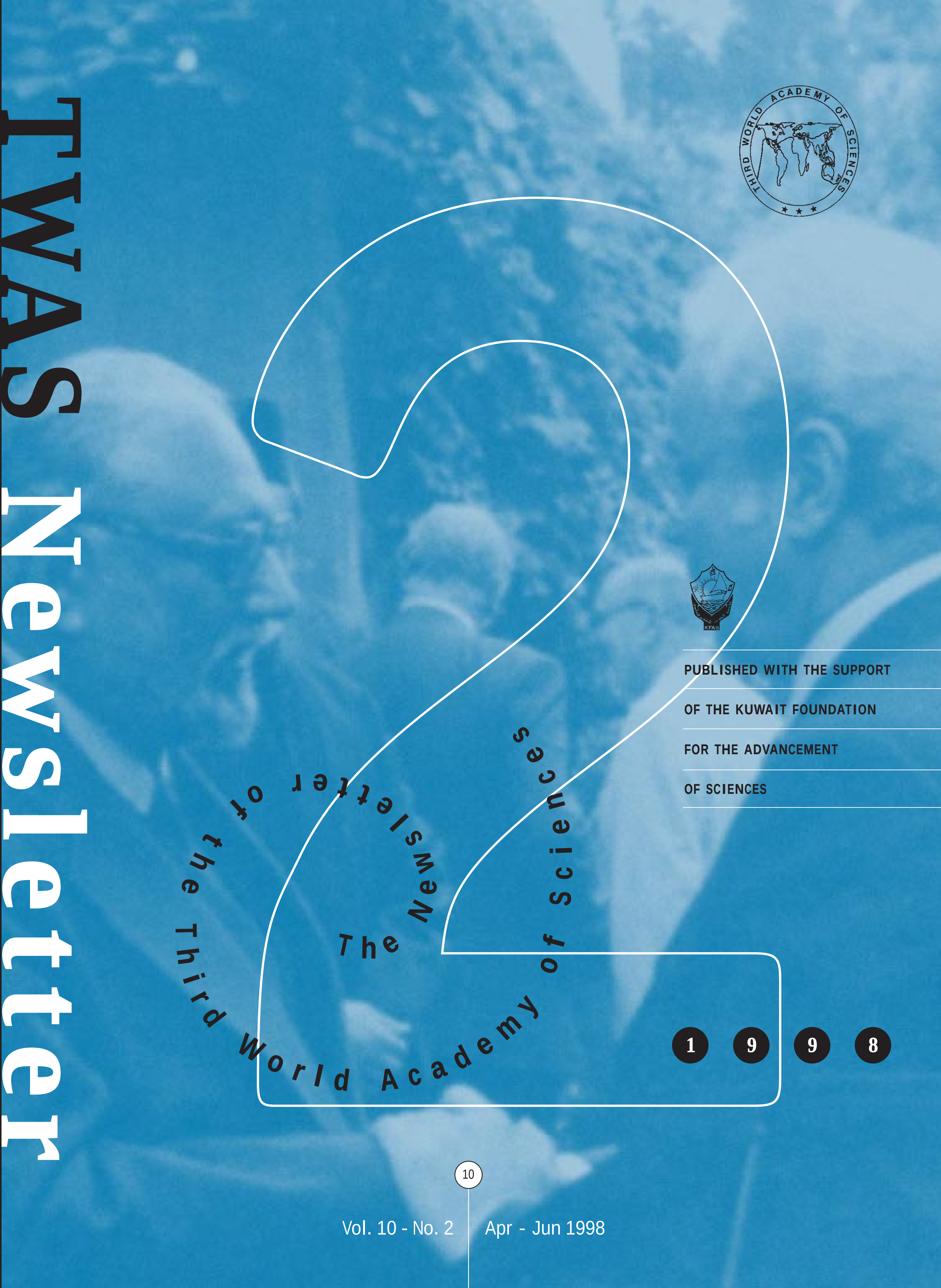
TWAS Newsletter



The Newsletter of the Third World Academy of Sciences

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EDITOR'S NOTE

Then and Now

On 10 November 1983, the founding members of the Third World Academy of Sciences (TWAS) met for the first time in Trieste, Italy. As a result of that historic meeting, the organization's founders, 42 distinguished scientists from the developing world (including all of the South's Nobel Laureates at the time), cited four issues where they believed the new Academy could make a difference: encouraging the pursuit of scientific excellence in the developing world, addressing the needs of young scientists, facilitating South-South and South-North scientific cooperation, and establishing strong links with national and regional academies.

On 9 December 1998, the Academy will hold its tenth General Meeting, also in Trieste. Since our initial gathering, the issues first outlined by our founders have continued to guide our activities. On the eve of our next General Meeting, I thought it would be helpful to highlight our past accomplishments and offer a glimpse of the future.

TWAS's second General Meeting, held in Trieste in July 1985, was a historic event. Not only did the occasion mark the first TWAS General Conference, but equally important UN Secretary General Javier Pérez de Cuellar was the guest of honour at the Academy's official inauguration. Thanks to a generous grant of US$1.5 million from the Italian government, TWAS members discussed and instituted a set of programmes for awards, grants and fellowships designed to address the four issues agreed upon at the first meeting. In effect, the 1983 meeting outlined the lofty goals of the Academy, and the 1985 meeting provided the means for reaching them.

Since then, the Academy has met at least once every two years to review and approve activities, initiate and discuss new strategies, and elect a new council. In addition to Trieste, meetings have taken place in China, Venezuela, Kuwait, Nigeria and Brazil.

The third General Meeting, held in Beijing, China in 1987, was our first meeting to take place in a developing country. Three important initiatives were discussed and approved: to organize a gen-

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C/O THE ABDUS SALAM INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS
PO BOX 586
34100 TRIESTE, ITALY
PH: +39 (040) 2240327
FAX: +39 (040) 224559
TELEX: 460392 ICTP I
E-MAIL: TWAS@ICTP.TRIESTE.IT
HTTP://WWW.ICTP.TRIESTE.IT/~TWAS/TWAS.HTML

EDITOR
DANIEL SCHAFFER
ASSISTANT EDITOR/SET UP
GISELA ISTEN
TWAS SUPPORT STAFF
HELEN GRANT, HELEN MARTIN, LEENA MUNGAPEN, SANDRA RAVALICO
DESIGN & ART DIRECTION
SANDRA ZORZETTI, RADO JAGODIC (LINK, TRIESTE)
PRINTING AND BOUNDING
GRAPHART SNC

eral conference every two years in a developing country, build a network linking national science academies and research councils in the South, and establish a programme to promote women scientists in the third world. The last two proposals led to the creation of the Third World Network of Scientific Organizations (TWNSO) in 1988 and Third World Organization of Women in Science (TWOWS) in 1989.

