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TWAS newsletter

THE NEWSLETTER OF THE THIRD WORLD ACADEMY OF SCIENCES

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Enlarging the Science Circle

The Third World Academy of Sciences (TWAS) has gained an international reputation for its efforts to promote science in the developing world. Since the Academy's inception nearly two decades ago, a pair of basic strategies have driven its overall mandate: first, to acknowledge and honour the most eminent scientists in the developing world by electing them to the Academy, and, second, to develop a wide range of programmes designed to enhance both the skill levels of scientists and the capacity of scientific institutions throughout the South.

Progress on the first front can be measured by the more than 600 world-class scientists who have been elected to the Academy in fields of basic science. Progress on the second front can measured by the growing recognition and impact of the Academy's core activities: TWAS prizes in basic and applied sciences (among the most prestigious science prizes in the developing world), research grants (that have assisted more than 1600 scientists in the South); fellowships and associateships (which have helped to foster South-South and South-North cooperation); and the sponsorship of meetings and lectures (including the organization of biennial general conferences, which are among the South's largest and most significant scientific meetings).

The enduring strength of TWAS has been largely due to its ability to stand true to its mandate and steadfast in the strategies it pursues to advance its goals. The Academy's clarity of purpose and faithful reliance on a consistent set of tactics has helped it to achieve a distinct identity among scientific communities both in the South and North. Yet the Academy has also been willing to alter its core strategies when changed circumstances warrant such reforms. That is the case in TWAS's decision to welcome social scientists and economists into its membership class of 2001. The official induction of these members took place at the TWAS 8th General Conference in New Delhi this past November.

Since TWAS's founding in 1983, the Academy's membership has been comprised of basic scientists. There have been just two exceptions: Fernando Henrique Cardoso (TWAS Associate Fellow 1984) who, early in his career, was a professor of political sciences at the University of São Paulo, Brazil, and, more recently, president of Brazil, and the late Arthur

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TWAS NEWSLETTER
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Lewis (TWAS Associate Fellow 1985), who was awarded the Nobel Prize in economics in 1979.

There are several reasons why TWAS has decided to broaden its membership roster beyond the basic science community.

First, the Academy, often in cooperation with its affiliated organization, the Third World Network of Scientific Organizations (TWNSO), has become more engaged in projects designed to apply scientific knowledge to critical economic, environmental, and social problems facing the developing world. These efforts are testimony to the success that some developing countries have achieved over the past several decades in building their scientific expertise. The time has now come, the Academy believes, to put that expertise to work on issues of significance not only to the global scientific community but to the people living in the countries where Academy scientists live and work.

Second, governments throughout the developing world – like their counterparts in the developed world – are increasingly demanding that scientific research should focus on national concerns. Scientific communities would be foolish not to be responsive to our governments' requests.

Third, it has become clear that many of the critical problems facing the developing world cannot be solved by the insights provided by a single discipline. Efforts to address such concerns – whether access to safe drinking water, the application of renewable energy sources, the conservation of biodiversity, or broad-based efforts to combat disease and improve public health – all require multidisciplinary strategies that engage not only findings provided by the basic sciences but also contributions from the social sciences and economics.

And, fourth, the global scientific community itself has become more interested in multidisciplinary science. This is a trend that TWAS, which has emerged as a major player in international science, intends to embrace in order to be even more responsive to the needs of scientists in an ever-more globalized world.

For all these reasons, TWAS extends an especially warm welcome to its new members in the 'social and economic sciences' category:

R. Cardoso de Oliveira

P. S. Dasgupta

• **Roberto Cardoso de Oliveira**, *Visiting Researcher at the Center for Research and Graduate Studies on the Americas (CEPPAC) at the University of Brasilia, Brazil, whose long list of scholarly and scientific publications make him one of the world's foremost anthropologists studying indigenous people in the Americas. He has also earned acclaim as a teacher, advisor and consultant. de Oliveira's on-site research of the Brazilian Terêna and Tukúna peoples has broadened our knowledge of indigenous cultures and deepened our understanding of the roots of human civilization.*

• **Partha Sarathi Dasgupta**, *Frank Ramsey Professor of Economics at the University of Cambridge, UK, one of the pioneers in the development of the field of ecological economics. His breakthrough studies on the links between the local natural resource base and the state of the local economy have helped transform not only our view of rural societies in the developing world but the way in which international aid should be allocated. (For a detailed discussion of Dasgupta's career, see page 15).*

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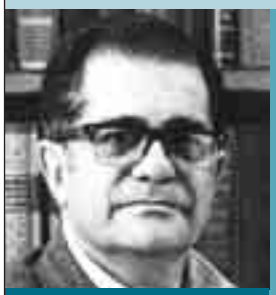
• **Miguel Leon-Portilla**, *Emeritus Researcher at the Institute of Historical Research of the National Autonomous University of Mexico, a world-renowned anthropologist and historian who has been teaching in his home country for nearly half a century. Leon-Portilla founded the prestigious Seminar on Nahuatl (Aztec) Culture, which has served as a training ground for several generations of scholars who have adopted and refined Leon-Portilla's methodology for the study of indigenous texts and his research protocols for enhancing our understanding of indigenous cultures.*



M. Leon-Portilla

• **Ali A. Mazrui**, *Director of the Institute of Global Cultural Studies at Binghamton University in Vestal, New York, USA, an internationally recognized political scientist who was born in Kenya and has devoted his career to the study of North-South relations, African politics and the organizational culture of international institutions. Mazrui has not only authored numerous scholarly books but has written for the popular press and served as a consultant for television documentaries and news programmes. He has been involved in several United Nations projects ranging from efforts to protect human rights to programmes to limit nuclear proliferation. He is also an internationally recognized expert on Islamic culture and history.*

A. A. Mazrui

• **Niu Wen-Yuan** *was the founding director of China's first sustainable development research institution, the Chinese Academy of Sciences' Institute of Policy and Management. In 1998, he also launched China's first nationwide sustainable development programme. His basic research efforts have led to the development of internationally recognized theoretical paradigms and quantitative models for sustainable development and generalized frameworks for understanding the impact of regulations on environmental protection and economic growth. Niu devised what has come to be called the 'Niu index', which has become a standard tool for economists interested in this problem.*

Niu Wen-Yuan

• **Ismail Serageldin**, *director of the* Bibliotheca Alexandrina *in Alexandria, Egypt, is an internationally recognized economist and former World Bank official who has published extensively on issues relating to sustainable economic development in the South. During his tenure at the World Bank, Serageldin promoted efforts to improve the Bank's relations with nongovernmental institutions and coauthored several reports demonstrating the importance of human resource capital in economic growth. Early in his career, Serageldin taught at Cairo and Harvard universities. He has served on a number of advisory committees for academic institutions and international research centres both in the South and North.* ■

I. Serageldin

LINKS AND PROGRESS

THE EUROPEAN COMMISSION'S CHRISTIAN PATERMANN RECENTLY VISITED TWAS TO OUTLINE A NEW MULTI-YEAR STRATEGY FOR EUROPEAN-WIDE SCIENTIFIC RESEARCH. HIS MESSAGE? THE EUROPEAN UNION IS SEEKING PARTNERSHIPS WITH THE DEVELOPING WORLD.

With the launch of the first European Framework Programme in 1984, the European Union (EU) embarked on a continent-wide science policy strategy designed to bolster Europe's scientific foundation through the creation of cross-boundary networks among its national scientific enterprises.

This year, the EU announced its Sixth Framework Programme, which will remain in place from 2003 to 2006. The willingness of the EU to issue a series of frameworks is testimony to the programme's success – and so too is the ever-expanding budget. The Sixth Framework will receive €17 billion, representing a 17 percent increase in budget over the previous framework. The budget, moreover, represents 3.9 percent of the EU's total budget. Europe as a whole spends only 1.9 percent of the EU's member states' gross domestic product for research and technology. By 2010, the EU hopes that the budget for scientific research will increase to 3 percent of GDP, which will then be among the highest percentages in the world.

Progress under the framework strategy has been due largely to the programme's ability to set priorities and forge partnerships among scientific institutions throughout Europe. In the past, European science had been handicapped by the twin problems of funding dispersal among nations (small sums of money spread over a myriad of projects) and activity fragmentation (a great deal of project overlap and duplication).

These ongoing issues will be tackled with increasing commitment through the European Research Area (ERA) initiative, which is a cornerstone of the new framework. The purpose of the ERA is to create an 'internal research market,' an area marked by the free movement of knowledge, researchers and technologists that the EU hopes will stimulate both increased cooperation and competition among scientists.

A unique feature of the Sixth Framework Programme is that it also allows for and indeed promotes cooperation with individual scientists and scientific communities in the developing world. About €600 million of the €17 billion budget has been set aside for encouraging so-called 'third countries' – that is, non-EU member states – to work cooperatively with EU scientific institutions on the framework's thematic priorities. These priorities include genomics and biotechnology for health; information technologies; nanotechnologies and nanosciences; aeronautics and space; food quality and safety; sustainable development; and citizen and governance in a knowledge-based soci-

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ety. Most of these funds will be used to build partnerships between scientific communities in the EU and the developing world.

The knowledge and networks that TWAS and its affiliated organizations – specifically, the Third World Network of Scientific Organizations (TWNSO) and the Third World Organization for Women in Science (TWOWS) – have developed over the past several decades could be invaluable to the EU's outreach efforts. The Academy's channels of communication, for instance, could help EU-based scientists make valuable contacts with people and institutions in the developing world. Moreover, TWAS's strong links with scientific experts from the South could help the EU establish a large pool of consultants able to assess and judge the grant applications that the EU expects to receive.

It is the EU's firm belief that it can help bring developing countries into the mainstream of modern development and that science and technology are powerful engines for driving this effort. The fact is that we all live in a knowledge-based society and that this knowledge – drawing largely from advances in science and technology – can serve as a primary tool for eradicating poverty, reversing environmental degradation and combating such major diseases as HIV/AIDs, malaria and tuberculosis.

Efforts to address these critical global concerns depend, in large measure, on the exchange of scholars (both North-South and South-South), the forging of closer links between research and industry, and the fostering of an atmosphere that stimulates technological and managerial innovation.

While the EU's efforts to engage the developing world is driven, in part, by moral and ethical considerations, it should be noted that self-interest is also a compelling factor. In some ways, the framework's goal of engaging developing world scientists represents an extension of the EU's ongoing efforts to broaden the circle of scientific cooperation in order to make science more innovative, efficient and effective.

It is believed that the success already achieved in meeting these goals by promoting cooperation on the European continent can now be extended beyond the borders of Europe itself. Similarly, opening up the competitive tendering process to an even larger pool of institutions will lead to higher quality research proposals and project outcomes. That, in turn, will mean a greater return on the investment that Europe makes in science and technology. There may be no better way of helping others as we help ourselves. ■

Christian Patermann
Director of Environment
Directorate General for Research
European Commission
Brussels, Belgium

For additional information about the EU's Sixth Framework Programme, see ⋯⁘
europa.eu.int/comm/research/fp6

DRYLAND BIODIVERSITY: NEXT STEPS

AFTER WORKSHOPS IN MONGOLIA, OMAN AND CHILE, THE GLOBAL ENVIRONMENT FACILITY-SPONSORED PROJECT ON DRYLAND BIODIVERSITY CONCLUDED WITH AN INTERNATIONAL CONFERENCE IN EGYPT. LESSONS LEARNED AND FOLLOW-UP ACTIONS DOMINATED THE DISCUSSIONS.

The pyramids of Giza – the world famous desert structures still standing and still stunning after 5000 years – served as an ideal backdrop to an international conference for "Promoting Best Practices in the Conservation and Sustainable Use of Biodiversity of Global Significance in Arid and Semi-Arid Zones in the Developing World" held recently by the Third World Network of Scientific Organizations (TWNSO).

The conference, which took place from 14-17 December 2002, marked the concluding event of a two-year project sponsored by the Global Environment Facility (GEF). The Desert Research Centre of Egypt served as the local organizer of the event, which was attended by more than 100 people from 32 countries.

As Adoub Hadid, chief executive director of the Egyptian Environmental Agency, pointed out in the opening session of the conference, the ancient civilization of the pharaohs learned to live in harmony with – indeed to prosper in – Egypt's dryland environment by respecting nature's bounty and avoiding excessive use of its resources, including its biodiversity.

More recently, he noted, Egypt has again focused attention on the country's resources by adopting a vigorous programme for the creation of protected habitat areas. Plans call for the official designation of 40 protected areas, covering some 17 percent of the nation's landmass. To date, the national government has established 23 protected areas covering nearly 10 percent of the country.

Hadid's description of Egypt's on-going efforts to create protected habitats and, by implication, to con-

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serve the nation's dryland biodiversity, was just one example of the many experiences – at local, national and regional levels – that have been examined during this two-year GEF-sponsored initiative. Regional workshops – held in Ulanbataar, Mongolia; Santiago, Chile; and Muscat, Oman – together attracted more than 140 delegates from 60 countries in Africa, Asia, Europe and North and South America.

