough to ensure broad-based international scientific collaboration on a sustainable basis.

Substantial investments must also be made in other universities if future generations of scientists are to be adequately trained to participate in international research initiatives at the highest levels.

Sub-Saharan Africa once had some of the developing world's finest universities, including the University of Khartoum where I taught in the 1970s and 1980s. But political turmoil and sparse funding ultimately robbed these universities of their capacities and denied attractive employment opportunities to a generation of professors. As professors hired in the 1970s and 1980s reach retirement (many, in fact, already have), there is an urgent need to train young scientists because so few professors are in their forties and fifties.

Third, each country must establish and support a national science foundation. Such institutions can serve as a source of merit-based funding for science. Very few scientifically lagging countries currently have science foundations. Indeed in sub-Saharan Africa, there is only one: the South African National Research Foundation. Nigeria announced plans to launch a science foundation in 2006 with a US$5 billion endowment. But efforts to secure this funding have not yet succeeded.

Fourth, each country must establish technology innovation centres, preferably within or near their universities to nurture a welcome synergism between education, research and innovation. International research collaboration in the 21st century will largely focus on projects tied to global challenges: for example, efforts to mitigate the impact of global warming, conserve biodiversity, broaden the scope of renewable energies and restrain the spread of infectious diseases. Scientists must therefore be schooled not just in science but also in the process of innovation, and they must be taught how to appreciate and overcome the challenges posed by efforts to transform scientific findings into useful products and services. Innovation centres can help in this effort.

Fifth, scientifically lagging countries that lack a merit-based na-




tional science academy must build one (for example, among the 48 countries in sub-Saharan Africa, there are just 13 national science academies). And nations that have merit-based science academies must strengthen these institutions.

Science academies, despite their knowledgeable and prestigious membership, remain an underutilized resource. These institutions could serve a key role in fostering international collaborative research by identifying a country's preeminent researchers and providing expert advice on global science-based initiatives that should be vigorously pursued by their governments.

North-South and South-South research partnerships between scientists and scientific institutions of unequal capabilities, of course, should not be abandoned. Scientific exchange, after all, often generates valuable outcomes even under less than ideal circumstances.

Yet for the full promise of South-South collaboration in research to be realized, the yawning gap in scientific capabilities between countries, and especially between developing countries, must be closed. That's the goal of TWAS's broad-ranging efforts to train the next generation of scientists through a postgraduate and postdoctoral programme for students and young researchers living in countries lagging in science and technology.

In short, when it comes to collaboration in research in the developing world, fruitful collaboration must ensure that indigenous capacities in science and technology are strong enough for local scientists to participate as true partners in joint projects and programmes.

The world's least developed countries are also the world's least scientifically proficient countries. These countries can benefit greatly from South-South cooperation not just through joint research projects but even more importantly through education and training programmes that provide the next generation of scientists with the knowledge and skills that they need to succeed. Young scientists in LDCs should take advantage of these opportunities to help their nations build a strong foundation in scientific excellence.

The message to the governments of LDCs is: create and sustain conditions that encourage your young scientists to stay at home. The message to young scientists in LDCs is: give your country a chance to help you.

The future of South-South collaboration in research depends in large measure on reaching an accommodation, especially in LDCs, between science and society that enables scientists to pursue their careers in their own countries and to get involved in solving real life problems.

What is true of any strong and productive partnership is also true of science: collaboration in research does indeed begin at home. ■

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A similar version of this article was originally published by SciDev.Net on 14 May 2008.

LIKE SO MUCH ELSE IN CHINA, WHEN IT COMES TO HEALTHCARE, THE NUMBERS ARE STARTLING, THE CHALLENGES DAUNTING AND THE PROSPECTS FOR IMPROVEMENT ARE BRIGHTER THAN THEY HAVE EVER BEEN.

In China, a rapidly developing country, average annual per capita gross domestic product (GDP) has risen to nearly US$2,500. Yet, an estimated 15 million rural residents live in absolute poverty (less than US$110 a year) and 23 million urban dwellers live on subsistence allowances (eligibility varies in different parts of the country). It should not be surprising, then, to discover that China's disease profile displays characteristics of both rich and poor nations.

PUBLIC HEALTH IN CHINA

Some 4.5 million people in China continue to suffer from tuberculosis, hepatitis and other diseases usually associated with impoverished countries. At the same time, lifestyle maladies – obesity, diabetes, hypertension and heart ailments – non-communicable diseases most often associated with developed countries – are on the rise.

The person now leading China's efforts to address the nation's broad public health challenges is Chen Zhu, TWAS Fellow 1999 and co-chair of the InterAcademy Panel's (IAP) executive board.

Chen, who was appointed Minister of Health in June 2007, is a world-renowned molecular biologist. His cutting-edge research has provided insights into the causes of and possible treatments for cancer, and he has also played a key role in improving the level of laboratory research and medical education in China.

Chen was educated in China and France, and worked at the Hôpital Saint Louis *in Paris before returning to China in 1989 to pursue his career at home. In 1998, he was named director of the Chinese National Human Genome Centre in Shanghai, spearheading China's contribution to this high profile and highly successful global research effort. At the time, China was the only developing country to serve as a full partner in this project.*

Chen and his collaborators also played a key role in China's efforts to identify the molecular epidemiology of the SARS virus following the deadly epidemic in China in 2003.

Before assuming his ministerial post, Chen worked as a research professor and clinician at Ruijin Hospital, which is affiliated with Shanghai Jiao Tong University's School of Medicine, one of the nation's leading medical centres. He has published widely in such leading journals as Nature, Science *and the* Proceedings of the US National Academy of Sciences (PNAS), *and has also received many international awards, including the French* Chevalier de l'Ordre National de la Legion d'Hon-

neur. *Chen is just the second Chinese citizen appointed to a national ministerial post who is not a member of the Chinese Communist Party. Wan Gang, China's minister of science and technology is the other.*

During a recent trip to Amsterdam to attend the IAP Executive Committee Meeting, the editor of the TWAS Newsletter *had an opportunity to speak with Minister Chen about the major health challenges faced by China. Excerpts of the hour-long interview follow.*

China has made rapid and sustained progress in advancing several key health indicators. What are the major factors driving these dramatic improvements?

Health researchers and clinicians agree that trend lines showing how long people are living are among the most revealing indicators of the state of a nation's health. In 1950, the average life expectancy in China was 35. In 2000, it was 71.4.

Today, people in China are living longer thanks largely to a growing number of well-trained health practitioners and dramatic improvements in the healthcare system.

Such improvements continue to take place at a swift pace. For example, between 2000 and 2005, the average life expectancy of our citizens rose from 71.4 years to 73 years. In other words, China has been able to enjoy rapid advances in this most critical health indicator even as the country nears the age-longevity profiles of developed countries. This, I believe, is a remarkable achievement.

Longevity is not the only health indicator in China heading in the right direction. Infant mortality has declined from 47 deaths per 1,000 live births in 1975 to 15.3 deaths per 1,000 in 2007. As a result, China's infant mortality rate is now approaching the rate in Europe and the United States. Encouraging trends also exist for maternal health and the incidence of such infectious diseases as malaria.

Chinese leaders have considered public health a national priority and I think it is fair to say that our efforts to improve the state of health have attained measures of success that few thought would be possible in such a short period.

What are the major challenges facing China's healthcare system?

The broad range of improvements that we have achieved in healthcare does not mean, of course, that we have accomplished our goals and that everything and everyone are fine. Enormous problems persist, and new, ever more daunting, healthcare issues continue to surface as social and economic conditions in China evolve at a rapid pace.

At an institutional level, the primary challenge facing China's healthcare system is the gap in care that exists between urban and rural residents.

That is not to say that compelling healthcare issues do not exist in urban areas. They do. For example, there are increasing incidences of respiratory problems in diverse demographic groups driven by rising levels of air pollution. Injuries and trauma caused by a growing number of traffic accidents have become major healthcare concerns. Cases of hypertension and heart disease, especially among urban residents, are on the rise. And since the outbreak of SARS in 2003, the

potential for an epidemic has remained a top public healthcare concern. Crowded urban areas with migrant populations are the most vulnerable to such a threat.


Chen Zhu

Nevertheless it is also true that in China urban residents generally receive better healthcare than their counterparts in rural areas. Like other countries in both the developed and developing worlds, urban areas are served by the best hospitals and research facilities – for example, Peking Union Medical College, Shanghai Fudan University and Shanghai Institute of Haematology at Ruijin Hospital.

In the countryside, services are provided through a stair-stepped system of coverage that begins in the village, where primary healthcare is provided, and then moves on to the township and county where citizens can find care and treatment for more complicated health problems. The government covers 80 percent of the annual insurance premium. Residents pay the other 20 percent. These dual payments provide the financial basis of the New Rural Cooperative Medicare Scheme, which also includes cost-sharing arrangements for the treatment of major ailments and diseases.

The system for rural healthcare suffers from a shortage of health practitioners. The government is trying to rectify this situation through a variety of measures: for example, by providing incentives for doctors, especially young doctors, to practice in rural areas (if not permanently then at least for one and perhaps several years), and by improving the infrastructure of rural clinics and hospitals so that doctors can practice good medicine in remote areas. The introduction of electronic communications – marked by rapid advances in e-medicine – is proving to be an invaluable tool in this effort.

You have spoken about the challenges on the institutional front. What are the challenges that China faces on the medical front?

China, like other rapidly advancing developing countries, faces a 'double disease' burden – that is, the nation suffers from the maladies of both poor and rich countries.

In the more impoverished regions of the country, largely rural areas, there remain high incidences of such long-standing infectious and communicable diseases as tuberculosis. We even have to contend with pockets of malnutrition that continue to plague the poorest, most remote areas of the country, and incidences of malaria that sometimes flare up along our southern and southwestern borders with neighbouring nations.

In China's wealthier regions, mainly in the cities along the eastern coast, there are increasing incidences of such lifestyle maladies as diabetes, hypertension, strokes and heart and respiratory diseases. Cancer is also on the rise, in part, because of better and earlier detection and, in part, because of adverse environmental impacts and an ageing population. We are also witnessing a rise in mental illness, again, in part, because of improved and more rigorous diagnosis and because of dramatic changes in family and social structures. Occupational safety has become an important medical issue, and traffic accidents are now the fifth leading cause of death and injury in China's major cities. Emerging infectious diseases such as HIV/AIDS and SARS add to the nation's healthcare challenges.

All of this makes healthcare in China a complicated, multifaceted challenge that requires a range of policy options to be considered – and implemented – if we are to improve the health and

well-being of our citizens. We have initiated a plan, called 'Healthy China 2020', which provides a detailed blueprint for reaching our goals of improving people's health by 2020. The latter is also the target date set by the government for transforming China into a well-off nation.

To what extent does China's medical research and healthcare community interact with their counterparts in other parts of the world?

China enjoys close and growing relationships with medical researchers, public health workers and clinicians in both the developed and developing world.

For example, China was the only developing country to participate as a full partner in the human genome project, a model exercise in international scientific cooperation that we proudly contributed to and that helped us to build our own capacity in this area of the biological sciences.

This experience has paid significant dividends for medical research in China. For example, the ability of my research group at the Chinese National Human Genome Centre in Shanghai to genetically map the molecular evolution of the SARS virus was a direct result of our involvement in the human genome project.

Today, an increasing number of China's medical researchers are conducting joint studies with their European colleagues seeking to meld Chinese traditional medical practices, which are often rooted in thousands of years of experience, with contemporary western medicine. For example, together they have conducted laboratory experiments searching for scientific verification for the effectiveness of herbal medicines. These efforts have led to some valuable applications of medicinal herbs for the treatment of disease. For example, the herbal drug artemisinin, isolated from the shrub *Artemisia annua*, which has long been used in traditional Chinese medicine, has become a primary drug for the treatment of *P. falciparum* malaria.

China's medical research community also works closely with health research institutes in the United States on issues related to drug use and methadone treatment, and on improving efforts to monitor the spread of HIV/AIDS.

Medical practice, like so much of science, is only as good as the information on which it is based. As a result, we have launched study projects with US and European scientists examining possible genetic and environmental factors responsible for obesity and diabetes, both growing global health problems affecting rich and poor countries.

China's medical researchers also work closely with their counterparts in the developing world. We have cooperated, for example, with medical practitioners in neighbouring Asian countries investigating the spread of malaria along our common borders. Mosquitoes, as we all know, do not respect national boundaries. As a result, it is in each country's interest to pursue effective strategies for combatting and treating this debilitating mosquito-borne disease.

Cooperation between Chinese and African medical communities dates back to the early 1960s when China began to send doctors to work shoulder-to-shoulder in hospitals and clinics with African doctors, nurses and technicians.

The programme calls on Chinese doctors to take two-year or three-year assignments in Africa to provide medical services to local people. We think this effort not only bene-

fits Africa but also helps to train local doctors. About 1,000 Chinese doctors are currently sent each year to hospitals and clinics in some 40 African countries.

Last year, the Chinese government decided to expand this programme by launching 30 anti-malaria centres in Africa. This initiative reflects China's increasing ability to serve as a South-South link for improving medical research and public heath. A major responsibility of these centres is to train African public health professionals in the most up-to-date malaria prevention and control measures. China is also providing anti-malaria drugs and insecticide-treated bed nets. If successful, this effort could lead to additional partnerships with Africa's medical research and public health communities designed to address a wide range of health issues of common concern.

