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STREAKS OF SUNSHINE ARE RADIATING THROUGH THE SHADOWS OF THE WORLD'S DARKEST ECONOMIC DOWNTURN SINCE THE GREAT DEPRESSION. WHILE ESTIMATES VARY, MANY OBSERVERS BELIEVE THAT THIS YEAR CHINA'S ECONOMY WILL GROW BY 10%, INDIA'S BY 8% AND BRAZIL'S BY 7%.

Can wealth buy excellence?

Overall, economists project that the gross domestic product (GDP) of countries with emerging economies will grow by 6% or more, compared to 2% or less in developed countries. Studies project that countries with emerging economies will account for more than 70% of global economic growth not only in 2010 but for years to come. Economic growth is among the primary reasons why trade between developing countries is accelerating at a rapid pace. According to the World Trade Organization (WTO), South-South trade, again led by China, India, Brazil and other emerging economies, is growing at an unprecedented rate. This year, trade between China and India alone is expected to reach USD60 billion. Indeed, emerging economies currently account for 30% of all end-use consumption of goods and services worldwide. This represents a threefold increase over the past two decades and is now comparable to that of the United States.

The bottom line is this: a large part of the developing world is becoming richer; this trend is occurring at an accelerating pace; and one of the primary forces driving rising levels of wealth is the increasing level of trade among countries in the South.

What does wealth and trade have to do with excellence in research and education? The answer is quite a bit. That's because sustainable excellence in education and research often depend on a country's wealth and openness.

Yet the ability of each nation to set in place a pathway for sustainable development also depends on its ability to arrive at a threshold of excellence in science and technology.

In today's world, advances in science and technology often drive wealth creation, especially when a country reaches a certain level of economic well-being. At the same time,

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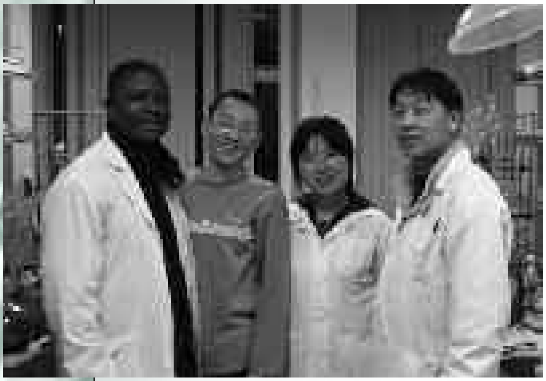

science is an international enterprise that places an unwavering focus on openness and transparency, which is enshrined in its peer-review process for publications and its commitment to unbiased, outside replication of laboratory results.

It is also important to note that expanding wealth and openness can play a critical role in expanding and sustaining excellence in science. It is all part of a comprehensive, long-term strategy, marked by economic growth, quality education, research excellence, discovery, innovation and financial rewards that feed into one another to strengthen positive trends in each.

Some countries may be able to generate wealth without strong educational and research systems (for example, due to a rich endowment of natural resources). Other countries may be able to create strong educational systems despite their weak economies.

Nevertheless, over the long term, a strong educational and research system is difficult to sustain unless a nation has a strong economic base. In this sense, sustained wealth can create sustained excellence in education and research.

What will ultimately determine the success of such efforts, however, are the policies that are put in place to advance the goals of science-based sustainable development, once a certain basic level of wealth is achieved.

China has drawn on its vast pool of cheap labour and a well-planned centralized decision-making process to build an unrivalled manufacturing base that is now the envy of the world. India has tapped its large pool of educated citizens – and, more recently, its vast youthful population – to serve as a springboard for sustainable economic growth, moving from low-end services (for instance, phone call centres) to increasingly high-end goods and services in information technologies and pharmaceuticals. Brazil, meanwhile, has emphasized the development of specific economic sectors – including petroleum, the manufacture of jet engines for private aircrafts and the production of biofuels.

In each of these countries, a certain degree of scientific capacity was already in place before reform measures were enacted to promote sustainable economic growth. The Chinese government had invested substantial sums of money in education, science and technology since its first days in power. The fruits of this investment, however, were largely hidden from view until China opened up to the world in the early 1980s. India had a substantial network of science institutes built during the British Raj and then expanded during the era of its first president, Jawaharlal Nehru. Beginning in the 1990s, Brazil made significant investments in strengthening and expanding student enrolment in science and technology, drawing in part *on the revenues generated by those sectors of the economy that were growing.*

The point is that when it comes to strategies for creating excellence in education and research, there is no single strategy for ensuring success. Indeed instead of seeking to uncover and embrace universal principles, each country should focus on its indigenous strengths to create a strong and enduring foundation for economic growth.

Yet, regardless of the path that is taken, investments in science and technology should be in place even before vigorous efforts at economic reform are launched. Equally important, investments in science and technology must continue once the economy takes off. In fact, as the nation's reservoir of wealth deepens, the level of investment in education and research must also expand to ensure that the pace of economic growth is sustained.

As recent trends indicate, countries with emerging economies are increasing their trade with other developing countries. These efforts are designed not only to help push economic growth to new heights but also to broaden the channels of exchange. The fact is that expanding trade helps to create a virtuous circle of economic growth, quality education, research excellence, discovery, and financial rewards.

So, what should developing countries, which have yet to enter the virtuous circle of science-based wealth creation, do to become part of these promising trends?

First, they should embark on a long-term strategy for science-based economic growth that rests on good governance and that draws upon its indigenous strengths – much like China, India and Brazil have done. Such strategies imply that investments in education and research must be part of the economic development plan from the very beginning. The issue isn't growth then *science, but growth* and *science.*

Second, it means that these countries, once a certain level of growth is attained, should continue to devise – and revise – broad-based strategies for strengthening their teaching and research capacities in ways that are not only commensurate with their expanding economic prowess but also provide a durable platform for future growth.

Specifically, it requires adequate and consistent investments in improving teaching and research. It requires a focus on the next generation of scientists, especially in countries with aging faculty. It requires support for fellowship and exchange programmes with universities and research institutes in other countries. And it requires a commitment to engage both the education and research communities in international initiatives that promote an exchange of ideas and focus on cutting-edge strategies for addressing critical challenges.

In pursuing such initiatives, everything should be on the table. Nevertheless, based on the premise that not everything can be done at once, the training of scientific and technological personnel should rank higher than "brick and mortar" considerations, and applications of science and technology to address social needs should be a national priority. In addition, each nation's priorities should be tied to international pursuits in science and technology as much as possible to help inform and enlighten policy discussions at home.

These are exciting times for education and research in the developing world. The scientific and technological capabilities of an increasing number of developing countries are becoming stronger (bolstered by their growing economies), trade between developing countries is increasing, as are the levels of scientific exchange, and a diverse set of successful models for economic growth and scientific capacity building are now in place allowing other developing countries to craft strategies from a broad range of options.

Speaking from the perspective of the world of science, the bottom line is this: scientific excellence can help generate wealth even in the poorest of countries, serving as one of the critical underpinnings that enable economies to grow. Wealth, in turn, is one of the primary factors reinforcing and sustaining the pursuit of scientific excellence. Once both are present, a nation's economic growth is likely to reach new levels of well-being from which it will be difficult to fall. There will, of course, be economic cycles – good times and bad – but no going back to the impoverishment that characterizes the poorest countries.

The deep economic recession of the past two years, which developing countries seem to be weathering better than developed countries, has infused all of these trends with an added sense of confidence in the South that rapid progress is indeed possible and that strategies for progress can be based on ideas and tactics that have been devised by other developing countries.

All of this suggests that excellence in research and education has a fair chance of taking hold in a growing number of developing countries in the years ahead. The best news of all may be that the success which is being achieved is increasingly drawing on policies that have been devised by developing nations themselves.

When scientific capacity and wealth increases, many other worthy goals come into reach. That is precisely what is happening in the developing world today.

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SCIENCE FOR COMMERCE

WE HAVE REACHED A STAGE IN GLOBAL DEVELOPMENT WHEN EVEN THE POOREST COUNTRIES CAN READILY DERIVE MATERIAL BENEFITS FROM INVESTMENTS IN SCIENCE AND TECHNOLOGY, SAYS HENERI A.M. DZINOTYIWEYI (TWAS FELLOW 1988), MINISTER OF SCIENCE AND TECHNOLOGY DEVELOPMENT IN ZIMBABWE. IN LIGHT OF THESE TRENDS, ALL DEVELOPING COUNTRIES SHOULD TAKE AGGRESSIVE MEASURES TO COMMERCIALIZE THE KNOWLEDGE THAT IS BEING CREATED BY THEIR SCIENTISTS.

For decades, scientists in developing countries have urged their governments to pay special attention to science and technology (S&T). Their main arguments have centred on the belief that, through S&T, countries could ultimately chart a path towards sustainable economic growth. That belief has been confirmed by recent trends in the developing world – most notably, the rapid development of Brazil, China, India and other emerging economies.

Governments in the developing world have nevertheless responded in different ways to the challenges posed by S&T-based development, primarily due to the circumstances that they face. More immediate problems – the very problems that S&T promises to overcome over time – historically have often impeded investments in S&T.

The issue, simply put, has been this: How can governments in poor countries invest in S&T when the spectre of hunger and poverty looms so large in the daily lives of their people?

For similar reasons, when governments in developing countries embrace S&T, they have often displayed a clear preference for applied science. Scientists, of course, have been quick to emphasize that strong links exist between basic and applied science. Indeed they have contended that the lines between

the two have become increasingly difficult to discern.

In this sense, the scientific community has argued that all aspects of science should be supported. Such discussions have been commonplace at scientific meetings ever since the 1980s, often wrapped around the adage that “without basic science there is no science to be applied”.

Despite the urgings of the scientific community to think otherwise, government officials in developing countries, for the most part and at least until recently, have tended to view science as a long-term endeavour that may ultimately impact society and the economy but that will do little to mitigate today’s critical problems.