The sixth General Meeting, held in Trieste in 1993, coincided with the tenth anniversary of the Academy's birth. The occasion provided an opportunity to reflect on our accomplishments and devise a strategy for our continued success. Members discussed and approved the Academy's first strategic plan and officially launched a campaign to create a US$10 million endowment fund to cover the Academy's operational costs.

The eighth General Meeting, held in Trieste in 1996, was a sad event. Just days before Academy members gathered, Abdus Salam, the guiding force behind the creation of TWAS and president from our founding until 1994, passed away. Participants immediately agreed to hold the meeting in Salam's honour and to pay special tribute to his visionary and energetic leadership.

As TWAS members meet for their tenth General Meeting in Trieste this December, three important tasks will be high on the agenda: electing a new council for the next two years, discussing and approving strategies to implement the recommendations of the second strategic plan (approved at the Academy's ninth General Meeting in Rio de Janeiro last year) and re-invigorating the Academy's fund-raising efforts, especially for the endowment fund. We also hope our membership will be greeted by good news: an announcement that the Italian government and the United Nations Educational Scientific and Cultural Organization (UNESCO), the Academy's administrative body, have concluded an agreement providing a permanent legal basis for the Italian government's financial contribution to TWAS. Such an announcement will ensure that the Academy continues to advance the agenda that its founding members first articulated 15 years ago.

No one at that first meeting could have anticipated the Academy's future impact on science in the developing world. And no one can now predict TWAS's impact in the future. However, with the strength of our membership and the security provided by a stable financial base, we can be confident that the Academy will continue to make a difference for thousands of scientists in the developing world.

Mohamed H.A. Hassan
TWAS Executive Director

COMMENTARY

CITIES AND SHAKES

Shocking headlines over the past several decades tell the story. In 1985, a major earthquake in Mexico City kills 9,500 people; in 1988, a thunderous quake in Spitak, Armenia, causes 25,000 deaths; and in 1990, powerful tremors in Luzon, Philippines leave 2,000 dead. The fact is that earthquakes often create life-and-death situations for hundreds of millions of people living in some of the world's most densely populated urban centres. Worldwide, more than 20,000 people on average are killed by earthquakes each year.

This December, the TWAS tenth General Meeting will hold an international symposium that examines the seismic risks faced by megacities. In the following essay, Giuliano Panza, professor of seismology at the University of Trieste in Italy, who is organizing the symposium, talks about the risks posed by earthquakes, especially in megacities in developing countries. The symposium will include talks by more than 15 earthquake experts—seismologists, engineers, planners and emergency managers. TWAS plans to publish these presentations in an edited collection.

Earthquakes are old as the earth itself. Yet, despite unprecedented advances in science and technology, we have become increasingly vulnerable to the earth's tremors. From Los Angeles, California, to Papua New Guinea, earthquakes have taken a terrible toll over the past decade.

What accounts for our vulnerability? The irregularity and long intervals between earthquakes dull public awareness and undermine governments' willingness to invest in earthquake mitigation measures. Similarly, effective strategies require more than a commitment to science and technology. Indeed they necessitate difficult administrative and management measures, which often test the political will of public institutions, especially those in the developing world where people are most at risk.

Yet, the most important factor behind our increasing vulnerability to earthquakes lies in the rapid rise in population, particularly in the developing world's megacities, where flimsy building construction and woefully inadequate public utilities place residents at great risk. Today, more than one-third of the world's population—some 2 billion people—live in earthquake-prone areas, largely sprawling urban conglomerations such as Mexico City (16 million people), Beijing (12 million people) and Karachi (10 million people)—all of which have experienced devastating earthquakes in the past few decades.

During this century, fourth-fifths of all deaths caused by earthquakes have taken place in developing countries. Based on recent statistics, we can expect about 9,000 people worldwide to die from earthquakes next year. Approximately 8,000 will reside in developing countries.

In 1950, only half of the world's urban earthquake-threatened population lived in developing countries. By 2000, the proportion will climb to 85 percent. By 2025, about

5 billion people—roughly two-thirds of the world's population—will live in cities. Such unprecedented growth will strain urban infrastructures—buildings, roads, bridges, water facilities, sewage systems and electric-power networks. Cities, particularly megacities in the South, are becoming more densely populated and more fragile. No other natural disaster exposes this vulnerability in more dramatic and tragic fashion than an earthquake.

As with many other natural disasters, earthquakes have both immediate and long-term effects. You don't need to be a seismologist to realize that when thousands of people die and property damage runs into billions of dollars, communities do not quickly recover. Experts estimate, for example, that potential disruptions caused by a major earthquake near Ecuador's capital city of Guayaquil could cut the nation's annual gross domestic product (GDP) by half. Indeed the 1995 earthquake in Kobe, Japan, pared 1 percent from Japan's GDP—the world's second largest economy—despite the government's rapid response.

How can scientists help counteract these adverse impacts? An earthquake's tragic effects can only be lessened through comprehensive assessments of seismic hazards whose ultimate goal should be to raise public awareness about potential risks. Such awareness might lead to policy measures that improve building designs and construction making them more resistant to seismic jolts. At the same time, such assessments might help both citizens and public officials more fully appreciate the grave risks associated with current population and land-use trends, especially those taking place among the developing world's megacities. During this century, average earthquake-related mortality rates in developed nations have fallen by a factor of 10. The factor in developing countries has remained constant.

In 1996, the United Nations Department of Humanitarian Affairs launched the Risk Tools for Diagnosis of Urban Areas Against Seismic Disasters project. Based on information gathered from recent earthquakes, its aim has been to develop practical tools for assessing seismic risks in large cities. In 1997, the United Nations Educational Scientific and Cultural Organization (UNESCO) funded the Realistic Modelling of Seismic Input for Megacities and Large Urban Areas project. Its goal is to evaluate seismic hazards in some 20 urban areas, mostly in developing countries. As part of a larger UNESCO multidisciplinary programme, the Earthquake and Megacities Initiative, it marks a critical first step in devising effective earthquake mitigation policies for megacities worldwide.

Such strategies require earth scientists, seismic engineers, sociologists, planners and emergency-response experts to share information. That's what the TWAS symposium will seek to accomplish through broad-ranging discussions of the scientific, technological, administrative and management measures that must be considered if we hope to curb the tragic impacts of one of nature's most devastating displays of power.

Megacities and earthquakes are a dangerous brew. Now that we have mixed one with the other, perhaps scientists can help us reduce the risks associated with putting so many people atop of some of the world's "shakiest" areas.

Giuliano Panza
University of Trieste
Trieste, Italy

S&T IN THE ISLAMIC WORLD

The Ministerial Standing Committee for Scientific Cooperation (COMSTECH) has become one of the leading voices for science and technology in the Muslim world.