Where are China's strengths in medical research? Which areas of research would you like to see made stronger in the years ahead?

China's primary strengths in medical research are two-fold – one, which is long-standing, is based on our history and large population; the other has emerged over the past decade or two and must continue to take root if we are to join the ranks of countries with world-class medical researchers, public health workers and clinicians in a full range of public health issues.

First, China has a vast population, portions of which have lived in relatively small isolated groups for generations. This provides an ideal demographic environment for medical research and clinical trials focusing on diseases that may be caused, at least in part, by genetic factors. This led US and Chinese scientists to survey select groups in China as part of a joint research project examining the rising incidence of diabetes.

Second, Traditional Chinese Medicine (TCM) is a valuable part of our nation's heritage. Efforts to incorporate TCM into modern medicine not only offers an harmonious philosophy for the practice of medicine but also provides a potential treasure trove of resources for drug discovery.

Third, China has a growing pool of well-trained scientists and clinicians who can serve as worthy partners in international projects at the frontiers of medical research. There are currently some 250 medical research institutions across the country. Some are world-class. More than 250,000 students graduated with medical and health-related degrees in 2006, a figure that is replicated annually. Most of the students with medical degrees will become practicing physicians who devote their careers to patient care. Yet a sizeable portion will undoubtedly choose to pursue careers in medical research working closely with colleagues at home and abroad. In addition, China continues to build and expand a network of institutions devoted to public health issues. The main pillars of this network include the Ministry of Health and its affiliated organizations (for example, the Chinese Centre for Disease Control and Prevention and the Chinese Academy of Medical Sciences), other biomedical research institutions and universities, and the Administration of Traditional Chinese Medicine as well as the State Food and Drug Administration.

The progress we have made is plain to see. But more needs to be done. We need to



attract more young people not just into medical research but also into various fields in public health – for example, healthcare administration, management, finance and delivery. We need to invest more resources into translational research to speed findings from the laboratory to the clinic or, in current professional jargon, from the bench to the bedside. We need to continue to build our infrastructure both for medical research and patient care. We need to place more emphasis on preventive care, which will require strengthening healthcare education for school children and adults. We need to improve coordination among our existing healthcare institutions. And we need to create a stronger legal framework to ensure that the nation's health insurance system is extended to include all citizens and that it receives adequate funding in the future so that the commitments which are made today are sustained and ultimately fulfilled. These are the priorities that I am determined to pursue as minister of health.

What has life been like since you were appointed minister?

I am by nature a researcher and have spent virtually my entire career in classrooms and laboratories focusing on medical science and patient care. My appointment as minister represents quite a change in direction and focus. I am indeed honoured – and I might add humbled – to be given an opportunity to play such a prominent role in seeking to improve the health of China's 1.3 billion people.

I have been on the job eight months. So I think it is fair to say that I am still learning. Nevertheless, I bring a certain point of view to the position based on my professional background and my status as only the second individual to be appointed a cabinet minister who is not a member of the Chinese Communist Party.

I see myself, for example, as a leader who is mainly responsible for implementing, and not setting, policy. I also believe that success will depend on cooperation and a division of labour. In this sense, managing the ministry carries many of the same challenges that must be met in administrating a big research project that includes a large number of laboratories and, in some instances, international exchange and collaboration.

First, you must nurture a congenial and productive relationship among the staff. Second, you must foster a cooperative relationship among various governmental institutions that have responsibility for health-related issues – much like a successful leader of a large research project often depends on fostering a cooperative relationship among different individuals and institutions. And third, you must take issues related to human resource development very seriously.

If I effectively implement the healthcare policies that the government has put in place, I think the Ministry of Health will have made a significant contribution to improving public health. Will this approach prove successful? Come back in five years' time to ask me. I should know by then. ■

LIGHTING THE WAY TO A BETTER FUTURE

GLOBAL ECONOMIC GROWTH DEPENDS ON ENERGY – NOW MORE THAN EVER. WILL THERE BE SUFFICIENT ENERGY SUPPLIES TO ENSURE CONTINUED ECONOMIC DEVELOPMENT? JOSÉ GOLDEMBERG (TWAS FELLOW 1990) EXAMINES THIS CRITICAL ISSUE.

The world's energy future has been placed at risk by two trends that pose formidable global challenges. One trend is marked by an unprecedented rise in global energy consumption, which is being driven by the developed world's insatiable appetite for exhaustible fossil fuels together with the growing energy needs of China, India and other 'rapidly developing' developing countries. The other trend is marked by the spectre of rising greenhouse gas emissions related to the burning of fossil fuels, which is a major source of global warming.

In the following article, José Goldemberg (TWAS Fellow 1990), professor of physics, University of São Paulo, Brazil, and co-director of the study panel for the recently published InterAcademy Council (IAC) report, Lighting the Way Toward a Sustainable Energy Future*, explores the key forces underlying today's energy challenges. Goldemberg also proposes a course of action that could help 'light the way' to a brighter energy future.*

The world has good reason to be wary of its energy future. Current global demand for oil has pushed oil prices to nearly US$150 a barrel, adding to the world's economic woes and threatening to spur a global economic downturn. Major disruptions in oil production in Saudi Arabia, Nigeria and Venezuela could spark an immediate crisis in oil supplies, heightening global tensions to the breaking point in a world where conflict is all too common. Meanwhile, global climate change, induced by the burning of fossil fuels is accelerating and could well pose the greatest environmental challenge in human history.

The world, in short, is producing and consuming too much fossil fuel for its own good. Coal, oil and natural gas, as we all know, are finite resources, and while ample supplies currently exist (at rapidly rising prices), energy experts contend that may not be the case in the

decades ahead. Using too much while having too little of any vital resource does not bode well for the future. This prospect is particularly worrisome for a resource as critical as energy.

Despite the daunting challenges, there are ways forward that could help ensure that sufficient, yet environmentally benign, supplies of energy are available to fuel future global economic growth. The ways forward will depend, in large measure, on advances in science and technology.

What I propose below is a common-sense approach for dealing with the world's current energy challenges. Beyond advances in science and technology, the approach will require political will and commitment, global cooperation and innovation, and a long-term perspective that embraces patience and acknowledges a degree of sacrifice, especially by the world's richest countries.

Realizing a sustainable energy future will not be easy. But it is feasible. The ultimate rewards would be a more secure and sustainable energy future and a healthier environment for the entire global community.

These are goals that we all share. The question is how do we get from here to there without compromising the quality of life currently found in much of the developed world, or slowing the encouraging signs of sustained economic growth now unfolding in many regions of the developing world.

José Goldemberg

It is no secret that global energy use is following an unsustainable path. This is especially true in developed countries where per-capita energy use has reached extraordinary and, according to most energy experts, reckless levels. Human beings require between 2,000 and 3,000 kilocalories to lead healthy, active lives. The average US citizen, in contrast, uses 230,000 kilocalories a day. That is a rate of energy use equivalent to the biological needs of 100 people. The average European citizen uses about 115,000 kilocalories or half the amount of his or her US counterpart. The average Chinese or Indian citizen uses between 23,000 and 75,000 kilocalories and the average citizen of Namibia around 2,000 kilocalories a day.

The world is producing and consuming too much fossil fuel for its own good.

The issue of energy inequities should not be minimized. It is a root cause of poverty and hopelessness for the world's most impoverished citizens, a primary reason for the decline of the finite supplies of fossil fuels and a source of resentment between those who consume an excessive amount of energy and those who consume too little.

Between 1971 and 2004, worldwide energy consumption nearly doubled, and energy experts expect an additional 50-percent increase by 2030 as develop-

ing countries become wealthier and use more energy to meet their expanding needs and desires.

As the International Energy Agency (IEA) recently forecast, if current trends continue, world oil consumption is likely to increase 40 percent by 2030 (using 2004 as a baseline). Carbon dioxide emissions, spurred largely by energy production and consumption, are likely to increase 55 percent.

Strategies seeking to reduce energy use should begin by focusing on efforts to tap technologies – both long-standing and cutting-edge – that are designed to improve energy efficiency. In fact, doing more with the same amount of energy through greater energy efficiency is the best way forward in efforts in charting a successful course for a more sustainable energy future. Put another way, energy efficiency is the 'low hanging fruit' that should be harvested early on when devising global and national energy strategies designed to meet today's challenges.

Developing countries should not emulate the developed world's energy-intensive development pathways.

Developing countries have a distinct advantage in pursuing efforts to improve energy efficiency. For the most part, they have made only minimal investments in energy infrastructure. Conversely, key elements of the energy infrastructure characteristic of developed countries – for instance, centralized fossil-fuel-fired electric power stations and extensive and intricate powerline networks – often have lifespans spanning several decades. That is a heavy burden to shoulder for countries trying to move into an energy future marked by greater efficiency.

Take, for example, the case of commercial airplanes. The aging but well-maintained airplanes that comprise major portions of US commercial fleets (some planes are more than 30 years old) consume 30 percent more fuel than newer, more fuel-efficient airplanes. Nevertheless, these older planes are not about to be replaced, given the cost of new commercial airplanes. A Boeing 777, for example, carries a price tag of more than US$200 million.

Such circumstances give an enviable economic advantage to developing countries seeking to chart a more sustainable energy future. They are able to embrace newer, more energy-efficient, technologies with fewer social disruptions and without having to write off the 'sunken costs' embedded in ageing energy technologies and systems.

Advances in engineering, materials and system design make it not only possible to manufacture airplanes that consume less fuel but also to construct buildings that use less energy for lighting, heating and cooling. Indeed recent advances in building design and energy systems have created indoor spaces for living and working characterized by zero-net energy consumption – that is, they create as much energy as they use.

Developing countries, in short, do not have to – and, in fact, should not – emulate the developed world's

energy-intensive pathways to economic development. Advances in science and technology have provided a better pathway to energy development and its associated economic benefits.

Here are two examples of how that could play out in terms of policy. Brazil has become a global leader in the production of renewable energies, thanks largely to its successful efforts to develop biofuels. Today, some 40 percent of the fuel consumed by Brazil's automobiles, lorries and buses is derived from ethanol produced from sugar cane. Tata Motors in India, meanwhile, recently announced that it would begin to manufacture a car priced at US$2,500. The Tata Nano will not only fit the pocketbooks of less wealthy people but will get 23 kilometres per litre of fuel.

As these examples illustrate, low per-capita use of energy in developing countries in the past, accompanied by limited use of energy-intensive technologies and scant development of energy and transportation systems, can prove to be advantageous today. But that advantage can only be realized if the requisite knowledge and skills are acquired to 'leap-frog' the past and high step into the future.

The energy challenges we face are daunting. The simple truth is that we are too dependent on fossil fuels. Some 80 percent of the world's demand for energy is currently met by fossil fuels – coal, petroleum and natural gas. Energy experts estimate that affordable global oil supplies will largely be exhausted in 40 years or so if global oil consumption continues to increase at the current pace.

Compounding the problem inherent in finite supplies is this: today's energy policies are largely shaped by security concerns. Accessible and affordable energy underpins national economic well-being. As a result, a volatile mix of growing demand and dwindling supplies has increased geopolitical tensions that carry the potential for conflict.

Current patterns of energy consumption are also unsustainable for environmental reasons – an issue that could ultimately eclipse global concerns for economic vulnerabilities related to energy consumption. The fourth Intergovernmental Panel on Climate Change (IPCC) report, published in 2007, stated that average global temperatures have risen 0.74 degrees centigrade over the past 100 years. The report, moreover, projects

BIOFUELS IN BRAZIL

Brazil has become the world's leading nation for the development and use of biofuels. It has done so through a systematic government-led effort that began in the 1980s in response to the first Arab oil embargo and that has continued to the present (with a respite in the 1980s and 1990s when the price of oil declined and the price of sugar rose). Today, 40 percent of the energy used for transportation in Brazil is derived from biofuels. The system is based on a nationwide biofuels retail distribution network and flex-fuel automobiles that can run on gasoline or 75-25 blend of petrol and ethanol. Last year, more than 85 percent of the cars sold in Brazil were flex-fuel vehicles.

Biofuels have not only curbed Brazil's emissions of greenhouse gases but have also improved air quality in the country's cities. At the same time, biofuels research and development has raised the global profile of Brazil's scientific and technological community and provided a valuable niche export.

While the world continues to approve of biofuels and biofuels' production and consumption continues to expand, recent critical analysis suggests that the environmental balance sheet may not be as favourable as proponents of biofuels suggest. That is, when you account for the energy used to grow biofuel crops and to manufacture ethanol and then subtract those figures from the energy savings derived from the use of biofuels, it does not differ significantly from conventional patterns of energy production and use. Critics, moreover, increasingly point to the growing competition for food, fuel and fibre that takes place as additional land is used to grow crops for fuels, which leads to rising food prices.

As the experience in Brazil shows, the expanded use of biofuels has decreased the emission of greenhouse gas. That is a positive trend that can undoubtedly be replicated elsewhere. Today, in Brazil, ethanol supplies about 40 percent of the fuel needs of automobiles (in the United States, the second largest producer of ethanol, the figure is 3 percent). The production of ethanol consumes about 1 percent of Brazil's agricultural land. Within 20 years, it is estimated that 10 percent of the land will be used to grow energy crops. Second generation biofuels in Brazil and elsewhere, moreover, will rely increasingly on wood fibres, switchgrass and agricultural wastes, and thus present much less competition for food production.

that temperatures will continue to rise in the years ahead, causing unprecedented changes to our climate and ecological systems. The IPCC attributes the rise in temperatures to the emission of carbon dioxide and other greenhouse gases that are largely due to the burning of fossil fuels. There is, in short, a growing global consensus that continued reliance on fossil fuels is posing unacceptable environmental risks to the future well-being of our planet.