This perception, however, is now changing. The success of countries with emerging economies has influenced the thinking of many. Yet concerns about the delayed benefits of basic science still hold sway in many of the world’s poorest countries.

It’s not that the countries have turned their back on basic science. It’s just that their leaders strongly believe that they must first face other, more immediate, challenges.

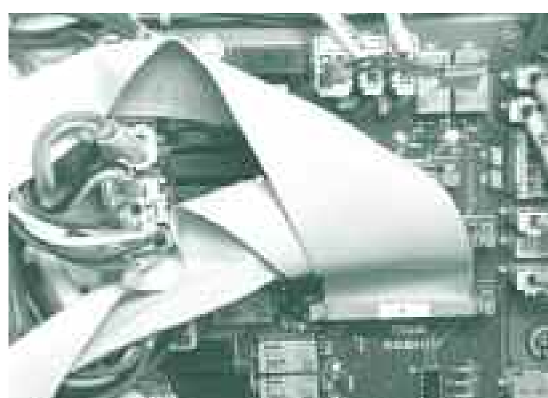
The good news is that S&T now generates substantial benefits in the short term that can help grow and transform every national economy. The best way to demonstrate these benefits, however, is through the commercialization of scientific findings so that knowledge is turned into goods and services that benefit society. Revenues generated through commercialized goods and services can then be used to support S&T activities as part of a virtuous circle that helps advance both science and society.

TARGETS AND PROGRESS

For several decades, beginning with discussions at the UN Conference on Science and Technology for Development held in Vienna in 1979, international organizations have urged developing countries to dedicate at least 1% of their gross domestic product (GDP) to S&T. It is also the goal that the African Union (AU) has encouraged its member states to strive for.

While such targets are welcomed, they are not enough to ensure social and economic progress, especially if countries turn a blind eye to the targets once they have been announced. The critical question is this: regardless of the levels of investment that are made in S&T, how will the knowledge that is created be transformed into products and services that reduce poverty and grow the economy?

That is why I would like to make the following proposal: That all countries, no matter how poor, embark on a broad strategy to commercialize the knowledge that is acquired and generated by their scientists. And, moreover, that they



adopt methodologies capable of assessing the impact that applications of S&T have on the GDP. At least 20% of the growth in GDP that can be attributed to science and technology should be reinvested to advance S&T even further.

If such a national accounting system is to be sustained, it must be managed on an ongoing basis. Developing countries, in fact, must be prepared to continue to support S&T even in years when the GDP is not growing. This can be accomplished by creating an S&T investment fund where an expanding pool of money can be deposited during periods of economic growth and then withdrawn during periods of economic downturn.

The ultimate goal is to ensure a steady stream of funds for S&T during good times and bad. With sufficient foresight and astute management, the ebbs and tides of GDP should not stymie investments in S&T.

ABIDING PRINCIPLES

The policy itself, however, must be based on a number of abiding principles.

All stakeholders, including scientists, must agree that S&T activities should focus on the creation of goods and services that promote economic and social development.

Political leaders must be willing to turn to the scientific community as a source of unbiased information and as an arbiter in helping to determine which policy proposals will actually make a difference in the economic and social well-being of the nation. Scientists, in turn, must be willing to serve in such capacities.

Scientists must be allowed to dedicate a portion of their time on initiatives designed to commercialize their research, including efforts to establish technology parks and incubators. Similarly, scientists and the institutions for which they work must view such an investment of time as valuable for individual researchers and the institutions as a whole.

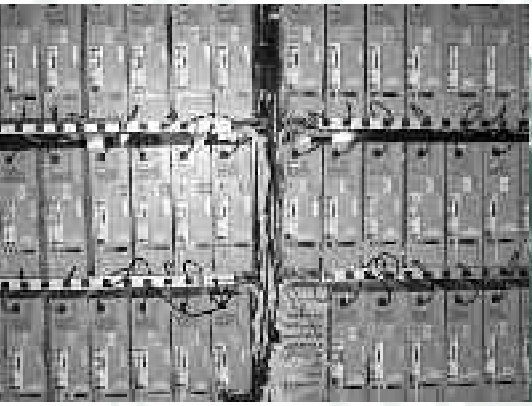
Intellectual property rights must be safeguarded in the interests of both individual scientists and their institutions. Benefits must flow not only to society, but also to those responsible for their creation.

All countries, and particularly countries in the South, must allow their scientists to freely travel to and work in countries where it is easier to apply and commercialize scientific findings. This would help to expand the long-standing principle of scholarly and scientific exchange to collaborative initiatives between academic institutions and commercial enterprises. Equally important, it would provide an important framework for turning knowledge into products and services with market value.

Poor countries need to foster innovation both in science and business. The scientific community can play a critical role in this effort by collaborating with indigenous businesses that are currently serving only local markets but that have the potential to reach customers in both poor and rich countries. Scientists should apply their expertise to help ensure that products and services available in the country meet international standards so that they can be sold abroad.

Countries should take steps to identify and support young students who display talent in business and entrepreneurship. They could do this, for example, by creating "olympiads" in business, innovation and entrepreneurship similar to the "olympiads" that have been created for science and mathematics. Scientists should be willing – indeed eager – to serve as organizers and judges at such events.

Scientists and businesspeople should work together on strategies that promote higher end goods and services as a means of allowing their countries to move up the value chain and become less reliant on low-cost labour and the export of resource-based commodities as the primary engines of their economies. China and India offer excellent examples of how strategic investments in S&T can not only reduce poverty and increase economic opportunities in the short-term, but also provide a pathway for building a knowledge-based economy over the long term.



S&T NOW

The past three decades have witnessed the emergence of a growing number of examples of successful strategies for science-based development in the developing world. An increasing number of countries can serve as models for others.

This success is also visible in terms of a broad range of fields. Information and communication technologies (ICTs) have revolutionized the way that knowledge is communicated, and access to ICTs has helped to place developing countries on a more equal footing when it comes to acquiring information that is the lifeblood of insight and discovery.

The same is true of biotechnology, which is providing opportunities for dramatically increasing crop yields without placing additional pressure on global resources. Biotechnology, in fact, has revolutionized agriculture, producing higher yielding crop varieties that can withstand harsh environmental conditions and enhance nutrition. It also holds great promise for helping to advance medical research and improving public health.

But biotechnology is not without its critics. Those with concerns contend that widespread applications of biotechnology could ultimately render irreversible damage to global biodiversity.

Scientists should play a central role in public debates over biotechnology, offering expert information and insights on the benefits and risks posed by biotechnology

agricultural science in Malaysia. Such capacity, moreover, is bound to grow in the years ahead.

The promise of science, in fact, has never been brighter. Its impacts are no longer on the horizon but are within our reach. The key to grasping the opportunities afforded by these developments lies in efforts to successfully commercialize scientific knowledge.

In this sense, the definition of scientific capacity building in the poorest developing countries must be expanded to include not just knowledge acquistion but notions of innovation, entrepreneurship and marketing. The good news is that there is now a sufficient number of developing countries that have done just that.

By following the example that these countries provide – and adapting it to their own circumstances – there is every reason to believe that all developing countries will be able to embark on a path to science-based sustainable development in the years ahead.

Such trends will not only benefit these countries but also the entire global community where greater economic and social well-being and equity will make for a more peaceful and harmonious world.

In short, it's now time to break down the walls between science and commerce and to start building bridges instead.

and advice on the regulations that should be enacted to ensure that applications of this technology not only reap immediate benefits for society but are safe for the future well-being of the planet.

Nanotechnology is another scientific frontier that holds great promise for improving social and economic conditions in the developing world.

A number of developing countries – for example, Brazil, China, India, Iran, Morocco and South Africa – are making substantial investments in nanotechnology. Their hope is that this technology, which allows materials to be built at the atomic and molecular level, will help improve water quality, enhance the effectiveness of pharmaceuticals and brighten the prospects for the widespread use of solar energy.

However, like biotechnology, nanotechnology has its critics who contend that insufficient research has been done to assess the potential environmental and health risks posed by microscopic nanoparticles. Again scientists can play a key role in this debate by offering research-based information and insights into the benefits and possible risks posed by nanotechnology.

LONG-TERM SHORT

Many developing countries, including poor developing countries, have developed a degree of scientific capacity – at least in a limited number of scientific sectors – for example, space science in Nigeria, nanotechnology in South Africa and

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WOMEN SCIENTISTS MEET IN BEIJING

THE ORGANIZATION FOR WOMEN IN SCIENCE FOR THE DEVELOPING WORLD (OWSDW) – FORMERLY KNOWN AS THE THIRD WORLD ORGANIZATION FOR WOMEN IN SCIENCE (TWOWS) – HELD ITS FOURTH GENERAL ASSEMBLY IN BEIJING, CHINA, IN LATE JUNE 2010. THE ASSEMBLY WAS PRECEDED BY AN INTERNATIONAL CONFERENCE, 'WOMEN SCIENTISTS IN A CHANGING WORLD', ORGANIZED IN CLOSE COOPERATION WITH THE CHINESE ACADEMY OF SCIENCES (CAS). MORE THAN 600 WOMEN SCIENTISTS FROM 55 COUNTRIES WERE IN ATTENDANCE. XI JINPING, VICE PRESIDENT OF THE PEOPLE'S REPUBLIC OF CHINA, PRESENTED THE OPENING ADDRESS.

"There has been a profound change in the world's economic system and structures since the global financial crisis," Xi Jinping told the participants. "While economies are recovering from the crash, impacts persist. Moreover, we live in a time of growing uncertainty. There are questions, for example, concerning food security, energy supplies and climate change. And demands on the global environment continue to increase at an accelerated pace."

Xi noted that science and technology must be a driving force in the development of societies and that there is a clear and compelling need to turn to science and technology to guide both national and global efforts for sustainable growth.