Project participants described wide-ranging efforts to conserve and protect biodiversity resources in dryland regions – efforts that have proven to be as varied as the locations in which the participants lived and worked, including Chile's Andean foothills, northeast Brazil's semi-arid *caatinga* zone, Tunisia's Matmata mountains, Morocco's Ziz valley, Mongolia's Gobi desert, China's Horqin sandy grasslands, Oman's mangrove forests, South Africa's Bokkeveld plateau, and southwest Africa's Namib desert (see article on page 11).

A major outcome of this project will be the publication later this year by Kluwer Academic Publishers of 35 of these shared experiences. Ten to twenty additional experiences will be included in a policy-oriented booklet now being prepared by the TWNSO secretariat. The full texts of all of these case studies will also be placed on the project's website (*www.gefbiodiversity.org*) where browsers can review the reports and respond to the issues raised by the authors. Project organizers hope that the site will help promote a vigorous interactive dialogue on issues related to the protection and conservation of biodiversity resources in dryland regions in developing countries.

The international conference in Egypt was dominated by two concerns. The first focused on the broad lessons that could be derived from the case study experiences presented at the workshops, while the second concentrated on the steps that may now be taken, in the words of advisory committee member Leonard Berry, "to advance the good work that has been done over the past two years." Berry is director of the Florida Center for Environmental Studies at Florida Atlantic University, USA.

"Lessons learned," notes lead project consultant John Lemons, professor of environmental science at the University of New England, USA, "include a wide range of issues related to scientific research, public policy and management, local participation in decision-making, and institutional partnerships and capacity building."

"One of the most valuable lessons learned from this project," says Hassan Hassan, a former World Bank official who serves on the advisory board, "is that the developing world has gained a broad range of scientific experience in the conservation and use of biodiversity.

"Much of this experience," Hassan adds, "has remained localized. As a result, one of the next steps in this process should be the promotion of a dialogue among scientists and policy makers so that the scientific experience acquired in laboratories and fields

throughout the South can gain a more prominent role in larger policy discussions and decisions."

Gloria Montenegro, another member of the advisory board, agrees. "It is critical," she asserts, "for scientific institutions and grassroots organizations to become more involved in policy making."

"This is a two-way street," she adds. "On the one hand, scientists must be willing to pursue policy-oriented research issues and to present their findings in ways that policy makers can understand and find useful. Policy makers, meanwhile, must be willing to open not just their corridors but their meeting rooms and offices to scientists."

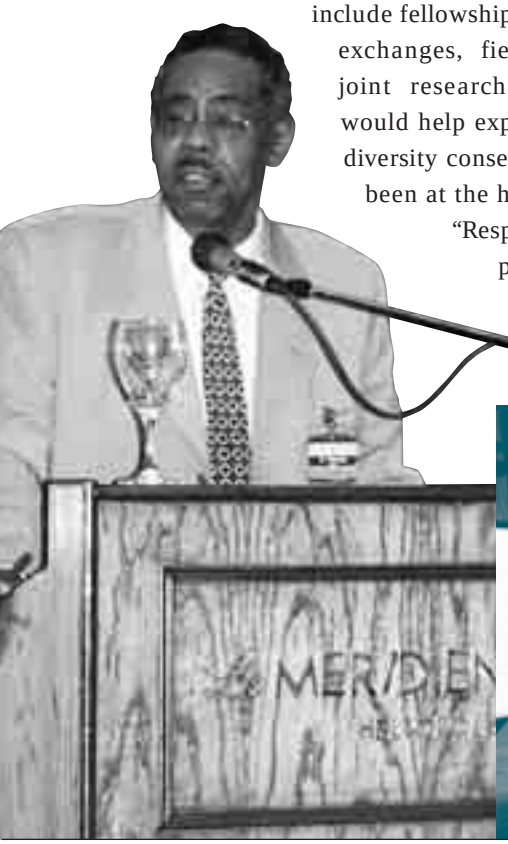
In discussions concerning the conference's other major concern – the steps that should now be taken – Mohamed Hassan, secretary general of TWNSO, observed that project participants raised a number of possible options, ranging from efforts to improve the project website so that participants can continue to communicate with one another, to the development of a full-scale research and training programme that would include fellowships, travel grants, scientific exchanges, field demonstrations and joint research initiatives. The latter would help expand the expertise in biodiversity conservation and use that had been at the heart of the initial project. "Responsibility for such comprehensive programmes," Hassan adds, "would rest with a small number of institutions, carefully chosen after a vigorous competition. These institutions, in effect, would serve as catalysts to boost scientific capacity throughout the region in which they are located. Ultimately, the institutions could even serve as national and even international centres of excellence."

Scientific institutions and grassroots organizations must become more involved in policy making.

An intermediate stage in this process will take place in late summer when a workshop will be held at Alakhwayan University's Center of Environmental Issues and Regional Development in Ifrane, Morocco. The three-day event, scheduled for 27-30 August, will bring together research scientists, science administrators and policy makers from throughout the developing world to discuss how the vast storehouse of scientific expertise on issues related to biodiversity can be more fully integrated into the policy-making arena at both national and international levels. GEF has given TWNSO approval to use unspent funds from the existing project to cover the expenses of the Morocco workshop.

The international conference in Egypt ended with a 'statement of intent' that endorsed the creation of a network on biodiversity in arid and semi-arid zones in the South.

"Although many institutions in the developing world have been involved in pioneering innovative projects related to the conservation and sustainable use of biodiversity resources in arid and semi-arid zones," participants declared, "insufficient mechanisms are in place for the sharing of information on



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successful experiences." Therefore, participants urged that the proposed network:

- Identify and disseminate information on best practices.
- Encourage collaboration among centres of excellence in the South.
- Sponsor training and research programmes.
- Assist efforts by local communities to conserve, develop and effectively manage biodiversity resources, especially to meet local needs.
- Serve as a bridge between scientific institutions, local communities and national and international decision makers for the promotion of science-based strategies for biodiversity resource conservation and sustainable use.

More than one billion people depend on dryland biodiversity resources for their survival.

As Lemons declared at the conclusion of the workshop: "This project has been driven by the fundamental importance of dryland biodiversity to our global environment and global community."

Some simple statistics confirm Lemon's observations: More than one-third of the world's land mass is arid or semi-arid and more than one billion people, many of whom are among the world's most impoverished and vulnerable inhabitants, depend on dryland biodiversity resources for their survival and well-being.

The knowledge that this project has shed on these issues and the public attention that it has drawn to these often-neglected resources may represent its most significant outcome. Equally important, however, has been the project's ability to foster an exchange of information among participants who have long-laboured on like-minded issues but often in isolation from one another.

How to transfer the lessons learned from each of these experiences into a larger policy setting is the major challenge that project organizers and participants alike will have to tackle in the years ahead. All those involved in the project would agree that successfully meeting this challenge should prove enormously beneficial for both the treasure trove of biodiversity found in dryland regions and, more importantly, the people who have depended on these resources for their survival and material well-being for aeons of time. ■

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DRY AND DRIER

NEW CHALLENGES IN THE WORLD'S OLDEST DESERT

What's the climate like in Namibia, a country of nearly 2 million people located on the southwest coast of Africa? In a word: dry. Or, if you prefer two words: dry and drier. Yet such conditions do not prevent the country from enjoying a rich diversity of biological resources. In fact, these resources form the basis of an intricate ecological mosaic that illustrates how biologically rich drylands can be.

Namibia's climate 'varies' from 'dry subhumid' in the northeast, through arid and semi-arid in the central regions, to extremely dry along the southern Atlantic coast.

These different climatic zones help create a checkered landscape, including the Succulent Karoo, an internationally renowned 'biodiversity hotspot' that is home to almost 5000 plant species, nearly 2000 of which are found nowhere else in the world. Namibia also has less well-known local and regional zones that create a diverse template of biodiversity. For example, the central Namib Desert, supports many endemic species of reptiles, invertebrates and lichens, all sustained by water from the frequent fogs that roll in off the Atlantic coast.

For more than 40 years, the Desert Research Foundation of Namibia, a non-governmental organization previously called the Desert Ecological Research Unit, has worked in partnership with Namibia's Ministry of Environment and Tourism. The most noteworthy product of this collaboration has been the establishment of the Gobabeb Training and Research Centre, created in 1962 and reorganized as a joint venture in 1998. The Centre focuses on research and training programmes that draw on the rich ecology of the Namib Desert for hands-on investigations, complementing the Centre's classroom work and laboratory sessions.

Moreover, because so much of Namibia's protected area falls within the Namib Desert, the Centre has served as a focal point for understanding not only the specific region in which the desert is located, but the rich biodiversity found in the country's other dry areas. Centre researchers, in turn, have provided information for both policy analysts and decision makers, especially on issues related to the development of the nation's tourism industry.

BEETLE MANIA

While most other ecological research programmes in Africa have targeted the so-called 'charismatic megafauna', such as lions and elephants, research at the Desert Research Foundation has focused on finding explanations for the high species richness of tenebrionid beetles in the Namib Desert. In effect, the foundation has been propelled by the belief that small things can cast revealing light on the behaviour of ecosystems.

In Namibia, this beetle family, known for its ability to survive in dry environments (flour beetles, for instance, which can extract the moisture they need to survive from dried cereal products, are in the same family), is represented by more than 200 endemic species, many with their own peculiar adaptations to life in a hot dry climate.

There are, for example, beetle species with white or yellow patches on their abdomens that reflect the

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sun's rays. The average body temperature of these beetles is up to 5ºC lower than the average body temperature of other, darker species. As a result, these white- and yellow-marked beetles can forage for longer periods during the heat of the day.

The fog-basking beetle and the fog-trapping beetle, on the other hand, are well-known for their drinking habits. Picture this. By standing on their heads when the fog rolls in, water condenses on their abdomens and subsequently trickles down into their mouths. In this way, the beetles can guzzle enough water to survive in the harsh desert climate. Engineers have even analysed the surface structure of these beetles to improve the design of 'fog harvesting' equipment that can provide clean drinking water in dry environments.

PLANT LIFE

The Namib Desert not only displays a rich diversity of 'upside-down circus beetles'; it is also home to a wide-range of plants that have successfully adapted to this dry, harsh environment by developing innovative water intake and retention mechanisms.

Members of the Welwitschiaceae family are one intriguing example. These unusual plants, which harvest water from fog, consist of just two long, strap-like leaves, whose edges are constantly worn away by blowing sand.

Research on the desert environment's rich biodiversity is being carried out with the help of the Topnaar, one of the area's indigenous peoples. The Topnaar, who live along the seasonal Kuiseb River in the Namib Desert, are the only people that reside within the borders of a Namibian park. Scientists working at the Gobabeb Training and Research Centre on the lower Kuiseb River live among the Topnaar. This arrangement has facilitated an exchange of information between university-trained researchers and local residents, enabling both parties to learn from one another.

Several research projects, undertaken directly with the Topnaar, focus on developing markets for indigenous fruit as well as community-based tourism and fog harvesting. A number of developmental non-governmental organizations have also joined the effort, lending their expertise on market development strategies.

The Desert Research Foundation is also a source of interpretive information for the growing number of tourists that visit the desert, the second most important destination in Namibia after Etosha National Park.

BEST IS BEST

Due to the arid nature of much of Namibia, large tracts of land have remained undeveloped. However, changing global perceptions of the value of such landscapes and the biodiversity they contain have fuelled international tourism. This, in turn, has affected public policy, as tourists, attracted by the unspoiled landscapes and the region's unique flora and fauna are themselves adversely impacting the

fragile desert ecosystem, placing at risk the ecological conditions that lured them there in the first place.

Obviously, there is a need to develop 'best practices' for the conservation and sustainable use of Namibia's unique biodiversity, and this is being undertaken by a loose partnership of public, private and nongovernmental organisations. Taking the lead, the public sector manages a number of established national parks, game parks and reserves. Today protected areas cover more than 10 percent of Namibia.

The private sector's initial forays into biodiversity protection took place in the 1970s when new legislation gave commercial farmers, with freehold tenure, ownership of the game found on their farms. New regulations allowed neighbouring farmers to form conservancies and thereby gain the rights to harvest their game.

This has led to a variety of management approaches, ranging from benign game viewing and bird watching to more controversial trophy hunting of such protected species as elephant. Private-sector involvement, however, generates much-needed foreign exchange income, thus motivating the public sector to expand its interest in biodiversity.

Namibia's public sector is also working closely with nongovernmental organizations to promote community-based natural resource management through conservancies on commercial and communal farming lands. In the mid 1990s, new legislation permitted communities, with support from nongovernmental organizations, to form conservancies that have allowed them to benefit from the wildlife and tourism activities on conservancy land.

This initiative, moreover, is helping communities to gain control over other resources such as grazing and water. In the absence of a communal land act, the conservancy movement appears to be giving communities a way of protecting their biodiversity while preventing further land degradation.

SUSTAINABLE DEVELOPMENT

The Desert Research Foundation and the Gobabeb Training and Research Centre are also part of the Namibian government's Biodiversity Task Force, which plays a leading role in the country's long-term research on biodiversity.