Fortunately, scientists not only understand the nature of the energy challenges but also are optimistic that the challenges can be met. They have, in fact, already devised effective technical solutions to address some of the biggest challenges. The prospects for additional scientific and technological advances, moreover, are bright, especially if substantial and sustained financial investments are made in energy research and development.

A BRIEF HISTORY OF RENEWABLES

When the World Commission on Environment and Development report, Our Common Future *(commonly called the Brundtland report in deference to the chair of the commission, Gro Harlem Brundtland), was published in 1987, modern renewable sources of energy – for example, solar and wind power and emerging biofuels – accounted for less than 0.5 percent of the global energy supply. The widely read report, which touted the "untapped potential" of these energy sources, prompted a flurry of activity designed to boost the development of renewable energy. These efforts often took place in remote rural areas in developing countries where the prospects for decentralized forms of electricity seemed most promising. Windmills, photovoltaic panels and solar heating devices became common features of the rural landscape in many developing countries.*

But the effort proved largely unsustainable and the first generation of modern renewables failed to leave a lasting mark in the developing world.

Why was this so and what can we learn from this experience? First, the equipment and systems were often designed, constructed and operated by outside experts from the developed world. When the foreign researchers and technicians left, the local population did not have the skills or the knowledge to maintain the equipment or operate the systems. Second, the units were too small-scale and scattered to provide the volume of energy that was needed. Even in places where energy use is low, scale matters, not only because it makes a visible difference in peoples' lives and therefore commands more public attention and support, but also because it helps reduce costs. And third, the effort suggested that renewable energy was a poor person's energy source and therefore the experience did not resonate in the developed world where additional research and development could have made a difference in advancing research and development.

Today, the situation has changed dramatically. Renewable energy capacity is rapidly increasing both in the developed and developing world. Grid-connected solar photovoltaic systems, for example, increased 55 percent in cumulative capacity worldwide between 2004 and 2005. Wind-generated power grew by nearly 25 percent during the same year. And over the past decade, ethanol production in Brazil has grown at an annual rate of more than 10 percent.

Renewable energy still constitutes a minuscule percentage of total primary energy supply – less than 4 percent in 2004. But its global rate of growth is approaching 1.5 percent a year. If current trends continue, then renewables could constitute 15 percent of primary energy consumption by 2020.

The Brundtland report referred to renewables as an untapped but potentially invaluable source of energy. Yet, the early development of renewable energy in the 1980s and into the 1990s suggested it would remain a boutique energy source of limited impact. That may no longer be the case. High oil prices, global warming and growing scientific and technological capacity in the developing world are helping to turn renewables into a primary energy source with a bright future.

For example, such on-the-shelf energy-saving technologies as compact fluorescent bulbs can substantially curtail the energy needed for lighting. These bulbs, which are readily available in an increasing number of countries, use 75 percent less energy than standard incandescent bulbs and last up to 10 times longer.

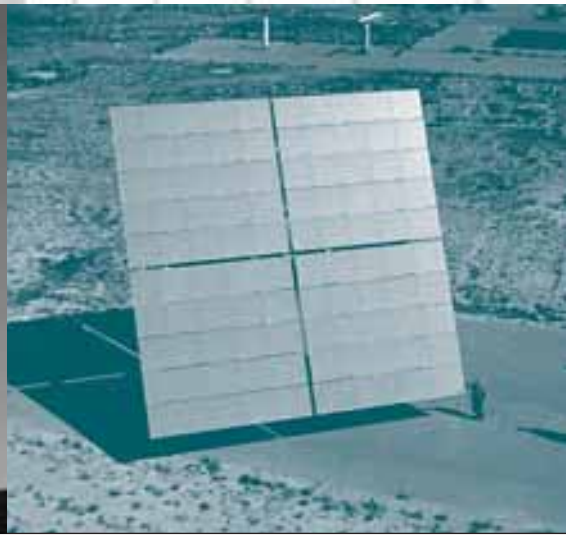
Other technologies – for instance, effective systems for carbon sequestration, which seek to store carbon dioxide before it wafts into the atmosphere – have shown promise in the laboratory. But the systems remain expensive and additional stumbling blocks must be overcome before they can be built on a commercial scale. Nevertheless the science and technology behind the quest for carbon sequestration rests on solid ground, and the prospects for its application are encouraging if we can marshal the financial resources and political will to continue research and development.

Doing more with the same amount of energy is the best way forward.

Recent advances in renewable energies are not only welcome but also hold promise for even greater contributions from renewables in the future. For example, the contribution of renewable energy to the global energy mix, mainly represented by solar energy, has almost doubled in the past 10 years. Wind power's contribution has increased by 25 percent annually. As of 2006, the overall percentage of renewable energies in relation to total energy use was just 5 percent. That figure could reach 15 percent by 2020 if current growth rates continue.

Indeed energy experts project that this percentage is likely to increase substantially over the coming decades. But compelling technological and management challenges remain stubbornly in place and continued investment in scientific and technological research and development is necessary to reduce the hurdles that stand in the way of progress.

There is a need, for example, to explore the potential of such new energy carriers as hydrogen, although cost and infrastructure restraints mean that the widespread commercial use of hydrogen is decades away. There is the need to improve energy storage and conversion systems so that intermittent energy resources – for example, wind, solar photovoltaic and geothermal energy – can be more easily integrated into baseload electric generation. There is the need to expand and increase the efficiency of long-distance transmission systems to reduce line losses. High-voltage, direct current transmission lines and 'smart' grid technologies could be a key to meeting this challenge. There is a need to expand the range of crops and to upgrade the production process of biofuels to improve the efficiency and limit the environmental impact of this growing source of energy. There is a need to expand renewable energy expertise beyond the few countries in which it is now concentrated (for example, Brazil, China, Europe and the United States). And there is a need to explore the potential for new sources of renewable energy – most notably, biofuels derived from the con-



version of lignocellulosic feedstocks, including agricultural residues and wastes that have the potential to produce five to ten times more fuel than sugar cane and corn. Advances in molecular biology also have the potential to reduce energy inputs and increase energy outputs derived from biomass feedstocks. All of this, however, will require additional research and development.

Coal is the most abundant of all the fossil fuels. Experts estimate that existing supplies of coal are sufficient to meet global energy needs for the next 150 years. Yet coal creates the highest percentage of greenhouse gases and thus poses the greatest threat to the global environment. Indeed coal-fired power plants produce almost twice as much carbon dioxide per unit of energy than power plants that operate on natural gas.

China, India and the United States all have large coal reserves that provide a source of energy security in an increasingly volatile world. Indeed coal-fired power plants currently generate more than 80 percent of China's electricity and China is currently bringing one coal-fired plant online every 7 to 10 days. The global challenge is to develop and deploy power plants that rely on advanced coal technologies as quickly as possible and to retrofit as many conventional coal plants now in operation as possible so that they emit lower levels of greenhouse gases.

The global scientific community has an obligation not only to work collectively to improve energy efficiency and to expand the use of renewable energies. It must also become more actively involved in energy policy discussions.

That is why those who participated in the IAC report *Lighting the Way Towards a Sustainable Energy Future*, which was funded in part by the governments of Brazil and China, have sought out political officials at the highest levels of government to present the report's findings. In China, Stephen Chu (Nobel Laureate 1997), head of Lawrence Livermore National Laboratory in the United States and a co-director of the study group for the IAC report, has met with Prime Minister Wen Jiabo. In Brazil, I have met with the Minister of Science and Technology, Sergio Macado Rezende (TWAS Fellow 2004), who agreed to bring the report's finding before the President's Council of Energy Policy. We also plan to hold a series of workshops around the world to engage both the policy makers and the public in the full range of issues and options outlined in the report.

Scientists are optimistic that the challenges can be met.

National agencies and international institutions across the globe have published numerous reports on energy issues. Many of these reports have provided valuable insights and outlined potentially effective responses to the world's energy challenges.

The sad truth is, however, that few of these reports have found their way into public debates about energy policies in either the developed or developing worlds. We are hopeful that *Lighting the Way Toward a Sustain-*

able Energy Future will be an exception and that the policy options outlined in the report will become an integral part of policy discussions that ultimately lead to a sustainable energy future.

Developing a comprehensive policy for sufficient and reliable energy supplies remains an important goal. Nevertheless this should be only one element of the global energy agenda. In addition, the agenda must seek to provide energy services to the more than one billion people worldwide who do not currently have access electricity; it must seek to produce energy in ways that do not damage the global environment; and it must be based on policies that dampen, rather than spark, geopolitical competition for limited energy resources.

The dual quests for equity and sustainable access must drive our global energy future. This will require concerted efforts to expand energy systems – both centralized and decentralized – into rural and impoverished areas, improve energy efficiency, reduce carbon emissions into the atmosphere, increase the use of renewable energies, and develop advanced systems of energy production and transmission. All of this will necessitate continual scientific and technological research and development.

The energy challenge we face is a multifaceted challenge and as the IAC report concludes: "Better results will be achieved if many avenues are explored in parallel, if outcomes are evaluated with actual performance measures, if results are reported widely and fully, and if strategies are open to revision and adaptation."

The report goes on to say that "Science and technology clearly have a major role to play in maximizing the potential and reducing the cost of existing energy options while also developing new technologies that will expand the menu of future options."

Despite the energy challenges we currently face, clean, affordable, high-energy fuels are attainable. Reaching this goal will require continual advances in science and technology both to light and lead the way. ■

ABOUT IAC

The InterAcademy Council (IAC), located at the Royal Netherlands Academy of Arts and Sciences in Amsterdam, produces reports on scientific, technological and health issues related to today's global challenges. The IAC board is composed of 15 science academies and representatives of the InterAcademy Panel on International Issues (IAP), the Council of Academies of Engineering and Technological Sciences (CAEST) and the InterAcademy Medical Panel (IAMP). Upon receiving a request to provide advice on a particular issue, IAC assembles an international panel of experts who serve on a voluntary basis. They review the current state of knowledge on the topic and prepare a draft report detailing the panel's findings and recommendations. IAC draft reports undergo an intensive process of peer review by other international experts. In addition to the energy report, IAC has produced reports on science and technology capacity building, African agriculture and women in science. For additional information about IAC, see www.interacademycouncil.net.

FOR THE LOVE OF LEMURS

THIS YEAR MARKS THE 10TH ANNIVERSARY OF THE THIRD WORLD ORGANIZATION FOR WOMEN IN SCIENCE'S (TWOWS) POSTGRADUATE TRAINING FELLOWSHIP PROGRAMME FOR WOMEN SCIENTISTS FROM SUB-SAHARAN AFRICA AND THE LEAST DEVELOPED COUNTRIES (LDCS).

Generously funded by the Swedish International Development Agency (Sida), the TWOWS fellowship programme seeks to help young women scientists from developing countries with poor scientific capacity to continue their education and training by attending universities in developing countries with proficient and growing scientific capacity. The goal is to provide not only the financial support that these women need to obtain advanced degrees but also to upgrade their education and training. At the same time, the programme, by providing recipients with the opportunity to receive their degrees from a university outside of their native countries but within the developing world, seeks to encourage fellowship recipients to remain in the South to pursue their careers and not become part of the scientific diaspora in the developed world.

Sylviane Volampeno, who was awarded a TWOWS fellowship in 2006, was born and raised in Antsirabe, Madagascar. She received her undergraduate and master's degrees in natural sciences from the University of Antananarivo in Madagascar. That is where she first became acquainted with the blue-eyed black lemur, a strong-limbed, long-tailed primate, about the size of a house cat, which is endemic to Madagascar.

Today, Volampeno is currently at the University of KwaZulu-Natal in South Africa, where she is completing her doctoral studies.

But if you think that Volampeno spends most of her time in classrooms and laboratories, think again. The place you are more likely to find her is in the plush tropical rainforests of Sahamalaza Peninsula in a remote corner of northwestern Madagascar.

There, she lives among the lemurs, hoping to gather and analyse information about their behaviour and habitat that will help convince government officials to take the steps that are necessary to save this threatened species from extinction. It is a labour of love that has been made possible by the TWOWS postgraduate fellowship programme.

The TWOWS programme is helping to define and advance the career of Volampeno and many other young

women scientists whose studies and research initiatives are making a difference in the world of science and, more generally, in places that are among the poorest in the developing world.

Volampeno recently exchanged a series of e-mails with Tasia Asakawa, an editorial assistant with the TWAS public information office, describing her life and work. Excerpts of these exchanges follow.

The blue-eyed black lemur is endemic to Madagascar.

WHY LEMURS?

I was a 20-year-old undergraduate student at the University of Antananarivo in Madagascar when I first saw lemurs in the wild. I had enrolled in an ecology course at the university that included field trips to the Analamazoatra Special Reserve. The reserve is a protected rainforest in eastern Madagascar. It is one of the few places where lemurs can still be found in their natural habitat.

During the course, I learned that lemurs, which are endemic to Madagascar, play an important role in ecosystem preservation and are a vital component of the priceless natural heritage of Madagascar.