"The scientific community," Xi observed, "must seek to provide a greater understanding of nature. And to achieve this lofty goal, we need greater participation of women scientists.

"We thus have an obligation," he asserted, "to respond to the needs of women scientists not just for the sake of the scientists but also for the sake of the global community.

"As the world's largest developing country," Xi went on to say, "China has made the issue of women scientists a national priority. We are dedicated to protecting women's rights and helping women advance their

NEW EXECUTIVE BOARD

Fang Xin, a research professor and member of the presidium of the Chinese Academy of Sciences (CAS), was elected the new president of OWSDW. Outgoing president, Kaiser Jamil (India), remains on the executive board as 'immediate past president'.

The OWSDW board for 2010-2014 also includes:

Africa: Dolly Ahbor Ighoroje (Nigeria), vice president, and Esi Awuah (Ghana), member;

Arab Region: Samira Omar (Kuwait), vice president, and Rokhsana Abdul Rahman (Yemen), member;

Asia and the Pacific: Farida Habib Shah (Malaysia), vice president, and Sudha Nair (India), member;

Latin America and the Caribbean: Mayra de la Torre (Mexico), vice president, and Miriam Diaz (Venezuela), member.

careers, and we support women in their efforts to make new and greater contributions to China's economic development," he declared.

In sentiments that concurred with Xi Jinping, Kaiser Jamil, outgoing OWSDW president, called for more to be done to "protect the rights of women and help them to advance their careers." She noted that women succeeded in all areas of science but they remain too few in numbers, especially in many parts of the developing world.

Women are still under-represented in science and technology.

"We need," she contended, "to remove the roadblocks that women face on a daily basis and allow them to assume their rightful place in the workplace equipped with the know-how and skills that they need to succeed."

Other officials giving opening remarks at the ceremony included Naledi Pandor, South Africa's minister of science and technology; Lu Yongxiang, president of CAS; Mohamed Hassan, executive director of TWAS; Lidia Brito, assistant director general of UNESCO's science policy division; Howard Alper, co-chair of IAP; and David Ruth, executive director of the Elsevier Foundation, the sponsors (along with TWAS) of the first 'TWOWS Awards for Young Women Scientists'.

Indeed, the TWOWS/OWSDW awards proved to be the highlight of the opening ceremony. Ten of the 12 young women researchers chosen by the selection committee were present in Beijing to receive their awards from Vice President Xi (see box on p. 16).

CONFERENCE KICK-OFF

Naledi Pandor, Minister of Science and Technology of South Africa, gave the opening speech at the OWSDW international conference, 'Women Scientists in a Changing World'.

"China's phenomenal economic growth serves as a source of inspiration for much of Africa," she began. "It gives African countries renewed hope that we too can lift our citizens out of poverty.

"China's economic transformation has been closely associated with increased investment in science, technology, and engineering," she continued, adding that

China's president Hu Jintao is an engineer, China's premier Wen Jiabao is an engineer, and almost every Chinese official in a position of power is a university graduate with an engineering degree.

"Enter the office of any head of any Chinese state-owned entity, and you will find an engineer," she said. "Yet, the official will in all probability be a man. Even here in China, and indeed in most of the developing world, women's scientific skills and abilities are still underutilized.

"Women," Pandor lamented, "are still under-represented in the fields of science and technology. Women are still under-represented in top research managerial positions, and women are still under-represented in science, technology, and innovation policy-making.

"As a result, one of the primary challenges for the developing world is to ensure that the gender imbalance in the practice of science, technology and innovation activities is addressed.

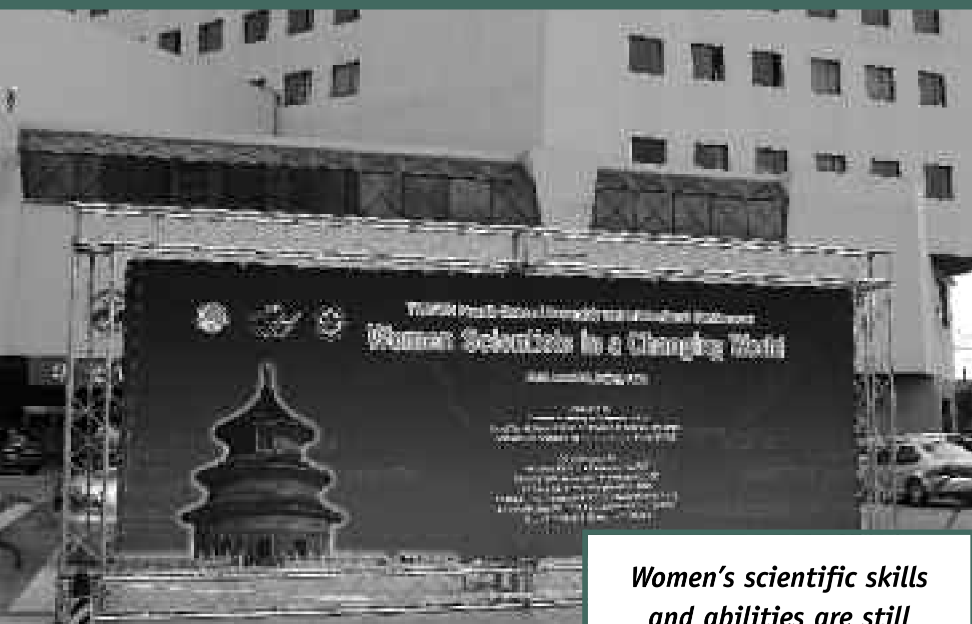
"Without incentives that support and recognize women in research, significant change is unlikely to take place," maintained Pandor.

Finally, Pandor called attention to the need to encourage girls to take classes and pursue careers in science. And she urged women scientists, especially those participating in the OWSDW conference, to serve as role models and mentors in their countries for the next generation of women scientists.

INVITED LECTURES

Following Pandor to the podium was Sharon Hrynkow of the Bureau of Oceans, Environment and Science, U.S. State Department, who spoke about 'Women scientists as change-agents in a changing world", a presentation that outlined the over-arching theme of the conference.

"Despite the challenges", Hrynkow observed, "this is a time for great optimism for women in science." Indeed, she added, "we are at a moment when many



> ***Women's scientific skills and abilities are still underutilized.***

positive trends are converging." Hrynkow cited four key reasons to be optimistic:

First, momentum for science is at an all-time high in many nations: China, for example, recently outlined plans to support nearly 4 million researchers by 2020; Brazil, under the Lula administration, has doubled its science budget in less than a decade; and Algeria has proclaimed it will double its research budget over the next five years.

Second, programmes are being developed and implemented to encourage women to pursue careers in science. For example, the US National Foundation's ADVANCE programme enables US universities to support women (and men) as they care for their children, elderly parents or tend to other family matters. Support for extra postdocs or technicians to keep the laboratory moving in the absence of the principal investigator is a key feature of this programme, which has now been replicated in other nations, including Switzerland.

Third, women are finding new ways to serve as mentors, supporters, and collaborators in science. They are networking with each other to propel the agenda forward. Organizations such as OWSDW have played – and must continue to play – a pivotal role in this effort.

Fourth, the importance of educating girls is becoming part of the global policy agenda. For instance, the Commission on the Status of Women, a UN body, has announced that its theme for the 2011 meeting will be 'Access and participation of women and girls to education, training, science and technology, including for the promotion of women's equal access to full employment and decent work'.

SCIENCE TALKS

Following Hrynkow, Esther Orozco, professor, Department of Experimental Pathology, CINVESTAV-IPN, Mexico, who was the first of four L'Oréal-UNESCO




TWOWS TO OWSDW

In Beijing, TWOWS members voted to change their name to the Organization for Women in Science for the Developing World (OWSDW). The new name is intended to better reflect the organization's focus on promoting both the greater participation of women in science, technology and innovation as well as the use of science, technology and innovation to improve the lives of people in the developing world.

prize laureates to give presentations, spoke about the 'Biological sagacity of pathogens: The biggest challenge to human intelligence'. The talk examined the ways in which humans may become infected by pathogens and the mechanisms that the pathogens use to avoid the host's immune response.

"The best way for us to fight pathogens," concluded Orozco, "is to study them and to gain new knowledge. Pathogens pose a hidden, yet significant, challenge to economic development and are a major reason why we need both basic and applied science."

An overview of the L'Oréal-UNESCO award scheme for women scientists was provided by another previous winner, Grace Taylor Olaniyan, professor, Department of Chemical Pathology, College of Medicine, University of Ibadan, Nigeria, who reviewed the scheme's implementation and growing recognition and impact since its inception 12 years ago.

The final two L'Oréal-UNESCO laureates to speak were Nagwa Meguid, head, Department of Human Genetics, National Research Center, Egypt, who outlined her thoughts on the 'Recognition of Arab women in science: A model of efforts in human genetics', and Ameenah Gurib-Fakim, Dean, Faculty of Science, University of Mauritius, who spoke on 'From basic sciences to a business model: The case of medicinal and aromatic plants in Mauritius'.

In total, the conference featured some 35 parallel sessions focusing on such topics as 'Women scientists and global change'; 'Women, innovation, entrepreneurship and leadership capacity'; and 'Gender mainstreaming in the global scientific community'. There was also a 'Young women scientists forum', which included:

- Presentations by the recipients of the first-ever OWSDW Awards for Young Women Scientists.
- A networking session for graduates of the OWSDW Fellowship programme, which provides grants to young women scientists from sub-Saharan Africa and Least Developed Countries (LDCs). To date, some 87 young women have graduated through the programme. With travel grants provided by the Swedish International Development Cooperation Agency (Sida), which also sponsors the fellowships programme, 27 graduates came to Beijing to share their experiences and present their scientific work.
- A discussion panel organized by IAP, the global network of science academies, on 'Regional perspectives on IAC's *Women for Science* report: Recommendations for the Global Network of Science Academies'.
- An announcement by the Elsevier Foundation that it had renewed its support for the OWSDW Awards for Young Women Scientists.
- Another announcement by the Elsevier Foundation that it will support a 'National assessments and bench-

WHERE WOMEN STAND IN PHYSICS

The four young women physicists who won 'TWOWS Awards' in Beijing offer contrasting examples of the under-representation of women in this field of science.