For example, under the aegis of the Task Force's Environmental Observatories Network of Namibia, an environmental observatory has been established at Gobabeb that has become a member of the International Long-Term Ecological Research Network, a group of research centres in 25 countries sponsored, in large part, by the US National Science Foundation.

In collaboration with Namibia's Department of Water Affairs, the Desert Research Foundation has also worked with communities that depend on water from the Kuiseb River basin to pilot the creation of basin management committees, a key administrative component of Namibia's draft water act. A similar

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approach has been devised to address national concerns about desertification through the formation of federal government partnerships with rural communities. Such partnerships are designed to forge strategies for the sustainable development of natural resources – focusing on the conservation and wise use of biodiversity – in Namibia's driest regions.

At the international level, the Directorate of Environmental Affairs in the Ministry of Environment and Tourism has also played a part in the country's ratification of such international agreements as the Convention on Biodiversity, the Convention to Combat Desertification, the Ramsar Convention, which protects wetlands, and the Convention on International Trade in Endangered Species. These efforts have enabled Namibia to participate in international discussions on the global management of critical resources.

The Desert Research Foundation, together with such partners as the Polytechnic of Namibia and the University of Namibia, also offers hands-on training opportunities for students and researchers throughout Namibia. In the past year alone, 1,200 students and scientists visited the Centre. In a young developing country like Namibia, this approach has resulted in many graduates assuming positions in both the public and private sectors with enhanced capacity and understanding of the relevance of biodiversity.

BACK TO BASICS

Dissemination of science-based information to governmental agencies, in general, and the tourism industry in both the public and private sectors, in particular, has increased the nation's knowledge of its dryland ecosystems and rich biodiversity. However, much of this information has been designed to tap the commercial value of these resources.

Basic research, in contrast, has become a secondary concern. As a result, new information with potential long-term value for the conservation and sustainable use of biodiversity resources has not kept pace with the challenges that are emerging as these resources become used more intensely.

Such a shift in balance from basic research to ecotourism development could have a negative impact on the long-term health of biodiversity resources. If such worries prove to be correct, neither the environment nor the economy will be well-served. This may prove to be the most compelling reason for pursuing a vigorous scientific research programme – both basic and applied – for the conservation and sustainable use of dryland biodiversity resources in Namibia. ■

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***J R Henschel,** Executive Director*
Gobabeb Training and Research Centre
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This article is based on a case study report prepared for the TWNSO/GEF project "Conserving Biodiversity in Arid Regions - Best Practices in Developing Nations" For additional information, contact info@twnso.org

The Academy's core strength," notes C.N.R. Rao, TWAS's president, "has been – and will remain – focused on honouring and rewarding scientific excellence and accomplishment in basic scientific research – biology, chemistry, physics and the medical sciences. However, we have also come to realize that the Academy's growing concern for putting science to work to address critical problems in the developing world requires not just insights provided by basic scientists but also ideas that only experts in the social sciences and economics can provide."

For this reason, in 2001 TWAS decided to open its membership to world-class experts in the social sciences and economics. "We hope that such efforts will not only broaden the reach of the Academy," Rao observes, "but also create greater synergy between our knowledge of the natural world and our understanding of human nature and behaviour."

The TWAS class of 2001, which totals 51, included six social scientists and economists among its ranks: Roberto Cardoso de Oliveira, Brazil; Miguel Leon-Portilla, Mexico; Ali A. Mazrui, Kenya; Niu Wen-yuan, China; Ismail Serageldin, Egypt; and Partha Sarathi Dasgupta, India.

BRIDGING THE DISCIPLINE DIVIDE

Like their counterparts in the basic sciences, the Academy's newest members in the social sciences and economics represent the world's foremost researchers. And like their counterparts in the basic sciences, these members have either worked in the South or have lived in the North but devoted a major portion of their research efforts to issues of critical importance to the South (see pages 3 - 4 for brief biographies).

The work of Sir Partha Sarathi Dasgupta, Frank Ramsey Professor of Economics at the University of Cambridge, UK, represents world-class research that stands on its own as a unique contribution to our understanding of global issues and complements insights into such fields of basic science as biology and environmental science. More specifically, Dasgupta's pioneering efforts in the field of ecological economics have not only transformed our perception of the developing world's ability to manage its natural resources but have also highlighted the ingenious ways in which residents of the developing world have managed their own natural resources despite a lack of financial resources and limited access to technology.

At first glance, ecology and economics appear to have little in common. The study of economics traces its roots back to the work of Adam Smith in the late 18th century. About 100 years later, in 1869, the German biologist Ernst Haeckel coined the word 'ecology'. Ecology itself, however, only entered mainstream science in the early to mid 20th century. The merging of the two – into what has come to be called ecological economics – is, therefore, a relatively new phenomenon.

Despite its recent origins, though, the importance of ecological economics has not been lost on a

wide range of institutions involved in sustainable development. In 2002, the prestigious Volvo Environment Prize, for example, was awarded to two pioneers and long-time collaborators in the field, Karl-Göran Mäler, professor of economics at the Stockholm School of Economics, Sweden, and Partha Dasgupta.

What exactly is 'ecological economics' and why should organizations like TWAS, that are interested in science-based sustainable development, especially in the developing world, take an interest in its findings? At a recent meeting in Trieste, the editor of the TWAS Newsletter spoke with Partha Dasgupta to find out.

What is ecological economics? What are its roots and what are your contributions to this field?

Ecological economics has its roots in the classical works of political economists like David Ricardo, who published his *Principles of Political Economy and Taxation* in 1817. Ricardo thought that land, which is obviously finite in area, placed a limit on an economy's potential because its innate productivity was fixed. His research took place during the early stages of the Industrial Revolution. The wealth-creating success of the revolution, however, shifted the focus of economics from such constraining factors as land to boundless technological advances that observers came to believe could overcome land-based – indeed resource-based – constraints. Basically, the Industrial Revolution indicated that human beings could override resource constraints by being clever. The history of economics is largely rooted in the history of the Industrial Revolution. That has been unfortunate, not only for Ricardo, but for all students of economics, because for nearly 200 years, economics short-changed concerns about natural resource constraints. Economists concluded that, if you had a sufficient number of innovative ideas and funds to invest in technology (mainly machinery), you could ignore natural capital. As I said, Ricardo saw land as finite, but land's productivity lies in how it is used. The global land mass may remain the same, but its fruitfulness can change – for better or worse. Since the time of Ricardo, there have been occasional writings on resource constraints. For example, in the 19th and 20th centuries, publications in England examined whether the nation's coal reserves, the UK's main energy source, could eventually be exhausted. But such studies appeared only sporadically and eventually became even less common as coal gave way to oil and natural gas. Then, in the early 1970s, scholarly attention focused on the potential exhaustibility of natural resources in general, mainly in response to a dramatic rise in oil prices. Since then, studies on resource limitations have been conducted on fisheries, timber and water supplies, to name just a few. These studies are all part and parcel of the field of economics. Nonetheless, they have remained largely outside the mainstream of the profession.

While the issues have been viewed as interesting, they are considered isolated problem areas by most conventional economists. Moreover, nearly all of these studies focused exclusively on economic problems of importance to developed countries. My own interest in ecological economics evolved from my interest in rural poverty in such regions as sub-Saharan Africa and the Indian sub-continent. One question was: If you are in a poor society, what do you do about borrowing? Suppose, for example, there is a drought: How do you borrow enough money to get through it? No formal credit markets exist but informal networks often do. I became interested in learning more about these poor-country networks where people can borrow, lend and obtain insurance, for example. Anthropologists have studied these networks for a long time and, after reading their findings, I realized that many resources in poor rural areas – for example, ponds, grazing lands and local forests – were not privatized but held as common property. The key question was whether such resources were well managed. Scholarly literature suggested that they were not necessarily badly managed, even when heavily used. So I tested various economic analyses to try to understand how such cooperative action could take place without the intervention of the state and, in the 1970s, developed several models. In carrying out this research, I realized that the communal capital assets these people relied on were almost entirely natural resources, and that their income was derived from such assets as land, forests, water and the services that these natural resources provided. Ecological economics, therefore, is really about 'ecological factories': the transformation of the goods and services that nature is providing and their entry into human production systems. It takes information about natural ecosystems and embeds it into economic models in the same way we have embedded information about coal mines, steel mills, factories and roads into more conventional economic models. Previous economic models had never before considered such ecological inputs and were thus flawed.

You started out as a student of physics. How did you make the transition to ecological economics?

I was born in Dacca – which was then in India and is now in Bangladesh – in 1942, and earned my undergraduate degree in physics at the University of New Delhi. I planned to be a theoretical physicist because in the 1960s that is what my brightest student colleagues wanted to do. My next move was to go to Cambridge, UK, to do a bachelor's degree in applied mathematics. During my second year, I began to discuss various issues with economics students – issues that I found very interesting. Fortunately, even after I completed a pre-PhD year in theoretical physics, the faculty at Cambridge was flexible enough to allow me to switch my major. As a result, I graduated with a PhD in economics in 1968. As you can see, none of this background had anything to do with ecology; it was all mathematics, physics and economics.

What were the issues that initially engaged you?

The key chapter of my dissertation, which has become one of my most cited publications, focuses on population. It asks the question: How many people should there be in the world? Philosophers have been examining this perplexing issue for a long time, but they were unable to ask the question in a precise way. The philosopher Henry Sidgwick, for example, in his book *The Methods of Ethics* (1874), addressed the question. He concluded that the total number of people in the world should be a number that maximizes human happiness and well-being. Sidgwick's reasoning, however, only gave us a way of thinking about the problem, not the answer. What I did was to put

that same question into an economic model. In other words, I put Sidgwick's utilitarianism to use in a world with finite resources. I concluded that the ideal number of people was finite, for the same reason that the Earth's resources are finite. However, perhaps the interesting conclusions of my study was that the optimum average well-being is not much higher than the well-being at which life is only just worth living.

So does your model predict an unsustainable maximum?

Yes. Several years ago, Joel Cohen, head of the Laboratory of Populations at Rockefeller University, New York, published a book: *How Many People Can the Earth Support?* (1995), in which he considered the issue of sustainability. Cohen contends that defining the limits of land, food production and water supply will lead to a more definitive estimate of the number of people the Earth can sustain. But I was not asking the question of sustainability, I was asking the question of optimality. The optimal number of people, of course, would be lower than the sustainable number because you have to leave room for human happiness – well-being. Sustainability doesn't take human well-being into account. In joint work with Nobel laureate Kenneth Arrow of Stanford University and Karl-Goran Mäler of the Beijer Institute in Stockholm, I have recently connected sustainability of human well-being with sustainability of an economy's productive base in a way that is usable empirically.

What mechanisms do people living in societies without markets or infrastructure use to manage their natural capital?

In the absence of a market, they devise their own mechanisms. Some African villages, for example, remain very isolated. Yet without any markets or infrastructure, they are able to trade amongst themselves and agree on how to manage the property on which they depend – building houses and creating 'marketable' products that they buy and sell with each other. However, they are mainly subsistence farmers and most of their capital is natural capital drawn from the natural environment. Such assets often are localized – for example, a pond in the centre of a village, which belongs to one village and not to another. The pond, however, doesn't belong to a particular person within the village. Therefore everyone must agree on how to share and use the water. These are critical issues for which the key question is: How will the rules and regulations be enforced? This is another area of ecological economics in which I developed an interest, turning to 'game theory' to better understand the processes involved. For example, several hundred people could be trying to devise a scheme that is both enforceable and sustainable. They need to understand the social and ecological dimensions of the problem in order to forge a long-term sustainable solution. When people say that local communities know more about local ecology than an outsider – no matter how expert he or she may be – they're often right. Scientists obviously know more about chemistry than local villagers, but villagers know certain patterns: the time of year particular flowers bloom or trees grow most rapidly. These local ecological processes, in turn, must be understood to make sense of the social agreements and norms of behaviour that respond to them. That is the heart of ecological economics: a deep appreciation for local back-

ground factors – both in the community and in nature – that drive the system and are an intrinsic part of it.

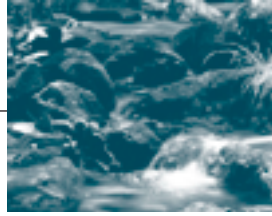
Could you give us an example of how such non-market institutions work?

One example that helps shed light on the relevance of ecological economics in policy making involves the case of a small group of farmers in Nepal who relied on a canal system to irrigate their crops. Upstream farmers could siphon off the water first. If they took too much, little water would be left for farmers downstream. However, the poorly constructed canals required constant maintenance. Upstream farmers therefore needed the help of their downstream neighbours to keep the system going. Over the centuries, the two groups developed detailed agreements on water and labour allocations. Everyone knew what was expected of him or her. An outside aid organization subsequently decided to finance the construction of a durable canal system. Such an effort, designed to save both time and money, seemed to be a good thing. But when the agency implemented its plan, the outcome turned out to be contrary to the desired effect. A more efficient and durable canal was indeed constructed, and labour and maintenance costs were reduced. However, upstream farmers now enjoyed even greater leverage in deciding how much water to allocate to their downstream counterparts. Inevitably, the upstream farmers reduced the amount of water going downstream. The moral of the story? The well-intentioned aid policy had serious adverse repercussions because it failed to consider the local community's long-standing non-market rules and regulations. Economists, in short, are more adept at dealing with market institutions and arrangements and forecasting the consequences in terms of price fluctuations. Their scholarly perspective, however, may not always match the perspective of those living on the ground.