For example, lemurs help propagate rainforest plants. Fruit, pollen and nectar are the mainstays of their diet. They digest the plant leaves and stems but not the seeds, which they deposit on the ground as they whisk across the landscape. Because of their ecological importance and intriguing appearance and behaviour, I wanted to place lemurs at the centre of my future master's research.

In late summer 2002, representatives of a consortium of non-governmental organizations (NGOs), led by the Wildlife Conservation Society and *Association Européenne pour l'Etude et la Conservation des Lémuriens* (AEECL), visited the animal biology department at the University of Antananarivo seeking a researcher to study

TWOWS FELLOWSHIPS FOR POSTGRADS

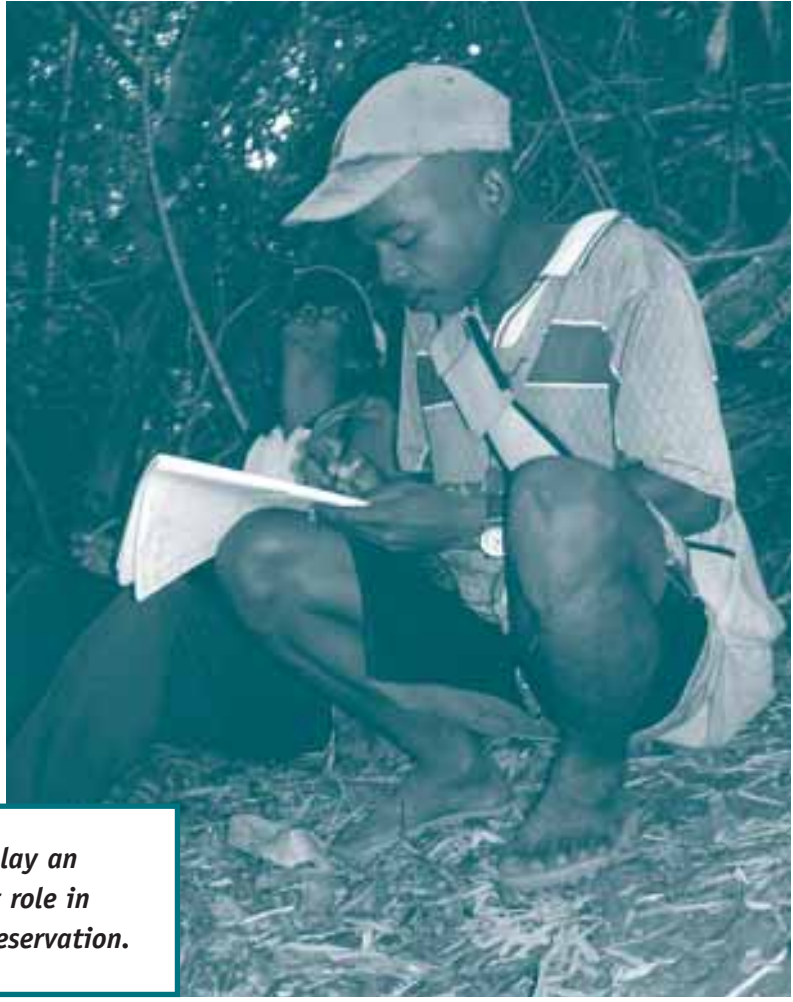
The Third World Organization for Women in Science (TWOWS) offers Postgraduate Training Fellowships for Women Scientists from Sub-Saharan Africa and Least Developed Countries (LDCs) at Centres of Excellence in the developing world to women scientists who would like to pursue postgraduate research in the basic sciences: biology, chemistry, mathematics and physics. The fellowship covers travel expenses and a monthly living allowance for a maximum of three years. It is supported with funds generously provided by the Department for Research Cooperation (SAREC) of the Swedish International Development Agency (Sida).

The main objective of the scheme is to contribute to the emergence of a new generation of women leaders in science and technology, and to promote their effective participation in the scientific and technological development of their countries. For more information about TWOWS and its postgraduate training fellowships, please visit www.twows.org.

blue-eyed black lemurs in Madagascar. I sent my CV to the consortium and was called in for a personal interview in November 2002. Shortly thereafter, I learned, to my delight, that I had been accepted and would be given support for my Master's degree project, which I began in early 2003 and completed in 2004.

Blue-eyed black lemurs, unlike the other lemurs, are characterized by distinctive luminescent blue eyes. They are, in fact, the only primates other than humans to have blue eyes. These lemurs also display sharp colour differences between the sexes. The males are completely black. The females are rusty brown. Scientists call this difference dichromatism.

Unfortunately, these beautiful and unique animals have dwindled in number to a precious few. Their habitat has been progressively destroyed by human activity and not adequately protected. If we are to find a way to keep blue-eyed black lemurs from becoming extinct, it will take innovative strategies that combine species protection with habitat preservation in the broadest sense of the terms.



Lemurs play an important role in ecosystem preservation.

Given the beauty and ecological importance of lemurs, I am convinced that this is a challenge well worth our efforts, and it is a challenge I am honoured to be part of. Indeed, partly due to our efforts, the blue-eyed black lemur is now a flagship species for all conservation efforts on the Sahamalaza Peninsula.

HOME RANGE

Saving lemurs will require saving the ecosystems in which lemurs live. And that poses another challenge. The Sahamalaza Peninsula, largely comprised of lush semi-deciduous and subhumid forests, has faced risks to its health and survival just as acute as those faced by its blue-eyed inhabitants. In the past, slash-and-burn agricultural practices have seriously degraded the lemurs' habitat. Local populations have had no choice – or so it seemed – but to draw on the area's natural bounty for their survival and livelihood. Previous efforts to curb destructive activities in the area had failed. As a result, in January 2005 the government declared immediate temporary protection for core zones on the Sahamalaza Peninsula that had been designated for future protection as a national park.

A great deal of damage had already been done. Nevertheless, the government's decision was good news. This is especially true for blue-eyed black lemurs since the Sahamalaza Peninsula is its main habitat. The decision, moreover, has not, as some critics predicted, had an adverse impact on the local population. Farmers

have turned to more ecologically sound practices such as sustainable rice cultivation, ecotourism and the making of handicrafts.

BACKGROUND MATTERS

Historically, the blue-eyed black lemur's habitat has been restricted to northwestern Madagascar where the Sahamalaza Peninsula is located. Three rivers in the area mark the boundaries of its range: the Andranomalaza River in the north, the Maevarana River in the south and the Sandrakota River in the east. The Mozambique Channel marks the western boundary. Part of the Indian Ocean, the 460- to 950-kilometre-wide channel lies between Madagascar and the African continent.

At present, four species of lemur live on the peninsula. In addition to the blue-eyed black lemur, there is the Sahamalaza sportive lemur, the fat-tailed dwarf lemur and the northern giant mouse lemur.

The blue-eyed black lemur is the only diurnal lemur (that means it is active during the day). The three other lemur species are nocturnal (or active during the night). As I mentioned before, the blue-eyed black lemur is also the only lemur with such strong sexual dichromatism and – indeed the only non-human primate – with blue eyes.

The blue-eyed black lemur has been at risk for some time, primarily due to rice cultivation, cattle grazing and logging which have destroyed their habitat. Indeed, scientists had not seen them since 1880 and thought that they were extinct in the wild. Fortunately, the blue-eyed black lemur was rediscovered on Sahamalaza Peninsula in 1983 in an expedition funded by Mulhouse Zoo and Strasbourg University in France.

Despite their tightrope existence and recent rediscovery, blue-eyed black lemurs, surprisingly, have not been the subject of many scientific studies.

Given the dearth of data, here's what we think we know. Largely because of habitat destruction, scientists believe that the total population of the blue-eyed black lemurs is in the low thousands, a minuscule number that places their continued survival in serious doubt. In fact,

MADAGASCAR'S THREATENED DIVERSITY

Madagascar, located in the Indian Ocean off the southeastern coast of Africa, is the world's fourth largest island. It also one of the globe's biodiversity 'hotspots'. It is home to 5 percent of the world's plants and animals, of which more than 80 percent are found only in Madagascar. Eight plant, four bird, and five primate families live nowhere else on Earth. That is also true for more than 80 percent of Madagascar's flowering plants, 95 percent of the nation's palms and 100 percent of lemurs. These startling figures are testimony to the unique evolution of Madagascar's fauna and flora, which developed largely in isolation after the island broke off from continental Africa some 80 million years ago. The island remained uninhabited by humans until around 200-500 CE.

Today Madagascar's unique habitat and distinctive species are threatened by a number of factors. The island's population, although still small, is expected to double by 2025, reaching some 35 million people. Such growth will undoubtedly place additional pressure on the nation's ecosystems, especially when considering that some three quarters of the nation's population live on less than US$1 a day. Unsustainable timber exploitation and slash-and-burn agricultural practices have scarred the landscape, and the cultivation of rice and cattle have adversely impacted the nation's fragile soils. Broad stretches of coconut groves and cinnamon plantations have replaced the natural forest. Mining for bauxite, ilmenite, nickel, sapphires, rubies, and other metals and minerals that some experts think may be found in abundance pose an increasing threat to the nation's ecology. In all, scientists estimate that only 18 percent of Madagascar's original vegetation remains.

As Conservation International notes on its website (www.biodiversityhotspots.org)*, Madagascar's more than 50 lemur species represent "the island's charismatic worldwide ambassadors for conservation". Fifteen of Madagascar's lemur species are now extinct. Volampeno's research and fieldwork are designed to help prevent the blue-eyed black lemur from joining the list. If successful, it could serve as a model for preserving the nation's precious heritage of natural resources.*

the International Union for the Conservation of Nature (IUCN) listed the blue-eyed black lemur as critically endangered in April 2005 because of an estimated 80 percent population reduction over the past 25 years.

One sign of hope, however, is that research shows that these lemurs can live in different forests, including secondary forests, and that, given ample protection, they are more successful at breeding than other types of lemurs. On the other hand, studies have also shown that adverse changes in their habitat, especially environmental degradation, compromise their ability to reproduce. In other words, if a blue-eyed black lemur's environment is healthy, they are healthy. If the environment is not healthy, then the future of the blue-eyed black lemur is placed at risk.

Saving lemurs will require saving the ecosystems in which lemurs live.

THANKS TO TWOWS

I first learned about the TWOWS fellowship for young women scientists while working with the Wildlife Conservation Society. A colleague told me about an opportunity to obtain degree-related research funding from an organization in Italy. I checked out the TWOWS website, reviewed the criteria, concluded that my education and experience would make me a good candidate for the programme, and decided to apply. At the time, I was looking for funding to pursue a doctoral dissertation, preferably at a university abroad. Six months after I submitted my application, I learned that I had been granted a fellowship, and in 2006 I began my studies at the University of KwaZulu-Natal, School of Biological and Conservation Sciences, South Africa. I will earn my PhD in 2010.

The fellowship has enabled me to broaden my investigations into the development and behaviour of blue-eyed black lemurs in the wild. Specifically, my assistants and I were able to observe five groups of blue-eyed black lemurs over two successive birth seasons. The fieldwork took place in Ankarafa forest in the western part of Sahamalaza Peninsula. We closely observed but never directly interacted with the animals. While it is true that the lemurs can become accustomed to seeing humans and therefore remain calm in their presence, had we tried to touch or even approach them, they would have fled immediately.

Moving from one group to another on a daily basis, we relied on what biologists call an 'animal focal sampling method' to collect data. That is, we concentrated on one individual in the group (the focal point individual) to observe his or her behaviour and interactions with others. Normally, we followed the individual from 7:00 to 11:30 and again from 13:00 to 17:30.

Facilitating our research was a nearby research station set up in 2004 by AEECL and the Universities of Antananarivo and Mahajanga in a UNESCO Biosphere Reserve in the Ankarafa Forest. It assisted our efforts and allowed us to monitor such natural and human forest activities as fires, hunting and wood gathering, and then relate these activities to the lemurs' behaviour. The research centre also provided a meeting point where we could share our findings with our colleagues.

I once came across a two-week-old blue-eyed black lemur that had been fatally attacked by a fossa *(Cryptoprocta ferox)*. The fossa is a strong-clawed mangoose-like carnivore that is endemic to Madagascar. Like the blue-eyed black lemur, it too is a victim of environmental degradation and intrusive human activities. In fact, IUCN has listed the fossa as an endangered species. In the wild, friend and foe alike face common dangers to their future that neither is in a position to counteract.

IN THE FUTURE

After earning my doctoral degree, I would like to continue working on efforts to conserve Madagascar's biodiversity and particularly on efforts to protect blue-eyed black lemurs.

The research is important to Madagascar and carries significant implications for the future health of the nation's ecology. The steep decline in the number of lemurs signals an overall decline in the health of the environment. Efforts to protect lemurs also promise to assist the economy by creating jobs for the local population, especially if such efforts are tied to larger initiatives to protect Madagascar's natural resources and promote ecotourism.

On a personal level, the research is sufficiently challenging to provide excellent training that should serve me well in the future. I should also add that the topic of my research generates national and international attention, which has prompted interaction and exchange with other researchers both at home and abroad.

Despite the success that I have achieved, my future is by no means secure. I have chosen a research field, and more specifically a topic, that takes place in a remote locale, requires a long-term commitment and is expensive. To cover the costs of my research to date, I have not only had to secure funds from TWOWS, but also Conservation International, the Wildlife Conservation Society, AEECL and IdeaWild.

