The Italian government's decision to provide a 'permanent' source of funding for TWAS comes on the heels of the Academy's 20th anniversary celebration in China. It is a decision that creates a firm and lasting financial foundation for the organization.

29 GENNAIO 2004. GAZZETTA UFFICIALE DELLA REPUBBLICA ITALIANA. ACCORDO TRA L'ORGANIZZAZIONE DELLE NAZIONI UNITE PER L'EDUCAZIONE, LA SCIENZA E LA CULTURA (UNESCO) E IL GOVERNO DELLA REPUBBLICA ITALIANA CONCERNENTE L'ACCADEMIA DELLE SCIENZE DEL TERZO MONDO (TWAS).

Italian Parliament Signs TWAS Budget into Law

Notices in a national register of governmental laws and regulations rarely capture your attention – unless, of course, the law pertains to you.

On 29 January, TWAS had plenty of reasons to read the Italian government's register – *Gazzetta Ufficiale della Repubblica Italiana*. The reason was at once simple and compelling: On that date, it was officially announced that the Italian government had signed into law a permanent annual budget for TWAS, marking the successful conclusion to a five-year – indeed 20-year – journey for the Academy.

Under the terms of the law, the Italian government's contribution to TWAS will eventually reach €1,550,000. In addition the Italian government is providing €775,000 a year to the InterAcademy Panel on International Issues (IAP), the global network of merit-based science academies that functions under the administrative umbrella of TWAS in Trieste.

"The Academy's 20th anniversary celebration in China last October," says C.N.R. Rao, president of TWAS, "confirmed TWAS's strategic role both in helping to build scientific capacity in the developing world through South-South cooperation and in serving as a

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TWAS NEWSLETTER
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valuable institutional link between the South and North on a broad range of issues related to science."

"The Italian government has always been generous in its support of TWAS – and, in fact, the Academy would not exist today if not for Italy's munificence," adds Rao. But until now, funding took place on a year-by-year 'voluntary' basis. "The Italian parliament's willingness to pass a permanent law represents one of the most important milestones in the Academy's history. It's significance," Rao says, "cannot be overestimated."

"We must extend a particular thanks to Hassan Dalafi, a long-time staff member of the International Centre for Theoretical Physics (ICTP) and, more recently, an administrator with United Nations Educational, Scientific and Cultural Organization's (UNESCO) Regional Office for Science and Technology in Europe (ROSTE), located in Venice, Italy," notes Jacob Palis, TWAS's secretary general. "He was instrumental in shepherding the law through both the lower and upper chambers of the Italian parliament, where it ultimately received unanimous approval."

Dalafi, who was a close associate of Nobel Laureate Abdus Salam, the founding president of both the ICTP and the Academy, sees the law's passage as the fulfillment of Salam's dream. "Salam was as dedicated to TWAS as he was to ICTP. He saw both institutions as key elements in his overall campaign to promote science and technology in the South. I am sure that if he were alive today he would be smiling broadly knowing that the two institutions to which he devoted his adult life now enjoy secure and bright futures. They are in a stronger-than-ever position to promote the good work he envisioned for them."

"Reaching this goal," Rao notes, "is not only a credit to Salam's vision, but also to the hard work and dedication of the TWAS membership, which consists of more than 700 prominent scientists from around the world, and the Academy's staff, which has been so expertly led by Mohamed Hassan. An institution is only as good as its people and TWAS has been fortunate enough to have active members and a dedicated staff."

The law itself calls on the Academy to pursue its overall mandate to:

- Recognize, support and promote excellence in scientific research in the South.
- Provide promising young scientists in the South with the research and training facilities necessary for the advancement of their work.
- Facilitate and encourage cooperation among leading scientists and institutions in the South and between them and their counterparts in the Italian Republic.

In addition to covering the cost of the TWAS staff, the funding will be used to:

- Award competitive research grants for young scientists and scientific institutions in the developing world, with special attention paid to the needs of scientists and scientific institutions in the least developed countries.

[CONTINUED PAGE 4]

• Provide fellowships and associateships to prominent young scientists in the South for research collaboration with colleagues at institutions in the South and in Italy.

• Support research collaboration between centres of scientific excellence in the South and their counterparts in Italy.

• Confer prizes honouring individual scientists from the South who have made outstanding contributions to the advancement of science and its application in solving practical problems.

Finally, the law calls on TWAS to establish a five-person steering committee comprised of one representative appointed by UNESCO, two representatives appointed by the Italian government (one of whom will be a scientist) and two representatives from the developing world (one appointed by UNESCO's director-general and the other by the Italian government). The committee, which will meet once a year, will oversee the future direction and coordination of TWAS's activities.

"The law will neither change the Academy's mandate nor its day-to-day responsibilities," says TWAS's executive director Mohamed Hassan. "But it will place the Academy on a secure financial footing and that should help advance our goals in the years ahead. We are indeed thankful to the Italian government for the confidence it has shown in our efforts. We also look forward to working closely with our colleagues in Italy and elsewhere as we seek to fulfil our mutual objectives of improving the state of science and science-based development throughout the South." ■


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DELLA REPUBBLICA ITALIANA

PARTE PRIMA Roma - Giovedì, 29 gennaio 2004

PROFILING SCIENTIFIC EXCELLENCE IN THE SOUTH

THE THIRD WORLD NETWORK OF SCIENTIFIC ORGANIZATIONS (TWNSO), IN COOPERATION WITH THE SOUTH CENTRE AND THE THIRD WORLD ACADEMY OF SCIENCES (TWAS), RECENTLY PUBLISHED THE THIRD EDITION OF *PROFILES OF INSTITUTIONS FOR SCIENTIFIC EXCHANGE AND TRAINING IN THE SOUTH*, A BOOK OUTLINING THE CAPABILITIES OF OUTSTANDING RESEARCH INSTITUTIONS IN THE DEVELOPING WORLD. MORE THAN 500 INSTITUTIONS ARE INCLUDED IN THE VOLUME.

Earlier this year, two important reports were published outlining potential strategies for promoting scientific capacity building in the developing world: the InterAcademy Council's (IAC) *Inventing a Better Future: A Strategy for Building Worldwide Capacities in Science and Technology* (*www.interacademycouncil.net*) and the United Nations Millennium Project science task force's *Science, Technology and Innovation* (*www.cid.harvard.edu/cidtech/interim_report.doc*). The latter, issued as an interim report, will be published in its final form by the end of the year.

Both reports present broad agendas for narrowing the North-South divide in science and science-based development. Recommendations range from creating an international grant fund for promising young researchers in the South, to providing training in science and technology to civil servants throughout the developing world, to reforming systems of higher education in the South in an effort to place their training and research activities more in line with national economic development strategies.

While both reports emphasized the critical role that national governments must play in the development of science and technology – from government financing for education to government programmes for ensuring gainful employment for their scientists – both reports also cite the importance of South-South and South-North cooperation in providing pathways for scientific and technological progress.

One of the missing links in efforts to promote global cooperation in science and technology has been a general lack of information and knowledge concerning the capabilities of universities and research centres in the developing world.

Until recently, the work of these "tillers of the lonely plough," as one observer recently put it, has gone largely unnoticed in the North, and sometimes even within their own countries. And while progress has

[CONTINUED PAGE 6]

been made in raising the visibility of high-level scientific research in the developing world, today only the most noted Southern research institutions – for example, the H.E.J. Research Institute of Chemistry, Pakistan; the Chinese Academy of Sciences' Institute of Atmospheric Physics; Brazil's National Institute for Pure and Applied Mathematics; and the Jawaharlal Nehru Centre for Advanced Scientific Research in India – have achieved international recognition. The good work of hundreds of other university departments and research institutions in the South goes largely unnoticed and unappreciated.

Such shortcomings make it difficult for the world's scientific community to establish a research agenda that is truly global in scope. It also prevents the scientific community from taking advantage of its full pool of knowledge workers. Finally, it creates an imposing obstacle to efforts for promoting science-based sustainable development. Simply put, sustainability without science is not sustainable.

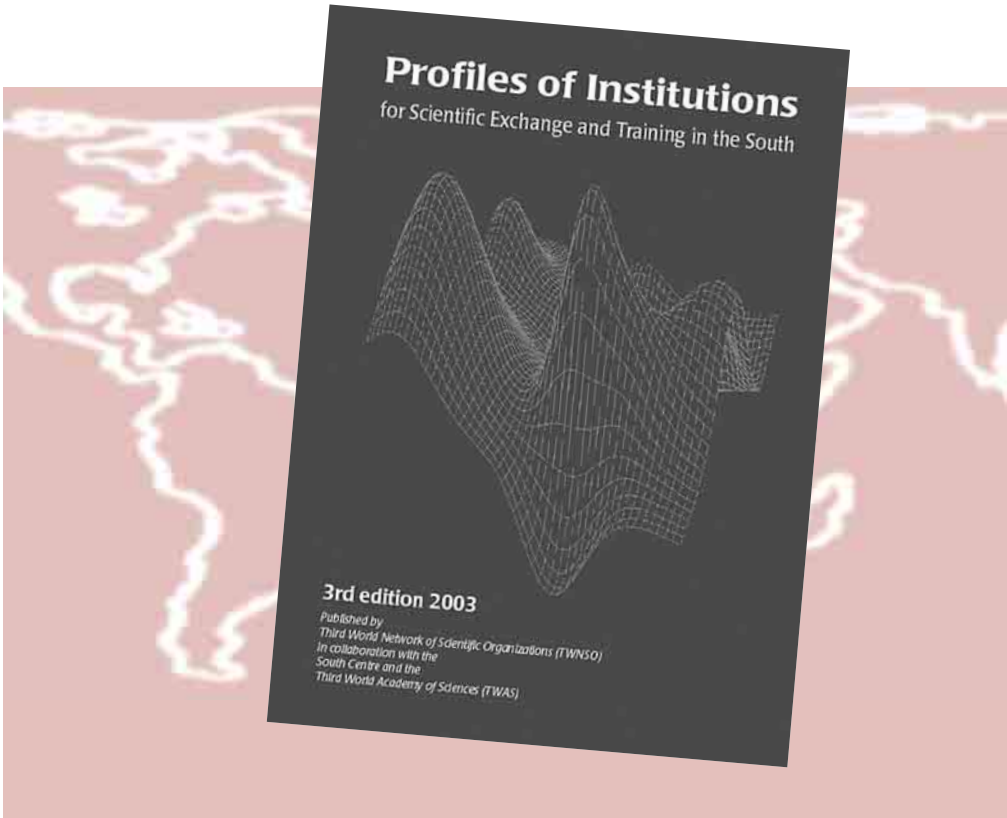
In our knowledge-based world, a lack of knowledge – or, more specifically, a lack of knowledge of where to find the knowledge that is needed – is clearly a significant handicap for policies and programmes designed to improve the material and social well-being of people and nations.

That is why the publication of the third edition of *Profiles of Institutions for Scientific Exchange and Training in the South* represents an important contribution to the growing discussion on the need to promote science-based development, especially in the developing world.

The volume offers a thumbnail sketch of the capabilities of 525 leading research centres, institutes and universities in the South, including 43 institutions located in the world's least developed countries (LDCs). It presents information on each institution's major fields of interest, its full range of activities (including publications, patents, library holdings, workshops and conferences), the state of its classrooms and laboratories (including a description of its equipment), its cooperative agreements with other institutions and its future plans. A revised index and redesigned tables are intended to make the information even more accessible for scientists, scientific administrators and policy makers.

Profiles of Institutions for Scientific Exchange and Training in the South is the third edition in this series. The first volume, published in 1994, listed 208 institutions, while the second volume, published in 1998, contained 431 institutions.

The 525 institutions detailed in our most recent edition represent a 20 percent increase in institutions over the second volume and 250 percent increase over the first edition – a reflection of the growing capabilities of scientific research centres in the developing world,



particularly among the South's largest and wealthiest nations.

Yet, the fact that one-half of the institutions listed in the book come from five nations – Argentina, Brazil, China, India and Mexico – suggests that an ominous split exists not just between the South and North but also between the South's most scientifically proficient and scientifically laggard nations.

While this growing South-South gap complicates efforts to improve the state of science and technology in the developing world, it also presents unprecedented opportunities for progress, particularly if effective programmes for South-South cooperation can be put in place that enable developing nations with rising scientific capabilities to lend a helping hand to less capable nations.

And cooperation is exactly what *Profiles of Institutions for Scientific Exchange and Training in the South* is designed to foster. In fact, previous editions of the resource book have served as a valuable reference point for the TWAS/UNESCO (United Nations Educational, Scientific and Cultural Organization) Associateship scheme, which allows talented developing world scientists to visit centres of excellence in the South twice during a three-year period. The programme gives participants an opportunity to improve their research skills and forge valuable collaborations with colleagues in other parts of the developing world.

The information contained in *Profiles of Institutions for Scientific Exchange and Training in the South* has also been used to identify institutions for the TWAS-administered South-South research exchange programme co-sponsored by the OPEC Fund for International Development and UNESCO – a programme that encourages scientific research centres to join together for the purposes of pursuing research projects in fields where they share common interests and complementary skills.