Your work has been a blend of social and basic science. Could you describe the 'bridging' strategy that has guided your efforts?

Human history dates back just 10,000 to 15,000 years. In an evolutionary sense, we have existed for just a blink of an eye. Commonalities among human beings, therefore, should be significant. Since we all come from a common stock, how is it we have we have moved along such different paths in such a short time? In other words, we should be asking why cultures differ rather than accepting that they are different. Philosophically, this view differs significantly from the post-modernists' view and from mainstream social research, which focuses on differences, not similarities, between people and cultures. I don't see, for example, why there should be a North-South scientific divide. After all, the tools of scientific exploration and application are neutral. Of course, we should expect a village in sub-Saharan Africa to be organized differently than a village in rural India, and for a neighbourhood in Rio de Janeiro to be organized differently than a neighbourhood in New York City. Nevertheless, because of our common origins we should be able to detect significant commonalities in social organization and behaviour among all of these places. This is one way that I have built bridges between economics, the social sciences and the 'hard' sciences. Historically, economic studies have been wedded to philosophy and the humanities. At the Univer-

sity of Cambridge, for instance, economics did not become an independent discipline until 1903. Such pioneering British economists as John Stuart Mills and Adam Smith were often regarded as moral philosophers and, because of the British Empire, that sentiment percolated in India and other members of the British Commonwealth as well. After World War II, however, economics became increasingly mathematical in its orientation, and by the time I was a student in the 1960s, mathematical reasoning dominated economics research. In a sense, this mid-20th century trend represented a rebellion against the philosopher-economist point-of-view. An entire generation of postwar economists analysed the global economy as if it were a natural system allowing their mathematical calculations and models to describe what was happening but rarely offering their own take on events. A number of us, however, believed we needed to pay critical attention to the interplay between economics and such factors as social systems and the environment. Economic paradigms, in short, were not simply to be formulated but observed. In addition, we believed that our understanding of economic principles would be enhanced, not compromised, by the integration of economics with the social and basic sciences. That is how the field of ecological economics took root within the intellectual terrain initially tilled with more conventional tools of analysis. Early practitioners in the field, however, held fast to one thing: their inquiries could not be based on philosophy. If, for example, a village depends on a natural asset such as a river, stream or pond for its economic well-being, philosophical musings won't help in understanding how these assets can be sustained. It was clear to us from the beginning that such resource issues require a rigorous analytical blending of economics, social science and basic science. As a result, efforts to distance ourselves from the economic profession's recent preoccupations with mathematics did not mean a return to its philosophical roots. In fact, it led us to a place where we could draw insights from both the social and 'hard' sciences. Perhaps the most serious bottleneck in our inquiries has been our limited understanding of the way in which fundamental scientific forces influence the natural environment in which the social system operates. I believe that what economics needs now is a closer relationship with such basic sciences as biology, chemistry and physics (as compared to the humanities) and that ecological economics as an interdisciplinary field of study will continue to grow in both size and importance. It is for these reasons, among many others, that I am honoured to have been elected a member of the Third World Academy of Sciences. ■



RENEWABLE ENERGY FOR THE DEVELOPING WORLD

MORE THAN 1.5 BILLION PEOPLE IN DEVELOPING COUNTRIES DO NOT HAVE ACCESS TO ELECTRICITY. HOW WILL THEIR ENERGY NEEDS BE MET? RENEWABLE ENERGY MAY BE PART OF THE ANSWER.

The Third World Network of Scientific Organization's (TWNSO) Workshop on Promoting Best Practices for Renewable Energy Technology Applications was held from 7-9 October 2002 in Trieste, Italy.

More than 30 participants, arriving from countries as diverse as Argentina and Zimbabwe, attended the meeting, which was sponsored by the United Nations Development Programme's Special Unit for Technical Cooperation among Developing Countries (UNDP/TCDC) and the Abdus Salam International Centre for Theoretical Physics (ICTP). The World Renewable Energy Network (WREN), headquartered in Reading, United Kingdom, served as a cooperating agency.

"More than 1.5 billion people – one fourth of the world's total population – do not have access to electricity," Francisco Simplicio, UNDP/TCDC's information manager, noted in his opening address to workshop participants. "Most of the world's electricity-deprived people live in sub-Saharan Africa and south Asia, which are also the regions with the largest number of the world's least developed countries. The relationship between a lack of electricity and a lack of development is not coincidental. If your house doesn't have electric lights, you're likely to be poor."

While national electricity grids, anchored by large centralized fossil-fuel-based power plants, have served as the conventional means of supplying electricity in the past, new strategies for decentralized electricity production, which draw on renewable sources of energy, could well represent the future of electricity production, most notably in the developing world's rural areas.

Simplicio cited several reasons for this outlook.

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First, conventional strategies for supplying electricity have been designed for densely populated urban areas where a large consumer base justifies heavy capital expenditures for the construction of the power system's infrastructure. Such systems, as a result, will probably continue to be built to serve megacities that are growing both in number and size throughout much of the developing world.

However, sparsely populated rural areas, where a significant portion of the world's 'power-less' people still live, pose energy challenges likely to be better met by decentralized electricity networks that are both faster and cheaper to build. In sub-Saharan Africa, for example, 70 percent of the population lives in rural areas and only 8 percent of them have access to electricity.

Decentralized electricity systems have become more common in the developing world.

Second, Simplicio noted that decentralized electricity systems, which rely on more benign sources of renewable energy, do not carry the same environmental liabilities associated with conventional power plant facilities – most notably, such unwanted but unavoidable by-products as air-borne particulates that cause urban air pollution and greenhouse gases, especially carbon dioxide, that are widely recognized as a major cause of global warming.

"Decentralized electricity systems based on renewable energy sources have indeed become more common in the developing world over the past few years," says Simplicio. Between 1998 and 1999, for example, China's windpower capacity increased by more than 30 percent to 300 megawatts while, by 1999, India's windpower capacity had grown to nearly 1,100 megawatts. Likewise, over the past five years in Kenya, 20,000 to 30,000 rural homes have had solar equipment installed, approximately double the 12,000 to 14,000 households that were connected to the country's electricity grid during the same period.

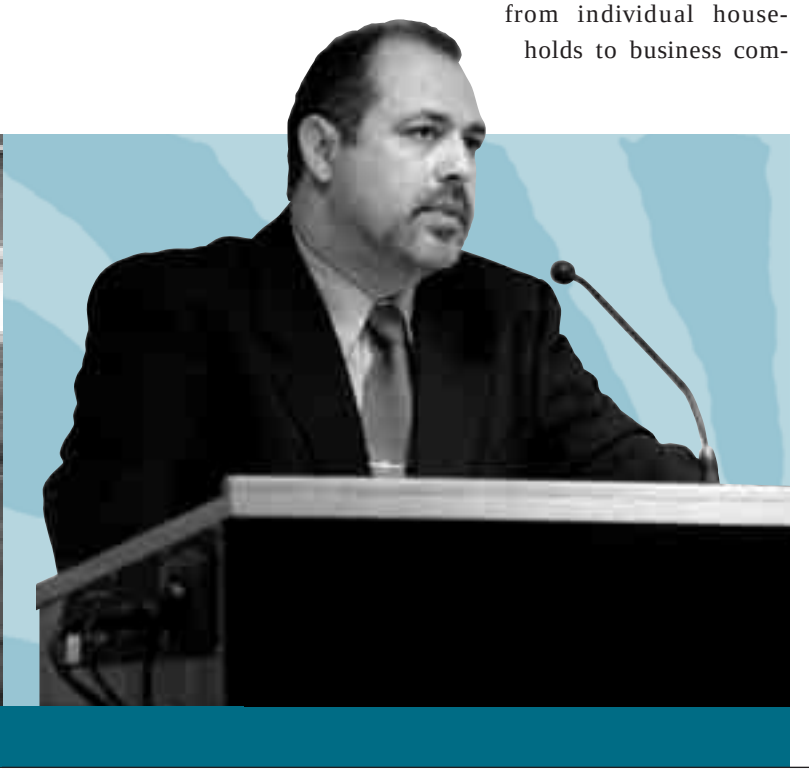
"The key to further progress in power access," Simplicio adds, "lies in South-South cooperation – not just in scientific research but also in the development and application of new technologies. That is because many of the renewable-energy technologies developed in the North may not be affordable – or, for that matter, applicable – in the South."

Renewable energy systems – whether in the North or South – do not come without their own set of risks and disadvantages. Large hydroelectric power projects, for example, require the displacement of hundreds of thousands and sometimes millions of people.

Moreover, once the dams are built, the oxygen-deprived slack water that flows downstream from the dam can cause a dramatic decline in riverbed vegetation and native fish populations. Similarly, the dams and rechanneled riverbeds impede the flow of sediment to the delta, thus sapping what is often a region's most dynamic ecosystem from the nourishment it needs to remain a vital source of biodiversity over the long term.

Meanwhile, solar panels, when placed side-by-side across large swathes of countryside in order to generate large amounts of reliable power, can leave behind a scarred landscape. And modern windmills with their futuristic propeller-like designs fail to convey the same pastoral ambiance associated with their Dutch counterparts built in the 17th century. The whishing sound of the blades makes a relentlessly eerie noise that belies the tranquility that is often associated with such a wholesome source of energy. More importantly, they can pose a serious threat to native and migratory birds.

Despite these drawbacks, the good news is that decentralized electricity systems, which rely on such renewable sources of energy as hydro- and solar-power, come in many different shapes and sizes. As a result, such systems can be adapted to meet a vast range of energy needs ranging from individual households to business complexes and mid-sized villages. Throughout much of the developing world, where energy demand remains meagre, experts estimate that units producing as little as 100 kilowatts of power would be sufficient for individual household use. Such flexibility carries enormous appeal and utility.



For these reasons, strategies to expand alternative energy supplies do not have to focus exclusively on the construction of massive dams, extensive arrays of solar panels, or large wind farms.

For example, the Vietnamese government, with the help of international donors, has developed a diverse network of mini-scale hydropower systems to provide electricity to remote rural villages and even to single households. These systems have left the environment virtually untouched (see article on page 26). Similarly, in Costa Rica, mini-scale solar power systems, some tailored to supply electricity to individual families, generate enough kilowatts for lighting, cooking, listening to the radio and watching television. Meanwhile, in India, larger solar systems are able to meet the needs of an entire village while leaving a 'light footprint' on the landscape.

It is not only the varied scale of these decentralized systems that deserves attention but also the range of uses to which they are put. In Nigeria, for example, solar systems have enabled poultry farmers to rear healthier chickens that command a higher price in the marketplace; in India, such systems have been used for crop drying and food processing, helping the nation continue its remarkable transformation from a net importer to a net exporter of food; in Saudi Arabia, they serve as an energy source for lighting road tunnels; in Burundi, for providing a power backup for community health clinics; and, in Iran, for generating sufficient hot water for public baths.

Innovative applications of renewable energy systems are not just a function of advances in technology. Success also depends on effectively addressing issues related to education, training and public appreciation and understanding. If decentralized renewable energy strategies are to deliver electricity on a sustainable basis, then recipient communities must develop the capabilities to finance, build and operate these power systems over the long term. Experience, moreover, shows that projects are more successful

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when those who use the technologies are consulted at all stages of the project's implementation – from the initial planning, to the point when the systems are up and running, to the time that maintenance and refurbishing becomes necessary.

Historically, such projects have been donor-funded and, as often happens in such cases, when the funding runs out, the project languishes. As efforts in India illustrate, a financial system based on loans and credit may prove to be more successful in the long term because clients are given a direct stake in the success – or failure – of the effort.

However, trends that draw on investment, rather than donor strategies, must recognize that regardless of the financial system put in place, the pool of potential customers for decentralized power systems in the developing world usually includes the poorest members of society. Therefore the cost of installing and, equally important, maintaining the system must be kept as low as possible. For example, solar-panel, battery-recharging centres, developed and operated by Zimbabwe's Scientific and Industrial Research and Development's (SIRDC) Energy Technology Institute (ETI) have cut the cost of solar energy use in rural households by 50 percent.

Science's greatest challenge will be to build global energy systems to replace oil.

The system works like this: Individual households purchase two sets of rechargeable batteries and then continually exchange the fully charged set for the spent one (the latter is taken to a nearby community-based solar-recharging centre).

By adopting such a 'battery and switch' strategy, users have been able to forego costly investments in solar panels. Such an effort reflects the kind of thinking that must take place if renewable energy projects in the developing world are to successfully meet the needs of their client base.