Abdus Salam, the Nobel Laureate who spearheaded the drive for the creation of Third World Academy of Sciences (TWAS) and served as the Academy's president during the first decade of its existence, was quick to note that the Islamic world enjoyed a rich scientific legacy.

In fact, he often cited the Quran to illustrate the deep-seated respect for science that was part of Islamic tradition. "Some 750 verses of the Holy Quran (almost one eighth of the book)," he noted, "exhort believers to study Nature, to reflect, to make the best use of reason in their search for the ultimate and to make the acquiring of knowledge and sciences obligatory upon every Muslim...."

At the same time, Salam often acknowledged that the central role that science had played among Islamic countries came to an abrupt halt in the 11th century and has never been the same. Late in his life, Salam lamented that among "the major civilizations on this planet, science is the weakest in the Islamic Commonwealth."

In January 1981, the Organization of Islamic Conference (OIC) established a Ministerial Standing Committee for Scientific Cooperation (COMSTECH) at its third annual meeting held in Makkah-tul-Mukarrama, Kingdom of Saudi Arabia. The Committee was created to promote the scientific and technological capabilities of Muslim countries through closer "cooperation and mutual assistance." OIC's 55 member states, ranging from Afghanistan to Lebanon to Uganda, are home to more than one billion people—a fifth of the world's population.

Through the years, COMSTECH has concentrated on several broad objectives:

- To pursue collaborative research on issues of common concern within the OIC region—for example, desertification and agricultural productivity.
- To create effective institutional networks for planning, researching and developing basic science and high technology, including state-of-the-art information technologies.
- To establish benchmarks for assessing the scientific and technological capabilities and progress of OIC member states.

The ultimate goal of COMSTECH has remained simple to articulate yet difficult to achieve: to build the "indigenous capability of member states in the fields of science and technology through cooperation and mutual assistance."

Since its inception, COMSTECH has concentrated on a wide range of topical areas, which the Committee believes are either central to the future well-being of OIC member states or at the cutting edge of scientific inquiry worldwide. These areas include biotechnology, agricultural productivity and microelectronics. For example, it has organized seminars and workshops in biological conservation in Brunei Darussalam, laser applications in Kuwait, agroclimatology in Pakistan, and waste management in Jordan.

"Despite its limited resources, COMSTECH has done much to advance the cause of science and technology throughout the Muslim world," says TWAS fellow Atta-ur-Rahman, COMSTECH's Coordinator General. "However, its impact could be that much greater if it could secure additional funding."

"COMSTECH has done much to advance the cause of science and technology throughout the Muslim world."

For this reason, COMSTECH's executive committee has launched a "collaborative and cooperative projects" programme designed to encourage the Committee and OIC member states to seek funding from international donors for future projects.

Over the long term, COMSTECH will try to secure external funds for the creation of new inter-Islamic research networks as well as an Islamic university on science and technology. For now, the Islamic Development Bank has agreed to support a COMSTECH training initiative with a grant totalling more than US$2 million. Other funding agencies include the International Foundation for Science (IFS), which has joined COMSTECH in sponsoring a project to aid young Muslim researchers, and the government of Pakistan, which recently provided COMSTECH with US$1 million for the promotion of scientific and technological cooperation in the Muslim world.

COMSTECH has also signed a Memorandum of Cooperation with TWAS that will enable both organizations to jointly pursue activities of mutual concern in the years ahead. These activities will include a:

- **Research and training fellowships programme** offering training to some 100 scientists each year who are given opportunities to work in centres of excellence across the Muslim world. Institutions currently participating in this programme include the Centre for Agriculture Economic Studies in Cairo; Ferdousi University of Mashad in Mashad, Iran; and the Pasteur Institute of Morocco in Casablanca, Morocco.
- **Spare parts programme** supplying funds—usually less than US$500—for the replacement of worn-out or malfunctioning equipment parts. The programme is designed to allow scientists to concentrate on what they do best—research—and not be diverted by equipment problems that sap their energy and attention.
- **Visiting scientists programme** encouraging the exchange of scientists among OIC members states, especially those who share common research interests. The programme focuses on both mature scientists with a proven track record of accomplishments and young, promising scientists seeking postdoctorate experience.

The Committee's strategy is based on the belief that advances in science and technology hold the key to overcoming the difficult challenges the Muslim world faces today—problems arising from "economic exploitation, cultural subversion and the slow rate of growth."

"Islamic solidarity...in scientific research and technological development" is essential for "the common good and progress" of the Muslim world, note COMSTECH officials. Cooperative initiatives such as those launched by the Committee provide the most important vehicles for enabling the Muslim world to "recover from its slumber and regain its lost glory in science and technology, which was its privilege for many centuries." ■

For additional information about COMSTECH, please contact:
COMSTECH Secretariat, 3-Constitution Avenue, G- 5/2, Islamabad - 44000, Pakistan, phone (+92 51) 9220681 - 3; fax (+92 51) 9211115; e-mail comstec@paknet1.ptc.pk.

SOUTHERN CYBERSPACE

The information revolution promises to accelerate advances in science. But some observers fear it will leave researchers in the developing world even farther behind.

HISTORY SHOWS THAT ADVANCES IN TECHNOLOGY OFTEN ENHANCE EXISTING INEQUALITIES. A RECENT STUDY BY THE U.S. NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION, FOR EXAMPLE, REVEALED THAT WHILE ACCESS TO COMPUTERS, MODEMS AND ONLINE CONNECTIVITY INCREASED throughout the United States between 1994 and 1997, the gap between the rich (mainly white and non-Hispanic immigrants) and the disadvantaged (mainly black, Hispanic and inner city populations) had widened considerably.

Let us consider scientific research in India. Researchers must find out what is happening around the world as well as keep others informed about what they are doing. Information is the key to knowledge and dissemination of information crucial for the scientific enterprise.

In pre-independent India, when such world-class scientists as C.V. Raman, Meghnad Saha and J.C. Bose made their critical contributions to knowledge, professional journals served as the main vehicle for scholarly communication. Scientists worldwide had virtually the same level of access to information, although those working in developing countries received their journals a few months later than their European colleagues.

Despite the tremendous proliferation of journals today, many of them remain beyond the reach of libraries and research institutes in the South, especially journals published by commercial firms. The best academic science library in India, at the Indian Institute of Science, receives some 1,560 serials, including those that arrive free of charge or through an exchange. In the United States and Europe, many university libraries subscribe to some 50,000 journal titles.