Similarly, the Third World Network of Scientific Organizations (TWNSO), a TWAS-affiliated organization that functions under the Academy's administrative umbrella, has relied on *Profiles of Institutions for Scientific Exchange and Training in the South* to build a series of networks of scientific institutions in a variety of subject areas that include indigenous and medicinal plants, renewable energy, water management, and dryland biodiversity.

With funding from the Global Environment Facility (GEF), the United Nations Development Programme's (UNDP) Special Unit for Technical Cooperation among Developing Countries (TCDC) and the World Meteorological Organization (WMO), TWNSO and TWAS have brought together scientific institutions throughout the developing world to share experiences in the application of science and technology to address critical everyday problems related to the issues cited above. The source of

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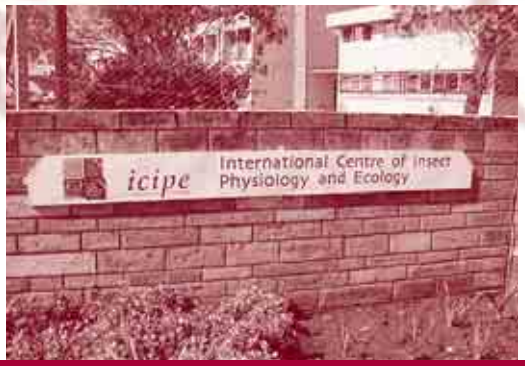

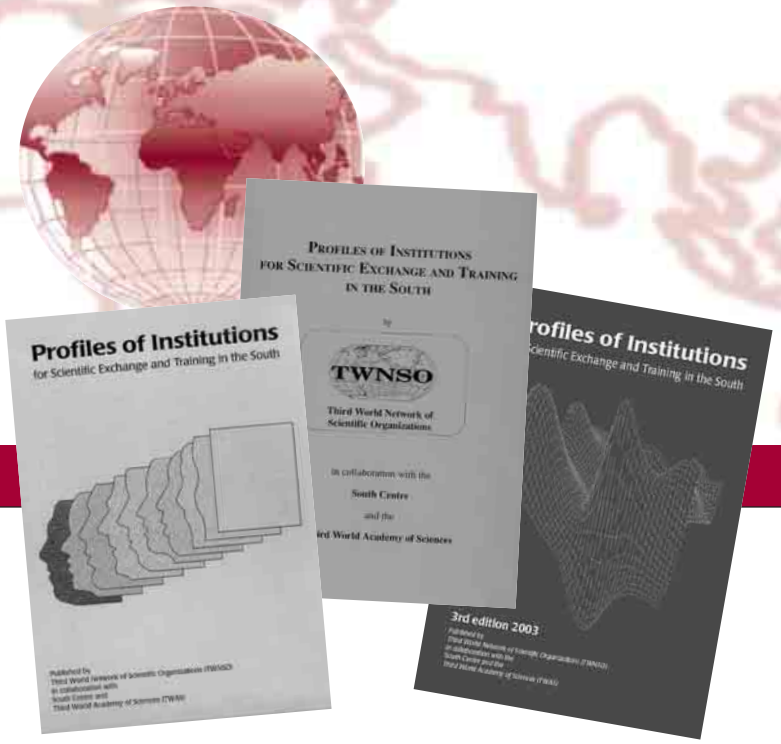

the network for each of these initiatives has been *Profiles of Institutions for Scientific Exchange and Training in the South*.

When Abdus Salam, the founding president of TWAS, and Julius K. Nyerere, former president of Tanzania and founding chairman of the South Centre, conceived of a book designed to profile the capabilities of institutions of scientific excellence in the developing world in the early 1990s (as an outgrowth of discussions at the 1992 'Earth Summit' in Rio de Janeiro), science in the South was in a radically different state.

China had only recently emerged from decades of isolation to rejoin the global scientific community, Brazil had only just begun to invest consistently in science and technology, and the computer software revolution was not even a glimmer on the horizon in India. Indeed the internet itself barely extended beyond a tiny group of physicists largely employed at CERN (the European Organization for Nuclear Research) and other top-flight physics research centres based in the United States and Europe.

As C.N.R. Rao, president of TWAS, notes: "While the world of science has dramatically changed over the past decade, the importance of reference books such as *Profiles of Institutions for Scientific Exchange and Training in the South* has not diminished. Indeed it can be argued that the need for these books has intensified in the light of the rising importance of South-South and South-North cooperation in science and technology as cornerstones for sustainable development. That's why the publication's sponsors expect the demand for this latest edition to be even greater than for the previous two editions."

Boutros Boutros Ghali, the former secretary general of the United Nations who now serves as chairperson of the South Centre, concurs with Rao's observation by noting: "The world may have changed but the need for information is more critical than ever. Having an easy-to-use 'roadmap' that charts the location of a great deal of this information in a single volume will surely prove invaluable to both individual scientists and scientific institutions in the South and North. It is for this reason that we expect the third edition of *Profiles of Institutions for Scientific Exchange and Training in the South* to generate a lot of interest – and, even more importantly, a great deal of use." ■

For additional information about Profiles of Institutions for Scientific Exchange and Training in the South, *contact:*

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INTERACADEMY PANEL HOLDS GENERAL ASSEMBLY

IAP'S MEMBERS MET IN MEXICO TO ASSESS THE PANEL'S PAST AND LAY OUT A PROGRAMMATIC ROADMAP FOR THE YEARS AHEAD.

The headquarters of the Mexican Academy of Sciences, situated on a mesa overlooking Mexico City, served as the site of IAP's triennial General Meeting and Conference on Science, held in December 2003. Highlights included IAP's endorsement of five statements on critical science-related issues, the election of a new executive committee, and the decision that the Panel's secretariat will remain in Trieste. With the recent announcement that the Italian government will fund IAP on an annual basis, IAP's future looks bright.

The InterAcademy Panel on International Issues (IAP) held its triennial General Assembly in conjunction with its Conference on 'Science for Society' from 1-5 December in Mexico City. More than 120 representatives from 62 science academies worldwide attended the event.

At the assembly, representatives:

• *Unanimously agreed to keep the IAP secretariat in Trieste for at least the next three years.* IAP moved to Trieste in 2000 and since then has functioned under the administrative umbrella of the Third World Academy of Sciences (TWAS). TWAS will continue to oversee the day-to-day operation of IAP, providing managerial, accounting and public information assistance. The Italian government has announced that it will provide IAP with an annual budget of €775,000 under a parliamentary law that guarantees yearly funding.

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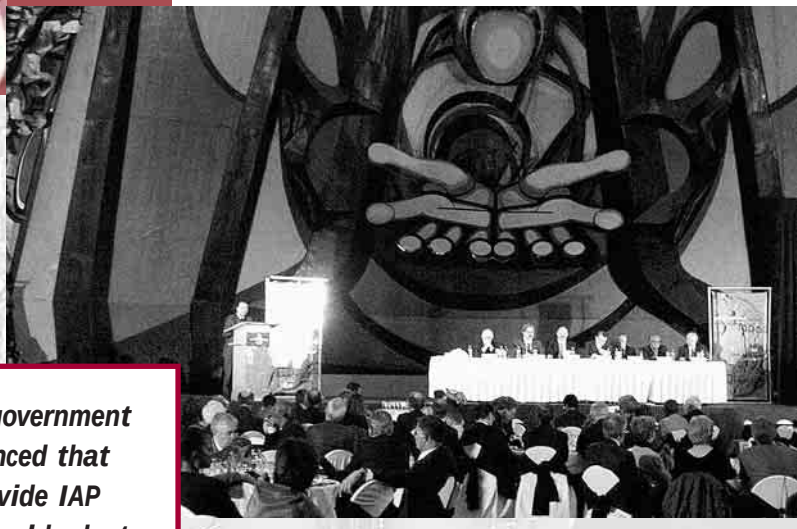


• *Elected a new 11-member executive committee.* The new committee consists of science academies from Bangladesh, Brazil, Cuba, India, Italy, Japan, the Netherlands, Nigeria, Senegal, Sweden and the United States. In addition, the representatives elected Yves Quéré and Chen Zhu co-chairs of the executive committee. Quéré, serving a second term, is a distinguished solid state physicist and held the post of foreign secretary with the French Academy of Sciences from 1995 to 2003. Chen, who succeeds Eduardo Krieger, president of the Brazilian Academy of Sciences, is an internationally renowned scientist who holds both a medical degree and a doctorate from University VII, France. He also coordinated China's efforts for the Human Genome Project.

The Italian government has announced that it will provide IAP with an annual budget of €775,000.

• *Reviewed the full range of IAP activities in the major thematic areas that had been at the centre of the Panel's agenda from 2000 to 2003.* These themes included capacity building for young science academies, science and education, science and the media, and strategies for improving the health of mothers and children in developing countries. Highlights of IAP activities over the past three years include workshops on capacity building for science academies in Africa, Latin America and the Caribbean region, and in countries with predominantly Muslim populations. These workshops have not only attracted widespread media attention but, more importantly, have helped to raise the profile of science academies in these regions. Africa, for example, has embraced the recommendations issued at the IAP capacity building workshop and established a regional network of science academies – the Network of African Science Academies (NASAC). Representatives from science academies in Islamic countries have followed a similar strategy by announcing the creation of the

Network of Academies in the Organization of Islamic Conference (NASIC) at a meeting in Islamabad, Pakistan, in March 2004. In addition, IAP helped to establish a well-respected and widely accessed website for the exchange of information on mother and child health issues that is now managed by the Pasteur Institute. The Panel also held a series of workshops on science education, most notably in Malaysia, Mexico and India.

• *Issued five statements on science-related issues that have shaped IAP's agenda for the past three years.* The statements, which are designed to influence policy makers working both in national governments and international organizations, focus on the following issues: access to scientific information; capacity building for young science academies; science education for children; the health of mothers and children in the developing world; and science and the media. Overall, the statements highlight the important role that science can play in addressing critical global problems and emphasize the need to enhance scientific capacity in developing countries as a key strategy for providing 'scientifically lagging' nations with the tools that they need to overcome the obstacles that stand in the way of sustained development. For the complete text of the statements, see *www.interacademies.net/iap/*.

• *Voiced its support for therapeutic cloning while simultaneously calling for a ban of human reproductive cloning.* In autumn 2003, IAP released a statement on human cloning that called for a ban on reproductive cloning but expressed membership support for therapeutic cloning or cloning for research purposes. The

[CONTINUED PAGE 12]

statement was part of a larger effort to influence the debate on human cloning that was taking place at the UN headquarters in New York City. In December 2003, IAP reiterated its position on human reproductive and therapeutic cloning when the UN decided to reopen discussions on the topic. The UN assembly ultimately decided to postpone a vote for one year (see "IAP Enters Cloning Debate," *TWAS Newsletter,* Vol. 15, No. 4, pages 2-5).

• *Engaged in a wide-ranging series of scientific sessions related to the conference's overall theme of 'Science for Society'*. Presentations, for example, focused on scientific capacity building in the developing world, food security in Africa, science-based efforts to curtail the spread of AIDS, last year's response to Severe Acute Respiratory Syndrome (SARS), the current state of climate change research, science education in China, and an overview of science in Mexico. The conference also held two satellite symposia on the final day devoted to science education and the management and sustainable use of groundwater. ■

For additional information about the IAP Conference and General Assembly in Mexico City see www.interacademies.net/iap/ or contact ···⁘ ***Joanna Lacey****, IAP secretariat c/o TWAS, Strada Costiera 11, 34014 Trieste, Italy tel: +39 040 2240 680 fax: +39 040 2240 688 e- mail: iap@twas.org*

SCIENCE, INFORMATION AND ETHICS

Among the overall points of discussion at the IAP Conference and General Assembly in Mexico City, none proved as critical, yet as elusive, as the topic of ethics. In the following article, Nobel Laureate Yuan Tseh Lee (Chemistry 1986), president of the Academia Sinica, Taiwan, China, contends that in a world driven by heartless global economic competition, where science and technology plays a critical role in determining winners and losers, it is essential for scientists to be guided by ethical principles if they hope to contribute to global economic and social well-being and international peace. He also explains why he thinks the sharing of information – and its ethical use – are more important than ever.

As a scientist, I often ask myself if science has really brought substantial benefit to humankind.

Critics contend that advances in science and technology have benefited only about one-third of the people on Earth. For example, when we glorify the enormous material impact of the Industrial Revolution, we must not forget that countries that failed to catch the 'industrial wave' became colonies of Western powers and suffered immensely.

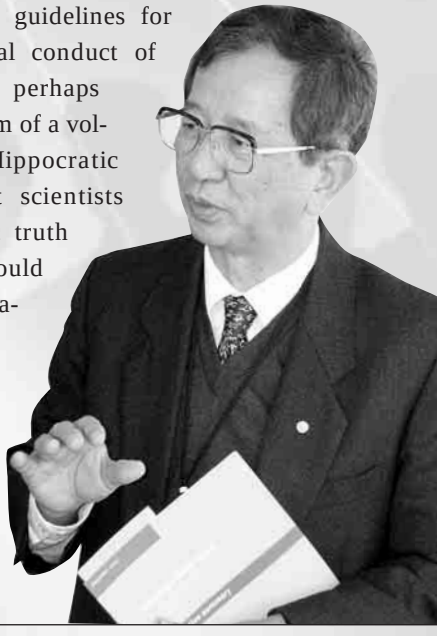
The fact is that recent human history has been marked by a relentless competition among nations that has produced more losers than winners.