It has not been easy to acquire adequate funds and I don't expect it will get any easier. Long-term research in remote locations necessitates a large and sustained budget that will undoubtedly depend on support from many different sources. The financial requirements, moreover, are likely to become even greater if I choose to pursue a postdoctoral post or a faculty research position in this field.

Yet, I remain undaunted, indeed optimistic, that I will meet these challenges, and that the blue-eyed black lemur will be a centrepiece of my career and my life in the years ahead. My experience to date tells me so. And my TWOWS fellowship is helping to give me the training and credentials that I need to have confidence that things will work out in the future.

I am also guardedly optimistic about the future of the blue-eyed black lemur, despite the immediate threats to its survival. In July 2007, the government passed legislation making Sahamalaza a national park. That is a key decision that will hopefully help bring the blue-eyed black lemur back from the brink of extinction.

The government's decision, of course, is welcome. But, in my mind, it is not sufficient to ensure success. Research must continue to uncover more information about the behaviour of blue-eyed black lemurs and, ultimately, to serve as the basis of effective plans for its long-term survival.

I fervently hope to be an integral part of this effort in the years ahead, applying the knowledge and skills that my TWOWS fellowship has made possible. ■



Silviane Volampeno
University of KwaZulu-Natal, South Africa

BASICS MATTER

TWAS RECENTLY ENTERED INTO AN AGREEMENT WITH UNESCO'S INTERNATIONAL BASIC SCIENCES PROGRAMME AND THE INTERNATIONAL CENTRE FOR GENETIC ENGINEERING AND BIOTECHNOLOGY TO PARTICIPATE IN A COOPERATIVE PROGRAMME DESIGNED TO BUILD SCIENTIFIC CAPACITY IN MOLECULAR BIOLOGY AND GENOMICS IN DEVELOPING COUNTRIES. THE PROJECT WILL SEEK TO ACHIEVE ITS GOALS BY NURTURING THE CREATION OF SCIENTIFIC NETWORKS.

Scientific capacity building has been a hallmark of TWAS ever since the Academy's inception in 1983. The primary focus of the Academy's efforts has been on individual scientists, as reflected in TWAS's research grants, fellowships and awards programmes; and scientific institutions, as reflected in its expanding efforts to assist research units and university departments of science in the scientifically and technologically lagging developing countries (S&TLCs). Progress has been achieved thanks largely to the generosity of others – for instance, the Italian government, the Swedish International Development Agency (Sida), illycaffè and the Kuwait Foundation for the Advancement of Sciences (KFAS).

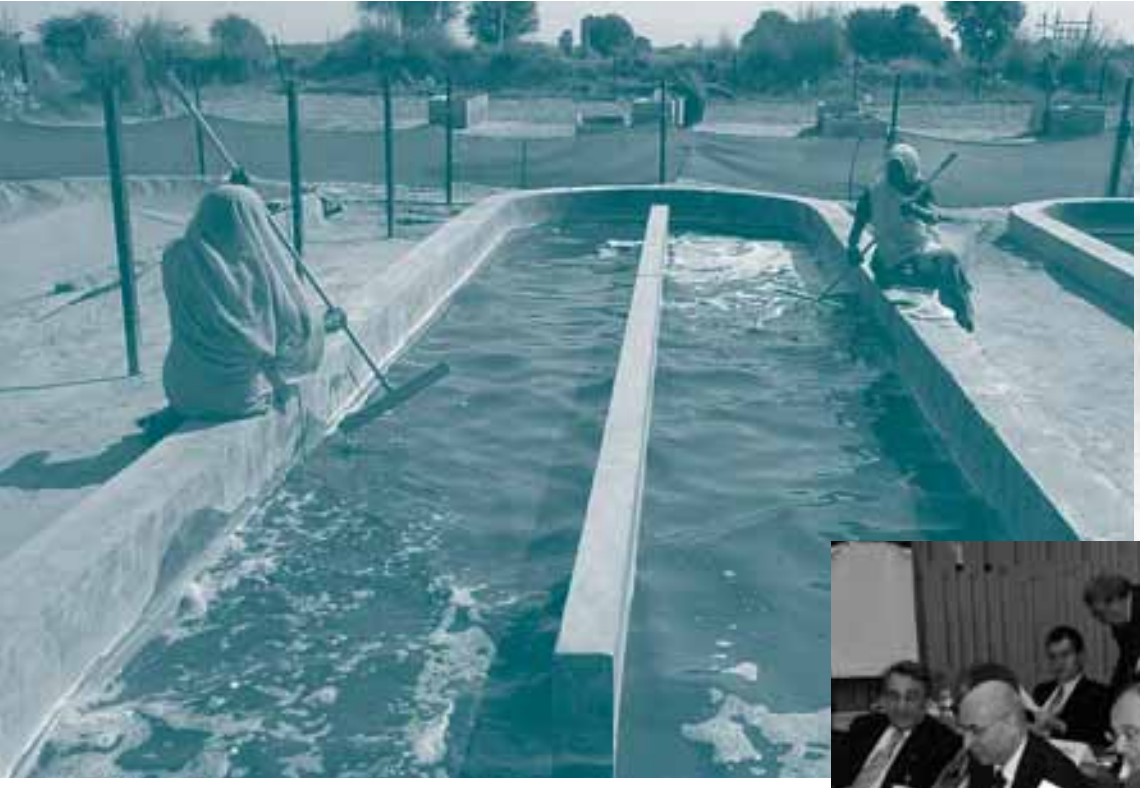
It is fair to say that these efforts have left an enduring mark on science in the developing world. Yet it is also important to recognize that science in the South has evolved rapidly over the past quarter century, and so have the funding mechanisms by which these advances have taken place.

It would, therefore, be unwise for the Academy to rest on its laurels and to continue to operate as it has in the past. Success, moreover, has often been spotty, and progress, where it has occurred, has prompted new challenges, not the least of which is the growing gap in scientific capacities within the South.

As a result, today there is a greater need for funding strategies that emphasize not only individuals and institutions but also institutional partnerships and networks. These efforts, in addition, must focus not just on scientific capacity *per se* but on scientists and nations that are most in need.

Similarly, it has become increasingly important for organizations such as TWAS to join with other like-minded institutions to pool their resources in order to increase the scope and effectiveness of their initiatives.

That is why the Academy is delighted to announce that it has joined UNESCO's International Basic Sciences' Programme (IBSP) in Paris and its scientific neighbour in Trieste, the International Centre for Genetic Engineering and Biotechnology (ICGEB), to launch a project for capacity building in molecular biology and genomics. The initiative will constitute one of five flagship programmes of the IBSP.



"The purpose of the programme," says Jorge E. Allende (TWAS Fellow 1985), a professor at the Institute of Biomedical Sciences and vice president of research at the University of Chile, "is to encourage research teams from around the world, and especially from the developing world, to come together to focus on an issue of common concern that will allow them to learn from one another and expand their research agendas."

Allende, who is a member of the IBSP scientific board, also notes that: "The research groups that are chosen will already have some degree of experience and expertise in a select field of molecular biology and genomics – for example, the development of molecular techniques to improve crop resistance to a particular insect, or to better understand the molecular mechanisms that drive the growth of cancerous tumours."

"Our hope," adds Dorairajan Balasubramanian (TWAS secretary), director of research at L.V. Prasad Eye Institute in Hyderabad, India, "is that, by working together, these groups will not only effectively share their knowledge and experience but will also produce results that ultimately help improve the lives of people." The projects, he adds, "will be chosen, first and foremost, on the basis of scientific excellence and, secondly, on the potential contributions the research findings can make to society." Like Allende, Balasubramanian also serves as a member of the IBSP scientific board.

Today there is a greater need for funding strategies that emphasize institutional partnerships.

Following the same strategy that proved successful for the TWAS-ICGEB project focusing on increasing plant tolerance to abiotic stress, this initiative will begin with a call for 'letters of intent' from prospective candidates who will be asked to submit a brief research proposal and a list of potential collaborators (see 'More Crop Per Drop', *TWAS Newsletter*, Vol. 18, No. 4, 2006). "Each proposal" says Allende, "is expected to include a research team from a member state of the ICGEB and an institution that is located in a country that TWAS categorizes as scientifically lagging. This list currently consists of 80 countries, most of which are least developed countries."

Based on a careful vetting of the proposals by a scientific board selected by the three sponsoring institutions, the coordinators of the short-listed proposals will be invited to attend a workshop where they will present

PARTNERS AGAIN

In a March 2006 memorandum of agreement, TWAS was named a major partner of the IBSP. In this capacity, the Academy agreed to collaborate with IBSP on initiatives of mutual interest, to encourage individuals and institutions that the Academy works with to actively participate in IBSP projects, and to consult with IBSP for the purposes of identifying optimum strategies for joint TWAS-IBSP actions. Two TWAS members – Jorge E. Allende and Dorairajan Balasubramanian – have been members of the IBSP scientific board since the programme's inception in 2005. The UNESCO/IBSP-TWAS-ICGEB project on molecular biology and genomics fits into a larger pattern of collaboration between TWAS and IBSP and, more generally, reflects the Academy's close relationship with UNESCO, its parent organization.

The Academy's ties to ICGEB date back to the 1980s and were most recently on display in the three-year TWAS-ICGEB joint programme promoting research on tolerance to abiotic stress in plants launched in 2005. Thus this new project on molecular biology and genomics fits nicely into the long-standing pattern of collaboration between the two Trieste-based scientific organizations that are both generously supported by the Italian government.

their ideas and elaborate on the proposals that they have submitted.

"The applicants", notes Decio Ripandelli, director, Administration and External Relations at the ICGEB, "will not only be asked to present their proposals. They will also be encouraged to exchange ideas with the other coordinators who will be attending the workshop as part of a larger effort to encourage networking." In addition, participants will hear from a group of scientists who will be invited to the meeting to offer suggestions on how the coordinators could transform their initial proposals into appealing full-length grant applications.

Following the conference, attendees will be asked to submit their final proposals to the scientific board, which will review the documents and make the final selection of candidates. Members of the board anticipate that about five proposals will be chosen and that each proposal will consist of two to four research teams.

"The two-stage selection process is more elaborate and perhaps more complicated than a conventional grant application process", says Balasubramanian. "But we think that it will serve the dual purpose of generating an exchange of ideas among research groups with similar research agendas and helping to ensure that we choose the best candidates." The projects will be officially launched in 2009.

NEW COURSE

"The IBSP is delighted to include this programme among its flagship initiatives for UNESCO's 2009-2010 biennium", says Maciej Nalecz, executive secretary of the IBSP programme and director of the Division of Basic and Engineering Sciences at UNESCO.

The goal is to help build the scientific capacities necessary for sustainable economic growth.

"The IBSP", notes Nalecz, "began in 2005 in response to a prevailing belief among UNESCO's members states that the basic sciences – biology, chemistry, mathematics, physics and other conventional disciplines that lie at the heart of the sciences – were receiving neither the attention nor the resources that they deserved. The goal of the project is to help build, through support for education, training and research, the scientific capacities that are necessary for sustainable economic growth.

"Basic science", Nalecz continues, "drives progress in medicine, information and communication technologies, space technologies, bio- and nano-technologies, lasers and new materials. It fosters increases in agricultural productivity and sets the foundation for environmentally sound industrial development. Therefore it should not be surprising that countries with poor scientific capacities are, more often than not, also economically poor countries."

The IBSP's first biennium from 2005 to 2007 proved a success. Over 250 project proposals were received from more than 80 countries. The response indicated that there were indeed a large number of institutions in the basic sciences that welcomed the creation of IBSP and were interested in the opportunities that it had to offer.

Over the course of its first two years, the IBSP ultimately lent its support to 39 projects.

- In Africa, for example, the IBSP supported an effort to establish an institutional network dedicated to promoting the conservation and sustainable use of microbiological resources. The effort was led by the Council for Science and Technology in Tanzania and the National Agricultural Research Organization in Uganda.
- In Asia, IBSP helped fund efforts for the creation of a regional fauna DNA databank. The initiative, based in Indonesia, was organized in cooperation with the DNA Data Bank of Japan and the National University of Singapore.

ICGEB GOALS

Founded in 1987 within the framework of the United Nations system, the International Centre for Genetic Engineering and Biotechnology (ICGEB) is an international organization with 54 member countries and 71 signatory countries. It is organized in three components – one in Trieste, Italy, another in New Delhi, India, and a recently opened complex in Cape Town, South Africa. It also maintains a network of 37 affiliated centres. ICGEB's mandate is to serve as a centre of excellence in research and training with special attention to the needs of developing countries and countries with economies in transition. ICGEB also plays an important role in promoting the application and sustainable use of biotechnologies and cooperates with other prominent international organizations on programmes concerning the protection of biodiversity, biosafety and risk assessment concerning the release of genetically modified organisms. For additional information, see www.icgeb.org.

- In Latin America, IBSP financed an international study of magnetic oxide-based nanostructures. This effort was spearheaded by *Centro Atómico Constituyentes Unidad de Actividad Física* in Buenos Aires, Argentina, in partnership with the *Istituto per lo Studio dei Materiali Nanostrutturati* in Bologna, Italy.
- In central and eastern Europe, IBSP supported a feasibility study for the creation of an international educational and training centre in plasma physics. This project was organized by the Moscow Institute of Physics and Technology and the Russian Academy of Sciences.
- Other notable IBSP projects evaluated the status of science and technology in the Caribbean, examined fresh water ecology in western Europe and explored potential risks and benefits from mass developments of cyanobacteria in tropical inland waters.