To make matters worse, due to the rising value of the U.S. dollar on international currency markets and dramatic increases in subscription prices, libraries in India and other developing nations have been forced to reduce the number of journals and data bases they receive. The situation in Africa is particularly bad. "When you call some of us scientists," an African professor recently told a journalist, "we laugh at ourselves. We know we can no longer make contributions to science. I do not know what my colleagues in Kenya or London have found, for example. So I cannot carry out an experiment and believe I am on the path to an original contribution....If I have been giving generations of students the same notes for the last 10 years, I should not call myself a scientist."

Now, many primary journals and data base collections have gone electronic. Title-listing services such as *Current Contents Connect*, abstracting services such as *SciFinder* and multidisciplinary citation indexes such as *Web of Science* are available on the web—at a fee that most university and research laboratory libraries in developing countries cannot afford. Many frontline journals have become increasingly accessible via password controls on the web through, for example, Elsevier's *Science Direct*.

Physicists have gone a step further. They circulate preprints electronically, via Los Alamos National Laboratory's *e-Print* archive, long before a hardcopy is printed in refereed journals. This service is offered free of charge to physicists worldwide. In theory, anyone anywhere in the world can use this service. In reality, though, one must have access to the appropriate technology, which most scientists in developing countries do not have. As a result, the performance of researchers can be adversely affected not because of their work but because they are not connected to electronic information networks.

Accessing information through CD-ROMs offers capabilities not possible through print, and accessing through the web offers capabilities not possible through CD-ROMs. As a recent editorial in *Science* noted, "Digital publishing has much to recommend it over print publishing....Uncomfortable trade-offs are involved...but the gains include ease of access, rapid delivery over great distances, and hypertext links from indexing services and bibliographic citations to the full text of cited documents."

Hardly any laboratory in the developing world has web access to these databases. How can scientists working in these laboratories be equal partners in the worldwide enterprise of knowledge production? The truth is that the transition from hard copies to electronic publishing likely will widen the gap between developed countries and developing countries and further marginalize already marginalized scientists and scholars in the South.

Most developing countries do not have the necessary infrastructure (computer terminals, networks, communication channels and bandwidths) to become equal partners in worldwide knowledge production and dissemination. According to Bruce Girard, former director of Latin America's community radio Pulsar, 95 percent of all computers are located in developed nations, and 10 developed nations, accounting for 20 percent of the world's population, have 75 percent of the world's telephone lines. Teledensity in India today is slightly less than 2 lines per 100 persons. This marks a vast improvement. Less than five years ago, teledensity in India was 1 line per 100 persons. In contrast, however, teledensity in the United States and Canada is more than 60 per 100 inhabitants. To make matters worse, most of India's telephones are concentrated in the largest metropolitan areas.

Many Indian universities, moreover, do not have e-mail or internet facilities. And those that do have such low bandwidths and poor terrestrial telephone connections that researchers remain unable to surf the net or do online searches. Dated technology restricts them to sending and receiving e-mail messages.

Those connected to new information technologies undoubtedly are much better off than before. But a vast majority of scientists in developing countries do not have access.

Take, for instance, the *e-Print* archive. This information service is available to physicists at only a few institutes in India—for example, the Indian Institute of Science, Institute of Mathematical Sciences and Tata Institute of Fundamental Research. More disturbingly, Indian physicists in such leading universities as the University of Delhi, Banaras Hindu University and University of Madras are not connected to the internet or e-mail at all. In contrast, every physicist in the United States and the United Kingdom enjoys easy access to e-mail and the internet.

The disadvantages that this disparity poses for scientists in developing countries are obvious. A growing number of journals, especially in the fields of science and technology, now receive and review manuscripts via e-mail and some journals are available only in electronic form. Editors of such journals likely will be reluctant to use referees from developing countries, even if they are exceptionally competent in their fields because it would be difficult to reach them electronically. Besides, many scientists in developing countries will be unable to publish their work in electronic journals.

The United Nations has voiced its concerns about the imbalance in access to electronic communication facilities. The UN's Administrative Committee on Coordination, issued a statement on Universal Access to Basic Communication and Information Services in April 1997 in which it stated: "We are profoundly concerned at the deepening maldistribution of access, resources and opportunities in the information and communication field. The information technology gap and related inequities between industrialized and developing nations are widening: a new type of poverty—information poverty—looms. Most developing countries, especially the least developed countries (LDCs) are not sharing in the communication revolution, since they lack:

- Affordable access to core information resources, cutting-edge technology and sophisticated telecommunication systems and infrastructure.
- The capacity to build, operate, manage, and service the technologies involved.
- Policies that promote equitable public participation in the information society as both producers and consumers of information and knowledge.
- A workforce trained to develop, maintain and provide the value-added products and services required by the information economy."

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The communication revolution is perceived as a liberating force. Yet, what is most likely to happen is that scientists and scholars in many developing countries will be among the last to join the revolution. In India, for example, the stock market community has a network of its own with dedicated telephone lines, but a vast majority of scientists do not even have telephones on their desks. The low level of information and communication technologies in developing countries may exclude a majority of scientists and scholars in these countries from the collective international discourse that is so essential for active participation in all fields of research.

"I would not be surprised if the gap between the scientifically advanced nations and the others widens even further."

Even today, when much publishing takes place in print, participation by developing country scientists in such high impact journals as *Science, Nature and Cell*, remains abysmally low. The gap in science and technology that now exists between developed and developing countries will widen. That, in turn, could exacerbate the "brain drain" problem and intensify the reliance that developing nations have for knowledge developed beyond their borders.

In an earlier era, Indian mathematician, Srinivasa Ramanujan, a genius who had not gone through a conventional training programme, was nurtured in the intellectually stimulating ambience of Cambridge University thanks to the foresight of G.H. Hardy. While such individual efforts may still help overcome obstacles on occasion, we need a more organized and systematic programme of action to combat the current crisis. Educational institutions and research laboratories must be granted satellite-based high-bandwidth access to the internet at low cost. At the same time, differential price strategies must be devised to allow institutions throughout the developing world to obtain the most recent journal titles and most up-to-date data bases.

On both fronts, I am not optimistic. For example, a proposal by V.S. Arunachalam of Carnegie-Mellon University in the United States to network 100 or so of India's academic and research cities has yet to see the light of day. A report submitted to the then Prime Minister, I. K. Gujral, by the Scientific Advisory Committee to the Indian Cabinet about a year ago has not been acted upon. Fortunately, the recommendations of the taskforce set up by Prime Minister A.B. Vajpayee, of which M.G.K. Menon, a Fellow of TWAS, is a key member and vice chairman, have been accepted by the government and will soon be implemented.

The dithering and slow pace of progress are all too characteristic of the Third World. It often takes far too much time to translate something from the realm of the possible to reality. Part of the blame, I think, rests with the academic community itself. No one ever complains. When things are not working out well, one must learn to complain, protest and demand appropriate action.