In recent years, although substantial progress has been made in international collaboration, economic competition among nations sets the beat to which the entire world marches. Countries that lag behind in this competition remain trapped in poverty and misery.

Our increasingly interconnected world will never be safe if large portions of our global population suffer from poverty, disease, illiteracy and unemployment. Scientists can play key roles in finding solutions to these problems. But to advance this common goal, scientists must work together to ensure that their expertise is not used by some to dominate others or to cause irreparable damage to our environment.

Critics contend that advances in science and technology have benefited only about one-third of the people on Earth.

In 1995, Sir Joseph Rotblat in his Nobel Peace Prize address said that: "The time has come to formulate guidelines for the ethical conduct of scientists, perhaps in the form of a voluntary Hippocratic Oath." He contended that scientists should not pursue scientific truth simply for truth's sake but should consider the ethical implications of their research.



While the importance of ethics in science can be traced to the writings of Francis Bacon in the 17th century, pledges founded on the common values and

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responsibilities shared among scientists and engineers have become commonplace in recent years.

For example, the Peace Pledge Movement for scientists, launched in Japan in 1999, calls on scientists "not to participate in research, development, manufacture, acquisition and utilization of nuclear weapons as well as other weapons of mass destruction."

Similarly, in 2003, TWAS fellows Daniel C. Tsui and Ding-Shinn Chen of the National Taiwan University asked young bioscientists admitted to the College of Medicine to declare:

- *At the moment of my becoming a member of the bioscience community, I do solemnly declare that I will respect the value and dignity of life and conduct myself to honour this profession. I acknowledge that I have a special responsibility for promoting the welfare of humankind, and will so behave as to pursue and exercise my bioscience knowledge in an ethical and socially responsible way. Never will I use my training to do harm to others or the environment, neither will I do anything to diminish social justice. Whatever action I take and career I choose, I will consider their moral implications. Since I realize that only ethically responsible bioscientists can hope to contribute to the peace and security of people, and thus promote genuine human flourishing, I make this declaration wholeheartedly and upon my honour.*

At our current stage of human development, there is a difference between the responsibility of an individual scientist and the scientific community as a whole.

If we do not fully appreciate and understand the rules of the game and consequences of competition in globalized market-driven economies, practicing so-called 'good science' for 'good purposes' will still produce wretched losers among us. As was the case with the Industrial Revolution in the past, new global competition based on information science and biotechnology is sure to create losers that will remain poor and miserable.

Scientists must realize that a nation can sustain its prosperity only when it is surrounded by prosperous neighbouring nations. Commitment to helping make our neighbours prosperous is one of the best strategies for success in the modern world.

For centuries, scientific knowledge has been shared freely among scientists. Moreover, scientists still generally believe that scientific knowledge should be shared by all – as Francis Bacon advocated nearly 400 years ago. Early last century, when Madame Curie was asked why she didn't patent her discoveries (if she had done so, she would have been as wealthy as Thomas Edison), her reply was quite simple: she believed that scientific knowledge belonged to all humankind.

Madam Curie's idealism is what led me to become a scientist. In our modern society, however, scientific knowledge is created, transformed into technology and put to use in society at an ever-increasing pace. As a result, science has become a fundamental element of economic competition. Patents and intellectual prop-

erty rights have become critical issues, and the sharing of knowledge now stops at basic scientific knowledge and so called 'pre-competitive' technology. Competitive technology is not freely shared.

The problem is that the time lag between scientific discovery and technology reaching the marketplace has become shorter and shorter. The lag was 100 years for automobiles, 5 years for computers, and only 18 months for microprocessors. In certain areas of scientific investigation, it is no longer possible to distinguish between basic research and associated competitive technology.

As the relationship between science and technology narrows, the dilemma of 'to share or not to share' has become an important issue – not only for applications of technologies, but for basic scientific discoveries. It is neither fair nor fruitful for some countries to produce most of the public scientific knowledge and others to dedicate themselves to protected, mission-oriented technological development in order to gain economic competitiveness.

In a market-driven economy, free and open economic competition and adequate protection of intellectual property rights are necessary for development. Yet, we must ask whether we can find new and better ways to share scientific knowledge and technology in a more orderly and equitable fashion to promote global sustainable development.

Strong public support for the advancement of science and the development of technology, together with a shortening of the patent protection period, would move us in that direction.

In recent years, in the field of high-energy physics and astronomy, scientists have shared their knowledge freely across national boundaries. In the field of biology, however, scientists now tend to protect their intellectual property rights. In international meetings biologists often are content to learn as much as possible while revealing as little as they can.

Whether this is due to the fact that high-energy physics and astronomy are supported by public funds while profit-making pharmaceutical industries dominate biological research is worth studying in detail.

Many of the problems we face today cannot be solved with current scientific knowledge and technologies – they await the accumulation of new knowledge and the development of new technologies. That is why we must continue efforts to advance science and technology and educate a new generation of creative scientists.

Scientists must also realize that science and technology cannot solve all of our problems. On the contrary, the rapid development of human activities, especially in a fast-moving global economy, which is propelled by advances in science and technology, could create new problems as contact among peoples becomes more frequent.

The 21st century will be a critical turning point for humankind. Economic globalization will ultimately reduce the risk of relying on military confrontations to settle international disputes. If what replaces military confrontation, however, is high-technology-based economic competition, then the advancement of science and technology will continue to be used as a tool of domination by some, rather than as a tool for the liberation of all.

A nation can sustain its prosperity only when it is surrounded by prosperous neighbouring nations.

If, however, we learn to solve problems together, learn to share our limited resources, knowledge and technology and to respect and understand different cultural heritages, it will be possible to construct a global village that strives toward sustainable development of all.

We cannot change the past, but we can begin to write the history of humankind for the 21st century. This is the first time in human history that all human beings have been faced with learning to work and live together as one family. It is a time for finally realizing that the planet on which we live is finite in space, capacity and resources. This is a necessary awakening – vital for the survival and sustainable development of humankind. If we make the right choices, the 21st century will be marked as a great turning point – the beginning of a new era in the history of humankind. ■

Yuan T. Lee
TWAS Fellow 1986
Nobel Laureate, 1986
President, Academia Sinica

FROM FIELDS TO PHARMACEUTICALS

HOW CAN TRADITIONAL HERBAL REMEDIES BE DEVELOPED INTO POTENTIALLY LUCRATIVE PHARMACEUTICAL PRODUCTS? A BROAD EXAMINATION OF THIS ISSUE SERVED AS THE CENTREPIECE OF A WORKSHOP HELD FROM 3-6 FEBRUARY IN TRIESTE, ORGANIZED BY TWNSO AND CO-SPONSORED BY THE UNDP/TCDC.

The cultivation and sustainable use of herbal plants are by no means academic issues. Indeed more than 80 percent of the world's people, including virtually the entire population of the developing world, depend on traditional plant-derived medicines to address their health needs.

A recent workshop, co-sponsored by the Third World Network of Scientific Organizations (TWNSO) and the United Nations Development Programme's Special Unit for Technical Cooperation among Developing Countries (UNDP/TCDC), examined efforts by researchers seeking to transform medicinal plants into pharmaceutical products. Sixteen scientists from 14 developing countries, were invited to discuss their experiences.

In addition, two guest speakers presented overviews of their organizations' work. Alan Hamilton, head of the International Plant Conservation Unit of the World Wildlife Fund (WWF), spoke about a range of conservation issues affecting medicinal plants (a summary of his presentation follows), and Jihad Noun of the International Plant Genetic Resources Institute (IPGRI) in Syria outlined the problems and concerns associated with preserving the genetic diversity of so-called 'new and under-utilized species', highlighting strategies for bringing wild plants into cultivation or conserving them in situ.

At the end of the meeting, the guest speakers joined the Advisory Board in producing a set of recommendations. Among these were:

- *TWNSO should recognize and promote the fact that adding value to medicinal plants through the development of pharmaceutical products is a major multi-disciplinary activity that holds great promise for the developing world.*

More than 80 percent of the world's population depend on traditional plant-derived medicines for their health needs.

• *Additional initiatives should be launched to conserve and rationally use the treasure trove of biodiversity found in the Third World.*

• *Scientific validation and benchmarking should be the focal points of all efforts to turn indigenous plants into pharmaceutical products. Such a strategy would allow these efforts to stand the test of time and make successful commercialization more likely.*

As with previous TWNSO workshops, all of the scientific presentations will be re-worked into case studies and published in the TWAS-TWNSO-UNDP/TCDC's 'Sharing Innovative Experiences' series. The volume is due out this summer.

Workshop delegates also agreed to establish their own network, centred around a regularly published newsletter, which will not only help them keep in touch with one another, but will also serve as a forum for the exchange of ideas and information. Sylvia Mitchell of the University of the West Indies, Jamaica, agreed to head up the initiative – now named the 'TWNSO Medicinal Plant Network' – with editorial assistance from TWAS staff.

This 'networking' initiative promises to have a far-reaching effect, enabling participants to continue their discussions and interactions long after they have returned to their own countries. Scientists with an interest in medicinal plants from other institutions in the South are welcome to join the network. ■

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CONSERVING MEDICINAL PLANTS

TWAS Newsletter, Vol. 16 No. 2, 2004

The World Wildlife Fund (WWF), founded in 1961, is now the world's largest independent conservation organization with a network of 52 offices working in more than 90 countries. It is widely known for its conservation efforts with regard to large mammals such as elephants, tigers and the panda, which is featured on its logo. For many years, the promotion of the conservation of plants – from rainforest trees to species with medicinal uses – has also been at the centre of WWF's global agenda.

The use of plants for medicinal purposes represents the largest use of biodiversity in the world. Many more species of plants are used as medicines, for example, than are used for food. Focusing on medicinal plants, therefore, has the potential for involving people more widely in conservation issues.

But there is no precise definition of a medicinal plant. In some cultures, a particular plant can be regarded as both a food and a medicine. In the West, regulations often prevent botanical products from being marketed as medicines and they are therefore often sold as food supplements, tonics or similar products.

Medicinal plants are also used in different ways in different systems of medicine. One classification divides such systems into three major categories:

- *Shamanistic medicine.* The use of plants by shamans is considered a more spiritual form of medicine.
- *Folk medicine.* Defined as being transmitted from generation to generation as part of a society's oral traditions, folk medicine is found around the world and is especially prevalent in Africa.
- *Scholarly medical systems.* These are well represented in Asia and include: traditional Chinese medicine; Kampo, or traditional Japanese medicine; Tibetan and Mongolian medicine, both based on Buddhist philosophy; Ayurveda used widely in India; and Unani, an Islamic medical tradition. There is also western herbal medicine, which varies a great deal from one country to another; and western allopathic medicine, which, historically, is also strongly botanically based and uses many drugs derived directly or indirectly from plants.

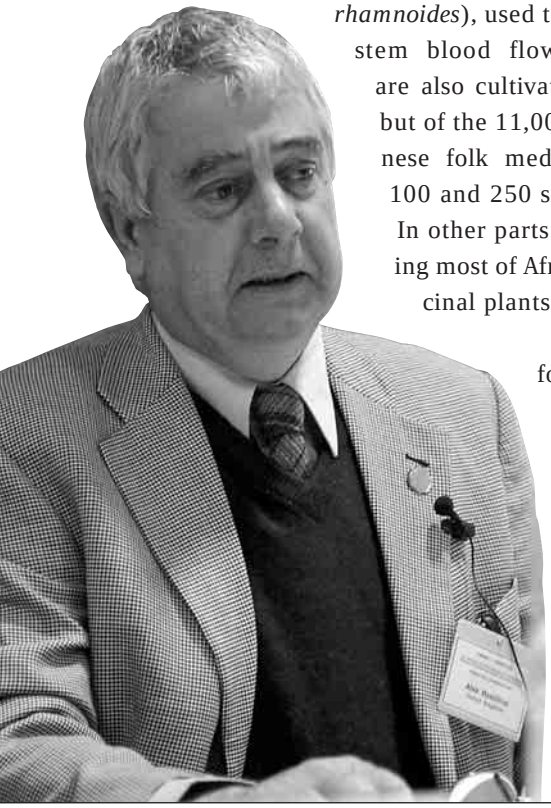
CONSERVATION PROBLEMS

A common feature of folk medicines is that they use many more plant species than the more scholarly systems. Of the 7,500 species recorded as being used medicinally in India, for example, fewer than 20 percent are used in Ayurveda. Similarly, of about 11,000 species used in China, only about 5 percent are commonly used in traditional Chinese medicine.