The year 2007 marked the end of the first biennium of the IBSP, and both the UNESCO executive board and member states issued assessments of the initiative. While recognizing the IBSP's success in raising awareness of the importance of basic science for national well-being and commending the programme for the contribution it had made to the promotion of basic sciences worldwide, both the executive board and member states urged the IBSP to take on a new direction.

Specifically, they called on IBSP to become less of a funding agency for small and discrete projects and focus instead on fewer initiatives that resided at the cutting edge of science and that had the potential to have an impact on global science. They also called for projects that were designed to forge partnerships as a way of leveraging the IBSP's limited budget.

As a result of these directives, the IBSP scientific board, led by its chair, Herwig Schopper, former director general of CERN (the European Organization for Nuclear Research) agreed to the following course of action for the IBSP's next biennium from 2009-2010: to provide funding for a restricted number of major projects that would serve as the flagship programmes for the IBSP.

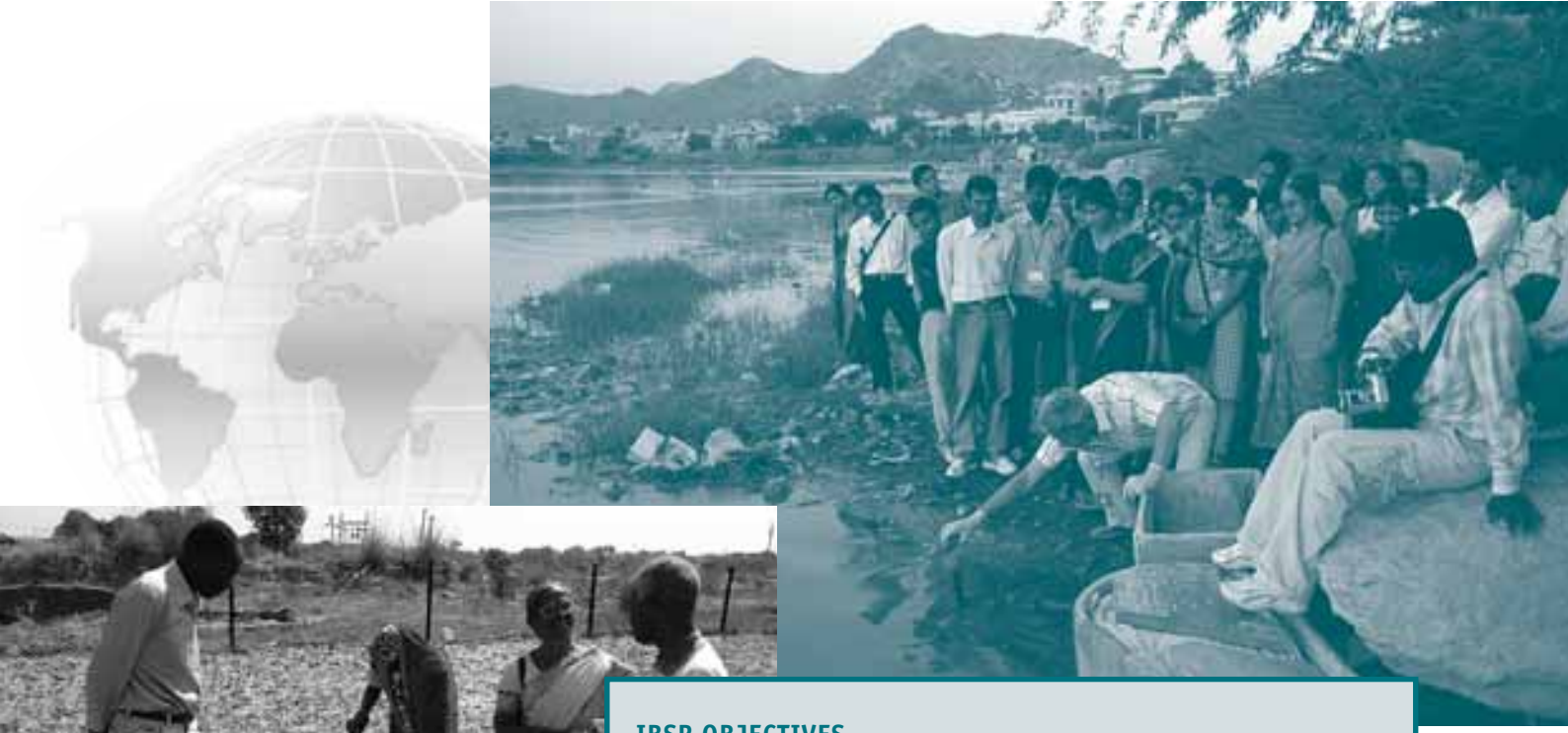
PROJECTS AHEAD

In addition to the IBSP-TWAS-ICGEB programme in molecular biology and genomics of pests and diseases of agriculturally important species of livestock and crops, the scientific board voiced approval for a number of other projects. Each of them will involve joint funding, the creation of networks and a two-year commitment from the participating parties.

- A project led by CERN to establish a network of electronic libraries and repositories for African universities and scientific institutes. The project will focus on making available on the web up-to-date scientific literature, including recent doctoral theses of African students.
- Another project led by CERN to train secondary school science teachers from developing countries to improve their teaching of physics as part of CERN's High School Teachers' Programme and Summer Student Training Programme.
- An initiative led by the International Brain Research Organization (IBRO) to build and sustain brain research in Africa through vigorous international partnerships.
- Finally, the scientific board considered adopting a joint IUPAP (International Union of Pure and Applied Physics)-ICTP (Abdus Salam International Centre for Theoretical Physics) project proposal to organize a series of training workshops and seminars on statistical physics and mathematics for scientists from developing countries. A final decision on this project will be made at a later date.

There is no applied science without basic science.

The scientific board also agreed to lend its name to a number of initiatives that had received significant backing from other sources and that promised to gain high



IBSP OBJECTIVES

The IBSP's principal objectives include:

- *Building national capacities for basic research, training, science education and the popularization of science through international and regional cooperation in national priority areas of development.*
- *Transferring and sharing scientific information and excellence in science through North-South and South-South cooperation.*
- *Providing scientific expertise for, and advice to, policy- and decision-makers and increasing public awareness of science-related ethical issues.*

visibility in the months and years ahead. These initiatives included:

- The International Training and Education Centre in Proteomics-Functional Genomics-Bioinformatics (BIOmics), to be hosted at the Weizmann Institute of Science in Israel. The institute is being considered for official designation as a UNESCO category II centre.
- The Caucasian Institute of Biotechnology at the Durmishidze Institute of Biochemistry and Biotechnology in Tbilisi, Georgia, which also being considered for official designation as a UNESCO category II centre.

At the same time, the scientific board agreed to consider funding a number of smaller projects but stated that it would not do so until it had time to set a priority list and to determine the amount of money that would be available after fulfilling its financial obligations to its flagship projects.

"We have done our best", noted Schopper, "to follow the lead of the UNESCO executive board and member states as part of a larger effort to expand the scope and impact of the IBSP. We believe that the programme, in its three brief years of existence, has proven the importance of creating an active agenda in support of the basic sciences. We are convinced, moreover, that initiatives like the IBSP-TWAS-ICGEB programme for molecular biology and genomics will help us to continue to make important contributions to the critical issue of scientific capacity building, especially in the developing world. As the adage goes, there is no applied science without basic science. And I might add that there is little or no chance for sustainable economic growth in the 21st century without a strong foundation in scientific capacity." ■

NATURE'S GREEN IS GOLD

AS PART OF A LARGER EFFORT TO HELP PROMOTE STRONG AND SUSTAINABLE SCIENTIFIC INSTITUTIONS IN DEVELOPING COUNTRIES, TWAS, WITH SUPPORT FROM A NUMBER OF DONORS, HAS BEEN ENGAGED IN A DECADE-LONG INITIATIVE TO PROFILE SUCCESSFUL SCIENTIFIC INSTITUTIONS IN THE SOUTH.

The effort has been driven by two key questions: what can policy-makers and administrators learn from the experience of others and how might they apply this knowledge to improve their own institutions? With a generous grant from the David and Lucile Packard Foundation, TWAS recently completed comprehensive profiles of five highly successful scientific institutions.

The following is a brief summary of the work of one of those institutions: the National Institute of Biodiversity (INBio), in Santo Domingo de Heredia, Costa Rica. The complete profile can be obtained by contacting the TWAS secretariat at info@twas.org.

Scientific and technological capacity in the developing world continues to expand at a rapid pace. That's the good news. Yet, for this capacity to be sustained and strengthened into the future, it must be institutionalized in universities and research centres across the South and not simply held in trust by a few talented and well-trained individuals.

Costa Rica, which in Spanish means 'rich coast', is a nation of endless beauty. With its emerald coasts, lush rain forests and rugged mountains, it has earned an international reputation as an earthly paradise.

This 'small, green' Central American nation – which serves as a land bridge between North and South America, and enjoys territorial waters in both the Atlantic and Pacific Oceans – is also 'biodiversity rich'. Although its 50,000 square kilometres represent just 0.3 percent of the world's total landmass, Costa Rica is home to an estimated 500,000 species, including 40,000 species of beetles and 20,000 species of butterflies. That is more than 4 percent of the total number of species on Earth, and more than twice the estimated number of species on the continent of Europe.

Yet, in the 1980s, Costa Rica faced an environmental crisis of its own making. Nearly one-third of its forests had been cut down during the previous 30 years in an effort to boost the economy by harvesting timber and clearing land for agricultural cultivation. The



destruction of the forest meant the destruction of habitat, which, in turn, threatened its biodiversity.

A group of enlightened public officials and scientists realized that the pace of deforestation was unsustainable and that a new course of action was needed. Their thinking, while largely shaped by national events, was also nurtured by a broad and growing array of international developments and documents that together constituted a paradigm shift in conservation theory and practice.

In 1980, the *World Conservation Strategy* – drafted by the World Conservation Union (IUCN), the United Nations Environment Programme (UNEP) and the World Wildlife Fund (WWF) – introduced the term 'sustainable development' and contended that conservation strategies should be tied to development. Seven years later, the Brundtland Report, *Our Common Future*, expanded upon these ideas.

Costa Rica is home to an estimated 500,000 species.

VALUING DIVERSITY

The *Instituto Nacional de Biodiversidad*, or National Institute of Biodiversity (INBio), was of one the key organizations to take shape as part of this welcome trend to build a more sustainable future. Its stated mission was, and remains, "to promote a greater awareness of the value of biodiversity as a means of ensuring its conservation and improving the quality of life."

"We were motivated", says Rodrigo Gámez-Lobo, founding president of INBio, "by the belief that the creation of protected areas – national parks, forests and wildlife reserves – would not be enough to save Costa Rica's land and resources."


Rodrigo Gámez-Lobo

A modest grant of US$85,000, approved by the Federation for National Parks in Costa Rica in 1989, got INBio off the ground. From these humble beginnings, the institute has grown into a highly respected international organization with a staff of nearly 175 (including 40 scientists) and an annual budget of approximately US$6 million.

INBio is neither a governmental agency nor a university. This means it has neither a guaranteed annual budget nor a precisely defined set of responsibilities designed as part of the government's overall environmental policies. Given these conditions, the organization's founders agreed, says Gámez-Lobo, "that our organization had to pursue objectives that were pertinent to society."

Asked what have been the main factors in the institute's success, Gámez-Lobo cites two: first, "INBio does not operate alone." The organization, he explains, "works in close collaboration with partners, both individuals and institutions, from Costa Rica and outside the country, and from the public and the private sectors." The second factor, he says, is "a skilled working team highly committed to INBio's mission and vision."

Less than two decades after its inception, INBio has emerged as one of the leading organizations for biodiversity conservation and management, not only in Costa Rica, but throughout the world.

DAVID AND LUCILE PACKARD FOUNDATION

The David and Lucile Packard Foundation was created in 1964 by David Packard (1912–1996), co-founder of the Hewlett-Packard Company, and his wife Lucile Salter Packard (1914–1987). Throughout their lives in business and philanthropy, the Packards sought to use private funds for public good. Guided by the founders' values, the foundation that bears their names supports both people and organizations with the aim of enabling the creative pursuit of science; conserving and restoring the Earth's natural systems; improving the lives of children; and advancing reproductive health. For additional information, see www.packard.org.

'SAVE, KNOW, USE'

INBio adopted as its motto the phrase 'save, know, use', from the *Global Biodiversity Strategy*, drafted by UNEP, IUCN and the World Resources Institute (WRI) in 1992. These three little words neatly express its philosophy: to save and sustainably use biological resources, one must possess the necessary knowledge; and to justify saving them, the resources must be used. (Although 'used' need not mean 'consumed'.)

The organization seeks to achieve these goals through a diverse set of activities that includes:

- Species inventory and monitoring (to date, INBio staff have collected and identified more than 3 million species).
- Communication and education (INBio oversees the management of a biodiversity park, a large publications programme and a broad range of training courses).
- Conservation (information generated by INBio is used in decision-making processes concerning the protection and sustainable use of biodiversity in the public and private sectors).
- State-of-the-art research initiatives drawing on such cutting-edge science and technology as bioinformatics and geographic information systems.
- Bioprospecting, often conducted with both public- and private-sector partners, as part of a larger effort to broaden the institute's financial base without compromising its research agenda.