In developed countries, there are significantly fewer female physicists than male. The divide is even more evident in many developing countries.

Christine Steenkamp, for example, who won the award for physics for the Africa region, observes that she is the first woman physicist to be appointed to a full faculty position at the University of Stellenbosch in South Africa. When asked why she thinks this is so, one explanation she gives is the lack of female physicist role models. "I hope that by making this breakthrough, I can help mentor more female students into careers in physics," she says.

The situation in Yemen is even more difficult. Sakina Fakhraddin A. Ali was accompanied by her colleague Magda A. Rahim Mohammed, when she came to Beijing to receive her award for physics for the Arab region. The two women represent the sum total of women physicists in Yemen.

Priya Mahadevan, who earned the award for physics for the Asia region, reports that, of the 30 physicists working in her institute, the S.N. Bose National Centre for the Basic Sciences in Kolkata, India, three are women – a situation that she regards as "not so bad" – despite the obvious disparity.

"When I say that we are three women faculty out of 30, I am comparing the situation with some departments of the other top universities and research institutes in India, which have far worse ratios." She adds that her institute, like many others, has a much higher percentage of students and postdoctoral researchers who are women.

"Of 100 students, 22 are female," she says. "The number of women who are postdocs and those holding other 'soft' positions (such as visiting fellows) is about 50%." According to Mahadevan, many women take breaks after their PhD studies and find it difficult to get back into the system, except for short-term, non-permanent positions.

She notes that "in other instances, getting a job in the same city as your spouse is a consideration. Several institutions have a hiring policy where both husband and wife will not be given a job in the same place – and often there is no other place for the spouse to get a job in the same city."

The fourth winner of the award for physics was Aimé Pelaíz-Barranco from the University of Havana, Cuba. "There is a good representation of women in science in Cuba, especially in biology, biochemistry, microbiology, chemistry and medicine," she says. "Physics and mathematics have lower representation, but the situation is not as severe as in many other countries. For example, women in the physics department of Havana University represent more 25% of the faculty."

Originally from Kenya, Emily Ngubia Kuria, who presented a paper on the gender-mathematics gap at the conference, works at the Institute for the History of Medicine, Charité Berlin, Germany, and is also an associate member of the Graduate School for Gender Studies at the Humboldt University, Berlin. Her research focuses on understanding female under-representation in science and on evaluating the validity of research in experimental psychology and neuroscience that continues to allude to biological roots for this phenomenon.

When asked how differences in the representation of females in physics and mathematics may have come about, Kuria says: "We cannot overlook the fact that women have been allowed to participate in academia for only a century. Mathematics and physics are male-dominated fields, and many female students must compete against entrenched attitudes. There are, of course, women who have entered and excelled in these fields. But for the numbers to increase, a critical mass of women must become permanent faculty members so that many more girls and women can come to believe they have equal opportunities."

marking of gender, science, technology and innovation' project. The seven-country assessment, which will be carried out in collaboration with WIGSAT (Women, Technology, Society), aims to provide a snapshot of the level of support, opportunities and participation of women in innovation systems in developed, emerging and developing countries, including Brazil, China, India, Indonesia, South Africa, the United States and Europe. A series of policy recommendations will then be developed to help countries achieve their national targets for women's participation in science, especially in those countries that are experiencing rapid growth in research.

GENERAL ASSEMBLY

The OWSDW Fourth General Assembly, held in Beijing as part of the meeting, gave members an opportunity to discuss the direction and ambitions of their organization. Indeed, members agreed to introduce several key changes that they hope will help position the organization to address current global challenges and opportunities and to support its emergence as a leading organization for women scientists:

- A new president and executive board was elected (see box on p. 12).
- A change in the name of the organization from the 'Third World Organization for Women in Science (TWOWS)' to the 'Organization for Women in Science for the Developing World (OWSDW)' (see box on p. 15).
- Amendments to the organization's statutes. Two changes were particularly significant. First, social scientists will be eligible for full membership of OWSDW (previously they were only allowed to be non-voting associate members). Second, women scientists from the developed world who have a proven track record of working for the developing world will now be allowed to join OWSDW as full members.

OWSDW is at a transitional point in its history.

In the Beijing Statement issued at the conclusion of the conference, participants called on governments and the international community to recognize, document and highlight the contributions made by women to science, technology, engineering and innovation, and to work with decision-makers to ensure the full participation of women and girls in all aspects of science and technology.

In the closing ceremony, OWSDW's newly elected president Fang Xin expressed appreciation to the membership for "putting its trust in me and electing me to lead OWSDW." She added that she "hoped to be able to continue to help the organization grow" during her term as president.

Fang went on to say that "OWSDW is at a transitional point in its history" as it seeks to "move from a small network to a large, active and influential global organization."

"The organization has come a long way," she observed. "Together, I am confident that we can make even greater strides for women scientists in the years ahead." ■

TWOWS/OWSDW 4TH GENERAL ASSEMBLY

Beijing, China, 27-30 June 2010

ISLANDS OF SCIENCE

MANY PEOPLE DREAM OF RETIRING TO ONE OF THE CARIBBEAN'S SUN-DRENCHED ISLANDS. BUT WHAT'S IT LIKE TO BE A SCIENTIST THERE? SEAN MCDOWELL (TWAS FELLOW 2008), A THEORETICAL CHEMIST, WHO WAS BORN IN JAMAICA AND NOW RESIDES IN BARBADOS, SPEAKS ABOUT HIS LIFE AND WORK ON A TROPICAL ISLAND.

As the saying goes, no man is an island. But island life can be confining for a theoretical chemist like Sean McDowell, a professor of chemistry at the Cave Hill, Barbados campus of the University of the West Indies (UWI). After all, his colleagues are spread across the world – some tens of thousands of kilometres and four time zones away.

"I don't know of any other theoretical chemists in the English-speaking Caribbean. There may be some people in my field in the non-English speaking islands, or in South America. But the scientists who I mainly collaborate with are in England, Canada and the US," he says.

Born in Jamaica, Sean McDowell has racked up an impressive number of accolades during his 14 years back in the Caribbean after having spent more than eight years studying and working in Europe and North America.

In 1999, he won a Caribbean Academy of Science young scientist award and in 2008 he was presented with the prestigious Caribbean Community (CARICOM) Award. He is a member of the UK's Royal Society of Chemistry, and in 2009, at age 45, he was elected to TWAS as its youngest-ever Caribbean member.

But even as one of the region's most prominent scientists, he still struggles to find time and funding for his research.

McDowell, in fact, is fortunate that his research does not require very expensive equipment. All he needs are computers with reasonable processing speeds to perform the calculations that he normally performs.

BONDS THAT TIE

As a theoretical chemist, his primary interests are the properties of the weak bonds that hold molecules

together. These are not the chemical bonds we are familiar with from atomic models — for example, the bonds that hold hydrogen and oxygen atoms together in a water molecule. Rather, they are other, weaker bonds, some of which are essential for better understanding important biological processes.

A prime example of such a weak, yet vital bond, is the hydrogen bond that forms between hydrogen atoms on one molecule and electron-rich sites on other molecules. This bond determines the structure and behaviour of DNA molecules.

"Even though our knowledge of the hydrogen bond dates back over a century, there are still surprising things about it that need to be explained. This is what my colleagues and I try to do," he says.

Over the past decade, much theoretical and experimental work has been devoted to the study of the non-conventional "blue-shifting" evident in some hydrogen-bonded complexes. While much has been learned, there is still a need for a widely accepted general theory or model.

It is not easy to explain to non-scientists the value of such fundamental work, McDowell admits.

"You can't tell how such work may be applied in the future. We set the broad framework for the science behind hydrogen and other bonding so that scientists can eventually exploit the knowledge and insights gained from this research to better understand the chemical and biological systems that play such a vital role in our environment and for our health."

Being a theoretician in a developing country isn't always easy, he adds. Politicians and funders favour more applied research that may prove fruitful in the short-term.