These examples point to the fact that a large proportion of the world's flora is considered as having medicinal properties. Indeed, our best guess is that some 50,000 species of the world's estimated total of 300,000 to 500,000 plant species are used in traditional medicine. That is why the use of medicinal plants is the strongest link there is between people and nature, and that is why these resources need to be carefully managed.

One obvious form of management is cultivation and it is fair to say that most of the species used in western medicine are now cultivated. Among these are the Madagascan periwinkle (*Catharanthus roseus*), the source of two anti-leukaemia compounds, and opium poppies (*Papaver somniferum*), the source of a number of drugs. However, only about 100 of the 50,000 medicinal plant species used worldwide are used in western medicine.

A few of the species used in traditional medicine, such as sea buckthorn (*Hippophae rhamnoides*), used to stem blood flow, are also cultivated on a large scale, but of the 11,000 plants used in Chinese folk medicine, only between 100 and 250 species are cultivated. In other parts of the world, including most of Africa, few, if any, medicinal plants are cultivated.



Most species, therefore – whether used locally or collected for national or international trade – are collected from the wild.

With the population of many developing countries still increasing, and the majority of people in the South reliant on traditional medicine for their primary healthcare needs, pressure is mounting on many populations of medicinal plants. Many species are simply being over-harvested or harvested in unsustainable ways. In some cases, the roots rather than the leaves are collected, destroying any chance for the plant to regenerate. Alternatively, the species in question may have a slow rate of growth and be unable to tolerate repeated cutting.

The use of plants for medicinal purposes represents the largest use of biodiversity in the world.

In addition, because medicinal plants belong to the 'informal economy' of many countries, trade in medicinal plants is poorly recorded in official statistics. Conservationists, therefore, cannot say how many species are threatened. The global estimate that 10,000 species are under threat from overharvesting and other pressures is an extrapolation – or best guess – from the available data.

Indeed, many scientists believe that we are in the midst of a massive anthropogenic extinction of biodiversity. One estimate predicts that 20 percent of the Earth's species could be extinct within 30 years, and it is likely that many medicinal plants – many with properties as yet unknown to science – will be lost during this mass 'die-off'.

Complete extinction is obviously a disaster for any species. In the case of medicinal plants, conservation bodies are also concerned about more insidious forms of extinction – the extinction of particular genes in a population.

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This so-called 'genetic erosion' is especially important when considering the secondary metabolites produced by a plant. That's because metabolites, which are often the target compounds for drug development, vary widely between populations of the same species growing in different locations. Over-collecting plants with beneficial properties growing in one location – a valley, say – could force people to collect the same species from harder-to-reach locations – such as farther up the surrounding hillsides. But there is no guarantee that the concentrations of the active ingredient will be the same in the two populations. Conservation of the genetic diversity within species, therefore, is as important as conservation of a diversity of species. Such genetic erosion is certainly occurring, but it has been little studied by scientists.

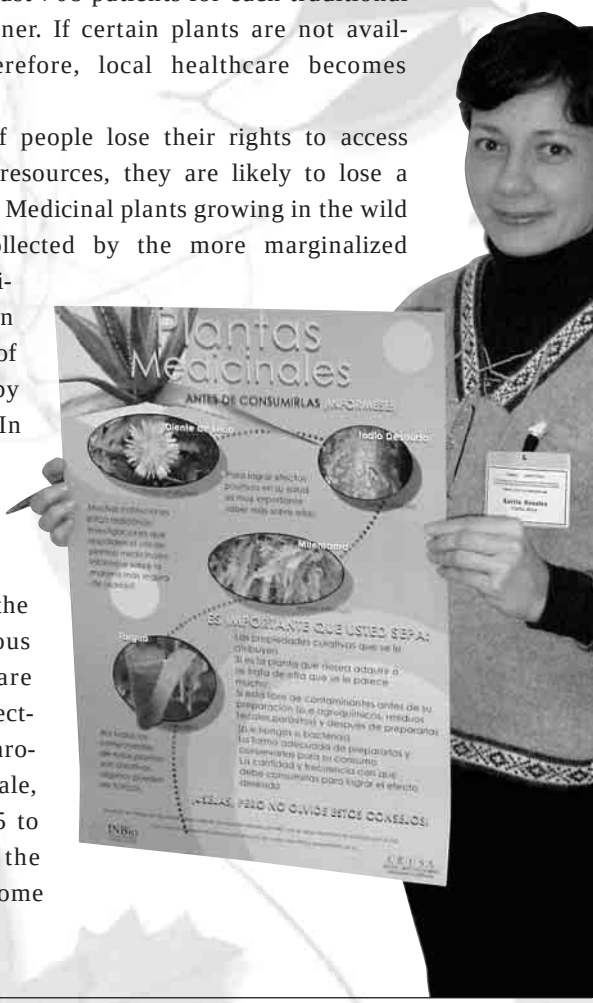
'Commercial extinction' is another worry. With many products that are collected from the wild (not just medicinal plants, but cod, fur seals, whales and tropical timber) there are widening areas of resource depletion as people travel greater distances to collect the resource. A prime example is the ever-expanding circle of fuelwood collection around many cities in developing countries, which is causing the depletion of nearby forests. Over-harvesting is having the same effect on medicinal plants but, unlike the removal of trees, it has gone largely unnoticed.

Despite these issues, we must also take into account people's livelihoods when planning and implementing conservation solutions. Nowadays, it is not enough to prevent a plant resource from being collected. If people are denied access to their traditional medicinal plants, unanticipated medical and social problems may follow.

In many parts of the world, the majority of people – sometimes more than 80 percent – depend on traditional medicine for their primary healthcare needs. For example, in rural Malawi, the ratio of doctors to patients is one to 50,000 whereas the equivalent ratio for traditional medical practitioners is one to 138. In Uganda, the figures are 25,000 patients for each doctor but just 708 patients for each traditional medical practitioner. If certain plants are not available locally, therefore, local healthcare becomes problematic.

Medicinal plants are generally collected by the more marginalized members of society.

In addition, if people lose their rights to access their traditional resources, they are likely to lose a source of income. Medicinal plants growing in the wild are generally collected by the more marginalized members of society who derive an important part of their income by trading them. In Nepal's Ghurka district, for example, 50 to 100 percent of households in the more mountainous northern area are involved in collecting medicinal or aromatic plants for sale, accounting for 15 to 30 percent of the total income of some households.



This situation also holds true for much of the rest of the world. If the plants are locally extinct – or unavailable due to such restrictions as the privatization of land – then these marginalized people lose a critical source of income.

IN AND *EX SITU*

In today's terminology, plant conservation works in two major ways: through *in situ* and *ex situ* management systems.

In situ systems leave the plants where they occur naturally and attempt to manage the land to favour their continued survival. In this way, both the target species, as well as all the other species sharing the ecosystem, are protected.

In practice, however, the *in situ* management of medicinal plants is generally poor. National forestry departments, for example, are usually more concerned with timber production and general forest protection and very few include medicinal plants – or the needs of local communities – in their land management plans.

Effective community management of a wild plant resource requires the designation of a reliable community institution – perhaps with support from the forestry department – with clear-cut management responsibilities and authority.

When using *ex situ* methods, conservation organizations intervene more indirectly in protecting a species. Here the key is cultivation.

For cultivation to succeed, the right species and varieties for a particular site must be selected. These may not necessarily be the species that grow locally in the wild. After all, crops such as maize, potatoes and tomatoes are grown throughout the world although they are indigenous to Latin America. For commercial purposes, it is more important to choose species that work, both ecologically and economically at a particular site. At the same time, it is important to cultivate local species if possible, linking this with the sustainable management of the wider habitat. Like i*n situ* conservation, this method should help conserve more biodiversity than just a single species.

However, without the assistance of outside specialists to provide advice on such issues as the introduction of new technologies and post-harvest treatments, local farmers may be unwilling to experiment with what would otherwise be a high-risk venture.

Despite some successes, cultivation remains an area where there is a great need for more practical initiatives. Although wild-collected plants often contain more of the desired active compounds, industry may

INTERNATIONAL CONSULTATION

WWF has joined forces with the Swiss-based World Conservation Union (IUCN) and TRAFFIC, an organization that helps monitor the Convention on International Trade in Endangered Species of Fauna and Flora (CITES). Together, these agencies are spearheading an international consultation process aimed at revising the current World Health Organization (WHO) guidelines for the conservation of medicinal plants, originally published in 1993. Later this year, the conservation organizations will present their findings to the WHO, which will analyse the results and – the conservation organizations hope – adopt the recommendations. Consultation is ongoing and anyone interested in the conservation of medicinal plants – including TWAS and TWNSO members – can take part in this exercise. For additional information, contact Wolfgang Kathe, the project administrator: email giraglia@t-online.de.

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prefer cultivated material because it is then more likely to attain assured supplies of uniform quality.

In addition, well-intentioned manufacturers of botanical products could help conservation efforts though guaranteed purchase agreements with communities or by providing technical assistance – for example, to reduce waste caused by poor drying procedures.

NEPAL: A CASE STUDY

The potential importance of medicinal plants to the future economic growth of Nepal is illustrated by the fact that the government has decided its priorities lie in developing two major sectors – tourism and medicinal plants.

The government of Nepal has decided its priorities lie in developing two major sectors – tourism and medicinal plants.

For several years, WWF has been running a 'People and Plants' project with the Dolpa people of Nepal. It is centred on the Shey Phoksundo National Park, a new national park – the largest in the Himalayas – located along the Chinese Tibetan border.

The Himalayas are a major source of medicinal plants, many of which are collected using unsustainable practices. About a billion people in India use Ayurvedic medicine and another billion in China use traditional Chinese medicine. Medicines in both traditions commonly contain Himalayan plants. Without any conservation measures in place, sought-after medicinal plants could be said to almost 'flow' off the mountains.

No modern health services exist in this part of Nepal – and there probably won't be for many years. Instead, people rely on Tibetan medicine. Tibetan doctors, known as 'amchis', have a long tradition of written medicine and have great knowledge and understanding of the Himalayan flora. Indeed, until the formation of the Shey Phoksundo National Park, they were also responsible for much of the natural resource management in the area.

Because WWF works among local people, our efforts are very participatory and interdisciplinary. We try to bring together our scientific knowledge, including ethnobotany, with local knowledge of land management and plant ecology provided by the amchis. Basically, we work to meld the two knowledge systems together.

Initially, we spent a year in the field, discussing various issues with the local community and trying to develop an overview of the problems and how to tackle them. Eventually, we decided on a two-pronged approach.

First, we helped the community set up pasture committees responsible for the field management of medicinal plants. In the Himalayas, pastures used for yak grazing can be extensive and take many hours to traverse. They also contain locally recognized subunits used, for example, for the rotational grazing of domestic animals. As these traditional 'field boundaries' were already in place, we decided to use them for testing different management regimes for medicinal plants – including rotational collection. These regimes were also based on indigenous knowledge, not only that of the amchis, but that of the yak herders and other stakeholders.

Second, we attempted to support traditional healthcare through the Tibetan medical system.

Nepal is a Hindu state that recognizes Ayurveda, but not the traditional Tibetan medicine practiced in this part of the country. Because there is no state support for Tibetan medicine, the amchis worry that their tradition will decline. Therefore, in Dolpa, we have helped build new medical centres where the amchis can work. We also support the training of apprentices. In addition, the centres act as hubs for monitoring the availability and management of the various medicinal plants.

It is still too early to know whether this model will work. However, word of this project in Nepal has now spread to other areas where Tibetan medicine is traditionally practiced, including Bhutan, where it is the main medical system, Sikkim in India, and elsewhere in Tibet. We recently brought practitioners from each of these areas together for the first time to discuss ways to strengthen their tradition and how to conserve their medicinal plant resources.

Details of how to conserve medicinal plants will certainly vary greatly from place to place. WWF hopes that its project at Dolpa will provide the basis for one model for this particular part of the world. ■

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STANDING UP FOR YOUTH

IN A NOD TO THE ADAGE 'YOUTH MUST BE SERVED', LAST AUTUMN'S CONFERENCE, ORGANIZED BY THE GLOBAL CHANGE SYSTEM FOR ANALYSIS, RESEARCH AND TRAINING (START) PROGRAMME AND HOSTED BY TWAS, BROUGHT TOGETHER 80 YOUNG SCIENTISTS FROM AROUND THE WORLD TO DISCUSS THEIR LATEST RESEARCH FINDINGS ON CLIMATE CHANGE.

The keenest scientific insights are often reserved for the young.

Albert Einstein, for example, was just 26 years old when, in 1905, he published no less than three seminal articles in the German scientific journal, *Annalen der Physik*. His articles, which included his mind-bending revelation on the theory of general relativity, turned our perception of the universe upside down.

Yet, the vast majority of scientists attending scientific meetings – the 'confabs' that serve as the lifeblood of the profession – are usually, shall we say, mature scientists. Their accumulated knowledge, prestige, resources and contacts often conspire to make them the most likely participants at scientific conferences and workshops – regardless of the field under study.

The Global Change System for Analysis, Research and Training (START) programme recently sought to reverse this long-standing trend by sponsoring the first-ever International Young Scientists' Global Change Conference. The event, hosted by the Third World Academy of Sciences (TWAS), took place at the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy, from 17-19 November 2003. More than 80 scientists, all less than 35 years of age, were in attendance. Fifty percent of the participants were women and 50 percent were from the developing world.