BOLD STEP

Although INBio was initially proposed as a government agency, the government decided against creating such an organization, citing both budgetary and bureaucratic constraints that would likely prevent quick responses to Costa Rica's urgent environmental challenges.

Its proponents instead devised a scheme for a non-profit, non-governmental organization that would have close ties to government but nevertheless operate independently and rely largely on aid agencies, foundations and private sources of funding for its financial well-being.

This initial decision was a bold, unprecedented step in Costa Rica and, more generally, a first for the region, where government has historically served as the sole source of support for environmental endeavours.

More significantly, it was a decision taken at great risk. Yet the organization's independent status has, over



the long run, enabled INBio to remain responsive, flexible and effective. On the downside, it has also made fund-raising and budgets a constant preoccupation.

As Gámez-Lobo notes, "our non-profit status is one of the primary sources of our strength. If we were part of the government, we would not be able to move so swiftly or so responsively.

"Not having a government sponsor has been a source of constant anxiety", he adds. "It has also kept us on our toes. Governmental status may have provided a guaranteed source of funding and peace of mind, but over the long term it would likely have come at a price that may well have depleted the very energy and drive that helps account for our success."

INBIO AT WORK

Taxonomy. INBio's taxonomical work remains at the centre of its mandate and its most noteworthy activity in the view of the international scientific community.

INBio's reputation is based largely on its expert ability to collect and catalogue Costa Rica's rich biodiversity. Three taxonomical units (fungi, arthropods and plants) lie at the heart of the organization's scientific efforts. Additional units – in bioprospecting, bioinformatics, geographic information systems and training – aid these efforts.

To date, INBio has collected, identified, catalogued and labelled more than 3 million species. The institute's vast collections make it one of the world's largest and most important organizations conducting this kind of work.

INBio's reputation is based on its expert ability to collect and catalogue Costa Rica's rich biodiversity.

Even in this most conservative of scientific pursuits, INBio's inventorying efforts have been innovative. Early on, the institute decided to turn to local citizens as a valuable resource in the collection and cataloguing of new species. Gámez-Lobo and Daniel Janzen – the renowned University of Pennsylvania ecologist and one of the founders of INBio – conceived of the idea of training lay people to be what they would call 'parataxonomists' (modelled on the concept of 'paramedics').

In deciding to solicit public help to accomplish one of its fundamental goals, INBio sought to achieve another goal as well. "From the beginning", says Gámez-Lobo, "the institute has been dedicated not just to pursuing excellence in science but also to garnering public support for our efforts and to educating the public about the value of biodiversity conservation and use. We were convinced that the best way to move forward on all of these fronts would be to engage the public in our activities."

With the parataxonomists' invaluable assistance, INBio has managed to find, over the past decade, an average of one new species every three days. Over the past three years, the average discovery rate has been approximately one new species a day – proof positive that scientists and lay citizens can work together to achieve a common goal of high social and ecological value.

Informatics. To better organize and access the information that has been collected, INBio created 'Atta', an innovative computer-based system designed to facilitate



the process of assembling, managing and generating information on Costa Rica's rich biodiversity.

The Atta system contains a database with more than 3.5 million records, each corresponding to a specimen collected by one of INBio's parataxonomists. Through a barcode label attached to each specimen, users of Atta can access the associated digital information. This includes where, when and how the specimen was collected, as well as who collected it. When the identification process is finished, a complete taxonomical description is added. Atta allows this information to be cross-referenced with such ecological information as forest cover, precipitation patterns, soil type and temperature variations.

The system has led to the creation of a series of ecological guidebooks that have facilitated the analysis and application of critical interrelated information historically stored in different places. In addition, Atta provides a framework for a digital publication system enabling a worldwide information exchange on Costa Rica's rich biodiversity.

Bioprospecting. Bioprospecting is the systematic search for chemical compounds, genes and micro- and macro-organisms that could lead to the development of products and services in pharmaceuticals, agriculture, biotechnology and other fields.

Because a useful compound or gene discovered in, say, a fungus on a leaf can yield greater financial returns than the logging or planting of whole swathes of forest, bioprospecting can be considered sustainable use *par excellence*. And it fits well with INBio's principles of 'save, know, use': prospecting for 'biochemical gold' promotes the idea of the hidden value in biodiversity and thus the importance of conserving and studying it.

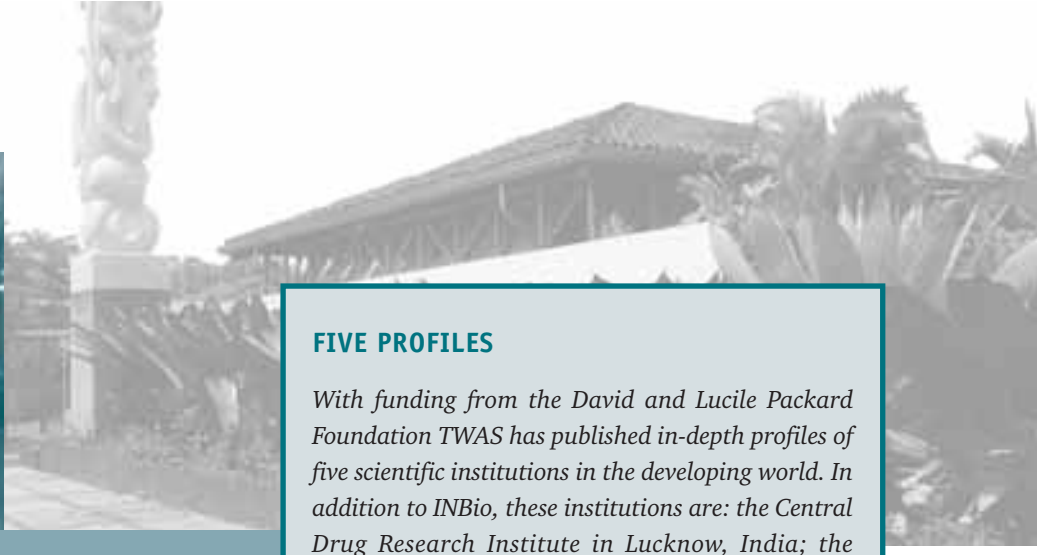
For these reasons, bioprospecting is an essential component of INBio's conservation strategy. Indeed, the institute has been a pioneer in the field. Its goal has been to plough any profits from the activity back into its research and conservation efforts.

Bioprospecting is an essential component of INBio's conservation strategy.

INBio instituted its bioprospecting programme in 1991. In the same year, it made international headlines when it signed a research collaboration agreement with the pharmaceutical giant Merck. The deal was widely hailed as an example of how to achieve the 'equitable sharing of benefits' that would be called for the following year in the Convention on Biological Diversity (CBD) at the 'Earth Summit' in Rio de Janeiro, Brazil.

Under the agreement, INBio supplied Merck with thousands of samples of plants, insects and soils. Merck was given exclusive rights to study these for two years, as well as to retain the patents to any drugs derived from them. In return, the pharmaceutical company paid INBio US$1 million up front to cover the costs of its surveying and research efforts. It also provided INBio with nearly US$200,000 worth of laboratory


Ana Lorena Guevara



FIVE PROFILES

With funding from the David and Lucile Packard Foundation TWAS has published in-depth profiles of five scientific institutions in the developing world. In addition to INBio, these institutions are: the Central Drug Research Institute in Lucknow, India; the Malagasy Institute for Applied Research in Antananarivo, Madagascar; the Centre of Biotechnology of Sfax, in Tunisia; and the Institute of Medicinal Plant Development in Beijing, China. For copies of these profiles, please contact the TWAS secretariat at info@twas.org.

equipment and agreed to pay the institute 50 percent of any royalties from drugs developed out of the partnership. These funds were to be channelled to Costa Rica's Ministry of Natural Resources for investment in biological conservation programmes. Merck also helped train INBio personnel in advanced bioprospecting technologies.

To date, INBio has signed bioprospecting agreements with more than 40 organizations, including the firms Bristol-Myers Squibb, Eli Lily, Diversa (now Verenium Corporation), Givaudan-Roure, British Technology Group and Indena, as well as several universities and research institutes.

Yet, overall, bioprospecting returns have been disappointing. While Merck is said to have found many of the compounds it screened to be promising, in the end no products were developed.

"The inability to produce a number of commercial products from this joint venture", says Ana Lorena Guevara, director of INBio's Bioprospecting unit, "does not mean INBio failed to derive significant benefits." In fact, she notes, in addition to providing INBio with laboratory equipment and valuable training, Merck helped INBio staff gain experience in managing projects designed to achieve commercial output.

INBio's track record reflects both the promise and the pitfalls of bioprospecting, especially efforts that seek to combine the diverse talents of product-oriented corporations and research-oriented institutions. It also underlines the odds against discovering a compound that will lead to the next blockbuster drug.

Nevertheless, thanks to its collaboration with Merck and other companies, INBio has managed to establish itself as a respected partner in the bioprospecting business, acquiring the requisite skills, experience and equipment.

INBioparque. INBioparque, a five-hectare biodiversity park located at the edge of the institute's administrative headquarters, opened in February 2000.

Nearly a decade after INBio's creation, its administrators realized that scientific research would not suffice to realize its lofty goals and that the institute needed to broaden its agenda to increase public awareness of its activities and what it hoped to achieve.

Thus the idea for INBioparque was born. The goal is to place the region's ecological riches on permanent display in a natural, yet accessible, setting and, at the same time, to build an educational centre for both children and adults.

Last year, the park attracted more than 150,000 visitors. They not only enjoyed access to a sampling of Costa Rica's ecosystems but also got to see the critters that inhabit these environments – butterflies, frogs, caimans, tarantulas and snakes.

"INBioparque", says Zamora, "provides visitors with an opportunity to experience a range of ecological zones in Costa Rica over a three- or four-hour tour. There is the premountainous forest, the rainforest, the dry forest and a butterfly garden in what used to be a coffee plantation."

Natalia Zamora

CHALLENGES AHEAD

The year 2005 proved to be a watershed in the history of INBio. Several large grants, which had fuelled the institution's inventory efforts and provided the backbone for its biodiversity resource development programme over the past seven years, came to an end.

Although the loss of funding was anticipated, it required INBio to lay off nearly one-third of its 50-member taxonomical staff. The institution, in turn, created smaller taxonomical units, which continued the inventory activities at a slower pace, while expanding such products and services as field guides and training courses.

INBio responded to the challenges by developing a strategy to make the institute less dependent on large external grants. It also sought to increase self-generated revenue from the marketing of its services and expertise – including consulting, training and bioprospecting – as well as from book sales and INBioparque receipts. The strategy, developed in 2002 in anticipation of the budget squeeze, called for 66 percent of revenue to be generated by INBio, and 34 percent from external grants. By 2006, this goal had been largely achieved.

In addition, INBio returned to its initial way of operating – maintaining a large number of small projects instead of a few large ones. Such an approach allows for more dynamism in the search for resources, while not excluding the possibility of larger donors. It also reduces the risk posed by the loss of a grant from a particular donor.

PEOPLE-CENTRED APPROACH

While INBio's tactics may continually change, the institute's goals do not. As a result, INBio's vision remains as intensely focused as ever: to serve as "a scientific and technological organization renowned for excellence and leadership, generating information and promoting initiatives to be incorporated into the life of society for the conservation and sustainable use of biodiversity".

Sustainable human development needs to be centred on people and based on conservation.

As articulated in INBio's examination of the future of the organization, *The Essence of the Institution*, "conservation is a human activity and depends on the interests and motivation of people". Consequently, the institute remains dedicated to the belief that "sustainable human development needs to be centred on people and based on conservation".

It is this enduring principle – founded on the belief in the oneness of people and place, conservation and use, and knowledge and its application – that has defined the success of INBio in the past. And it is this principle that will continue to determine the institute's level of success in the future.

Some institutions are research oriented. Some are action oriented. INBio is both, and therein lies its uniqueness and value – a treasure of enduring significance in the varied world of ecological institutions. ■

ACADEMIES FOR DEVELOPMENT

THREE SCIENCE ACADEMY NETWORKS ON THREE DIFFERENT CONTINENTS HAVE ISSUED A STATEMENT CALLING ON G8+5 COUNTRIES TO EXPAND THE ROLE OF SCIENCE, TECHNOLOGY AND INNOVATION IN COMBATTING POVERTY AND CREATING WEALTH.

The three science academy networks are: the Network of African Science Academies (NASAC), the InterAmerican Network of Academies of Sciences (IANAS) and the Science Council of Asia (SCA). Their statement was formally presented to world leaders attending the G8+5 Summit in Hokkaido Toyako, Japan, between 7 and 9 July 2008.

It is no secret that strong national capacity in science, technology and innovation (STI) is critical to social and economic well-being. Neither rich nor poor countries can succeed without it. But what specific steps should be taken, especially among poor countries, to help create the proper environment for STI to take root and grow?

Experience shows that there is a need for improving schools at all levels of education, from preschool to postgraduate studies. There is a need to invest in appropriate technologies that can be used to address critical social and economic challenges. There is a need to integrate STI into national development plans, and there is a need to expand the role of science academies in policy discussions for economic growth.