As for differential pricing, both publishers of primary journals and database producers are reluctant to embrace such measures. In a rare exception, the Institute for Scientific Information, in Philadelphia, Pennsylvania (USA), offers most developing country subscribers its Science Citation Index at 50-percent discount. Even then it is perceived as too costly.

Given all these circumstances, I would not be surprised if the gap between the scientifically advanced nations and the others widens even further, limiting the role of developing countries in the production, dissemination and utilization of knowledge even more than it is today. ■

Subbiah Arunachalam

Subbiah Arunachalam [Arun] is a distinguished fellow in information science at the M.S. Swaminathan Research Foundation in Chennai, India. This article is based on a talk he gave at the Ninth International Conference of the International Federation of Science Editors in Sharm El-Sheikh, Egypt, 7-11 June 1998.

The Visiting Professorships in Science and Sustainable Development programme seeks to address one of the major problems facing researchers in the developing world today: limited interactions with their colleagues in other parts of the world. Jointly sponsored by TWAS, International Council for Science (ICSU), United Nations Educational, Scientific and Cultural Organization (UNESCO), Commonwealth Science Council and Earth Council, the programme enables international scientific experts to visit universities and research centres on a continual basis over several years.

What's the programme's ultimate objective? According to its sponsors, the goal is "to provide developing country institutions and research groups, especially those lacking outside contacts, with the opportunity to establish long-term links with world leaders in science, technology and key areas of environment and development."

Here's how it works. Each year, several international experts, who are conducting research on issues of critical importance to the developing world, are given visiting professorship appointments to Third World institutions. The appointments usually last five years. The visiting professor is expected to go to the host institution a minimum of three times and stay at least one month each time.

Programme sponsors cover the cost of airfare plus any additional travel expenses. They also offer the professor a small honorarium. The host institution, on the other hand, agrees to pay for expenses incurred during the professor's stay.

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MAKING EVERY VISIT COUNT

Visiting professors work closely with their fellow researchers in the programme's host institutions. Through these exchanges, participants seek to strengthen existing research activities or launch new lines of inquiry that address critical scientific, public health or technological issues in the area or region.

"The success of the programme," notes Mohamed H.A. Hassan, Executive Director of TWAS, "depends on linking noted professors who have strong track records of success with institutions eager to expand their research horizons. Combining expertise and enthusiasm is one way to ensure the exchange is fruitful."

Since its inception, the programme has provided funding for some 25 professors. Research activities, ranging from lectures to workshops to laboratory experiments, have taken place in Cuba, Mongolia, Egypt, Turkey and Zambia. In all, some 13 countries have hosted professors participating in the programme.

For the past two years, Eva Harris, a molecular and cell biologist at the University of California's (Berkeley) School of Public Health, has worked with researchers at the Universidad Mayor de San Andres' Instituto de Servicios de Laboratorio de Diagnostico e Investigacion en Salud (SELADIS), in La Paz, Bolivia, to develop more effective and sustainable strategies for the diagnosis and epidemiology of such infectious diseases as tuberculosis, leishmaniasis, Chagas disease and dengue fever. What follows is a brief discussion of her efforts.

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Eva Harris is one of the scientific warriors on the frontlines of the campaign against infectious diseases.

Now her efforts, which began more than a decade ago, have received a boost from the TWAS visiting professorship programme. In 1996, she was awarded a small grant to establish a series of workshops in Bolivia. The workshops are intended to promote scientific capacity building as a way of enhancing the ability of local entities to control infectious diseases. This strategy involves providing training for local scientists and physicians in laboratory techniques, diagnosis and epidemiology, and grant writing. Activities focus on a particular procedure that goes by the scientific name polymerase chain reaction (PCR).

PCR enables specific fragments of DNA to be exponentially replicated so that they can be easily detected. Put another way, PCR allows a particular pathogen to be identified by virtue of detecting a fragment of its DNA rather than by detecting the organism itself. At the same time, the process allows scientists and medical practitioners to obtain important genetic information that can enhance their understanding of a disease's epidemiology. Such information may prove invaluable in efforts to prevent or contain the spread of an infectious disease.

"PCR has many advantages over traditional methods of diagnosis," explains Harris. "First, it can be used for both the diagnosis and epidemiology of viral, bacterial, fungal and parasitic diseases. As a result, the procedure enjoys a wide range of applications. Second, in certain cases, PCR has proven to be a more effective means of disease detection than traditional clinical-based diagnostic methods. Third, PCR can be made cost-effective through a simple, low-cost methodology that can be easily used by local scientists and medical practitioners who are properly trained."

That's where the TWAS visiting professorship programme comes into play. Harris will visit Bolivia at least three times over the next five years to work closely with her South American colleagues as part of a larger effort to promote the appropriate use of PCR .

"My experience with efforts at North/South cooperation have shown that two ingredients are essential for success," Harris says. "Those from the North must have an opportunity to remain active participants in the programme for extended periods. And those from the South must feel that the programme is theirs and not simply an initiative devised and managed by their colleagues in the North, however well-meaning they may be."

Harris has not been one to come and run. Her efforts to increase the use of PCR in Bolivia and throughout Latin America are now more than a decade old. The emphasis she has placed on adapting procedures to existing conditions and training local personnel have not only helped contain the spread of infectious diseases but have had the added benefit of strengthening the skills of the indigenous scientific and medical community.

Success within the region has gained increasing recognition in the North as well. And that has translated into additional resources. Harris, for example, has received grants from the Pan American Health Organization, American Society for Biochemistry and Molecular Biology and the New England Biolabs Foundation. In addition, a number of private U.S. biotech companies have generously donated equipment to hospitals and universities throughout Latin America, including institutions in Bolivia. Meanwhile, in 1997 Harris was awarded a prestigious MacArthur Fellowship in recognition of her unique contributions to the world of public health.

Efforts to secure the TWAS visiting professor fellowship began within an informal conversation with her colleagues at the Universidad Mayor de San Andres in La Paz, Bolivia, in June 1996.

"Gaining support for public health programmes in Latin America is no easy task; there are always other competing priorities," explains Harris. "A number of people at the university—most notably, Susan Revollo who has since become a close colleague of mine—thought the programme might be a good way to receive funding for travel and lodging that would help ensure our continuous interaction over several years. We drafted and refined the proposal over a two-week period and TWAS notified us that our application had been approved about two months after we submitted it."

One reason for TWAS's confidence in Harris's application was her track record of success. Since the late 1980s, she has developed and refined a strategy replicated many times in universities and health ministries throughout Latin America.

The programme consists of a series of progressively more complex workshops. Before the first workshop begins, local scientists and physicians identify three or four diseases in their country that deserve particular attention because of the public health risks they pose. The initial workshops provide a theoretical and practical introduction to molecular biology techniques. More specifically, pathogens responsible for the selected diseases are detected and genetically characterized through the use of PCR techniques.