"The START programme, which was launched in 2001, has had a significant impact on the building of scientific capacity throughout the world, particularly the developing world," notes Peter Tyson, chair of the organizing committee and vice president of the International Council for Science (ICSU). "This conference was organized, in part, because we believed it was time to recognize and encourage a new generation of climate change researchers, many of whom we had helped to train during the earliest stages of their

careers. In effect, we were seeking to showcase the work of the youthful individuals whom we have been assisting over the past several years.

"In some measure," Tyson adds, "the conference helped to confirm that all scientists, both young and old, are united by their quest for knowledge and the thrill of discovery. Nevertheless, the conference organizers – and the scientific community in general – recognize that we must do more to assist young scientists if our disciplines are to remain vital and productive in the years and decades ahead."

The keenest scientific insights are often reserved for the young.

The appeal of this young scientists' event was evident by the response. More than 1,100 scientists from over 30 countries submitted applications. An expert review panel met in Trieste in early June to vet the proposals, ultimately selecting some 80 applicants to attend the conference. Topics ranged from the impact of global climate change on coastal land-use patterns in southern Bahia, Brazil; to climate-induced decreases in ecosystem productivity in Lake Tanganyika, east Africa; and to the threats posed to coral reefs in the Red Sea due to rising water temperatures.

"We are only just beginning to understand how the Earth's climate operates as an integrated system," says Nobel Laureate Paul J. Crutzen (Chemistry 1995), who joined Tyson and Roland Fuchs, director of START, in helping to organize the conference. Crutzen also gave one of the keynote addresses focusing on the scientific lessons learned from investigations into the stratostopheric ozone hole.

Efforts to shrink – and eventually close – the ozone hole represent one of global scientific community's most significant success stories over the past two decades. The hole, created by the widespread use of chlorofluorocarbons (CFCs) and other ozone-depleting chemicals contained, for example, in aerosol cans, refrigerators, air conditioners, cleaning solvents and insulation, poses a serious threat both to the health of humans and the vitality of our global ecosystem. The threat has been diminished, however, thanks to restrictions imposed by the Montreal Protocol, enacted in 1987, and the development of CFC substitutes.

"As studies of our climate and weather have shown, the planet functions as a complex, integrated system

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responsive to natural internal and external forces, on the one hand, and anthropogenic impacts, on the other," says Crutzen.

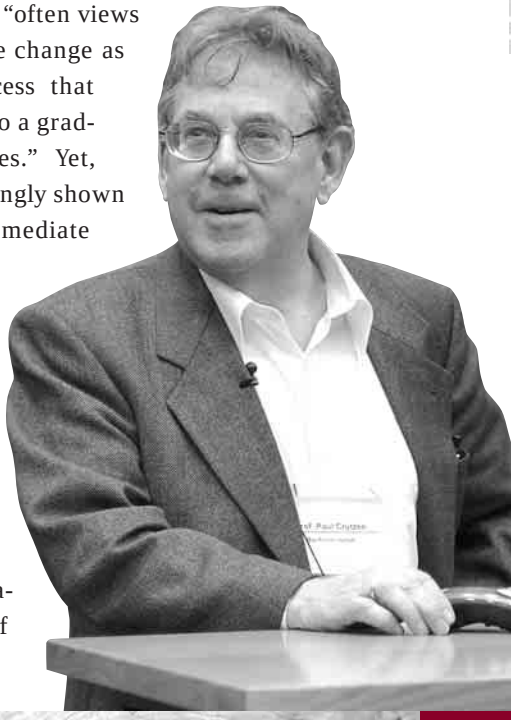
"Today's young scientists," he adds, "face compelling challenges in seeking to understand how that system works. The year 1998 was the warmest year in the last millennium and the 1990s, on average, was the warmest decade in the 20th century. We know, moreover, that there is a close correlation between rising concentrations of carbon dioxide and other greenhouse gases and increasing global temperatures. But we still have a great deal to learn, not only about the mechanisms responsible for this relationship, but also the 'feedback' processes that make the relationship so complicated and difficult to understand."

Climate change is a challenge that is likely to engage generations of scientists to come.

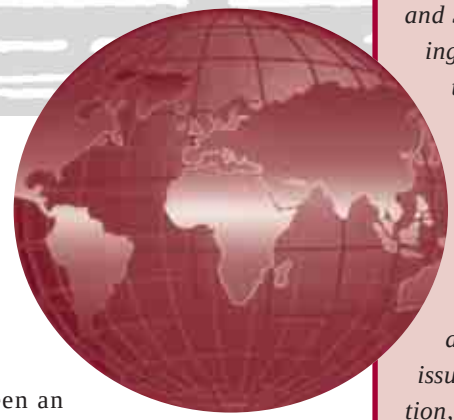
Indeed the chemical interactions that take place between the land, ocean and atmosphere are endlessly complex and usual don't lend themselves to simple explanations. Rising temperatures, for example, have made many arid regions throughout the world even drier. These drylands, in turn, have been stripped of their vegetative cover, which increases the intensity of dust particles in the atmosphere. Some of these particles are carried by the wind to distant oceans. The high micro-nutrient content of these particles, often rich in iron, nurtures a dramatic increase in ocean algae blooms. These blooms then draw carbon dioxide from the atmosphere as part of their life-sustaining process, helping to reduce the levels of this greenhouse gas.

"What all of this means for global climate change remains difficult to assess," notes Crutzen. "But answering this question with the confidence that only science can provide is critical if we are to truly understand the climate change phenomenon and, equally important, provide policy makers with the information that they need to make intelligent, effective choices."

"The public," adds Fuchs, "often views climate change as a process that leads to a gradual rise in temperatures." Yet, researchers have increasingly shown that the most serious immediate threat posed by climate change may be the higher incidence of such extreme weather-related events as hurricanes and tornadoes."



There appear to be 'stress thresholds' caused by surging temperatures and changing precipitation patterns, which, if



breached, can generate abrupt alterations in regional and global weather and climate patterns.

"We know," Fuchs notes, "that there has been an increasing number of extreme weather events over the past several years, but we don't know when the thresholds responsible for these events may be reached or whether such cross-over events can be reversed. The next generation of scientists will likely spend a great deal of time exploring such questions."

"Finally," adds Tyson, "scientists have developed a wide range of forecasts for potential increases in average global temperatures between now and the end of the 21st century. These forecasts vary from 1.5 degrees to 6 degrees Centigrade. It will be important for the next generation of scientists to narrow the range of probability through the development of more sophisticated models and methods of analysis. Greater precision in our forecasts – and greater confidence in our findings by policy makers – will help ensure that science plays a central role in what may prove to be the most critical environmental challenge that we will ever face. It is a challenge that is likely engage not just the current generation of scientists but generations of scientists to come."

As Crutzen observes, "the START International Young Scientists' Global Change Conference, which attracted the interest of so many young scientists from around the world, seems like an excellent strategy for creating a new generation of ambassadors for the environment. The enthusiastic response to our efforts offers a hopeful sign that our planet will indeed be shepherded by well-trained and dedicated weather and climate researchers in the future." ■

For additional information about START, see ⋯ ***www.start.org***.
For more information on TWAS's participation in the programme, contact ⋯ ***Sheila Khawaja***
email: info@twas.org

CLIMATE FOR PARTNERSHIP

This is not the first time that TWAS has teamed up with the Global Change System for Analysis Research and Training (START) programme as part of a larger effort to build and reward capacity building efforts in climate change research. TWAS serves as the executing agency for the four-year, US$7.5 million project entitled Assessments of Impact and Adaptation to Climate Change in Multiple Regions and Sectors (AIACC). Launched in 2001 with funding from the Global Environment Facility (GEF), the project is designed to expand the base and range of information on climate-change-related subjects in the developing world. Over the past three years, some 20 institutions in the South have been involved in comprehensive research initiatives intended to provide both information and training for addressing critical climate-change-related issues within their countries and regions. In addition, AIACC has held six international workshops, including a workshop in Trieste from 3-14 June 2002. For additional information about AIACC, see www.start.org/project_pages/aiacc. *Also see the* TWAS Newsletter, *'Climate Change Sparks New TWAS Partnership', Vol. 13, No. 4, 2001, pages 22-23, and 'Temperatures Rising', Vol. 14, No. 2/3, 2002, pages 30-33.*

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EARTH, WIND AND COWS

What does the overgrazing of grasslands have to do with global climate change?

"There is indeed an important connection," says Gervasio Piñeiro, a 30-year-old Uruguayan agronomist who currently serves as a teaching assistant with the Department of Natural Resources at the University of Buenos Aires, Argentina. "In the same way that soil erosion affects the flow and ecology of a stream bed, changes in soil composition impact the chemical make-up of the atmosphere – often placing both the soil and air at risk."

Piñeiro, who has led a three-year project examining the impact of intensive grazing on the organic content of soils in the Rio de la Plata grasslands that span the border between Argentina and Uruguay, presented his findings this past autumn at the International Young Scientists' Global Change Conference in Trieste. To his surprize and delight, his efforts earned him the Paul Crutzen Award for the best conference presentation.

The research plan that Piñeiro and his colleagues devised called for comparing 15 sites that had been intensively grazed for the past 5 to 30 years with 15 sites from which grazing animals had been excluded during the same period. Based on the current populations of cattle, sheep and other domestic animals, the scientists estimated that many pastures currently experience stocking levels more than 10 times higher than those pre-dating the European settlement of the region.

Farmers and ranchers have long realized that such intensive grazing has an adverse impact on the soil. However, they have not understood the process that leads to this unwelcome outcome nor the pace at which the change occurs.

Through their time-based comparative studies, Piñeiro and his colleagues not only showed that the soils were losing both nitrogen and carbon but they also devised a compelling explanation for the reason why this was occurring.

The researchers surmised that the nitrogen in the cows' urine, in the form of urea, was being transformed into gaseous ammonia. As a result, the nitrogen, which had been previously 'fixed' in the soil,

could now easily escape into the atmosphere. Because nitrogen is an essential nutrient for both plants and microbes, its loss adversely affects plant growth.

Stunted growth, in turn, constrains the accumulation of carbon in the soil, resulting in a net loss in the soil's organic carbon and, ultimately, in the release of carbon dioxide into the atmosphere. Likewise, some 30 to 50 percent of the carbon consumed by cattle is lost to the atmosphere, either as methane or carbon dioxide, both of which are greenhouse gases.

In compacted soils, such as those resulting from overgrazing, denitrification – the step-by-step transformation of nitrate in the soil into gaseous nitrogen compounds such as nitrous oxide – becomes more prevalent. Nitrogen, in the form of nitrous oxide, absorbs nearly 300 times more heat per molecule than the most prevalent greenhouse gas, carbon dioxide. That makes nitrous oxide a potent contributor to global warming.

"The most immediate impact of overgrazing is soil compaction," says Piñeiro. "But the more significant and potentially longer-lasting impact, which takes place over time, is the loss of nitrogen and carbon that not only saps the soil of its fertility but also increases greenhouse gas levels by releasing carbon dioxide and nitrogen into the atmosphere.

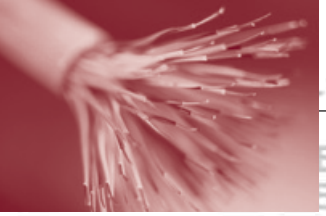
"I liken the process to skin cancer. It's difficult to detect at first and doesn't do much harm for some time. But after a long period it can cause serious, perhaps irreversible, damage."

"The prize committee," says Peter Tyson, chair of the conference organizing committee and vice president of the International Council for Science (ICSU), "faced a difficult choice because so many of the presentations were so good. However, we eventually agreed that Piñeiro's presentation deserved special recognition. Not only was it based on excellent research and analysis, but it also focused on the intimate connections that exist between all media – air, soil and water. In addition, his findings provided a potential scientific basis for policy measures that could simultaneously enhance the soil's fertility and curtail the emission of greenhouse gases."

Piñeiro and his colleagues are continuing their field surveys and studies as part of a larger effort to confirm their urine-ammonia-soil nitrogen loss hypothesis. At the same time, they hope to convince farmers and ranchers in Argentina and Uruguay that the planting of nitrogen-fixing legumes – for example, clover and alfalfa – could help replenish the nitrogen content of the soil.

"Nitrogen loss is a serious problem in grazing lands not only in the Rio de la Plata but in many other grassland regions. If we can devise a strategy that is both cost effective and ecologically sound, we can help sustain the health of the soil. That, in turn," Piñeiro adds, "will help ensure the long-term economic well-being of the farmers and ranchers who depend on the grasslands for their financial livelihood." ■

For additional information on this project, contact ***Gervasio Piñeiro***
email: pineiro@ifeva.edu.ar



DIGITAL DANCING: FROM GENEVA TO TUNIS

DIGITAL TECHNOLOGY PROMISES TO REVOLUTIONIZE THE WORLD, BUT ONLY IF ALL NATIONS HAVE ACCESS TO IT.