"But big discoveries," he states, "usually depend on driven individuals with insatiable curiosity who prefer

NETWORKING FOR SCIENCE

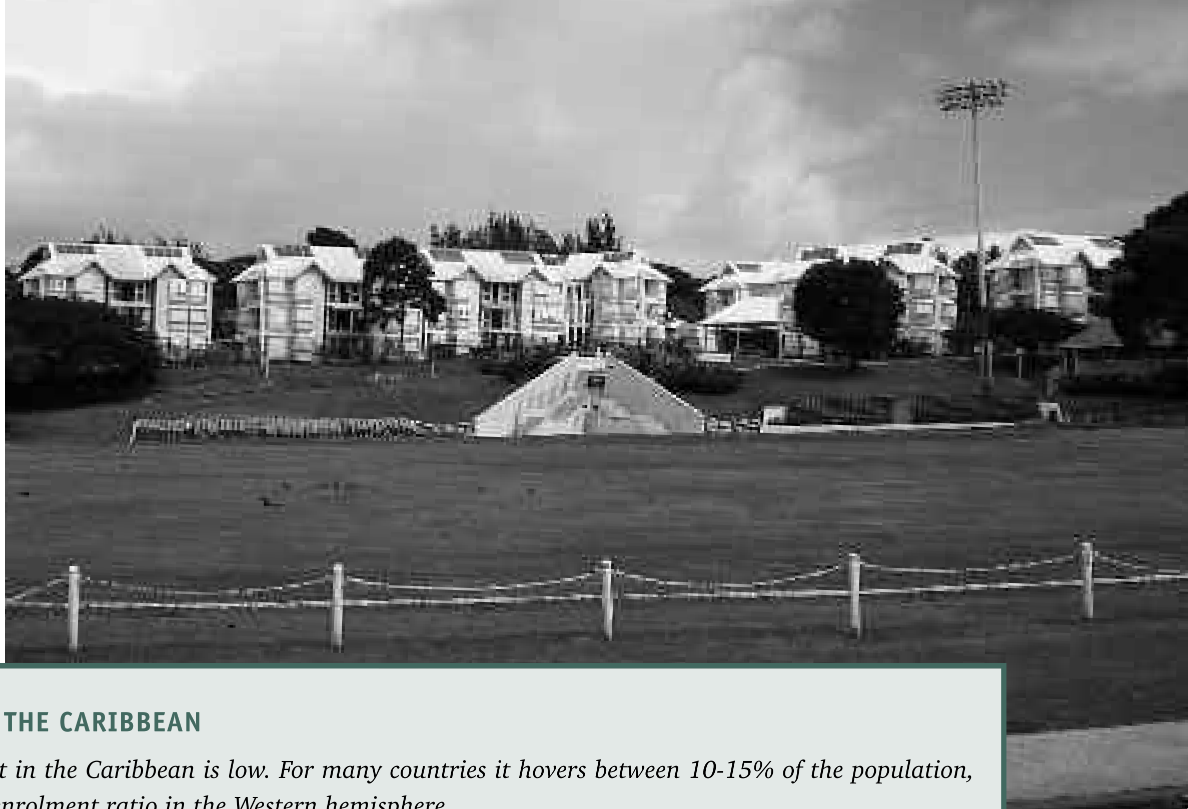
CARISCIENCE is a Caribbean network promoting research, development and postgraduate education in the basic sciences. Launched in 1999, it is supported by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and collaborates with TWAS.

CARISCIENCE has supported workshops, conferences, academic visits and a small number of R&D projects. It also oversees a Caribbean Young Scientist Fellowship Programme that enables PhD students to visit research institutions in Brazil, Mexico, Cuba, India and Italy.

On September 21, 2010, CARISCIENCE launched a Caribbean Science Foundation (CSF) in Port of Spain, Trinidad. The foundation's objective is to promote science, technology and innovation in the Caribbean and to harness scientific advances for the development of the region.

Drawing on support from Caribbean governments, private-sector donors and the Caribbean diaspora, CSF will offer research funding to Caribbean scientists, focusing on the following areas: energy, water and materials; transportation; agriculture and food science; medicine and health care; manufacturing; small and medium business development and entrepreneurship; information and communication technologies (ICTs); environmental science and engineering; and crime prevention.

The goal is to raise approximately USD13 million over the next three years to support 15 to 20 R&D projects. Each country in the Caribbean will be expected to contribute money to the foundation. The goal is for the CSF to be self-financing within seven years. For more information, see www.cadsti.org.



UNIVERSITIES IN THE CARIBBEAN

University enrolment in the Caribbean is low. For many countries it hovers between 10-15% of the population, which is the lowest enrolment ratio in the Western hemisphere.

Aside from a sizeable university sector in Cuba, the University of the West Indies (UWI) – consisting of three main campuses and a handful of centres and institutes scattered across the islands – dominates higher education in the Caribbean. Its three main campuses are separated by up to 2,000 kilometres.

UWI's enrolment exceeds 40,000 students, who come predominantly from the region's English-speaking countries. The oldest campus is at Mona in Jamaica, which was established in 1948 as a College of the University of London and gained independent university status in 1962. The two other campuses were established in 1961 and 1963 in St. Augustine, Trinidad and Cave Hill, Barbados, respectively. The university also has a school of tourism in Bermuda. In 2008, it established an open campus for distance learning.

Other universities in the region include the University of Havana founded in 1728, the University of Guyana, the University of the Virgin Islands, the University of St. Maarten, the Anton von Kom University in Suriname, and the University of Belize.

Since the early 1990s, the UWI's three main campuses have become increasingly autonomous. Whereas 30 years ago, chemistry was chiefly taught in Jamaica, the subject is now common to all campuses. The same is true for most other subjects.

This proliferation of courses means that the lion's share of students at any one campus today comes from the host country. A report published by UNESCO in 2007 identified this as a barrier to collaboration between campuses.

to explore more fundamental ideas and concepts that may not be immediately useful."

"I am such a person," he says.

CHEMICAL ATTRACTIONS

The joy of discovery has been with McDowell since he was a youngster growing up in Kingston, Jamaica. He inherited his curiosity from his father, an accountant, who enjoys reading. "My father's large library, containing books on literature, history, science and art, among other topics, provided me with enjoyment from an early age and helped me develop a wide-ranging interest, curiosity and appreciation of the world."

At 11, McDowell received a chemistry set for Christmas from his parents. In his diaries from that time he writes about chemical reactions, physics and the inspiring historical accounts of the great scientists who made important contributions to our understanding of the wonders of nature. "This was before I started learning about those subjects at school," he says.

The place to study chemistry in the English-speaking Caribbean is the University of the West Indies, Mona campus, in his home country — one of the three campuses that make up the institution (see box, Universities in the Caribbean). In 1985, he earned a bachelor's degree in chemistry from UWI with first class honours. "My path was set from then."

After his first degree and a stint as a graduate student at the Mona campus, a Commonwealth scholarship gave McDowell the opportunity to study for a PhD at the University of Cambridge, UK. There, his work brought him in close contact with some of the world's best theoretical chemists. He obtained his PhD in theoretical chemistry in 1992. While at Cambridge, he also played table tennis for the university and he still dusts off his racket whenever he visits.

The joy of discovery has been with McDowell since he was a youngster.

McDowell then became a post-doctoral student at the University of Western Ontario in Canada, where he stayed for three years until 1996 when he returned home. The choice was straightforward, he says.

"I could have opted to remain in Canada. But it's very cold up there and the competition for faculty posts is stiff. I thought it was time to return to the West Indies." He had a young family and believed it best to raise his family in the Caribbean with the traditional values that he was exposed to as a child. During his time in Canada, McDowell continued to do computational work, mainly exploring the three-body non-additive interactions between molecules in small clusters.

RED SHIFT BLUE

His work since returning to the Caribbean has mainly focused on the study of unusual rare-gas compounds and, more recently, on the properties of hydrogen bonding.

The molecular motion of the hydrogen atom tends to slow down when binding to electron-rich sites on other molecules. This is called the "red shift". It is so widespread that it was once thought to be the "signature" of hydrogen bonding.

By contrast, a "blue shift" occurs when the relative speed of the hydrogen atom increases upon binding. McDowell has recently made important theoretical contributions to our understanding of the unusual "blue shift" observed in some hydrogen-bonded complexes.

A particularly interesting new finding is the prediction of strong cooperative bonding between several hydrogen bonds and an unusual non-chemical bond called a halogen bond to produce a new class of complexes.

This finding implies that it is possible to produce very localized regions of opposite charge on a single atom in a molecule and suggests new ways of anchoring specific weak interactions to halogen atoms like chlorine that are ubiquitous in organic and inorganic chemistry. This also raises the possibility of exploiting, on the nanoscale, such highly directed weak interactions.

McDowell's move back to the Caribbean made it challenging for him to keep his research career going. In 1996, the number of chemistry faculty at UWI's Cave Hill Barbados campus numbered just five, and for the first time, McDowell was expected to devote the majority of his time to teaching.

"From 1985 to 1996, I focused on research. I did little teaching except for undergraduate laboratory supervision while at the Mona campus of the UWI in Jamaica. Within maybe a week of arriving in Barbados, however, I had to start teaching," he explains. The first years were tough. I like teaching, and I think that I'm good at it. But for me research is what is most important personally and professionally."

He was able to develop several projects to continue his research career, while balancing his new teaching duties. As he settled into his job, his teaching duties became more routine and less burdensome.

IN TOUCH

Since his promotion to professor in 2005, McDowell's time has also been taken up by administrative duties, culminating in his appointment to head the department of biological and chemical sciences at the Barbados Cave Hill campus in August 2009. Although his teaching has been scaled back in favour of his increased administrative responsibilities, he still manages to find some time for research.

The isolation from colleagues in his own field is less of a problem than it used to be, McDowell says. Modern information technologies have revolutionized his ability to engage with colleagues far away.

"During the year, I am in touch with my collaborators by e-mail. The only thing missing is day-to-day conversations. How I get around this is to go away during the summer, which I usually spend in the chemistry department at the University of Cambridge. There I can talk with colleagues in person and take advantage of the computational facilities and expertise that is available," he says.

FINDING FUNDS

Funding remains challenging for Caribbean scientists. Their governments dedicate little money to basic research. The UWI has some discretionary resources, but the amounts granted are typically small, says McDowell. Officials believe that the faculty are in a good position to find funding outside of the university.

But this is easier said than done. Caribbean scientists struggle to compete with better-resourced colleagues in the US, Europe and elsewhere. External funding sources also rarely focus on topics of particular interest to Caribbean scientists, such as the study of local plant and animal species, or developing ways of improving local agricultural practices.

There is, however, a silver lining for Caribbean science. This September, CARISCIENCE, a network promoting research in the region, launched the Caribbean Science Foundation, which aims to generate funding for indigenous research projects in disciplines of local interest. (See box, Networking for science, p. 21)

The foundation also hopes to boost collaboration within the region, which is currently more of an exception than a rule. Even at UWI, the three campuses rarely coordinate their research due mainly to their geographical separation.

Language is a major barrier to interactions between scientists from the English- and non-English-speaking

Funding remains challenging for Caribbean scientists.

countries of the Caribbean . "A lot of good science may be taking place in Cuba, but cultural and language barriers prevent us from collaborating," says McDowell.