As plenary speaker Brendan McNamara, director of Leabrook Computing, United Kingdom, noted in his address to workshop participants, global assessments on future oil supplies, which have recently been issued by such diverse groups as British Petroleum, the US Geological Survey, Volkswagen and World Resources Institute, all concur that production worldwide will peak in 2010 and then decline rapidly in the subsequent decades. His address, ominously entitled the "Coming Energy Winter," concluded that "the greatest challenge yet to science and technology" is likely to lie in efforts to "build new global energy systems to replace oil."

For the most impoverished segments of the developing world, the energy winter that McNamara forecasts has been present for generations. Whereas fossil-fuel-based energy sources launched the Industrial Revolution in the North and then served as the lifeblood of economic development in the developed world from the 18th through 20th centuries (culminating with the broad adoption of electricity in the first decades of the last century), the South has always relied on renewable sources of energy – wood, biomass, the sun's energy and flowing water – for its survival. If McNamara's assessment is correct (and, while other experts may quibble with the exact times of the oil production peak and decline, virtually all agree that the scenario is inevitable and sooner than we previously thought), then the era of fossil-fuel-based energy has passed.

Renewables are likely to be among the primary energy sources of the future – not just for heating, but for the production of electricity as well. In light of these trends, the developing world faces two main questions.

First, will the South be able to develop its own indigenous sources of renewable energy and then be able to deliver that energy in ways that improve the lives of its poorest citizens who face a debilitating energy winter every day? And second, will the decentralized renewable energy systems that are created generate sufficient amounts of electricity to allow developing countries to 'leapfrog' onto an economic development 'fast-track' so that they can begin to narrow the North-South divide.

As any track athlete will tell you, it is by no means easy to devise a strategy that enables you to simultaneously compete as a sprinter and long-jumper. Yet it can be – and has been – done.

And that is, metaphorically speaking, the challenge that developing nations now face as they seek to create, as rapidly as possible, an energy environment that meets the pressing needs of their citizens while laying the groundwork for generating a sustainable supply of electricity at a level that ensures robust economic growth in the future. Success belongs to those who are both fast and agile – two attributes that define decentralized renewable energy systems at their best.

For all of these reasons, many experts have come to believe that renewable energy's time has finally arrived. Will the technologies be up to the task? Will the capital outlays be sufficient to meet the challenge? Are governments fully committed to the effort? And will citizens receive the resources and training that they will need to harness the new emerging energies?

The answer to these – and a host of other questions – will largely determine the energy future of the developing world. ■

For additional information about the TWNSO and UNDP/TCDC workshop on Promoting Best Practices for Renewable Energy Technology Applications, please contact ⇢ ***Helen Martin***
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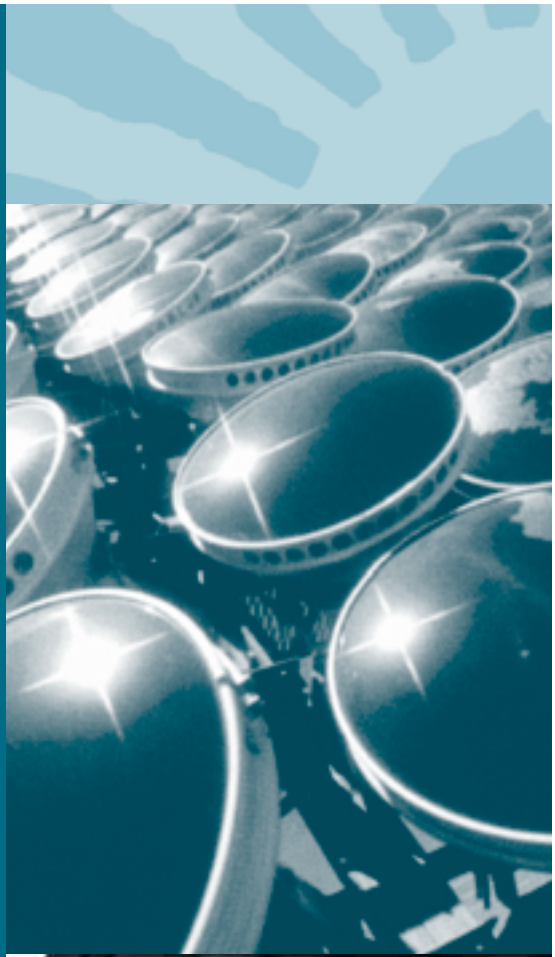

THE POWER OF WATER

RENEWABLE ENERGY IN VIETNAM

While Vietnam has made notable progress in alleviating poverty and promoting economic development over the past decade (its gross domestic product increased an average of 7 percent a year between 1996 and 2000), the country remains poor – most notably in rural areas, where nearly four out of five Vietnamese citizens continue to live.

As a result, reducing rural poverty is a high priority for the Vietnamese government. One of the major elements in the government's overall efforts to improve the economic well-being of its rural citizens – outlined in both its five- and ten-year development plans – revolves around providing rural households with access to electricity.

Today 75 percent of rural households in Vietnam have electricity, an enviable figure that has been reached largely as a result of concerted efforts by the government to electrify the country. By 2005, however, the Vietnamese government intends to extend access to electricity to 90 percent of the population. That amounts to 5 million people, equivalent to the population of Denmark.

The government's focus on electricity as a primary pathway to economic growth illustrates a full understanding of the lessons that history teaches us about the critical factors that drive development.

But it is the sources of electricity that the government intends to tap over the next few years that reveal how truly forward-looking its strategy is.

Following the same path to electric power pursued by countries as diverse as the United States and Soviet Union in the 1920s and 1930s, the Vietnamese government does indeed plan to extend the national grid. However, it will largely confine this effort to densely populated urban areas where the power infrastructure – generating plants, switching stations and high-tension lines – are already in place.

For the nation's 1100 remote rural or mountain-side communities with 3 million people (about four percent of Vietnam's population of 80 million) living in 750,000 households, the government has devised an alternative 'soft' path to electric power – one that will be both more economical and more environmentally benign than a strategy based exclusively on extending the capital-intensive national grid framed by stolid fossil-fuelled power plants and thousands of kilometres of high-tension wires laced across the landscape.

What is the Vietnamese government's alternative pathway for electrifying out-of-the way places? Renewable energy, or, more specifically, hydropower.

NEW PATH TAKEN

In 1999, the Vietnamese government launched a Renewable Energy Action Plan (REAP), supported by such international donors as the World Bank, the United Nations Development Programme, the Japan International Cooperation Agency and the Swedish International Development Agency.

As a first step, REAP organized a two-day workshop in June 1999 that was attended by more than 30 representatives of energy-related agencies and organizations in Vietnam.

Workshop participants identified the following renewable sources as having the most promise for future development:

- Mini-hydropower systems connected to the national grid.
- Mini-hydropower grids, unconnected to the national grid, that would operate independently or in tandem with diesel-powered hybrid systems.
- Household-scale micro-electric systems driven by hydro- or solar power.

Hydropower in Vietnam already accounts for more than 50 percent of the nation's total electrical capacity, which is currently 6,000 megawatts (MW), enough to meet the energy needs of 40 million people.

Today, moreover, grid-connected mini-hydropower systems generate about 60 MW of power. This electricity is derived from 48 separate systems with capacities ranging from 100 to more than 7,500 kilowatts.

Such systems have been financed by the government either directly or through international aid. While the systems have functioned well (only six of the 48 are currently nonoperational), their capacities could be increased significantly by upgrading their design. Indeed researchers estimate that hydropower-generated electricity, connected directly to the grid, could rise 8- to 10-fold reaching 400 to 600 MW under optimal conditions.

In addition to grid-connected hybrid systems, more than 300 independent hydro-grids have been installed. The collective capacity of these independent grids, each of which supplies between 5 and 200 kilowatts, totals about 70 MW.

These grids, however, have proven to be unreliable and, today, only about 100 of the 300 remain in operation. Breakdowns and abandonment have reduced their total output to just 20 MW. Recent studies, nevertheless, have concluded that commercially operated hydropower grids are far less likely to fail than community-operated grids and that reliable systems could generate between 300 and 600 MW of power.

Household-scale micro-hydropower systems, the third small-scale hydropower system currently in use in Vietnam, have proven particularly important in isolated rural communities that are located far from the national grid but close to suitable water resources. In fact, Vietnam has one of the world's largest markets for these systems and between 100,000 and 150,000 micro-hydropower generation kits have been sold.

Each micro-system provides between 100 and 1,000 watts to a single household or, in larger systems, to a small compact group of households or businesses with modest electricity demands. Since the late 1990s, 40,000 systems have been sold each year. However, only half of these have been bought by new users. The rest have been purchased by existing users to replace old, worn-out units. Indeed, poor-quality systems account for about 90 percent of sales.

Such inferior systems keep selling for one basic reason: They are cheap. Each unit, in fact, costs between US$15 and US$50 and installation adds US$50 to $100 to the overall price. That means all but the most impoverished residents can afford to purchase such a system, which provides enough electricity to turn on lights, radios, televisions and fans.

Micro-hydropower systems presently supply power to about 100,000 households. Together, these systems generate a total of 30 to 75 MW. Experts estimate, however, that such systems could meet the needs of 200,000 or more households and, in total, supply between 90 and 150 MW.

Micro-hydropower systems, however, carry limitations. Low quality translates into high maintenance costs. Indeed the system's annual costs of operation often exceed the unit's initial price. These systems, moreover, only supply electricity to house-

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holds and businesses that are located within 1000 metres of a running water source. In addition, irregular voltage due to variations in water flow can damage electrical appliances. The most disturbing consideration of all is that users often risk electrocution as a result of poor safety standards.

POWER'S PALS

To counter these drawbacks, engineers at the Vietnam National Center for Natural Sciences and Technology's (NCST) Institute of Materials Science (IMS) have designed three new types of micro-hydro PowerPal systems: MHG-200, MHG-500 and MHG-1000, each of which relies on new-generation rare-earth permanent magnets to produce electricity. PowerPals, which are efficient and productive, have the additional benefit of being relatively cheap to manufacture. Indeed they cost about the same as some lower-quality imports.

NCST/IMS scientists have also designed two models for each of the three PowerPal systems suited for different levels of water flow. The "sit-down" micro-hydropower system can operate in environments with 6 to 10 metres of headwater and a flow of 7 liters per second. "Stand-up" systems, meanwhile, are suited to operate at lower headwaters (just 1.5 metres). As the name suggests, MHG-200, MHG-500 and MHG-1000 produce 200, 500 and 1,000 watts of power, respectively.

Among the advantages built into the PowerPals is a new type of bearing made from composite materials. Because the bearings are lubricated by water, they do not need to be greased, making them virtually maintenance-free. The PowerPal units also use a low-cost induction generator controller, which accommodates a wide variety of power loads, thus protecting the electrical appliances that are being run off the system and reducing the risk of electrocution.

To date, PowerPal units have been tested in more than 20 countries and, more significantly, are commercially available in Nepal, New Zealand, Papua New Guinea, Peru and the Philippines, testimony to the fact micro-hydropower can be an effective, non-polluting energy source – at least in areas with year-round supplies of running water.

APPLICABILITY

About two billion people worldwide – one-third of the global population – do not have access to modern forms of energy. In these households, energy required for heating, cooking and lighting comes from such traditional sources as burning wood, dung or agricultural waste. Such sources of energy compel people to engage in time-consuming, often back-breaking work, to manually collect and process their fuel. That, in turn, leaves little time for the income-generating activities that are necessary for development to proceed, let alone the leisurely pursuits that make life enjoyable.

Cheap, simple and reliable sources of electricity suitable to local conditions are critical – in fact, irreplaceable – prerequisites for economic development in the developing world. Efforts that utilize a nation's previously untapped renewable energy sources hold the key to progress throughout the South. Vietnam's current experience in the development of its indigenous hydropower resources is just one case in point. ■

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This article is based on a full-length case study report published in Promoting Best Practices for Renewable Energy Technology Applications. *A copy of the monograph can be obtained from the TWNSO secretariat, email: info@twnso.org.*

OUT OF AFRICA: TWOWS' FIRST GRADUATE

HELPING YOUNG WOMEN SCIENTISTS IN THE SOUTH FULFIL THEIR POTENTIAL IS THE GOAL OF THE THIRD WORLD ORGANIZATION OF WOMEN SCIENTISTS' FELLOWSHIP PROGRAMME.

The Trieste-based Third World Organization for Women in Science (TWOWS), which was launched in 1993 under the auspices of the Third World Academy of Sciences (TWAS), has two basic mandates: To foster cooperation among eminent women scientists from the South and to help young women who have displayed scientific potential to advance their careers.

The TWOWS young women scientists fellowship programme is a prime example of the organization's work. Funded by the Swedish International Development Cooperation Agency (Sida-SAREC), the programme enables promising female students from sub-Saharan African nations and other Least Developed Countries (LDCs) to apply for grants to support postgraduate training leading to a PhD.