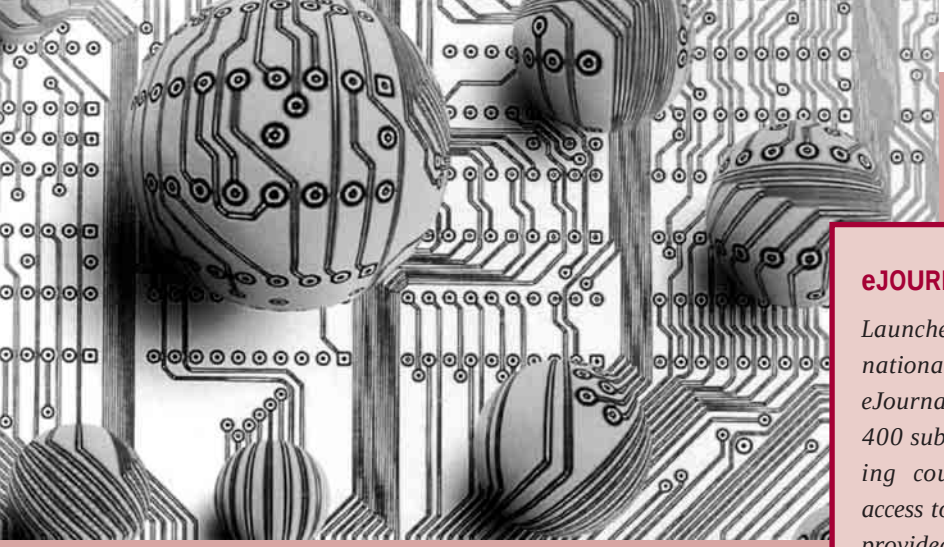
More than 11,000 people, including some 40 heads of state, attended the World Summit on the Information Society (WSIS) that took place in Geneva, Switzerland, from 10-12 December last year.

Organized by the United Nations International Telecommunication Union (ITU), the summit marked the first phase of a two-phase initiative to explore recent developments in information and communication technologies (ICTs) and the impact that ICTs are having on our global society. The second phase will take place in Tunisia in 2005.

In Geneva, the Third World Academy of Sciences (TWAS) helped ensure that science was accorded its rightful place at the centre of debates on the use of ICTs to promote sustainable economic development by proposing, together with other international scientific organizations, various principles and plans of action. In Tunisia, TWAS will help organize a series of sessions examining the impact of ICTs on the developing world, particularly in relationship to science-based development.

ICTs are powerful tools that could bring 21st century knowledge and skills to people in even the most remote and impoverished areas. The WSIS is designed, in part, to lend a helping hand to developing countries in their efforts to leapfrog the 'digital divide', join the global 'information society' and build their own 'knowledge-based economies'.

In preparation for the first phase of the World Summit on the Information Society (WSIS) held last December in Geneva, TWAS joined forces with other like-minded scientific organizations to develop key points for inclusion in the WSIS Declaration of Principles and Action Plan (see 'Divide No More', *TWAS Newsletter*, Vol. 15, No. 3, 2003, pages 29-33).



eJOURNALS DELIVERY SERVICE

Launched in autumn 2001 by TWAS and the International Centre for Theoretical Physics (ICTP), the eJournals Delivery Service now has nearly 400 subscribers from over 60 developing countries. Subscribers have access to more than 240 journals provided by such publishers as the Academic Press, the American Physical Society, the Optical Society of America and the World Scientific Publishing Company. In addition, last year, Elsevier Science, one of the world's largest and most prestigious scientific publishing houses, agreed to provide scientists in the South electronic access to its complete list of physics and mathematics journals.

The aim of the ICTP/TWAS eJournals Delivery Service is to distribute individual scientific articles via email to scientists in institutions throughout the Third World that do not have access to sufficient bandwidth to download material from the internet in a timely manner and/or cannot afford the connection costs. In this way, scientists are provided with up-to-the-minute literature to support their ongoing research. For additional information see www.ejds.org.

These organizations, including the European Organization for Nuclear Research (CERN), the International Council for Science (ICSU) and the United Nations Educational, Scientific and Cultural Organization (UNESCO), also held a workshop prior to the WSIS. This two-day meeting, given the descriptive title, The Role of Science in the Information Society (RSIS), was aimed at presenting delegates of the main summit with an understanding of the critical contribution that science played in the development of the world wide web and science's continuing key role in driving the future of information and communication technologies (ICTs). As CERN's research director Roger Cashmore succinctly put it: "Without science, there would be no information society."

Information and communication technologies could bring 21st century skills to people in even the most remote areas.

Over the next two years, as planning unfolds for the second phase of the WSIS, scheduled to take place in Tunis, Tunisia, in November 2005, TWAS will continue to work closely with other organizations in helping to shape the future of the information society – including exploring ways to expand the role of science and scientists in ICTs as an instrument for social change and ensuring that these enabling technologies are within reach of the developing world, including the least developed countries (LDCs).

So what exactly happened in Geneva? What was achieved? And how has the stage been set for the second phase of the summit in Tunisia in 2005?

ROLE OF SCIENCE

In his address at the RSIS, UNESCO director-general Koïchiro Matsuura summed up what is at stake.

"At a time when the current phase of the scientific-technological revolution shows no sign of slowing down, can we continue to ignore the fact that one-in-five of the world's people live on less than a dollar a day, and one-in-seven suffer from chronic hunger?

"The international community responded to the pressing need to address this state of affairs at the

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PAST, PRESENT AND FUTURE

In the run-up to the second phase of the WSIS in Tunis, TWAS and its international science partners, including the International Council for Science (ICSU), are helping to organize a satellite summit. The 'Past, Present and Future (PPF) of Research in the Information Society' meeting will take place from 13-15 November 2005 and aims to highlight the role of scientific research and knowledge in the information society. Special emphasis will also be placed on the problems, possibilities and successes of research institutions in developing countries. In particular, PPF will consider:

- the past: *the scientific and technological developments that have led us to where we are today;*
- the present: *cutting edge developments in both the public and private sectors; and*
- the future: *connectivity and collaboration issues that can be used to help close the digital divide for research institutions in the South.*

Sponsors for the satellite meeting include the US National Science Foundation, Louisiana State University, Intel and Internet2.

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2000 United Nations Millennium Summit by agreeing on a set of key development goals with time-bound targets – the Millennium Development Goals," continued Matsuura.

"Harnessing science and the power of ICTs can, both directly and indirectly, contribute substantially to realizing every one of these goals. It can create new economic opportunities that lift individuals, communities and nations out of poverty. Furthermore, ICTs can ensure greater availability of health and reproductive information, facilitate the training of medical personnel and teachers, and help empower women with the same rights and opportunities as men."

Proponents of the internet hope that, in the future, everyone will be 'connected'.

Proponents of the internet hope that, in the future, everyone will be 'connected' – just as Thomas Edison predicted that, one day, everybody would be able to turn night into day by having one of his inventions – the electric light bulb – in their homes. As TWAS vice president Lu Yongxiang put it in his address at TWAS 9th General Conference, held last year in Beijing, a key to accelerating economic development in the South is to launch war against what he called 'knowledge poverty' by investing in knowledge infrastructure.

Lu was quick to add that only with access to information – access made possible through electronic communications – will individuals, both in the South and in the North, be empowered to make correct decisions that will positively affect their future. Put another way, the digital divide can only be overcome if ICTs become truly global in scope.

A fundamental aspect of the internet is that it enables information – and data of all kinds – to be freely shared. This concept was addressed by Ismail Serageldin (TWAS Fellow 2001) of the *Bibliotheca Alexandrina*, Egypt, at the RSIS, when he predicted that digital libraries will become increasingly common. Such libraries, he noted, will eventually contain not only books and journals, but also video clips of famous speeches and recordings of great lectures. However, Serageldin cautioned, such issues as peer review, copyright and fair use still must be resolved before information can be made more freely available.

Despite the fact that, when it comes to internet access, many developing countries are still playing 'catch-up' with countries in the North, scientists and computer programmers are already working on the next generation of ICT known as the 'data grid'.

Luciano Maiani, director-general of CERN, explained that the grid is a way of connecting computers so that they can act in parallel, becoming – in effect – a 'metacomputer'.

The impetus for the grid has been the Large Hadron Collider (LHC) being built at CERN in Switzerland. The LHC will come on line next year and generate orders-of-magnitude more data than any previous high-energy physics project or – for that matter – any other research project. Moreover, the data must be made available to thousands of physicists around the world. In its current form, the world wide web cannot handle such vast amounts of information – hence the need for a new solution.

The idea is to link computers so that, instead of exchanging information – as with the web – their unused processing capacities can be integrated together. To accomplish this task, such technical difficulties as compatibility standards must be overcome, as well as such political concerns as international regulation, national sovereignty and data protection.

Maiani believes that the grid – and the power it will have to store and process data – will not only benefit scientific projects and institutions, but also commercial companies. Like the internet, he added, the grid is also being developed by scientists – another reason for including the role of science in the WSIS Declaration of Principles and Action Plan.

"The RSIS meeting," noted Mohamed Hassan, TWAS executive director, "was successful in that it examined the critical role that the scientific community played in the recent ICT revolution and, turning full circle, the effects that this new technology is having on the scientific community and how science is practiced around the globe."

WSIS

In contrast to the science focus of the RSIS, the WSIS itself highlighted the cultural and ethical problems created by the 'digital divide' – the gap in access to the internet between people in developing countries and those in the North.

EDUCATING THE EDUCATORS

In sub-Saharan Africa, more than 25 million people are living with HIV/AIDS and an additional 3 million new infections occur every year – mostly as a result of ignorance about the disease and how it spreads. Without a vaccine, the only means of HIV/AIDS prevention is through education.

To attend to this need, the Virtual Institute for Higher Education in Africa, supported by UNESCO and the National Universities Commission of Nigeria, is currently running a free, online course on HIV/AIDS education for all staff of educational institutions in sub-Saharan Africa.

The course aims to develop a critical mass of teachers who will then train others and disseminate knowledge of preventive HIV/AIDS practices throughout the region. Teachers are not only provided with basic information about the biology and sociology of HIV/AIDS, but are taught how best to instruct pupils on this content. Advocates hope that the programme will help people in Africa understand the nature and impact of HIV/AIDS and encourage them to change their behaviour to prevent further spread of the disease. For additional information, see www.viheaf.net.

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DIGITAL SOLIDARITY

At the conclusion of the WSIS in Geneva, developed and developing nations agreed to disagree over the creation of a 'Digital Solidarity Fund' designed to accelerate the development and dissemination of ICTs in Africa and elsewhere.

The fund, proposed by Abdoulaye Wade, President of Senegal, on behalf of the New Partnership for Africa's Development (NEPAD), would be administered by the UN and used to help technologically disadvantaged countries build telephone lines and other infrastructure to help narrow the digital divide.

According to ITU secretary general Yoshio Utsumi, some 1.5 million villages in developing countries still lack a telephone service, but it would cost just US$1.1 billion to connect them, or US$6.3 billion if internet access was also provided. "This is just 1 percent of global fixed-line revenue, or 3 percent of global investment in ICTs," added Utsumi.

However, the proposed fund ran into opposition from such developed countries as Japan and the European Union. Instead of a specific new fund, these countries contended, existing methods of funding should be examined. The WSIS Action Plan, therefore, calls on a task force, under the auspices of UN Secretary General Kofi Annan, to review existing financial mechanisms by December 2004 and to present their findings and recommendations at the second phase of the WSIS in Tunis in 2005.

Despite the controversy over the creation of a Digital Solidarity Fund, at the close of the summit, the cities of Lyon, France, and Geneva, Switzerland, together with the government of Senegal, announced joint contributions to the fund of Euros 1 million (US$1.2 million).

In countries preoccupied with such life-and-death as issues famine and HIV/AIDS, how realistic is it for governments to justify their preoccupation with bringing the internet to their people? Put another way, is the digital divide so significant when other divides – the nutrition divide, the health divide, the sanitation divide – all impede the well-being of the South?

In responding to this question, we need to remember this: the digital divide is different from all other divides because it involves an enabling technology. In other words, close the digital divide and you have an opportunity to close all the other divides – but only if you address the problem of this divide in ways that are central to the developing world. And that is where the summit revealed the existence of a North-South strategic divide within the digital divide itself.

As the summit unfolded, in fact, the 'divide within the divide' became increasingly evident by the juxtaposition of different issues of primary concern in the South and North. While representatives of developed countries talked of e-government, web commerce, information ownership, connectivity and next-generation technical issues, representatives from developing nations pondered the validity of prioritizing access to the internet, providing computers to schools, and even the need to provide a reliable electricity supply as a first step in the communications revolution. Despite Tim Berners-Lee, the inventor of the internet, foreseeing a world where everybody will be 'connected', many of the world's least developed countries have yet to fulfil Edison's prediction of an electric light bulb in every home.

As Adama Samassékou, president of the WSIS Preparatory Committee put it: "The WSIS presents a great opportunity that we must all seize to put in place a vast programme of development to preserve the dignity of the human being and of nations."