The Caribbean science foundation is a step in the right direction for the region, says McDowell. But he adds that Caribbean governments will need to put more money into science if they want to catch up with fast-developing regions like South America or Asia.

"There is some appreciation of the importance of science for development," he says. "Government officials understand and accept that science has played a part in the development of countries like Singapore. But they have yet to fully appreciate that it requires a lot of money and commitment to sustain research." ■

PARADISE ISLANDS?

Comprised of more than 7,000 islands and inhabited by over 36 million people, the Caribbean islands are known throughout the world as a vacation paradise. And to some extent that reputation is well deserved. The islands enjoy an extensive array of beautiful beaches and wonderful weather (an average of 3,500 hours of sunshine each year with temperatures rarely dipping below 20°C). Tourism provides on average 10% of the governments' annual revenues, nearly 15% of the gross domestic product and 12% of regional employment.

Yet, when it comes to science, the story is not as bright. For example, Trinidad and Tobago and Jamaica, two of the more scientifically proficient countries in the Caribbean, spent just 0.06% of their gross domestic product on research and development in 2007. That is about the same percentage as Lesotho in Africa. By comparison, Brazil spends more than 1% of its GDP on R&D.

KEY DATA FOR SELECTED CARIBBEAN ISLANDS

Country	Population (millions)	Surface area (sq km, thousands)	Life expectancy (years)	GNI per capita (current USD)	Human Development Index (rank)	Scientific publications (2001-2007)
Antigua & Barbuda	0.1	0.44	75	13,020	59	19
Bahamas, The	0.3	13.88	73	21,390	50	59
Barbados	0.3	0.43	77	9,330	30	345
Cuba	11.2	110.86	79	n/a	52	4,612
Dominica	0.1	0.75	77	4,790	70	32
Dominican Republic	10.0	48.67	73	4,330	95	134
Grenada	0.1	0.34	75	5,870	66	87
Haiti	9.9	27.75	61	n/a	154	84
Jamaica	2.7	10.99	72	4,800	97	1,191
St Kitts and Nevis	0.0	0.26	71	11,210	49	9
St Lucia	0.2	0.62	73	5,430	75	16
St Vincent and the Grenadines	0.1	0.39	72	5,130	85	5
Trinidad and Tobago	1.3	5.13	69	15,580	57	821

Sources: World Bank, 2008; UNESCO Science Report 2010.

PHYSICS FOR DEVELOPMENT IN COLOMBIA

COLOMBIA'S INTERNATIONAL CENTRE FOR PHYSICS (CIF), WHICH BEGAN AS A TRAINING CENTRE FOR YOUNG PHYSICISTS IN CENTRAL AND SOUTH AMERICA, IS NOW PURSUING A BROAD RESEARCH AGENDA WITH ECONOMIC GROWTH IN MIND. ITS EFFORTS PROVIDE A USEFUL PARADIGM FOR OTHER REGIONS IN THE DEVELOPING WORLD SEEKING TO PROMOTE SCIENCE-BASED DEVELOPMENT.

*The name belies the purpose. The International Centre for Physics (*Centro Internacional de Fisica *or CIF) in Bogota, Colombia, doesn't just focus on the study of physics but also engages in a wide range of activities designed to put science to work to help grow Colombia's economy. Eduardo Posada, CIF's director, outlined the centre's agenda at the meeting of the Coordinating Council of the Commission on Science and Technology for Sustainable Development (COMSATS), which was held in Trieste, Italy, last spring. TWAS hosted the event.*

"Abdus Salam, the Nobel Prize winning physicist from Pakistan who led the efforts to create TWAS and the International Centre for Theoretical Physics (ICTP) in Trieste," says Posada, "also proved instrumental in the creation of CIF. The centre was launched in 1985, some 20 years after the establishment of ICTP and just two years after the founding of TWAS. Salam was a pivotal figure in both the discussions and design that led to the initiative."

"CIF," Posada explains, "modelled itself after ICTP, offering training workshops and short courses for students interested in physics. Although not nearly as large or well-known as the ICTP, CIF became, in some sense, the international centre for theoretical physics of South and Central America." Over the past 25 years, the centre has organized some 200 training activities that have attracted more than 8,000 participants.

STRENGTHS IN COLOMBIAN SCIENCE

Colombia does have a number of strengths when it comes to science and technology, especially within the region. It is one of the few countries in Latin America (Argentina, Brazil, Chile and Venezuela are the others) that has launched a satellite into orbit. In April 2007, the Libertad I *('Freedom 1') was sent into space from the Baikonur cosmodrome in Kazakhstan. The satellite is designed to improve communications, especially in universities. Colombia also has a small nuclear research reactor. The reactor was given to the research community by the United States more than a decade ago and has recently been reactivated to supply neutrons for nuclear research related to material science and public health. Most significantly, Colombia has one of the most sophisticated and accomplished clinical and medical research communities in the developing world. For example, Colombia's medical researchers were pioneers in keratomileusis, refractive surgery to correct myopia;* in vitro *fertilization; and heart transplant surgery. Many of the advances took place in the 1980s and 1990s.*

Over the past decade, Colombia's medical research capabilities have been handicapped by the country's economic woes and political unrest and violence. Only in the past few years has the medical community begun to regain its footing.

The Colombian-born Posada earned a PhD in physics from the University of Lausanne in Switzerland in 1972 and returned to Colombia in 1975 to serve as the director of the National Federation of Coffee Growers' Chemistry Laboratory, where he remained for more than 15 years. It was during his tenure at the laboratory that he first became involved in CIF.

After holding its activities on a "space available" basis during the first five years of its existence, in 1990 the National University of Bogota gave CIF a 1,600 square metre building for its operations. The centre, as a result, would have greater flexibility in organizing its activities.

The centre's leaders, of course, welcomed this benevolent gesture. They viewed it not only as a vote of confidence for past performance but also as an opportunity to expand CIF's research agenda to encompass a variety of physics-related topics, ranging from biophysics to material science to optics.

Equally important, CIF decided to focus a good deal of attention on applications of physics to real-world problems and to explore issues with a direct bearing on the country's economic and social well-being.

PRACTICAL IDEALISM

"Idealism," Posada notes, "certainly helped to shape the centre's expanded agenda. CIF officials wanted to sponsor programmes that would not only train young students but also boost Colombia's economy.

EARNING RESPECT

CIF has developed several products that have been successfully sold to customers. Their sale represents a source of revenue for the Centre that it hopes to build upon in the years ahead.

CIF, for example, has developed a remote sensing metering system for measuring electricity consumption. The system, which has been sold to both residential and industrial customers, is based on short- and medium-range radio waves. Its low cost and ability to provide detailed profiles of energy use provide opportunities for customers to adopt economical energy savings measures.

Under contract with the Energy Enterprise of Cundinamarca (EEC), CIF has developed a power scanner prototype in response to a resolution passed by the Colombian Gas and Regulatory Commission requiring the nation's electrical power companies to meet international standards of reliability and quality. The scanner is capable of assessing whether these standards are being met. Such assessments are critical in enhancing the performance of a broad range of machines and electronic devices, including computers. They also play a critical role in reducing the damage and lengthening the lifespan of these devices.

CIF has also designed and operated a full-scale biofiltration bed and two pilot biofiltration systems designed to remove hydrogen sulphur from the air. The material for the filters, originating from indigenous fungal populations, was "bioaugmented" to increase the filter's effectiveness in neutralizing the gas and rendering it benign. Subsequent investigations showed that the system is capable of attaining a 97% efficiency rate. Hydrogen sulphur, which can be derived from natural and industrial sources, is a highly toxic and corrosive gas that carries

"Yet idealism," he is quick to add, "was not the only factor. Practical considerations also came into play."

The CIF's reform efforts took place within Colombia's unique framework for science and development. Colombia, with an annual gross domestic product of USD400 billion, invests just 0.5% of its gross domestic product (GDP) on research and development (R&D). Brazil, in contrast, invests 1.5% of its GDP on R&D and Brazil's economy is more than three times larger than Colombia's.

Colombia, not surprisingly, does not have a large scientific workforce. In fact, it is estimated that Colombia has just 150 researchers per 1 million population. Brazil, in contrast, has more than 600 researchers per million and China 1,000. Colombia's scientific institutions are also few in number, although over the past decade that number has increased. Its scientists, moreover, publish a small number of articles in peer-reviewed scientific journals – less than 500 a year, according to most surveys.

Colombia's shortcomings in science are undeniable. Yet it's also true that Colombia has developed an intriguing public-private framework for the financing of scientific institutions that contrasts with the strate-

an offensive odour which can cause nausea and headaches. More ominously, in high doses, it can cause long-term respiratory problems and, on occasion, can prove lethal.

Several different technologies can be used to control the gas. But biofiltration has proven to be one of the most cost-effective, environmentally safe options. The filtration system developed by CIF can be used for both monitoring and controlling the gas flow and it holds promise for addressing and mitigating the risks posed by other gases as well.

Civil strife and violence has afflicted Colombia for several decades. One of the legacies of this period of unrest has been a large number of landmines strewn across the landscape in war-torn parts of the country. These mines pose a mortal threat to innocent citizens. CIF, working with The National University of Colombia, is currently investigating ways to produce mine detection devices that guarantee the utmost safety and reliability. The focus has been on antipersonnel devices that can be operated by remote control. Nuclear techniques – most notably, gamma-ray and neutron scattering – have been the primary areas of CIF's research. Such techniques have been applied elsewhere, including in Bosnia-Herzegovina in the aftermath of the ethnic conflict that took place in the 1990s. But to be effective, such techniques must be highly sensitive to local soil and climatic conditions. Therefore, CIF scientists have been working to adapt the technology to local conditions in Colombia where soils are moist and humidity levels high. A laboratory prototype, based on neutron scattering techniques, has been developed with the help of the International Atomic Energy Agency (IAEA) in Vienna. It is awaiting field testing.

gies forged in most developing countries where the government is the primary – and often the sole – source of investment for science and technology. The Colombian strategy may prove to be particularly effective in the years ahead.