"By conducting the experiments themselves," Harris explains, "workshop participants gain first-hand experience in molecular techniques used for the diagnosis and epidemiology of infectious diseases."

A number of participants in the first series of workshops are then assembled into four or five teams that participate in the second series of workshops. These teams design a pilot study for which they collect samples and apply molecular techniques. In addition, each group designs a larger study and writes a grant proposal designed to seek additional funding.

"The objective," Harris notes, "is to make the projects as sustainable as possible by providing training in all the areas necessary for successful scientific investigations. At the

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same time, all of our projects are designed to have both scientific value and direct impacts on local public health."

"In the case of the initiative at the Universidad Mayor de San Andres, my colleagues and I identified three major diseases: tuberculosis, Chagas disease and leishmaniasis. Each of these diseases produce untold misery. For example, the disfiguring ulcerated lesions caused by leishmaniasis afflict some 400,000 people each year, mostly impoverished inhabitants of tropical and subtropical regions."

"PCR," Harris adds, "offers an important tool in combating this sometimes deadly infectious disease. Treatment for leishmaniasis is expensive, lengthy and may carry toxic side effects. Meanwhile, the symptoms often are associated with other diseases. That means it's important for medical practitioners to get the diagnosis right—for the sake of both the community and the individuals that they are serving."

"Because PCR offers a more rapid and reliable method of diagnosis than more traditional techniques," Harris notes, "it's a strategy well worth pursuing. In the case of tuberculosis, which if left untreated can cause death, PCR allows for rapid and sensitive diagnosis. In addition, PCR can be used to track individual stains of tuberculosis. That information can enhance our understanding of tuberculosis transmission patterns in the community and uncover risk factors associated with the spread of the disease. Such information often proves invaluable in designing effective prevention and control strategies."

So what's next in Harris's campaign against infectious diseases in Latin America. From the clinics to the workshops to the additional outside funding, the effort has already achieved impressive results. But Harris anticipates that the progress that has been made to date is only a beginning.

This fall, local and regional researchers will return to La Paz to present and analyse the results of their pilot studies and write grant proposals in an effort to receive funding for future projects. Some 30 researchers from nations throughout Latin America are expected to attend.

"I think there's no better way of being true to the mandate of the visiting professorship programme," Harris adds, "than by creating an environment that is likely to advance the region's public health goals long after my TWAS-sponsored visits come to an end." ■

For additional information about the programme for Visiting Professorships in Science and Sustainable Development, please contact:

TWAS, c/o The Abdus Salam International Centre for Theoretical Physics, Enrico Fermi Building, Via Beirut 6, 34100 Trieste, Italy, phone: +39 040 2240 387, fax: +39 040 224559, e-mail: twas@ictp.trieste.it.

ROAD TO INNOVATION BEGINS WITH SCIENCE

As Director General of India's Council of Scientific and Industrial Research (CSIR), TWAS Fellow (1993) Raghunath Anat Mashelkar heads one of the world's largest scientific research organizations. CSIR currently employs more than 25,000 staff members, including 3,000 research scientists with doctorates in disciplines ranging from physics to chemistry to biology to the environmental and social sciences.

Mashelkar, born in Goa, India, was educated at the University of Bombay where he received his doctorate in chemical engineering in 1969. After lecturing several years at the University of Salford in the United Kingdom, he returned to India in the mid 1970s to help launch the National Chemical Laboratory. Mashelkar's first-hand knowledge of scientific research (his personal fields of study include gel science, polymer engineering and fluid mechanics), combined with his administrative skills, helped to turn the National Chemical Laboratory into a worldclass facility.

In 1995, Mashelkar became CSIR's Director General. Since then, he has focused the Council's attention on a host of critical concerns now facing science in the developing world, including issues related to technology transfer, global scientific partnerships, patent protection and the need to strengthen public support for science.

In April, while visiting TWAS headquarters in Trieste, Italy, to chair a two-day meeting devoted to the UNESCO-TWNSO "We Can Do It" project, Mashelkar spoke to the Editor of the TWAS Newsletter *on a wide range of topics. What follows is an excerpt from their hour-long interview.*

Please trace the steps that brought you to the position of Director General of India's Council of Scientific and Industrial Research (CSIR).

I was born and educated in India. After receiving my Ph.D. from the University of Bombay, I was appointed a lecturer at the University of Salford in England. I was a young man in my early twenties and my career was on the rise. My family was happy to be living in England and I didn't foresee leaving at that time. Then I experienced an unexpected turning point in my life. Dr. Nayadumna, Director General of CSIR, contacted me to ask if I would meet him in London. At the time, Indira Ghandi, India's Prime Minister, was deeply concerned about the nation's "brain drain" problem. She asked Nayadumna to identify India's very best scientists, many of whom had migrated elsewhere, and offer them jobs on the spot. He told me a great opportunity was opening up in India to establish an engineering department in the National Chemical Laboratory and he asked if I would accept the challenge. The dream of lending a hand to the creation of a new technically advanced India was too tempting to pass up and I said yes immediately.

Would you please describe for our readers the state of research facilities in India 20 years ago?

At the time I started working at the National Chemical Laboratory, the research infrastructure was poor, particularly in my field of chemical engineering. The equipment couldn't compare to the equipment I had access to in England. Consequently, my research options were strictly limited. This problem was compounded by the fact that, at the time, the Indian rupee was not convertible into dollars. As a result, it was extremely difficult to purchase equipment from foreign vendors. Several years, in fact, often elapsed between the time you received permission to buy equipment and its delivery. In short, India's research institutions in the 1970s had neither the currency to buy what they needed, nor the know-how or infrastructure to build it themselves.

This problem, however, turned into an opportunity after I decided to launch a programme, based on my own research, that did not require state-of-the-art equipment. The effort not only proved a success in its own right but helped shape the overall strategy of the National Chemical Laboratory in the years ahead. At the time, I was a consultant for a private company that produced synthetic fibres with equipment it had purchased from abroad. The company's poly condensation reactors, which made the fibre, were excellent machines. But the company did not have a clue about how the machines

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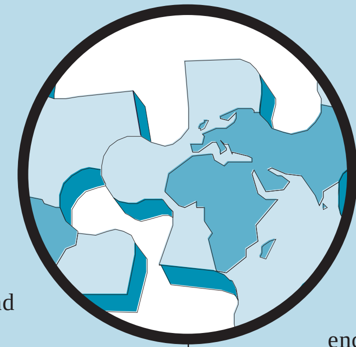

worked. For executives and line operators alike, the reactors were nothing more than black boxes. I was asked to construct a mathematical model that would help the company better understand the manufacturing process.