In themselves, ICTs are not of any use, continued Samassékou, but must be put to good use, helping to improve the well-being of all people, both in the South and North.

That is why the summit focused on such issues as preserving indigenous knowledge, highlighting the importance of ethics in science, and ensuring that the wealth of information now available on-line is used effectively in the promotion of economic development.

Even so, less than five years ago, critics were bemoaning the digital divide, fearing that new ICTs would widen rather than narrow the gap in knowledge and know-how between the North and the South.

Today, that fear remains. However, recent developments in the South suggest that advances in ICTs are beginning to fulfil their promise.

In Pakistan, for example, access to the internet is now available in 95 percent of the country, connection costs have fallen by a factor of 30 over the past 3 years, and internet cafes have brought telecommunication technology into the lives of many young Pakistanis. In Nigeria, the number of mobile phone users has increased from 500,000 to more than 2.5 million over the past two years. There is a proposal to link seven southern and eastern African countries with a US$300 million submarine cable system that will reduce connection costs in the region by 70 percent. And there is a drive to make all African high-school students literate in information technology (IT) by 2009, and all primary school children IT-literate by 2014.

Recent developments in the South suggest that advances in ICTs are beginning to fulfil their promise.

These and other examples highlight the fact that the South is becoming increasingly 'connected'. The question now is how to make effective use of ICTs to address critical social and economic issues.

Although WSIS provided little guidance on how this can be achieved, the idea behind the two-phase summit is for governments and nongovernmental and international organizations alike to develop specific proposals on making ICTs work for development in the South. (Some examples are highlighted in the 'boxes' accompanying this article).

Such concerns will also be the focal point of discussion at a side event now being organized by TWAS and other scientific organizations for the second phase of the WSIS, to be held in November 2005 in Tunisia.

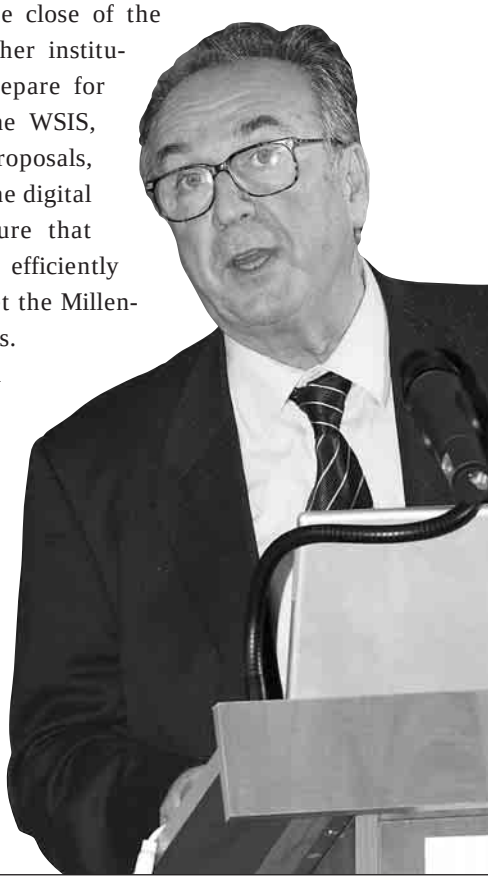
The Geneva phase of the WSIS ended with the heads of state and other delegates in attendance endorsing the Declaration of Principles and Action Plan, including all the points proposed by TWAS and its science partners.

Among the long-term goals the delegates agreed to were:

- Development of affordable and reliable high-speed internet connections for all universities and research institutions.
- Promotion of electronic publishing through open access initiatives and differential pricing for scientists and institutions in the South.
- Creation of long-term, systematic and efficient ways to collect, disseminate and preserve scientific data in a digital form.

"Through our role in the RSIS and WSIS, TWAS has helped ensure that the concerns of the South – and specifically the scientific community in the South – were heard at the highest levels of the international community," observed Mohamed Hassan at the close of the summit. "Like many other institutions, we must now prepare for the second phase of the WSIS, and develop concrete proposals, not only to try to close the digital divide, but to make sure that ICTs are effectively and efficiently put to work to help meet the Millennium Development Goals.

"Ultimately," Hassan noted, "information alone is of no use to anyone. It is how that information is put to work – and by whom – that will determine whether the electronic communications revolution changes society for the better, or simply reinforces existing trends." ■



SCIENTIFIC COLLABORATION IN ECUADOR

THE 2003 SIGMA XI FORUM, 'SCIENCE AND ENGINEERING: KEYS TO INTERNATIONAL UNDERSTANDING', HELD LAST AUTUMN IN LOS ANGELES, DISCUSSED A NUMBER OF ISSUES OF INTEREST TO TWAS AND ITS AFFILIATED ORGANIZATIONS. AS EUGENIA M. DEL PINO VEINTIMILLA (TWAS FELLOW 1989) REPORTS, A KEY TOPIC WAS HOW INTERNATIONAL COLLABORATION CAN HELP BUILD SCIENTIFIC CAPACITY IN DEVELOPING COUNTRIES.

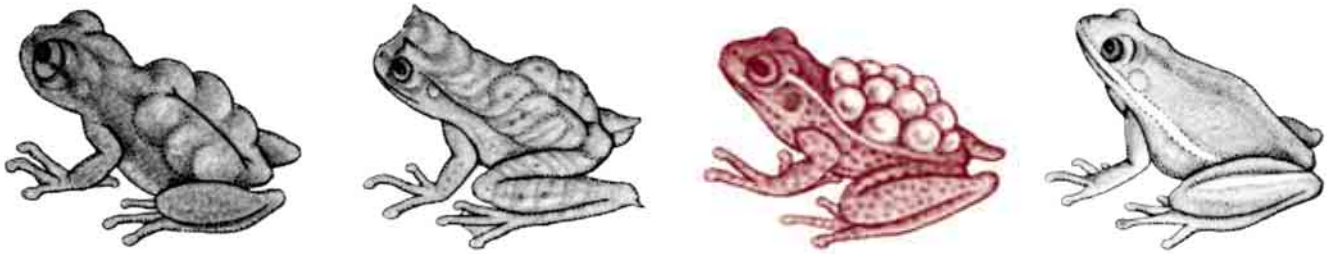
Sigma Xi, the Scientific Research Society, is a non-profit organization with a membership of more that 70,000 scientists and engineers elected on the basis of their achievements. Founded in 1886, the society has more than 500 chapters, publishes American Scientist, *and awards grants to young researchers. Additionally, it holds fora on critical issues at the intersection of science and society and sponsors a variety of programmes supporting science and engineering, science education, science policy and the public understanding of science.*

The 2003 Sigma Xi forum, held in Los Angeles from 12-13 November 2003, was attended by 130 scientists and engineers, about 50 of whom came from developing nations. Among the themes discussed at the forum were the outreach efforts of global scientific organizations, and science and technology cooperation between Mexico and the United States.

Another session, 'Collaborative Research: South-South and South-North', co-organized by Sigma Xi and TWAS, focused on successful examples of research cooperation between the developed and developing world.

Collaboration among scientists is increasingly recognized as an important strategy for strengthening science capacity not only in the less advanced nations, but across the entire globe.

Proving that such efforts can have a long-term impact, the following article – based on a presentation at the Sigma Xi forum – describes the establishment and development of a successful teaching and research initiative in biology at the Pontifical Catholic University of Ecuador (PUCE), which is now recognized by TWAS, TWNSO and the South Centre as a 'centre of excellence'.



BUILDING CAPACITY

An estimated 70 percent of species come from just 17 countries that are home to a so-called 'mega-biodiversity' of fauna and flora. Among this select group, which also includes Brazil, China and Peru, is Ecuador. Covering just 0.17 percent of the Earth's land surface, Ecuador is home to 10 to 20 percent of all land mammal, bird, reptile and amphibian species as well as 1,400 species of fish and more than 16,000 species of higher plants.

Despite the country's rich natural heritage, biology has only been taught at the Pontifical Catholic University of Ecuador (PUCE) since the 1960s. With assistance from Alliance for Progress, an aid programme for Latin America launched by the United States during the Kennedy administration, degree courses in biology and other natural sciences were instigated. Aid from Alliance for Progress provided funds for the construction of facilities, provision of laboratory equipment and teaching aids, and support for faculty and staff.

The programme focused on training high-school science teachers as a prerequisite for the promotion of science education. Gifted students were encouraged to apply for fellowships to receive graduate training in the United States. After the completion of the training abroad, these individuals often returned to Ecuador to teach at PUCE.

E. M. del Pino Veintimilla

Alliance for Progress stopped funding the initiative in 1969. Since then, biology teaching and research has been in the hands of the Ecuadorian faculty who have greatly advanced the effort. Today, PUCE has 11 technicians and other staff supporting 36 research scientists and professors, and an annual budget of about US$500,000.

Some 70 percent of species come from just 17 countries, including Ecuador, that are home to a 'mega-biodiversity' of fauna and flora.

This growth has been due to several factors, including the dedication of the faculty members, support given by the university, and collaborative links developed with other institutions both in the North and the South.

Ecuador's rich natural diversity has also helped, and long-term biological studies have been undertaken by members of the biology faculty. The School of Biological Sciences at PUCE is now recognized as one of the best centres for biological research and teaching not only in Ecuador but worldwide – a fact highlighted by its inclusion in the Third World Network of Scientific Organizations' (TWNSO) *Profiles of Institutions* publication, which lists centres of research excellence in the South (see article on pages 5-8).

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The success and growing demands of biological research and teaching at PUCE soon meant that the original science building became too small. In the 1980s, with funds provided by the Ecuadorian government, a new building was constructed. Demand on space continues to grow, and a new floor has recently been added to expand the laboratory facilities.

Funding for research on the biological sciences in Ecuador comes from such national grant agencies as the Foundation for Science and Technology (FUNDACYT), state and private oil enterprises, and local non-governmental organizations (NGOs), which provide research grants on the basis of a national competition. Some researchers at the School of Biological Sciences also obtain support from collaborative programmes with foreign scientists, universities, and institutions in both the North and the South, and from the provision of services to other institutions. Through its own programme of research grants, PUCE itself provides some support for research. In addition, for the past five years, the university has issued an annual call for research proposals and small grants that are provided to the faculty. PUCE also has a programme of student assistantships that contributes to the advancement of research and the training of students.

RESEARCH STATION

In 1994, the Ecuadorian Institute of Forestry, Natural Areas and Wildlife (now the Ministry of the Environment) created the Yasuni Research Station in the Ecuadorian Amazon forest, and subsequently deferred its administration to the PUCE School of Biological Sciences. The research station is a component of the Yasuni National Park and the adjoining Huaorani Reserve, both part of the Yasuni Man and Biosphere Reserve. Established by UNESCO in 1989, the reserve covers approximately 15,000 square kilometres of pristine rainforest, rivers and lagoons.

The mission of the research station is to:

- Promote and implement scientific research on the natural resources of the Yasuni National Park and Huaorani Reserve to provide a sound basis of ecological and other knowledge necessary for their conservation or sustainable management.
- Train Ecuadorian students and researchers in biological, environmental and related sciences.
- Cooperate with the indigenous peoples that inhabit Yasuni National Park and Huaorani Reserve to help them improve their living conditions in sustainable, socio-ecological ways.

In collaboration with the Smithsonian Institution and the Field Museum of Chicago (both in the USA) and the University of Aarhus (in Denmark), PUCE has established a permanent 50 hectare field research area in Yasuni Research Station to study forest dynamics – part of a network of 16 similar plots located mostly in the tropics. Investigations have already confirmed that the Yasuni forest has a rich biodiversity. For instance, the plot is home to some 300,000 trees and 1,100 different species of woody plants have been identified. With more than 20 species per hectare, the Yasuni forest has one of the highest woody plant diversity scores on record.

Scientists and students from PUCE and elsewhere now come to this well-equipped research station for both instruction and research. In the region's warm, wet climate, however, the original wooden buildings are decaying. In an ambitious plan, PUCE is replacing these older structures with concrete buildings designed to withstand the local weather conditions. Financing for the research station and its operational costs are largely covered by PUCE, but are supplemented by fees paid by visitors.