The programme works like this. Young women (typically below the age of 40), who have a master of science degree (or, in exceptional circumstances, a bachelor of science degree), are eligible for a TWOWS Fellowship. Students enrol at an academic institution in their own country. However, they spend a portion of their time – usually one or two years of their four-year course of study – conducting research at a recognized centre of excellence in the South, which is often, but not always, located in another country. Fellowship funds cover the cost of travel to and from the host institution as well as accommodation and living expenses. The host institution, in turn, is expected to provide free tuition, training, and laboratory supplies.

To date, TWOWS has awarded post-graduate fellowships to over 150 young women scientists from 37 countries.

What follows is the story of Aderoju Osowole from Nigeria, the first young woman scientist to graduate from the scheme.

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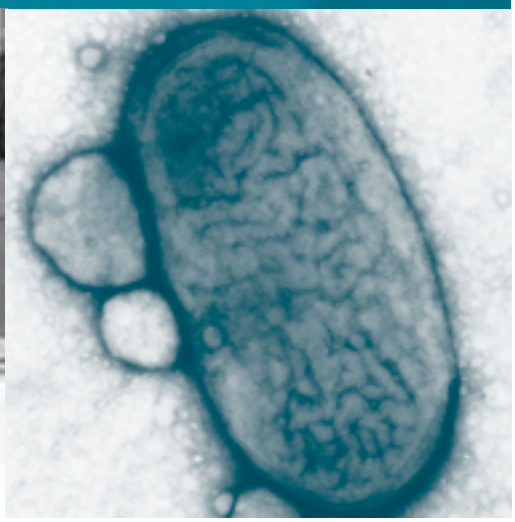


Despite the inhospitable learning environment she faced, Aderoju Osowole became hooked on science at an early age.

Aderoju grew up in Ibadan in southwest Nigeria, a sprawling city of over three million people, that she nevertheless describes as "a beautiful and peaceful place filled with many points of interest – both natural and cultural." These include Mapo Hill, which overlooks the entire city and was the site of government in the colonial era, the University of Ibadan, Nigeria's first university founded in 1948, and the Nigeria Television Authority, the first television station in Africa that began to air programmes in 1959.

During the first year of her secondary school education, Aderoju was introduced to such classic scientific demonstrations as the 'popping' sound created when a lighted splint is inserted into a test tube containing hydrogen, and the decolouration of green plants left to grow in the dark. "These observations," says Aderoju, "challenged my mind as a young girl and convinced me that I should study science."

After leaving high school, Aderoju went on to study chemistry at the University of Ibadan, gaining her bachelor's degree in 1990 and master's in 1993.

These milestones were followed by her enrolment, in 1997, in the university's PhD programme to study, as the title of her dissertation opaquely describes, the "synthesis, physicochemical and biological properties of cobalt, nickel and copper complexes of various substituted beta-ketoamines and their adducts."

In simpler terms, Aderoju began to investigate the characteristics of molecules containing both organic and inorganic components and, more specifically, how these molecules could be developed for use in such bio-industrial processes as the inhibition of corrosion caused by sulphate-reducing bacteria. Several of the compounds also showed potential antibiotic activity against such food-poisoning bacteria as *Staphylococcus aureus* and *Escherichia coli*.

During the early stages of this research, Aderoju realized that she would not be able to complete her work at Ibadan because equipment critical for her research – for example, a spectrometer to measure the mass and relative concentrations of atoms and molecules – was not available. A senior instructor, Gabriel A. Kolawole, who has since moved on to the Department of Chemistry, University of Zululand, Republic of South Africa, suggested that she might be able to overcome this obstacle by applying to the Third World Organization of Women in Science (TWOWS) fellowship programme for assistance.

Aderoju submitted her application in 1998 and she received notification of her acceptance to the programme later that same year. TWOWS fellowship funds enabled her to travel to the Indian Institute of Science's Department of Inorganic and Physical Chemistry in Bangalore, India – a recognized centre of excellence in her line of research. Aderoju spent one year of her four-year research programme in India.

"At Bangalore, I was able to carry out the micro-

analysis and infrared and mass spectroscopy analyses that I needed to complete my PhD research," explains Aderoju. "Together, mass spectroscopy and the microanalysis of carbon, hydrogen and nitrogen enabled me to determine the correct proportions of these elements in my chemical reactions and their products. Moreover, by analysing the infrared spectra, which was again made possible by the equipment in Bangalore, I could decipher whether the metal atoms I was interested in were linked to the organic molecules via carbon-oxygen bonds or carbon-nitrogen bonds, which is essential for predicting the behaviour of the compounds."

While at the Indian Institute of Science, Aderoju also enjoyed access to libraries stocked with up-to-date journals and equipped with state-of-the-art information search and retrieval systems – critical intellectual resources for every research project.

In July 2002, Aderoju was awarded her PhD, becoming the first scientist to graduate from the TWOWS fellowship programme.

Under the supervision of Varadachari Krishnan (TWAS Fellow 1996), whose research has focused on the biochemistry of cellular processes, Aderoju was also able to use the facilities and expertise available at Bangalore to venture into a new research area. She began to study porphyrins – organic compounds that, in the plant kingdom, combine with such metals as magnesium to produce chlorophyll, the molecule responsible for trapping light energy and converting it into chemical energy. In the animal kingdom, porphyrins combine with iron, to produce haem – as in the blood protein, haemoglobin, which absorbs oxygen in our lungs and transports and releases this essential constituent of life to our body's cells. Porphyrins, in brief, act as electron transport agents within cells and, for this reason, could have great potential as nano-components in such electronic devices as computer hardware and mobile telephones.

Aderoju obviously used her time in India well and, on returning to Nigeria, was able to complete her thesis. In July 2002, Aderoju was awarded her doctorate degree, becoming the first scientist to graduate from the TWOWS fellowship programme.

She is now back in Nigeria where both graduate and postgraduate students attend her lectures and benefit from the time she spent in India. She is also continuing her research on the chemistry of biologically active molecules that could find uses as catalysts and antimicrobial agents. In particular, Aderoju has identified a cobalt compound that, at optimal concentrations, kills 100 percent of *Streptococcus pyogenes* bacteria, the causal agent of tonsillitis, within an hour.

She admits that the lack of facilities in Nigeria impedes her progress. Her positive experience with the TWOWS fellowship, however, has given her the confidence to seek another fellowship that would allow her to go abroad to further characterize the complex organo-metal compounds she is interested in and to continue to explore their potential industrial applications.

A recent World Bank study covering 192 countries shows that human and social capital is responsible, on average, for about two-thirds of a nation's gross domestic product. If women are unable to fulfil their academic promise, one-half of a nation's human resource potential is compromised. In today's world, such a loss carries serious consequences for a nation's social and economic well-being.

In many developing countries (and developed countries as well), science jobs, especially at higher levels, tend to be male-dominated. In southern Africa, for example, women account for about 25 percent of science students, 10 percent of university teachers, and less than 1 percent of the total number of tenured science professors. This makes Aderoju – and other

[CONTINUED PAGE 32]

women like her (see box below) – true pioneers in their fields.

Aderoju readily admits that she sees herself as a role-model for other young women. "Female scientists," she says, "must excel beyond the artificially imposed limits set for them by society, which often still believes that women cannot attain the same level of achievement as their male counterparts. I attribute my own success to my strong determination, hard work and perseverance." Aderoju is now using her experience and knowledge to help other young women students at the University of Ibadan and elsewhere by giving them moral support and imparting skills and ideas through collaborative research.

With the help of TWOWS fellowships, talented and dedicated women scientists, despite their small numbers, are slowly helping to build the scientific capacities of their countries – and, in the process, boosting their own career prospects and helping to advance the economic and social well-being of their nations too. ■

FROM THE SLOPES OF KILIMANJARO

Margaret Samiji's talent for mathematics was recognized at an early age. At one point during her primary school education – in a small town in the Kilimanjaro region of Tanzania – she was taken to the next grade and given five maths questions to solve. She got four of them right.

Although her ability created some friction with the girls in her class, who told her not to try and compete with the boys, her proud mother offered encouragement: "They say science subjects are only for men, but you are good in mathematics. So take the challenge and go for it."

And "go for it" she did, obtaining both bachelor's and master's degrees from the University of Dar es Salaam. It was during her master's studies that she learned about the TWOWS Postgraduate Fellowship programme, to which she applied in 1998.

The successful application enabled Margaret to carry out part of her studies on the semiconducting properties of silicon carbide in the physics department at the University of Port Elizabeth in South Africa.

"I managed to finish my PhD studies in three years, which would have been impossible in Tanzania," says Margaret. "The physics department at the University of Port Elizabeth has well-equipped laboratories, trained technicians and a reliable electricity supply." She was also helped by having access to powerful computers and by being able to partake in regular, vibrant discussions about her work.

Margaret graduated in April 2003, becoming one of Tanzania's first women to obtain a PhD in physics – possibly even the first.

She has now returned to her native Tanzania where she hopes to encourage more young, female students to take science subjects. Margaret has also applied for additional funding to continue her research at the University of Dar es Salaam as well as collaborative projects with her South African colleagues.

MAKING SCIENCE COUNT

LAST OCTOBER, THE GROUP OF 77 HELD ITS FIRST-EVER 'HIGH LEVEL CONFERENCE ON SCIENCE AND TECHNOLOGY' IN DUBAI, BRINGING TOGETHER SCIENTISTS AND POLICY MAKERS TO DISCUSS THE FUTURE OF SCIENCE-BASED DEVELOPMENT IN THE SOUTH.

The Group of 77 (G-77), established in 1964, now comprises 134 nations. It is the world's largest coalition of developing countries.

Its first-ever High-Level Conference on Science and Technology, held in Dubai, United Arab Emirates, from 27 to 30 October 2002, was attended by some 400 ministers and ministerial staff from member states and more than 150 scientists from developing countries. TWAS played central roles, both in helping to select the scientists who participated in the conference, and in framing the conference's scientific agenda, which focused on issues related to information and communication technologies, biotechnology, and the development of science-based strategies for improving access to safe drinking water.

Among the outcomes of the conference was the unanimous adoption of a Declaration on the Promotion of Science and Technology in the South, known as the 'Dubai Declaration,' which calls on member states of the G-77 to tap the wellspring of scientific expertise that exists in the South to address issues of vital concern to the citizens of the developing world.

The declaration also calls for the creation of a trust fund for the promotion of knowledge and technology in the South and the establishment of a knowledge and technology consortium consisting of representatives of government, nongovernmental organizations and the private sector. Venezuela's Ambassador to the United Nations, Milos Alcalay, who serves as chairman of the G-77 in New York, called the declaration "a turning point in the strengthening of South-South cooperation in science and technology."

Apart from its official outcomes, the conference allowed the voice of many scientists and ministers from developing countries to be heard at a major international forum. Among those invited to attend, for example, was Abdul Bari Rashed, president of Afghanistan's newly re-established Academy of Sciences. Rashed was also asked to participate in TWAS's 8th General Conference and 13th General Meeting held in New Delhi the week before the G-77 event. In the following article, Rashed describes the current state of science in the country following two decades of war and chaos.

[CONTINUED PAGE 34]

RESEEDING SCIENCE IN AFGHANISTAN

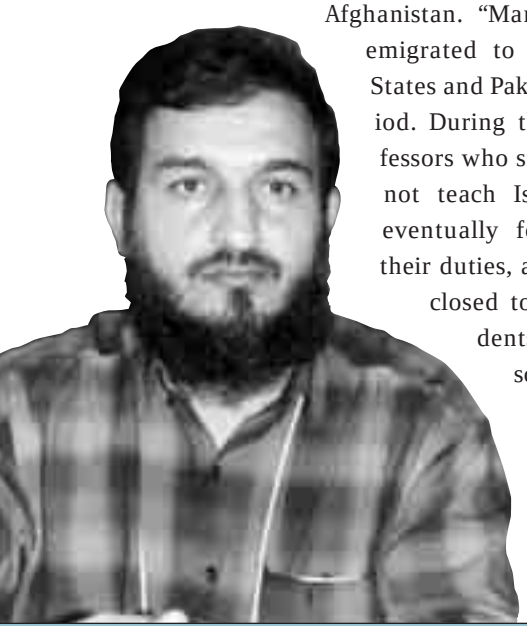
From the time of the Soviet invasion in December 1979 to the ousting of the Taliban government in November 2001, it seemed that time stood still in Afghanistan – or, even worse, ran backwards. An Afghanistan wracked by continual war and straightjacketed by religious fundamentalism found itself devoid of hope.

In 1999, the UN and the World Health Organization reported that the country had the world's highest child mortality rate – a quarter of all children failed to reach their fifth birthday. Between 1979 and 1999, the area of productive agricultural land fell by more than 30 percent and crop yields declined by 50 percent.

Environmental problems abounded too, including soil erosion and salination, polluted water supplies, deforestation and desertification, which was not helped by the worst drought in nearly half a century. These problems, and others, were exacerbated by the Taliban's systematic dismantling of the country's scientific infrastructure.

When the Taliban fell, Afghanistan, including its scientific community, had to start again – virtually from scratch.