At the same time, my findings helped the company improve the efficiency of what they were doing. But I soon realized that I was working at the border between scientific and industrial research, and that I was doing the latter without compromising the integrity of the former. Such an approach is exactly the one that has come to shape the work of the National Chemical Laboratory and, more generally, CSIR. Industrial research at India's national laboratories, which has been built on a strong scientific base, is driven by this simple fact: If you fail to develop that base, you confine yourself to reverse engineering, which at best only allows you to copy what others have done. That, in turn, puts you in a position that makes it extremely difficult to develop new products. All of this renders your scientific research less exciting and your industrial output less profitable.

Between 1989 and 1995, you served as the head of the National Chemical Laboratory. What goals did you establish for the Laboratory and what strategies did you devise to reach those goals?

The first thing I did was to try to construct a strong intellectual framework for the Laboratory's work. When I became director, the Laboratory had never been awarded a patent despite being over 40 years old. For me, only usable knowledge can create wealth. But for that wealth to work for society and the economy, it must be protected. Therefore, we worked hard to ensure that the Laboratory's new products and services were patented. At the same time, I brought a market orientation to the Laboratory. Before my arrival, words like business and management remained unpopular in India's national laboratories. I tried to change that attitude. For example, I created a business development department. At the beginning, many members of the staff resisted the effort, believing that it would sap scarce resources and compromise the integrity of their research. But eventually they came around. In my thinking, science has to make economic sense if it's to receive funding over the long haul. At about the same time, I was pursuing these initiatives at the National Chemical Laboratory, our umbrella organization, CSIR, had established a committee with a mandate to make the Council and its affiliated laboratories more market savvy. CSIR's so-called Mashelkar report—upon which this strategy was predicated—helped change the mindset of our scientists by offering them incentives to engage in applied science. The philosophy that drove the report's conclusions was this: Science nurtures technology and technology creates wealth. Scientists, in turn, should benefit directly from the wealth that they have helped to create through royalties and bonuses. The laboratories would also benefit from such a strategy through closer ties to industry. That, in turn, would likely increase their revenues through licensing fees and institutional royalties. Such revenues could make an enormous difference in a laboratory's annual research budget. Yet, most importantly, an incentive's strategy would generate greater wealth for the nation, which would reduce poverty levels and add to the material well-being of all citizens.

What was the mindset of India's scientists before incentives for research were introduced?

Our scientists were busy copying. Part of the mentality was driven by a deference for Western technology. The thinking went like this: Scientists in developed countries receive better education and training, have better facilities and create better products. We can't possibly compete; we are simply better off taking what they give us and doing the best we can in recreating it. And part of the problem was due to tariff barriers, which protected

Indian firms from the fiercest aspects of international competition. Because firms didn't have to worry about being buried by state-of-the-art products and services from abroad, they could afford to sell products based on older technologies. To counteract these circumstances, we needed to create an environment that would allow our scientists to think ahead.

CSIR's incentive initiative, launched in the late 1980s, tried to nurture a new mentality by encouraging Indian scientists to become more entrepreneurial in their outlook. And, the government's decision to lower tariff barriers, enacted in early 1991, forced the nation's industries to face the full force of global competition. In the process, it made business executives realize that science could help them successfully confront the new reality created by their exposure to international markets. Collectively, these two decisions brought the worlds of science and business, which had been worlds apart throughout India's history, closer together.

What is the future of scientific institutions in India?

A decade ago, I said that science was becoming a global enterprise and that India must quickly prepare itself for the inevitable consequences that would accompany this trend. We have taken important steps in meeting this challenge, but the forces of globalization are now stronger than ever. That's why it's important for our scientists to partner not just with domestic companies but with companies throughout the world to develop new products and processes.

We have made some progress in this area despite the fact that many companies in the North initially expressed much scepticism towards our efforts. Why, they said, should we work with scientists from developing countries? Why do we need them? What would we gain from such efforts? We overcame their doubts by making ourselves rich in intellectual capital. Such capital is cheap, it's desirable and it's something that both governments and industries across the globe are willing to pay for. When I took over the National Chemical Laboratory, the amount of money generated by licensing fees was zero. Last year, it was US$3 million—revenues derived, for example, from agreements with General Electric, DuPont and Eastman Kodak. As I like to say in speeches I give both in my country and abroad, India must stand for innovation not imitation.

What do you think is the future of India's CSIR?

When I became CSIR's Director General, I hoped to introduce changes among all CSIR institutions similar to those that I had spearheaded at the National Chemical Laboratory. In fact, I hoped to take our efforts a step further and place CSIR on a path to financial self-sufficiency. Last year, we received 4 billion rupees (US$100 million) from the Indian government. At the same time, we generated 2 billion rupees ($US50 million) through licensing fees and royalties received for our technologies, products and services. Five years ago, the Council's "self-generated" revenues were less than 1 million rupees (US$250,00). The progress we have made in our efforts to become self-sufficient has taken place without compromising the quality of our science. In fact, in many ways, our strategy has enhanced the quality of our research. I like what Louis Pasteur used to say: "There is no basic science. There is only science and its application." That is the spirit we hope to maintain through CSIR's national laboratory system. I am firmly convinced that such a spirit largely determines which nations succeed and which don't in today's global society. The value of the strategy, moreover, extends far beyond science into the core values of a society by encouraging people to believe that anything is possible and no challenge is beyond a solution. India has often been described as a rich country where poor people live. I hope in the years ahead, the work of the CSIR and its affiliated laboratories can help transform India into a rich country where rich people live—people rich in spirit, intellect and material well-being. ■

HAMDAN NAMED MINISTER

TWAS Fellow (1988) Mohammad Ahmad Hamdan has been named Jordan's Minister of Higher Education. Hamdan received his undergraduate degree from Cairo University in Egypt and his doctorate in statistical mathematics from Sydney University in Australia. He has taught mathematics and statistics at universities in Egypt, Lebanon, Saudi Arabia and the United States, and he has served as dean of faculty, students and research at the University of Jordan. Before his most recent appointment, Hamdan had been president of both Yarmouk and Hashemite universities in Jordan. He previously served in the capacity of Minister of Education and Higher Education in 1989-1990. His research areas include analysis of categorical data and distribution theory.