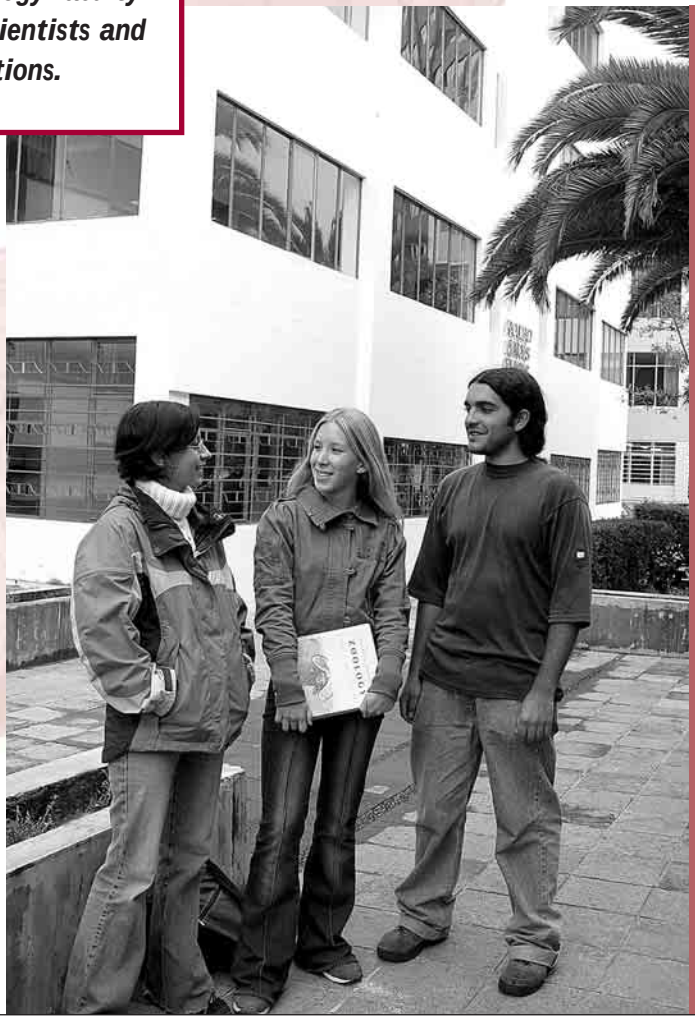
Active scientific links remain between members of PUCE's biology faculty and Danish scientists and institutions.

BIOLOGY AND ECOLOGY

Systematic biology and ecology are well represented at PUCE. The zoology museum (Quito Católica Zoology, QCAZ), which is maintained mostly with local funds, holds a representative collection of Ecuadorian vertebrates and invertebrates that attest to Ecuador's great biodiversity. The invertebrate collection, for example, contains more that one million insects. Plants are similarly well represented in the PUCE collections, with the herbarium (Quito Católica, QCA) containing about 200,000 specimens. These collections are of great importance and value to local researchers and foreign scientists alike.

Botanical research has benefited greatly from the Enhancement of Research Capacity (ENRECA) programme of DANIDA, Denmark's foreign aid organization. From 1989 to 2001, under the ENRECA programme, researchers from the University of Aarhus in Denmark collaborated with PUCE scientists to improve botanical research in Ecuador. In addition, the programme supplied equipment and provided training fellowships. Some students who took part in the programme have since obtained advanced degrees in Denmark and returned to continue their botanical research in Ecuador.

Although this assistance ended three years ago, valuable scientific links remain between members of PUCE's biology faculty and Danish scientists and institutions. The recent publication of several books and articles in international journals, many of them co-authored by staff from PUCE and several other foreign institutions, adds weight to the claim that the herbarium has developed into an internationally recognized centre of research for systematic and ecological botany.



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CELLS AND GENES

Cell and molecular biology research at PUCE has traditionally received less financial support than other areas of the biological sciences. With the aid of France's Institute of Research for Development (IRD), however, three molecular biology programmes are currently in progress.

The first of these is aimed at the molecular characterization of palm trees, and the genetic ties between wild and cultivated palm species. A second project is directed at the genetic analysis of cassava (*Manihot esculenta*), an economically important staple root crop, and its genetic introgressions with the related *M. leptophylla*, a species that is endemic to Ecuador. The third molecular biology project is aimed at isolating viruses that can be used as biological control agents for the Guatemalan moth (*Tecia solanivora*), a pest of potatoes introduced into South America in 1983 and first detected in Ecuador in 1996. For each of these programmes, the IRD provides researchers and laboratory equipment as well as training fellowships intended to build research capacity in Ecuador.

Other efforts are directed to the study of the insect vectors of the Chagas disease caused by the *Trypanosoma cruzi* parasite that is endemic in Ecuador. Funding for this study comes from a collaborative programme with the University of Ohio, USA, and local sources. In addition, the laboratory of human genetics, supported by FUNDACYT and other local sources, is characterizing the chromosomal abnormalities associated with exposure to different environmental agents and the incidence of certain types of cancer.

With the aid of France's Institute for Research and Development (IRD), three molecular biology programmes are currently in progress.

Researchers at PUCE are also studying the cell and molecular biology of development of marsupial and other frogs. These investigations not only provide valuable information concerning the biology of local species, but the modifications of early development that have been discovered have spurred important advances in our understanding of comparative anatomy and embryology. The programme has benefited from small grants provided during the 1970s under the UNDP/UNESCO Biology Programme for the Andean Countries, and from a gift of equipment from Germany's Alexander von Humboldt Foundation. Individual scientists from the United States and Europe have also been generous in providing both advice and key laboratory reagents. More recently, local funds have been

obtained from the PUCE research grant programme and from FUNDACYT, which will ensure the continuation of the project.

TRAINING AND LINKS

The School of Biological Sciences has provided basic training in biology to students who have since become biology teachers, thereby contributing to science education in Ecuador. Additionally, since the 1980s, a degree programme or *Licenciatura* in biological sciences has produced more than 300 graduates. These former students are now engaged in research and teaching at different institutions in the country and in such national agencies as environmental protection. Some of these graduates have also obtained higher degrees at universities in the United States and Europe and returned to work in Ecuador. In other cases, former graduates working abroad have established collaborative links with PUCE, and continue to contribute to biological research and teaching in Ecuador.

The biology faculty at PUCE also has strong links with research for the conservation of the Galapagos Archipelago, and some PUCE graduates have held key positions at the Galapagos National Park Service and at the Charles Darwin Foundation for the Galapagos Islands. PUCE's School of Biological Sciences also cooperates with other universities and institutions within Ecuador.

NORTH TO SOUTH

The support from the North that initiated teaching and research at PUCE in the 1960s has had an enduring positive impact. Cooperation with agencies from other countries in the North, such as the ENRECA programme of DANIDA, Denmark, and the IRD from France, have further enhanced the scientific growth of PUCE. Even so, important contributions have come from local sources, particularly for the construction of buildings. Funding for the areas of cell, molecular and developmental biology, though, has been scarce and additional assistance is needed if scientists working in these areas are to compete with their colleagues in the North.

Although PUCE collaborates with other institutions in Ecuador, such as the Darwin Foundation for the Galapagos Islands, collaboration with other countries in the South is extremely limited because of several difficulties. Among these are funding, which, for the most part, comes from countries in the North. In addition, the great distance between countries in the South, and the high costs of travel between those countries, add to the difficulty of establishing exchange and cooperation with scientists in the South. ■

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NEW PARTNER

• The United Nations University's Institute for Advanced Studies (UNU/IAS) has joined TWAS, the International Science Council (ICSU) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) in sponsoring the Visiting Scientist Programme. The objective of the programme is to provide institutions and research groups in the South, especially those with limited outside contacts, with the opportunity to establish long-term links with world leaders in science. For additional information see *www.ias.unu.edu* and *www. twas.org* under the 'Activities' link.

SCIENCE IN AFRICA

• TWAS has begun an informal collaboration with *Science in Africa* magazine, Africa's first online science internet portal. The website provides Africa-orientated science news to the continent and the rest of the world – and will feature relevant articles from the *TWAS Newsletter*. In addition, special sections of the site cater to young scientists and educators, while information is updated regularly on funding opportunities, science jobs and events. The website receives over 13,000 hits a day and, since its inception in 2001, has received well over 7 million visitors. Founding editors **Janice Limson** and **Garth Cambray** are both active scientists. Limson works in the Department of Biotechnology at Rhodes University, South Africa, while Cambray, a final year PhD student has launched Africa's first mead brewery – producing the traditional beverage from honey. Not yet three years old, *Science in Africa* has already received national and international recognition for its efforts in science communication. In 2002 it won the National Science and Technology Forum award for its outstanding contribution to science, engineering and technology and, in 2003, the magazine won the prestigious Highway Africa New Media award, an all-Africa award for journalism. The magazine can be viewed at *www.scienceinafrica.com*.

PRIZES FOR YOUNG SCIENTISTS

• The Ministry of Higher Education and Scientific Research of the Republic of Guinea has become the latest organization to offer TWAS Prizes for Young Scientists. Recipients, who must be under 40 years of age, are selected by the host organization on an annual basis, with the prize being awarded in each of the natural sciences on a rotating basis. Prizes are worth up to US$2,000 and are usually presented by a high-ranking official at a special ceremony. The Guinean ministry brings the number of ministries, academies of science, research councils and other scientific organizations in the South offering the prize to 35. Among the 2003 prize winners were **Paul Woafo** (Cameroon), **Arturo Ramirez Porras** (Costa Rica), **Gerardo Nieto** and **Reynaldo Santana** (Cuba), **Artbazar Galtbayar** and **Norovsuren Jadambaa** (Mongolia) and **Farhan Saif** (Pakistan). For additional information about TWAS Prizes for Young Scientists, contact *info@twas.org*.

Paul Woafo

Farhan Saif

WAYS TO GO

• Based on a concept first floated at the International Forum for Young Scientists at the World Conference on Science held in Hungary in 1999, the World Academy of Young Scientists (WAYS) has now been launched. With support from UNESCO, the Hungarian government and the Hungarian Academy of Sciences, WAYS promotes the scientific interests of young scientists in both developed and developing countries, and aims to give young scientists a voice regarding, for example, policy issues relating to science and technology and the popularisation of science. WAYS is currently processing membership applications from more than 60 countries. Membership is open to scientists between the ages of 15 and 40 as well as mentors and senior researchers and science administrators. For additional information, contact *ways@sztaki.hu*.

AWARD FOR ATIYAH

• Sir **Michael Atiyah** (TWAS Founding Associate Fellow), University of Edinburgh, UK, has been awarded the 2004 Abel Prize by the Norwegian Academy of Science and Letters. The prize, which carries a cash value of about US$1 million, is shared with Isadore M. Singer, Massachusetts Institute of Technology, USA, and was awarded for their outstanding role in building bridges between mathematics and theoretical physics, and especially for their joint discovery and proof of the Atiyah-Singer index theorem that brings together topology, geometry and analysis. The theorem is regarded as one of the great landmarks of 20th century mathematics. Atiyah has also served as president of the Royal Society in the UK, and helped launch the InterAcademy Panel (IAP), which is located in Trieste, Italy, alongside TWAS.

ZAYED PRIZE FOR OBASI

• **Godwin O.P. Obasi** (TWAS Fellow 1996) has been awarded the 2004 Zayed International Prize for the Environment in the Scientific and Technological Achievement category. Obasi, the former secretary-general of the World Meteorological Organization, was honoured for his efforts in creating the Inter-Governmental Panel on Climate Change (IPCC). The US$300,000 prize was shared with Egypt's Mostafa Tolba, former executive director of the United Nations Environment Programme (UNEP), and Sweden's Bert Bolin, former chairperson of the IPCC. The award ceremony was held in the Dubai International Conference Centre in February and was attended by His Highness Sheik Mohamed bin

Godwin O.P. Obasi

Rashid Al Maktoum, Crown Prince of Dubai and Minister of Defence for the United Arab Emirates.

MINISTERS ON THE MOVE

• In Brazil, economist **Eduardo Campos** has been named the new Minister of Science and Technology, replacing **Roberto Amaral**. In South Africa, **Ben Ngubane**, South Africa's Minister of Arts, Culture, Science and Technology, has resigned to become South Africa's ambassador to Japan. His post has been filled by the former Minister of Minerals and Energy Affairs, **Phumzile Mlambo-Ngcuka**, who is overseeing both ministries until additional cabinet changes expected in April. **Thabo Mbeki**, President of South Africa, thanked Ngubane for having "positioned South Africa as a major and influential contributor to the development of arts, culture, science and technology."

PANZA ELECTED

• **Giuliano F. Panza** (TWAS Associate Fellow 1996), a geophysicist from the University of Trieste, Italy, has been elected to the Italian National Academy of Sciences *detta dei XL*. Panza has earned an international reputation for his work on earthquakes and seismic hazards in large urban areas, including Beijing, Cairo and New Delhi, and for his research with scientists from India and Russia on the seismic energy of the Himalayan region. He has also developed a theory to explain the generation of tsunamis, and a model describing the subduction of the continental lithosphere in continental collisions that is now generally accepted among earth scientists. Panza follows in the footsteps of such notable XL academy members as Amedeo Avogadro, Enrico Fermi, Camillo Golgi and Guglielmo Marconi.

Giuliano F. Panza

GRANT DEADLINES

• Applications for TWAS and affiliated organizations programmes have various deadlines. Among those most imminent are: grants for TWAS Research Units in Least Developed Countries (31 May); TWOWS postgraduate training fellowships for women scientists (31 May); CSIR/TWAS Fellowships (1 June); Support for International Scientific Meetings (1 June); and TWAS Research Grants (1 July). Full details and application forms are available at *www.twas.org* under the 'Activities' link or contact *info@twas.org*.

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.

TWAS has more than 700 members from 81 countries, 66 of which are developing countries. A Council of 13 members is responsible for supervising all Academy affairs. It is assisted in the administration and coordination of programmes by a small secretariat, 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 160 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 90 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**

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