"Everything was destroyed during the decades of war Afghanistan experienced," says Abdul Bari Rashed, president of the Academy of Sciences of Afghanistan. "Many Afghan scientists emigrated to Europe, the United States and Pakistan during this period. During the Taliban era, professors who stayed behind but did not teach Islamic studies were eventually forced to relinquish their duties, and universities were closed to women. Some students continued to study science, but the quality of their education was poor."



An engineer by training, Rashed served as vice president of the Academy of Sciences of Afghanistan until 1996, when he left the country following the ascendancy of the Taliban. He remained in exile for six years, returning home in early 2002.

"The Academy of Sciences of Afghanistan is 70 years old," explains Rashed. "It has about 180 members who belong to one of three divisions – humanities, natural sciences and Islamic studies."

Although, like many of the world's most respected science academies, members are accepted on merit, the qualification process for the Afghan academy is somewhat unusual. Prospective members must take a written examination and present documentation, including a resume and samples of their work, which is evaluated by professors and academics who are already members of the academy. They must also pass a proficiency examination in one of the official languages of the United Nations.

> ***The Afghan scientific community can bounce back, but only if peace and security are maintained.***

Despite the severe hardship Afghanistan has faced, Rashed believes that, with help from outside sources, the Afghan scientific community can bounce back, but only if peace and security are maintained. "We have a number of institutes in Kabul, including the Kabul Polytechnic Institute and the University of Kabul, that have a core faculty in place," he says. "The University of Kabul has close to 200 faculty staff on its official employment rosters, and the University of Balkh in the north of the country and the University of Herat in the west each have about 100.

"However, our research institutions and university departments need funds to re-build their classrooms and re-equip their laboratories," says Rashed, "That money has to come from outside sources. The faculty, moreover, needs opportunities to interact with colleagues from other countries. That is why we are so eager to cooperate with Trieste's international scientific institutions, including TWAS, the Third World Network of Scientific Organizations (TWNSO) and the InterAcademy Panel (IAP).

"During the reign of the less rigid fundamentalist Islamic government that preceded the Taliban, the situation for academy scientists and, more generally, Afghanistan's scientific community, was relatively

good. There were opportunities for exchange visits and fellowships with the Soviet Union, for example, and the academy continued to organize seminars, conferences and publications.

"But soon after the Taliban came to power in the mid 1990s," Rashed continues, "scientific exchanges were halted. Today the Academy estimates that there is a backlog of 400 scientific papers secretly prepared but never published. We now hope that the fruits of our labour will see the light of day and that we can rejoin the global scientific community as full and productive members."

More than a year has passed since the fall of the Taliban regime. While major fighting has ceased, efforts to rebuild Afghanistan remain handicapped by inadequate funding, ongoing security concerns, and the fragility and weakness of the nation's institutions.

Before the Soviet invasion, Afghanistan was self-sufficient in food production. An aim of the international community is to get the country's farmers back to this level of production by 2007.

One of the major problems in this regard is the lack of seeds. Three years of severe drought have meant that farmers' limited seed stocks have not been replenished. The nation's seed bank – a repository of varieties adapted to local conditions – has also been destroyed, not once but twice. First during the civil war in 1992 and, more recently, when some scientists, on their own, tried to collect important varieties and store them in their basements. Their good intentions came to naught when the plastic containers were looted with all the seeds left mixed on the floor.

Fortunately, during the 1970s, seeds of many Afghan varieties had been sent to international seed banks for safekeeping. Now, organizations such as the International Centre for Research in Dry Areas (ICARDA) in Syria and other members of the Future Harvest Consortium to Rebuild Agriculture in Afghanistan, all members of the Consultative Group on International Agricultural Research (CGIAR), are sending these seed stocks back to Afghanistan, along with other varieties that could prove useful. To ensure that these repatriated seeds are of the best quality and remain healthy while being multiplied, strict scientific protocols are being followed. Science is also playing a lead role in assessing which varieties are best adapted to the country's different agro-climatic zones.

Much work still needs to be done to rebuild Afghanistan. Indeed the United Nations Food and Agricultural Organization (FAO) estimates that an additional US$25 million is needed – and needed quickly – for the agricultural rehabilitation project to continue; otherwise, the projected plans will have to be scaled back by 70 percent.

Thanks in part to the efforts of scientists – from international agencies, foreign universities, the Afghan Academy of Sciences, and the nation's own universities and polytechnic institutes – Afghanistan has taken the first halting steps to re-build its scientific community and eventually to re-enter the international scientific arena as an active participant. ■

WORDS...DEEDS ...ACTION?

MOHAMED HASSAN REFLECTS ON WHAT THE WORLD SUMMIT ON SUSTAINABLE DEVELOPMENT (WSSD) IN JOHANNESBURG DID – AND WHAT IT DID NOT DO.

The World Summit on Sustainable Development (WSSD) generated two broad reactions.

The first – and perhaps most prevalent – reaction was that the summit failed to deliver a substantive plan of action and therefore was nothing more than a global 'gabfest' in which groups of people already familiar with each others' points of views simply heard more of the same.

The second reaction was only slightly more optimistic: Not much was expected of the summit in the first place. Yet, while the event may not have delivered much, it did help to focus attention on critical global issues and, at the same time, perhaps lay the groundwork for productive endeavours in the future through so-called 'type II' partnerships that were forged between various nongovernmental entities. More than 300 such partnership agreements were signed.

What do these diverse opinions mean, if anything, for the developing world? And what, specifically, can science-based institutions like the Third World Academy of Sciences (TWAS), which has pushed for science-based development in the developing world for the past two decades, hope to carry forward from the event that might make their efforts more effective in the future?

SCIENCE PROMINENT

Thanks largely to the activities associated with the science forum, held during the first week of the summit, science gained a much higher profile at WSSD than at any of the previous UN global mega-gatherings, including the Rio de Janeiro Earth Summit, that took place a decade before.

Here's a small sample of some of the science-based discussions and actions that occurred:

• At a session of the science forum organized by TWAS and the International Council for Science (ICSU), in cooperation with the International Foundation for Science (IFS) and Leadership for Environment and Development International (LEAD), participant after participant emphasized the need to build scientific and technical capacity, especially in the developing world. The facts speak for themselves: 80 percent of the world's population lives in the developing world, but the developing world produces only 10 percent of the world's scientific publications and only 2 percent of its patents. Indeed scientific and technical capacity-build-

ing emerged as one of the major themes of the summit – a cornerstone of the discussions at each of the venues and a centrepiece of the type II partnerships that were signed.

• African ministers of science and technology met to discuss strategies for boosting the role of science and technology in efforts to advance sustainable development throughout the continent. Discussions focused on the need for greater sustained investments in education at all levels to ensure a scientifically literate public and the importance of building centres of scientific excellence to serve as focal points of South-South and South-North cooperation.

• Representatives of the world's national science academies spoke about the need to increase the educational and policy advisory roles of science academies both among citizens and public officials. National science academies are repositories of a great deal of scientific knowledge; yet that knowledge has too often been ignored when addressing critical societal needs.

• David King, the science advisor to the United Kingdom's Prime Minister, Tony Blair, emphasized the need to build centres of excellence in the developing world through South-North partnerships. He also emphasized the valuable role that unbiased scientific information plays in nations like his own and he urged other nations to take greater advantage of their own scientific expertise.

Scientific and technical capacity building emerged as one of the major themes of the summit.

• The UN Food and Agriculture Organization (FAO) and Consultative Group on International Agricultural Research (CGIAR) announced an effort to launch the Global Conservation Trust to protect and expand the world's gene banks as a fundamental prerequisite to halt the worldwide loss of biodiversity. The trust will seek a funding base of US$260 million.

PROBLEMS

While science may have gained a higher profile at the WSSD, the dialogue between the scientific community and others – most notably, government delegates and grassroots activists – remained largely muted. The summit took place at three major venues which were too dispersed – both in geography and disposition – to generate much interaction. The result was that government delegates tended to speak with government delegates, scientists with scientists, and activists with activists.

[CONTINUED PAGE 38]

Despite the summit's channelled conversations, all taking place, in a sense, at different frequencies, the summit's rhetorical emphasis on 'turning words into action' was welcomed. The developing world has the most to gain from devising effective programmes to address the critical issues that it faces. This is particularly true in confronting the set of issues – water, energy, health, agriculture and biodiversity – that UN Secretary General Kofi Annan has highlighted as among the most crucial facing the global community.

Yet, there are doubts about how much progress can be made in addressing these and other concerns when so much of the responsibility for progress is placed on the shoulders of small institutions with meagre resources. And that, in effect, was where the emphasis was placed at the summit. The question is this: Can we, in effect, generate macrochanges in microsteps?

It is for this reason that the governments' unwillingness to act beyond their critical national concerns proved to be such a major shortcoming at the summit. The United States received the most hostile reception for its emphasis on vague, target-less objectives – 'a vacuous triumph of rhetoric over substance' is how many critics viewed the US performance. But many other countries, both from the North and South, also displayed an unwillingness to think broadly when proposed concrete objectives in resource and energy conservation and use conflicted with their national agendas for development.

Scientists must continue to lobby their governments to support scientific research.

NEXT STEPS

The Rio Earth Summit may have erred in reaching too far; the WSSD may have erred in not reaching far enough. That is why I suggest the following 'next steps' for integrating long-range sustainability goals with strategies for addressing the more immediate environmental, economic and social problems that the developing world faces.

It would indeed be reprehensible to continue to follow the failed policies of the past; yet we would be equally misguided to ignore efforts that have made a positive difference in the past in the name of trying something different in the future.

• Scientists, especially in the developing world, must continue to lobby their governments to support scientific research. Such lobbying must be done on a systematic and consistent basis and must periodically be evaluated to assess its effectiveness. That is why the Nigerian government's decision to create a science advisory council may prove to be such an important step forward, and that is why the InterAcademy Panel's (IAP) efforts to build the capacity of science academies, especially enhancing their ability for dealing with public officials and the public at large, may help lay the foundation for more effective science-based policies in the future.

• The South – and North – must continue to support the work of the United Nations Development Programme's (UNDP) Special Unit for Technical Cooperation among Developing Countries (UNDP/ TCDC), the Third World Network of Scientific Organizations (TWNSO), and other like-minded institutions that have highlighted and analysed examples of successful applications of science and technology in addressing critical economic, environmental and social concerns in the developing world. For too long, science in the South has been labeled inferior science. Yet, a good deal of excellent science has taken place in the developing world, often science of direct relevance to the concerns of the region in which it was done.

• The North must continue to emphasize the building of centres of excellence in the South in a broad range of fields in basic and applied sciences. That is why the Millennium Science Initiative (MSI), now housed at the Princeton Institute of Advanced Studies within the Science Institutes Group (SIG), may prove to be such a valuable programme. SIG's efforts in South America have helped to bolster the level of scientific research at several research institutes and universities. The South also welcomes the preliminary efforts of the Royal Institute of International Affairs to help develop centres of excellence in Africa dedicated to science and technology for sustainable development.

• More generally, the North must devise scientific research programmes that combine scientific investigations of critical global issues with training compo-

nents that enable developing world scientists to eventually participate in these programmes as full and equal partners. That is why the long-named but carefully-organized Assessments of Impacts and Adaptation to Climate Change in Multiple Regions and Sectors (AIACC) project, funded by the Global Environment Facility (GEF) and operated jointly by the Global Change System for Analysis Research and Training (START) programme and TWAS, is poised to make an important contribution to capacity building efforts in the developing world. By melding research and training on such a critical issue as climate change, it is laying the groundwork for providing a new generation of scientists from developing countries with the educational background and skills that they need to pursue world-class research of importance both to their own countries and the world. And that is why the European Union's most recent framework for research, which sets aside some €600 million for cooperative research projects with scientific institutions outside the European Union, may help boost the general level of scientific excellence in the South (see article on page 5).

DEPENDENT VARIABLE

All of this suggests that the WSSD did not alter the prevailing perceptions of what needs to be done to ensure progress on science-based sustainable development in the developing world.

There were, in fact, no paradigm shifts in Johannesburg. Indeed the developing world did not need 10 more days of discussion to devise a strategy. It knows what needs to be done: elicit greater support for science and technology from their governments; generate greater global recognition and understanding of science-based initiatives in the South that have achieved some success; encourage greater investment from the North in training individual scientists and promoting centres of excellence in the South to ensure a broader and deeper base of world-class scientific expertise in the developing world; and generate greater concern among all parties for the South to devise and oversee its own science and technology enterprise as the single most important factor for long-term success.

Ultimately, WSSD's emphasis on both poverty and sustainability, which was widely criticized as politicizing the summit, may have proven to be its greatest asset and, more importantly, its most likely long-term contribution to efforts to build a more equitable world.

The reason is this: Science remains a dependent variable in all sustainability efforts. Its dependence is derived from two critical factors. First, for science to prosper in the South, the developing world must become a more hospitable place for scientists to live and work. Second, for science to find a lasting place in the policy arena among developing countries, the research agenda must be devised as a fully cooperative enterprise between the scientific community and the larger public.