CIF, like many research institutions in Colombia, is a private non-profit organization that does not receive any direct operating funds from the government. Consequently, it must seek funding for specific programmatic activities and then set aside a portion of its project-directed grant money – usually 15 to 20 percent — to pay salaries and overhead. More than 40 institutions in Colombia, many in agricultural-related fields, operate under the same financial scheme.

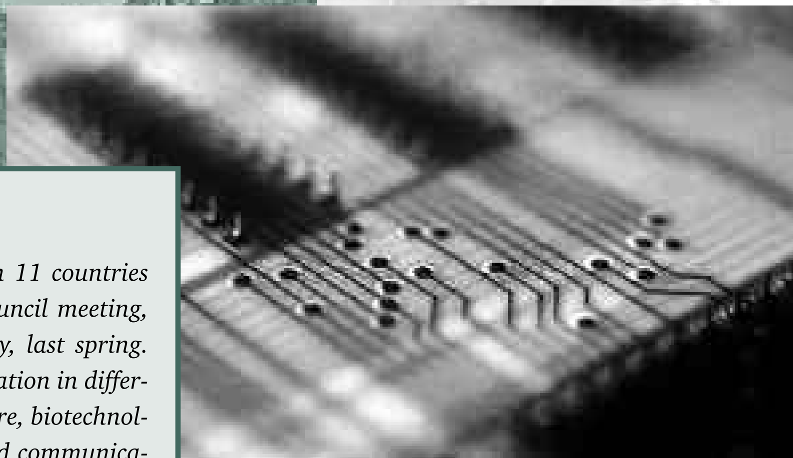
CIF is a private non-profit organization.

The funding structure certainly doesn't breed complacency, says Posada. In fact, as he notes, "it encourages the centre's scientists to be very entrepreneurial and to continually propose projects that appeal to potential donors, whether they are in government or the private sector."

Today, CIF operates on an annual budget of about USD2 million dollars and has a professional staff comprised of 25 people. There are five research groups, with four or five senior researchers in each one. Fifteen to twenty students, seeking either Masters' or doctorate degrees, usually in affiliation with the National University of Colombia, supply additional research capabilities.

At times, CIF also provides opportunities for a select number of undergraduate students "who have shown great aptitude in science and expressed great interest to learn more" to work with the Centre's staff on a part-time basis after school and on weekends. "In that way," Posada observes, "we are helping to encourage promising students to pursue careers in science."

CIF's facilities are equipped not just with classrooms but also with laboratories. The centre's fields of study and problem-solving experimentation include biophysics, material science, neuroscience and optics. Students seeking advanced degrees receive credit for their laboratory work and also gain valuable hands-on experience that is likely to serve them well in the



COMSATS

Delegates representing COMSATS centres of excellence in 11 countries participated in the organization's 13th Coordinating Council meeting, which was held at TWAS's headquarters in Trieste, Italy, last spring. Each delegate highlighted the achievements of his organization in different fields of science and technology, especially in agriculture, biotechnology, high-technology industrial products, information and communication technology, the environment, material science and space technology. Weather prediction, biofuels and communication satellites were among the specific topics discussed. Posada spoke about CIF's broad-ranging activities at the meeting.

The main goal of the Commission on Science and Technology for Sustainable Development (COMSATS), which was established in 1994 with funding from the government of Pakistan, is to help build scientific and technological capacity among its 21-member states through cooperation and the sharing of successful experiences in applications of science and technology for development.

At the Trieste meeting, COMSATS' Coordinating Council agreed to a communiqué endorsing a broad outline to create thematic groups to pursue research activities conducted by clusters of countries within COMSATS' member states. The communiqué also called on the member states to spend 2%-3% of their gross domestic product on research and development.

The Coordinating Council also elected Eduardo Posada as its new chairperson. He replaces Mohamed H.A. Hassan, who had served in that capacity for the past 15 years.

For additional information about COMSATS, see www.comsats.org.

future, especially if they choose to seek employment in the private sector.

CIF, for example, is currently engaged in studies of electro-physiological applications for the treatment of tropical parasitic diseases, including Leishmania, a potentially deadly ailment that afflicts an estimated 12 million people worldwide, virtually all of whom live in developing countries.

"This research effort," Posada says, "is designed to enhance our understanding of the physiological and biological mechanisms that drive not only Leishmania but all tropical diseases. Ultimately, we hope to provide evidence-based findings that can lead to better medical interventions and treatments."

Other CIF projects involve the development of sophisticated laser imaging techniques for environmental monitoring, studies of microorganisms for the creation of biofilters to address pollution problems related to the use of insecticides, and applications of nuclear techniques to uncover land mines that continue to pose a significant threat in conflict-ridden areas, including those places in Colombia that have been plagued by drug-related violence and civil unrest.

CIF has also gained increasing recognition for its technical prowess in developing electronic instrumentation for industrial use. To date, these efforts have led to the development of 20 specific product lines and three spinoff companies.

"Our success in developing state-of-the-art instrumentation," Posada says, "has helped us gain additional confidence from potential funders both in government and the private sector."

Sponsors are increasingly viewing the centre's research as part of a larger strategy to develop technologies that can generate both profits for private companies and greater wealth for the nation as a whole.

Both public- and private-sector institutions must learn to trust their researchers.

For CIF, of course, this means more opportunities to acquire grant money that will allow it to further develop and expand its research agenda. Since this aspect of CIF's work is devoted to commercial products and services, the centre calls on well-trained technicians to do the work. "Industry," says Posada, "expects our work to be professionally done and for that we need professionals."

LESSONS IN LEARNING

Posada's experience with the CIF provides many important lessons in learning that he continues to apply in devising effective strategies for forging closer ties between research and industry as part of a larger effort to promote science-based development in Colombia.

First, he says, both public- and private-sector institutions "must learn to trust their researchers to create products and services that will be useful and therefore profitable." For too long, he contends, Colombia's leaders have assumed that "science and technology were too complex and expensive to be developed indigenously." They have had little faith in the ability of their researchers to be practical and to pursue agendas that would generate "not just personal satisfaction but also value in the marketplace."

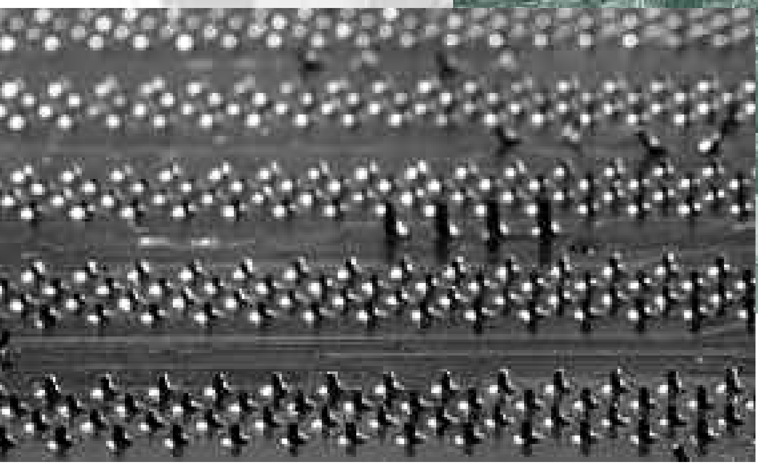
At the same time, Posada acknowledges that researchers "must gain the trust of managers and administrators." He maintains that the best way to do this is by engaging in projects that "help to improve the social and material well-being of their fellow citizens."

CIF's efforts have brought the world of research and commerce closer together and Posada strongly believes that other initiatives can also advance this goal.

"In some ways," he notes, "the public-private financing scheme that has been at the heart of Colombia's research programmes has laid a strong foundation for collaboration that can be applied to a broad range of initiatives. At some level, we don't need to change the research culture in Colombia," he adds, "as much as strengthen and expand it."

Second, Posada notes that Colombia should take steps to showcase its success stories. "Our citizens are well aware that their country's unfavourable international reputation lies in images of drug cartels and violence." But Colombians, he says, "are a hardworking people and the nation has recently taken important measures to improve its scientific capabilities. It has, for example, spent more money on its universities and research centres, and nurtured a more welcoming environment for foreign investment."

Posada notes that organizations like the Commission on Science and Technology for Sustainable Development in the South (COMSATS) and TWAS "could provide a great service by documenting the good work of scientific institutions that are making a difference in the lives of people in poor countries."



depends on institutional collaboration. This is especially true in poor countries like Colombia where building a critical mass of scientists, capable of augmenting and complementing each other's talents, remains a formidable task."

Third, Posada notes that Colombia should be proud of its recent progress in building science and technology. Yet it is also important to remember that "our overall capabilities remain weak and fragile. We have just begun the process and a great deal more work remains to be done." He believes that it is not only essential to continue to increase investments in science and technology but also to focus on critical research areas that have been largely ignored.

"In Colombia's case," Posada observes, "there are a number of 'enabling' technologies – for example, biotechnology – in which we still do not have basic competency." Advances in science and technology are likely to remain stymied unless we devote sufficient attention to such critical fields of study, he adds.

Scientific excellence begins with individual scientists.

Fourth, while Posada emphasizes the importance of providing support to individual scientists, he also maintains that it is important to encourage the development of associations or networks of local centres. "Scientific excellence begins with individual scientists. Consequently, there is no substitute for well-trained researchers," he notes. "Yet the ability to apply science to complex societal challenges also

DREAMS AND REALITY

"Abdus Salam was a world-class theoretical physicist who remains one of only a handful of scientists from the developing world to have been awarded the Nobel Prize," Posada says. But, as his renowned efforts to create ICTP, TWAS and CIF show, Salam was not only dedicated to building scientific research capacity in the South but also to utilizing science to build more prosperous and secure societies. "Both science and science-based development are part of his inspiring legacy and we hope to make that a part of CIF's legacy as well."