NEW MATH HEAD

TWAS Fellow (1991) Jacob Palis, Professor and Director of the Instituto de Matemática Pura e Aplicada (IMPA) in Brazil, has been elected president of the International Mathematical Union

Jacob Palis

(IMU). He was voted into office at IMU's 13th General Assembly, which was held in conjunction with the International Congress of Mathematicians. The joint meetings took place in August in Berlin. Palis, who was born in Uberaba, Brazil, received his undergraduate degree from the University of Rio de Janeiro and his doctorate from the University of California at Berkeley. He has served as Vice President of the International Council for Science (ICSU) and is a member of the Scientific Advisory Council of the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy. He has been elected to the Brazilian Academy of Sciences, Latin American Academy of Sciences and Indian Academy of Sciences. Palis's personal fields of interest include dynamical systems and differential equations. With more than 60 member countries, IMU is the largest mathematics association in the world. It is responsible for awarding the Fields Medal, which is comparable to the Nobel Prize in the field of mathematics.

COOPERATIVE MISSION

The South African Mission to the European Union recently concluded an Agreement of Cooperation in Science and Technology that affords South Africa participation in the European Union's Framework Programmes. The Mission has now launched a monthly electronic newsletter designed to keep South Africa's science and technology community up-to-date on the opportunities for cooperation afforded by the Agreement. For additional information, please contact Daan du Toit, Editor, SA-EU S&T, South African Mission to the European Union, Rue de la Loi 26 bte 14-15, 1040 Brussels, Belgium, samissie@innet.be.

Alberto Calderón Dies

ALBERTO CALDERÓN DIES

TWAS Fellow (1984) Alberto P. Calderón died on 16 April 1998 at the age of 77. Born and raised in Argentina, Calderón received his undergraduate degree from the University of Buenos Aires and his doctorate from the University of Chicago in the United States, where he taught for more than 25 years. He was a member of the American Academy of Arts and Sciences, National Academy of Sciences (USA), Royal Academy of Sciences (Spain), Latin American Academy of Sciences and Academy of Sciences and Institut de France. Calderón received international recognition for his pioneering work in partial differential equations and Fourier analysis. His collaborative research with Antonio Zygmund at the University of Chicago revolutionized the theory of singular integrals. Their findings are now known as the Calderón-Zygmund theory.

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JIAN SONG ELECTED

Jian SONG, former head of China's State Council and State Science and Technology Commission (SSTC) {recently reorganized into the Ministry of Science and Technology}, has been elected Vice Chairperson of the Chinese People's Political Consultative Conference (CPPCC), the nation's highest political body. In that capacity, Song will continue to focus on national and international issues related to science and technology. In addition, he will examine cross-cutting issues in education, population, resource management and environmental protection. The new Minister of Science and Technology is ZHU Lilan, former executive chair of SSTC. Throughout its existence, the commission worked closely with the Third World Network of Scientific Organizations (TWNSO). Officials at the newly created Ministry of Science and Technology expect their ties with TWNSO to remain strong in the future.

ESSIEN AWARDED

Etim Moses Essien (TWAS Fellow, 1994) has been awarded the 1997 Nigerian National Order of Merit. The government grants this award to individuals whose research has


Etim Moses Essien

made lasting contributions to national and international development. Essien, who is a medical doctor, was educated at University College Ibadan in Nigeria and the University of London at St. Thompson Hospital in the United Kingdom. He is currently a professor of haematology at the University of Ibadan in Lagos, Nigeria. Essien, who has taught in England, Canada and the United States, is a member of the Nigerian Academy of Science, African Academy of Science and American Association for the Advancement of Science. He has served as vice-president of the International Society for Haematology and on several panels and committees for the World Health Organization (WHO). In addition to his work on haematology, Essien has conducted research on malaria and iron deficiency anaemia. In 1993, he received a TWAS Award in Basic Medical Science.

MOSHINSKY HONOURED

Marcos Moshinsky (TWAS Fellow, 1985), emeritus researcher and professor at the Universidad Nacional Autónoma de México's Instituto de Física, has been awarded the UNESCO Science Prize for his contributions to theoretical physics, particularly in the fields of mathematical and elementary particle physics. The semi-annual award, which includes a US$15,000 cash prize, is granted to individuals who make significant contributions to basic science. Moshinsky, a native of Kiev, Ukraine, was educated at the Universidad Nacional Autónoma de Mexico and Princeton University. He is a member of the Academia de la Investigacion Científica in Mexico, Academia Brasileira de Ciências in Brazil, the European Academy of Arts, Sciences and Letters, the Pontifical Academy of Sciences, the Latin America Academy of Sciences and the American Academy of Arts and Sciences in the United States.


Marcos Moshinsky

WHAT'S TWAS?

THE THIRD WORLD ACADEMY OF SCIENCES (TWAS) WAS FOUNDED IN 1983 BY A GROUP OF EMINENT SCIENTISTS FROM THE SOUTH UNDER THE LEADERSHIP OF THE LATE NOBEL LAUREATE ABDUS SALAM OF PAKISTAN. LAUNCHED OFFICIALLY IN TRIESTE, ITALY, IN 1985 BY THE FORMER SECRETARY GENERAL OF THE UNITED NATIONS, TWAS WAS GRANTED OFFICIAL NON-GOVERNMENTAL STATUS BY THE UNITED NATIONS ECONOMIC AND SOCIAL COUNCIL THE SAME YEAR.

At present, TWAS has 479 members from 75 countries, 62 of which are developing countries. A Council of 12 members plus the president is responsible for supervising all Academy affairs. It is assisted in the administration and coordination of programmes by a small secretariat of 9 persons, headed by the Executive Director. The secretariat is located on the premises of the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy, which is administered by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the International Atomic Energy Agency (IAEA). UNESCO is also 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 151 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.
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 nearly 1800 women scientists from 82 Third World countries. Its main objectives are to promote the research efforts and training opportunities of women scientists in the Third World and to strengthen their role in the decision-making and development processes. The secretariat of TWOWS is currently hosted and assisted by TWAS.

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:
http://www.ictp.trieste.it/~twas

FELLOWSHIPS

Want to spend some time at a research institution in another developing country? Investigate the South-South Fellowships:
http://www.ictp.trieste.it/~twas/SS-fellowships_form.html

GRANTS

Need funding for your research project? Take a look at the TWAS Research Grants:
http://www.ictp.trieste.it/~twas/RG_form.html
TWNSO runs a similar scheme, for projects carried out in collaboration with institutions in other countries in the South:
http://www.ictp.trieste.it/~twas/TWNSO_RG_form.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:
http://www.ictp.trieste.it/~twas/SP_form.html

TRAVEL

Would you like to invite an eminent scholar to your institution, but need funding for his/her travel? Examine these pages, then:
http://www.ictp.trieste.it/~twas/Lect_form.html
http://www.ictp.trieste.it/~twas/Prof.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:
http://www.ictp.trieste.it/~twas/SM_form.html

COLLABORATION

You're collaborating with a colleague in another country and would pay a short visit to his/her laboratory? The "Short-Term Fellowships" may be the answer:
http://www.ictp.trieste.it/~twas/ST_Fellowship.html