For the sake of both science and society throughout the developing world, science itself must become more integrated in the political and economic environment in which it operates. That, to its credit, was one of the major themes embedded in all of the discussions that took place in Johannesburg and that's the word from Johannesburg that should be carried forth in the months and years ahead. ■

Mohamed H.A. Hassan
Executive Director
Third World Academy of Sciences (TWAS)
Trieste, Italy

THE ACADEMY'S NEWEST MEMBERS

IN 2002, 43 FELLOWS WERE ELECTED MEMBERS OF THE THIRD WORLD ACADEMY OF SCIENCES. TWAS'S NEWEST MEMBERS ARE:

AGRICULTURAL SCIENCES

- **SIQUEIRA Jose Oswaldo**, Brazil

BIOLOGY

- **ABDUL-SALAM, Jasem M.**, Kuwait
- **AZAD, Ahmed Abdullah**, South Africa
- **NAIR, Narayanan Balakrishnan**, India
- **GUZMAN, Maria**, Cuba
- **PANG, Tikki**, Indonesia
- **RAO, M. R. Satyanarayana**, India
- **SINGH, Jamuna Sharan**, India
- **TSETSEG, Baljinova**, Mongolia

BIOCHEMISTRY AND BIOPHYSICS

- **COLLI, Walter**, Brazil
- **DATTA, Kasturi**, India
- **DESIRAJU, Gautam R**, India
- **GEVERS, Wieland**, South Africa
- **SHAH, Farida Habib**, Malaysia
- **TOMA, Henrique**, Brazil

CHEMISTRY

- **CHOUDHARY, Muhammad Iqbal**, Pakistan
- **CURIEN, Hubert**, France
- **GALVELE, Jose Rololfo**, Argentina
- **RANGANATHAN, Srinivasa**, India

ENGINEERING SCIENCES AND TECHNOLOGIES

- **GUO, Lei**, China
- **IUSEM, Alfredo Noel**, Brazil

EARTH SCIENCES

- **JAN, M. Qasim**, Pakistan
- **KAMPUNZU, Ali Basira Henri**, Congo
- **PETTERS, Sunday**, Nigeria
- **ROSSWALL, Thomas**, Sweden
- **SALIH, Abdin M.A.**, Sudan
- **XU, Shaoxie**, China

MATHEMATICS

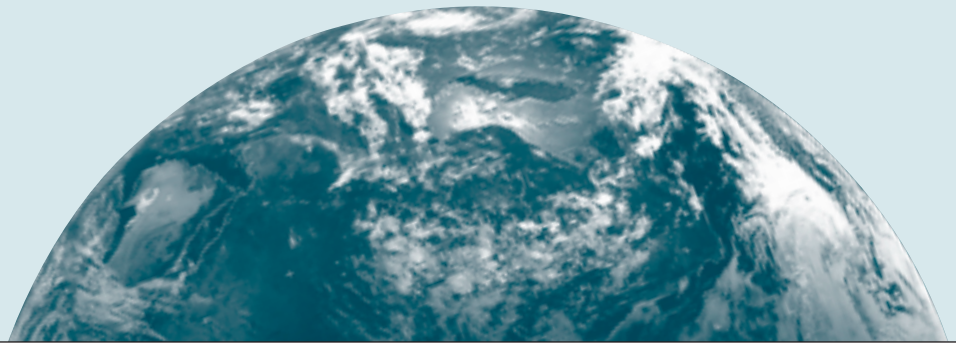
- **BEVILACQUA, Luiz**, Brazil
- **CORDARO, Paulo Domingos**, Brazil
- **GONZAGA, Clovis Caesar**, Brazil
- **MARCHESIN, Dan**, Brazil

MEDICAL SCIENCES

- **CAVALHEIRO, Esper Abrao**, Brazil
- **CHI, Je**, Korea
- **EL HASSAN, Ahmed Mohamed**, Sudan

PHYSICS AND ASTRONOMY

- **AL, Guoxiang**, China
- **ARAGAO DE CARVALHO, Carlos Alberto**, Brazil
- **DAVIDOVICH, Luiz**, Brazil
- **MANOHARAN, Periakaruppan**, India
- **MARISCOTTI, Mario A.J.**, Argentina
- **OGALLO, Laban**, Kenia
- **SINHA, Bikas**, India
- **SOMAYAJULU, Bhamidipati**, India
- **XIAN, Dingchang**, China



Additional information about the new members, including a brief description of the scientific achievements that led to their election, may be found on the TWAS website at www.twas.org by clicking on the 'Membership' link.

DEL PINO VEINTIMILLA HONOURED

• **Eugenia Maria del Pino Veintimilla** (TWAS Fellow 1989) has been awarded the Sheth Distinguished International Alumni Award, which recognizes Emory University (USA) alumni who have achieved international recognition. In 1972, after receiving her doctorate degree from Emory University's department of biology, del Pino returned to the Pontifical Catholic University in Quito, Ecuador, where she now heads a research programme in developmental biology. Her research on the physiology of the marsupial tree frog, unique to Ecuador, has made significant contributions to the broad field of vertebrate development. For more than 30 years, she has collaborated closely with the Charles Darwin Foundation, which is dedicated to the conservation of the Galapagos Islands ecosystem. Among the many awards and honours del Pino has received are a 1984-1985 fellowship from the Alexander von Humboldt Foundation to conduct research at the Cancer Research Centre in Heidelberg, Germany; election to the Latin American Academy of Sciences; and election to TWAS. In 2000 del Pino also received the prestigious L'Oreal-UNESCO Award for Women in Science. For an in-depth discussion of del Pino's works, see *TWAS Newsletter* 12 (January-March 2000), pp. 6-11.

Eugenia Maria del Pino Veintimilla

LIU RECEIVES TYLER PRIZE

• **Tungsheng Liu** (TWAS Fellow 1991) has been awarded the 2002 Tyler Prize. Liu, who is a professor in the Chinese Academy of Science's Institute of Geology and Geophysics, is an internationally recognized climatologist who has developed innovative ways to measure paleoclimatic change over the past 2.5 million years. His breakthrough techniques have focused on the windblown dust that forms thick deposits over much of central China. Liu's efforts have proved particularly instrumental in increasing our understanding of southeast Asia's monsoon system. He is also widely recognized for his discovery of Keshan's disease, an ailment that affects thousands of people. He and his group linked the symptoms to trace elements in local soils and water, particularly selenium. Liu, who is sharing the Tyler Prize with Wallace S. Broecker, Newberry Professor of Earth and Environmental Sciences at the Lamont-Doherty Earth Observatory, Columbia University, USA, is past president of the International Union for Quaternary Research (INQUA) and a founding member of the International Geosphere-Biosphere Programme on Past Global Change (PAGES). The Tyler Prize, established in 1973 by the late John and Alice Tyler is an international award honouring achievements in environmental science, policy, energy and health that confer great benefit to humanity, carries a US$ 200,000 cash award. For additional information see *www. usc.edu/tylerprize*.

Tungsheng Liu

CR RAO HONOURED

• **Calyampudi Radhakrishna Rao** (TWAS Founding Fellow), professor of physics and statistics and director of Multivariate Analysis at Pennsylvania State University, USA, was honoured with a US National Medal of Science at a ceremony held at the White House in Washington, DC. Rao received the medal for "his pioneering contributions to the foundations of statistical theory and multivariate statistical methodology and their applications, enhancing the physical, mathematical, economic and engineering services." Over the past six decades, Rao has been among the world's pioneers in the field of statistical science. He has authored 14 books and more than 350 research papers, and has received 27 honorary doctorates from universities in 16 countries. The National Medal of Honour, administered by the US National Science Foundation, is given to individuals who have made "outstanding contributions to knowledge in the physical, biological, mathematical and engineering sciences."

Maurice Tchuente

TCHUENTE APPOINTED MINISTER

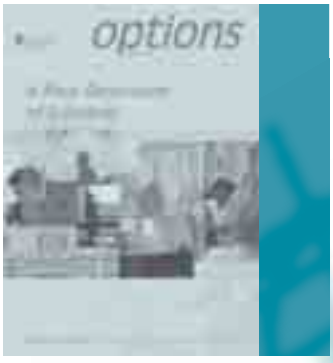
• **Maurice Tchuente** (TWAS Fellow 1999) has recently been appointed Cameroon's Minister of Higher Education. Tchuente, who previously served as rector at the University of Dschang (1996-98), the University of Ngaoundéré (1998-2000), and the University of Douala (2000-2002), is an expert in computer science, particularly in parallel processing and distributed automata theory. He is considered one of Africa's leading researchers in this field, especially well-known for theoretical results in systolic computation.

AAAS AWARD

• The American Association for the Advancement of Science (AAAS) is seeking nominations for its annual Award for International Scientific Cooperation (ISC). Through the award, the AAAS, in collaboration with its affiliated organizations, seeks to recognize an individual, or a small group working together, in the scientific or engineering community for outstanding contributions to international cooperation. Among the previous winners is Julia Marton-Lefèvre, executive director of LEAD International (Leadership for Environment and Development), who was honoured for her outstanding work in promoting and organizing international scientific cooperation. The award is open to all, regardless of nationality or citizenship. Nominations must be received by 1 August. The winner, who will be presented with the ISC award at the AAAS's Annual Meeting, receives a commemorative plaque, a US$5,000 monetary prize, and reimbursement for expenses to attend the conference. For further information, including a list of previous winners, see *www.aaas.org/about/awards.*

YOUNG SCIENTISTS' SUMMER PROGRAMME

• TWAS and Harvard University's Initiative on Science and Technology for Sustainability (ISTS), in partnership with the International Institute for Applied Systems Analysis (IIASA), are supporting four young scientists from developing countries to work on case studies relating to the "harnessing science and technology for sustainable development." The Young Scientists Summer Programme (YSSP), which has been organized by the Laxenburg, Austria-based IIASA since 1977, gives young scientists the chance to interact with top scientists in the fields of global environmental change and sustainable development. During the workshop, which runs from 2 June to 29 August 2003, participants will complete a report based on case studies of successful applications of science and technology for sustainable development in the fields of water, energy, health, agriculture and biodiversity. The workshop will be supervised by Jill Jäger (co-ordinator, ISTS). Participants will also spend some time visiting TWAS in Trieste, Italy, to exchange information on case studies, methodologies and results. For additional information, see *sustsci.harvard.edu/ists/*.



IIASA report

CSIR/TWAS FELLOWSHIPS

• India's Council of Scientific and Industrial Research (CSIR), together wth TWAS, has instituted a number of postgraduate and postdoctoral fellowships for foreign scholars from developing countries who wish to pursue research in newly emerging areas of science and technology in which CSIR has facilities and expertise. Postgraduate fellowships will be awarded for two years (renewable for a third year) to students with a master's degree, who are PhD candidates in their home country. For additional information about this programme, including a list of this year's recipients, see *www.twas.org* under the 'Activities' link.

WHAT'S TWAS?

The Third World Academy of Sciences (TWAS) is an autonomous international organization that promotes scientific capacity and excellence in the South. Founded in 1983 by a group of eminent scientists under the leadership of the late Nobel Laureate Abdus Salam of Pakistan, TWAS was officially launched in Trieste, Italy, in 1985, by the Secretary General of the United Nations.

At present, TWAS has more than 660 members from 76 countries, 62 of which are developing countries. A Council of 14 members is responsible for supervising all Academy affairs. It is assisted in the administration and coordination of programmes by a small secretariat of 9 persons, headed by the Executive Director. The secretariat is located on the premises of the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy. UNESCO is responsible for the administration of TWAS funds and staff. A major portion of TWAS funding is provided by the Ministry of Foreign Affairs of Italy.

The main objectives of TWAS are to:

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

TWAS was instrumental in the establishment in 1988 of the Third World Network of Scientific Organizations (TWNSO), a non-governmental alliance of more than 150 scientific organizations from Third World countries, whose goal is to assist in building political and scientific leadership for science-based economic development in the South and to promote sustainable development through broad-based partnerships in science and technology. **www.twnso.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 2000 women scientists from 87 Third World 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 85 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**

WANT TO KNOW MORE?

TWAS offers scientists in the Third World a variety of grants and fellowships. To find out more about these opportunities, check out the TWAS web-pages! Our main page is at:

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/Fellowships.html
www.twas.org/AssocRules.html

GRANTS

Seeking funding for your research project? Take a look at the TWAS Research Grants:

www.twas.org/RG_form.html

TWNSO runs a similar scheme, for projects carried out in collaboration with institutions in other countries in the South:

www.twnso.org/TWNSO_RG.html

EQUIPMENT

But that's not all TWAS has to offer. For instance, do you need a minor spare part for some of your laboratory equipment, no big deal, really, but you just can't get it anywhere locally? Well, TWAS can help:

www.twas.org/SP_form.html

TRAVEL

Would you like to invite an eminent scholar to your institution, but need funding for his/her travel? Examine the Visiting Scientist Programme, then:

www.twas.org/vis_sci.html

CONFERENCES

You're organizing a scientific conference and would like to involve young scientists from the region? You may find what you are looking for here:

www.twas.org/SM_form.html