The following statement calls on G8+5 countries to promote all of these initiatives and, more specifically, to devise a 10-year action plan designed to lay the groundwork for "sustainable and equitable global economic growth." ■

TWAS Newsletter, Vol. 20 No. 2, 2008

JOINT STATEMENT BY THE NETWORK OF AFRICAN SCIENCE ACADEMIES (NASAC), THE INTER-AMERICAN NETWORK OF ACADEMIES OF SCIENCES (IANAS) AND THE SCIENCE COUNCIL OF ASIA (SCA) TO THE G8 ON THE ROLE OF SCIENCE, TECHNOLOGY AND INNOVATION IN PROMOTING GLOBAL DEVELOPMENT.

On the occasion of the G8 Summit in Hokkaido, Japan, 7–9 July 2008, we, the members of the Network of African Science Academies (NASAC), the Inter-American Network of Academies of Sciences (IANAS) and the Science Council of Asia (SCA), submit the following statement to the leaders of the G8+5 countries on the role of science, technology and innovation in promoting global development, fostering human welfare and reducing global poverty as called for in the Millennium Development Goals (MDGs).

Recent global economic growth has been placed at risk by turbulence in financial markets. Yet, between 1998 and 2007, global gross domestic product (GDP) more than doubled. Between 2004 and 2007, it increased at an annual rate of nearly 4 percent. Moreover, for one of the few times in history, economic growth in the developing world exceeded economic growth in the developed world.

Sub-Saharan Africa, the world's poorest region, has actively participated in and benefited from these recent trends. Between 2000 and 2003, sub-Saharan Africa's GDP rose 3.7 percent annually. Between 2004 and 2006, the region's annual growth in GDP accelerated to 5.6 percent a year, and in 2007 GDP growth reached 6 percent. This represents the most sustained period of economic growth in sub-Saharan Africa in more than three decades.

This good news nevertheless does not hide the troubling news coming out of Africa. More than 40 percent of Africans live in extreme poverty. More than 70 percent live on less than US$2 a day. Some 26 million Africans are infected with HIV, and an estimated 2.5 million die of AIDS each year. More than 40 percent of Africans do not have access to safe drinking water. More than 70 percent do not have access to electricity. According to recent assessments made by the United Nations, no country in Africa is likely to meet all of the eight MDGs by the 2015 target date, and many African countries are unlikely to meet any of the MDGs by this time.

Differences in social and economic well-being between the least developed countries (LDCs) – most notably in Africa – and the rest of the world not only persist but also threaten to become larger. This growing disparity between rich and poor manifests itself in a variety of ways: between countries, within countries, by gender, and among workers.

The disparities are due partly to historical circumstances and partly to misguided economic policies that have resulted in weak institutions and rendered a large number of less privileged countries unattractive places for investment. But the disparities are also due to another factor: massive differences in the ability to generate, master and utilize science, technology and innovation.

One of the most critical issues that the global community faces is to continue to foster GDP growth and, at the same time, to make growth and human welfare more equitable. Building broad-based capacity in science, technology and innovation is fundamental to addressing these issues.

Over the past quarter century, we have moved from a world believed to have an unlimited bounty of resources to one where we must confront the reality of limited resources. Experts agree that people living in arid regions will have to compete for limited supplies of safe drinking water, and that current oil supplies (at least at affordable prices) may be exhausted by mid-century. Moreover, the spectre of global warming, largely generated by the burning of fossil fuels, may pose the greatest environmental challenge in the history of humankind. Another critical issue facing the global community is how to foster policies that result in the sustainable use of natural resources, on which long-term social and economic well-being depends.

We therefore call upon the G8+5 countries to partner with developing countries to achieve our common goals of poverty reduction and wealth creation by fos-

tering international collaboration in science, technology and innovation. Specifically, we propose devising a 10-year action plan that would lay the groundwork for sustainable and equitable global economic growth. We are proposing that the plan, devised in consultation with experts largely drawn from academies of science, focus on the following critical issues:

• Promoting quality education for all. There is no better way to foster equality of economic opportunity than to provide all citizens with an excellent education. Education nurtures the skills required for independent analysis and decision-making. Scientific education, moreover, should be a life-long endeavour. We therefore urge increased support for interactive science centres and laboratories to help make the world of science more accessible to both children and adults, especially in developing countries.

• Building sustainable capacity in science, technology and innovation. It is essential for each country to develop a critical mass of interdisciplinary problem-solving scientists, technologists and entrepreneurs who possess both scientific expertise and an appreciation of societal and developmental problems. This will require the establishment of world-class research universities capable of attracting the brightest students and setting global standards of excellence for the entire university system. We are requesting G8+5 countries to help fund the establishment of international research centres of excellence in developing countries staffed by local scientists who can collaborate as full partners in projects to be jointly executed by the international scientific community.

• Adapting existing technologies to meet critical local social and economic needs, and investing in new technologies to address real-life problems. The pathway to development followed by Brazil, China, India and other emerging economies has focused on developing a well-educated workforce capable of mastering existing technologies and adapting these technologies to meet the critical social and economic challenges faced by their societies. This is a pathway to development that should be followed by other developing countries. There is also a need to increase national and international investments in cutting-edge science and technologies, especially technologies that can stimulate economic growth. These technologies include information and communication technologies, biotechnologies, environmental technologies and nanotechnologies.

• Making science, technology and innovation integral parts of national development plans, and devising programmes to foster closer ties between the natural and social sciences and the public and private sectors. Scientific communities in developing countries, and especially in LDCs, have too often functioned in a vacuum separated from their societies. Special efforts should be made to design national research plans that are relevant to national needs and contribute to economic growth. These plans should promote interdisciplinary research and engage the private sector to work closely with government and universities .

• Promoting the role of science academies. Academies of science have played a critical role in global development, especially in providing independent expert advice to governments concerning science-related issues. These institutions should continue to become actively engaged in national and global initiatives for sustainable development. It is essential that national governments give science academies the resources and independence that they need to play this vital role. To ensure that science, technology and innovation become an integral part of each country's strategy for sustainable growth, science academies must participate in the design and implementation of national development plans. ■

***Network of African Science Academies (NASAC)**, located in Nairobi, Kenya, is comprised of 13 merit-based science academies in Africa.*

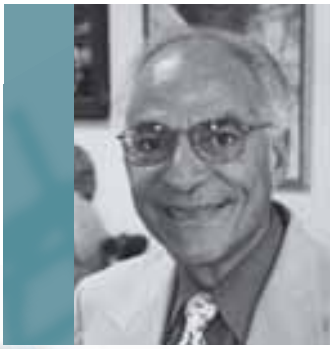
***InterAmerican Network of Academies of Sciences (IANAS)**, located in Rio de Janeiro, Brazil, consists of 14 merit-based science academies in the Americas.*

***Science Council of Asia (SCA)**, located in Tokyo, Japan, is comprised of 19 scientific organizations in Asia.*

Each network is dedicated to promoting science-based sustainable development.

RECOGNIZED

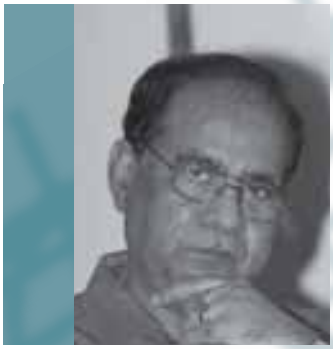
• **Farouk El-Baz** (TWAS Fellow 1985) received the 'Golden Award' from the Egyptian Ministry of Culture's Supreme Council of Antiquities on 18 April, International Heritage Day. The award was given in honour of El-Baz's archaeology research, especially for his efforts in preserving Egyptian archaeological sites by using non-destructive research technologies such as remote sensing. El-Baz is research professor and director of the Boston University Center of Remote Sensing, and adjunct professor of Ain Shams University in Cairo, Egypt. His other honours include Egypt's Order of Merit; the Award of Public Understanding of Science and Technology from the American Association for the Advancement of Science (AAAS); and the Exceptional Scientific Achievement Award from the US National Aeronautics and Space Administration (NASA).



Farouk El-Baz

AWARDED

• **Baldev Raj** (TWAS Fellow 2006) was recently given the Padma Shri award from the government of India and the Distinguished Alumni Award from the Indian Institute of Science, Bangalore. He has also won the Lifetime Achievement Award from the Indian Institute of Welding. Baldev is distinguished scientist and director



Baldev Raj

of the Indira Gandhi Centre for Atomic Research (IGCAR). At IGCAR, he has led research and development programmes that have played a pivotal role in developing the science and technology for fast breeder reactors and fuel reprocessing. Baldev is a fellow of the major science and engineering academies in India as well as of the German National Academy of Sciences. He has also served on the Scientific Advisory Council to the Prime Minister and the Scientific Advisory Committee to the Indian Cabinet.

DISTINGUISHED

• **C.N.R. Rao** (TWAS Founding Fellow and immediate past president) has been made a distinguished visiting professor at the University of California, Berkeley. He has also won the prestigious Nikkei Asia Prize for Science awarded by Nihon Keizai Shimbun, Inc. (Nikkei), publisher of Japan's leading business newspaper. The prize was given in honour of Rao's distinguished contributions to chemical spectroscopy, molecular spectra and chemistry of advanced materials. Rao is Linus Pauling research professor and honorary president, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore. His other honours include the Hughes Medal of the Royal Society, London; Einstein Gold Medal of UNESCO; India Science Prize; honorary fellowship at St. Catherine's College, University of Oxford, UK; distinguished research professor at the University of Cambridge, UK; and Khwarizmi International Award, government of Iran.

HONOURED

• **C.R. Rao** (TWAS Founding Fellow) was awarded an honorary degree from S.S. Barnala, Chancellor of the University of Madras. Rao is Eberly professor of statistics and director of the Center for Multivariate Analysis at Pennsylvania State University and

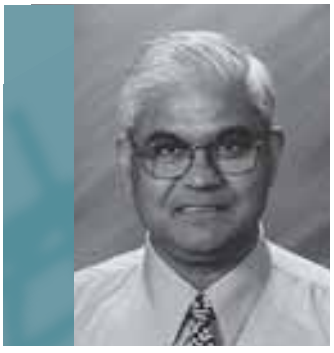
C.R. Rao

adjunct professor at the University of Pittsburgh. He has received honorary degrees from 28 universities in 16 countries and has been made an honorary fellow of numerous institutes, associations and societies. He has also been awarded the Emanuel and Carol Parzen Prize for Statistical Innovation, the Padma Vibhushan, India, and the National Medal of Science, USA.

PRIZED

• **Jagadish Shukla** (TWAS Fellow 1995) won the 52nd International Meteorological Organization (IMO) Prize from the World Meteorological Organization (WMO) for his outstanding work in meteorology. Shukla is professor and chair of the Climate

Dynamics Program at George Mason University and president of the Institute of Global Environment and Society (USA). He is also currently a member of the joint scientific committee of WMO's World Climate Research Programme and a commissioner in the Virginia Governor's Commission on Climate Change (USA). In addition to the IMO Prize,



Jagadish Shukla

Shukla has received the Walker Gold Medal of the Indian Meteorological Society, the Carl Gustav Rossby Research Medal from the American Meteorological Society, and the Exceptional Scientific Achievement Medal of the US National Aeronautics and Space Administration.

ELECTED

• **Padma Shukla** (TWAS Associate Fellow 2007) has been elected foreign member of the Royal Swedish Academy of Engineering Sciences (IVA). Shukla is an honorary professor at Ruhr University's Faculty of Physics and Astronomy in Bochum, Germany. He also holds visiting or honorary professorships at Umea University, Sweden; University of Strathclyde, Scotland; *Universidade Técnica do Lisboa*, Portugal; University of KwaZulu-Natal, Durban, South Africa; and COMSATS Institute of Information Technology, Islamabad, Pakistan. Shukla is a foreign member of the Royal Swedish Academy of Sciences and has been awarded the American Physics Society's Nicholson Medal for Human Outreach and the Gay Lussak-Humboldt Prize from the French Ministry of Science and Education. He holds an honorary doctorate from the Russian Academy of Sciences.

Padma Shukla

REMEMBERED

• **Pedro José Aymonino** (TWAS Fellow 1995) died on 5 March 2008 at the age of 80. Aymonino was a renowned Argentinian chemist. During his career, he held several academic and research positions, including: professor of inorganic chemistry at the *Facultad de Ciencias Exactas, Universidad Nacional de La Plata* (UNLP); senior researcher, *Consejo Nacional de Investigaciones Científicas y Técnicas* (CONICET); emeritus professor of the *Facultad de Ciencias Exactas*, UNLP; and director of the *Centro de Química Inorgánica*, UNLP. He published widely and pursued scientific and academic activities not only in Argentina, but throughout the world.

Pedro José Aymonino

• **Liu Tungsheng** (TWAS Fellow 1991) died on 7 March 2008 at the age of 91. Liu was educated at the National Southwest Associated University in Kunming, China, and the National Central University in Nanjing. He was professor at the Institute of Geology and Geophysics at the Chinese Academy of Sciences (CAS); honorary director of the Institute of Earth Environment at CAS; professor at the CAS Postgraduate School; and director of the CAS Committee of Environmental Sciences. For his distinguished contributions to geosciences, he received the Special Prize of the Chinese Academy of Sciences (CAS), the Chinese National Award in Natural Science, the Chen Jiagen Science Award in geosciences and an honorary PhD from Lingnan College in Hong Kong. He was a senior member of CAS and member of the International Eurasian Academy of Sciences.

Liu Tungsheng

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 Italian government.

The main objectives of TWAS are to:

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

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 associated 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 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 invite guest speakers from developing countries? You may find the help you need here:
www.twas.org/mtm/SM_form.html