For all these reasons and more, Posada says, "I think that if Salam were alive today, he would be more than pleased by the course of action that CIF has taken, and would undoubtedly offer uncompromising support for the centre's ongoing efforts to link science to social well-being." ■

For additional information about CIF, see www.cif.org.co.

ACADEMIES IN ACTION

WHILE ACADEMIES OF SCHOLARLY AND SCIENTIFIC KNOWLEDGE HAVE ALWAYS BEEN REVERED AS ASSOCIATIONS COMPRISED OF THE WORLD'S SMARTEST PEOPLE, THEIR IMAGE AS SANCTUARIES OF THOUGHT HAS LIMITED THEIR PROMINENCE IN SOCIETY.

In recent years, however, academies have been experiencing a resurgence driven by a greater sense of social purpose. Sergio Jorgé Pastrana, Foreign Secretary of the Academy of Sciences of Cuba and Chair of the membership committee of IAP, the global network of sciences academies, examines the role of science academies – both past and present.

This year marks the 350th Anniversary of the world's oldest continuously running academy of sciences: The Royal Society in the United Kingdom.

Yet, it would be wrong to assume that the history of science academies began with the UK's Royal Society. Indeed science academies are among the world's oldest and most revered organizations.

The origin of science academies dates back to Plato's academy in ancient Greece. In the first millennium of the common era (CE), the rapidly expanding Islamic world, drawing in part on the experience of the world of antiquity, assembled centres of learning that resembled Plato's academy in cities such as Baghdad and Alexandria. Indeed science-like academies in the Islamic world enlarged the cloistered environment of Greek academies to emerge as cultural centres that reached out to a larger public. That was certainly true of the *Bibliotheca Alexandrina* in Egypt.

POWER OF KNOWLEDGE

The roots of the modern academy lie not only in the thirst for knowledge associated with the Enlightenment but also with the quest for power associated with the rise of European nation-states in the 17th century. It is for this reason that the longest-lived academies are found in European countries, including Italy (*Accademia Nazionale dei Lincei*, founded in 1603), Germany (*Deutsche Akademie der Naturforscher Leopoldina*, founded in 1652), the United Kingdom

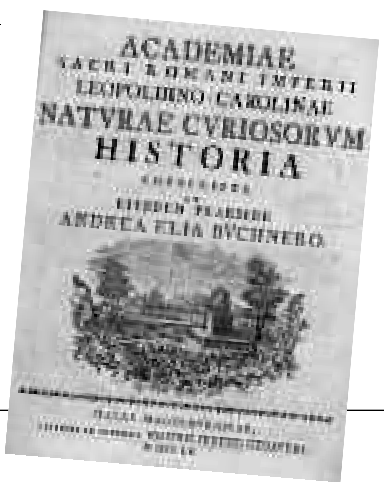
(Royal Society, founded in 1660) and France (*Académie des sciences*, founded in 1666). While the details of their development may differ, in each case the science academy was established not just to promote scientific excellence and discovery but also to serve as a source of national pride and strength.

The primary responsibilities of academies have remained remarkably consistent through time and can be divided into the following tasks: to recognize and honour scientific achievement; to lend support to scientists; to monitor and assess the state of scientific research both within their countries and abroad; to promote public understanding of science and help ensure the quality of science education; and to offer advice on science-related policy issues of societal significance. Some science academies – for example, the Chinese Academy of Sciences and the Russian Academy of Sciences – have also been given responsibility for operating scientific laboratories and overseeing large-scale scientific projects.

The primary responsibilities of academies have remained remarkably consistent through time.

Academies, of course, usually share these responsibilities with other institutions and groups, and, in many instances, may not be (indeed usually are not) the lead organization when examining and promoting these efforts. For example, principal authority for building a nation's scientific capacity usually lies with the ministry of science and technology; efforts to enhance science education with the ministry of education; the development of science policy agendas with appointees to the prime minister's or president's office; and the creation of research strategies with research centres and universities.

The one responsibility for which science academies have lead responsibility is honouring the nation's most eminent scientists through their election to the academy itself. Yet, even here, there is a great deal of competition, including growing lists of prizes for scientists both at the national and international levels; high-profile regional and global research projects that add lustre to a scientist's resume; and the election, often as a foreign or associate member, to other science academies. Even today becoming a member of the UK's Royal Society or the US National Academy of Sciences often carries more prestige and notoriety than being elected to the academy in the scientist's home country, especially if the scientist hails from a developing country.



The honours and rewards that an individual scientist attains are often rooted in his or her ability to "mind" the depths of a particular field of study. The more specialized the research, the more likely it

CHINESE ACADEMY OF SCIENCES (CAS)

The Chinese Academy of Sciences (CAS) was established on 1 November 1949, one month after the founding of the People's Republic of China. CAS serves as a key force behind the development of the country's scientific research system. From the beginning, its responsibilities included devising strategies for future S&T development, restructuring research institutions, and training and supporting professionals in science and technology. CAS has focused its efforts on developing long-term objectives for S&T development and promoting the nation's efforts to modernize through science-based development. Since 1998, it has led efforts to advance China's innovative capacity through cutting-edge scientific research and technology transfer. The academy's recent achievements include Chinese space explorations that have led to the discovery of high-energy electrons possibly coming from dark matter, development of the world's first quantum relay instrument, and construction of the Large Sky Area Multi-Object Fibre Spectroscopic Telescope (LAMOST). CAS, which currently has 692 members, continues to evolve and contribute in fundamental ways not only to China's scientific and economic development but also to the global advancement of scientific research and social welfare. For additional information, see english.cas.cn.

is to lead to new knowledge. And in science, it is new knowledge that attracts the most attention and that ultimately receives the greatest accolades and rewards.

The strength of a science academy, on the other hand, often resides in its diversity – that is, its ability to gain a strong presence in the full range of activities that must be pursued for a nation's scientific capacity to be built and sustained. That's another way of saying the strength of an academy lies largely in the wide-ranging knowledge and skills collectively represented by its members.

Academy members, for example, usually hold prominent positions in research institutions and therefore exert a strong impact on a nation's research agenda. In a growing number of countries, academy members have been appointed to high-level positions in science ministries, including to the post of minister, thereby playing a central role in building their nation's science policy frameworks. And, of course, academy members are usually professors and thus have a direct impact on the teaching of science. They not only shoulder responsibility for teaching the next generation of researchers but also for playing a key role in training the next generation of science teachers working in all levels of education.

One of the reasons for the rising prominence of national science academies is the increasing importance of science, technology and innovation in national economic development strategies.

As science has become an indispensable tool for development, science academies have come to be seen as an indispensable source of information for sustainable economic growth. This should come as no surprise: A knowledge society requires knowledge workers, and science academies represent one of the most important sources of knowledge workers that a nation has.

NO TWO THE SAME

While it is fair to say that science academies share many characteristics, no two science academies are exactly the same, either in their makeup or range of activities. As is true of all organizations, science academies are products of a complex web of history, culture, finances and leadership. They are, in short, a reflection of the countries in which they exist.

By definition, members elect members in science academies. The selection process, moreover, is based

L'ACCADEMIA DEI LINCEI, ITALY

L'Accademia dei Lincei*, established in 1603, is the world's first modern science academy. Historical sources suggest that the name "Lyncei", derived from lynx, was inspired by the scholars' love of science and the desire to explore the secrets of nature with perceptions as acute as those of the lynx. One of the first members of the academy was Galileo Galilei whose most important scientific works were published by the academy in the first half of the 17th century.* Lincei*, which is Italy's national academy, currently has 510 members. Its aim is to "promote, coordinate, integrate and spread scientific knowledge in its highest expression in the unity and universality of culture." The academy encourages scientific initiatives and serves in an advisory capacity both for national and international scientific concerns. More specifically, it advises the President of the Italian Republic on scientific matters. For additional information, see* www.lincei.it.

on merit and accomplishment. For many science academies, this represents their primary responsibility, together with the seminars, workshops, conferences, awards and prizes that they oversee for their members. More recently, academies have also developed a range of programmes designed to help members of the larger scientific community. Most notably, these include initiatives to assist young scientists and women scientists. And, increasingly, academies have pursued initiatives to engage the public in gaining a greater appreciation and understanding of science through the organization of public lectures and exhibitions.

As mentioned earlier, some academies, including those in China, Sweden, Russia, Egypt and Hungary, also operate large-scale research facilities. Others, such as those in France, the United Kingdom and the United States, do not. Yet, even those academies that oversee research facilities do not tread the same administrative paths. The Chinese Academy of Sciences, for example, manages research facilities in a broad range of fields, including climatology, genetic engineering, mathematics and physics. Scientists often work in these facilities for their entire careers as staff members of CAS. The Swedish Academy, meanwhile, provides seed money to nurture the creation and early growth of research institutions. At some point, the institutions either become strong enough to strike out on their own or move under the umbrella of another institution, most likely a university or research centre.

QUESTIONS OF MEMBERSHIP

Historically, some academies have placed liberal limits on the number of new members that they elect each year – sometimes as many as 50 or even 100. Other academies, meanwhile, have placed strict ceilings on membership – in some cases, allowing for a new member only upon the death of a current member.

Both strategies emphasize excellence. Yet, the strategies lead to slightly different outcomes. For example, academies that place a ceiling on new members tend to exacerbate their age and gender imbalance problems (worldwide, the average age of academy members is over 65, and only 5% of academy members are women). On the other hand, academies that provide for the election of new members each year (the US National Academy of Sciences elects on average 90 new members each year), tend to be more dynamic and cover a broader range of scientific fields, including cutting-edge scientific fields. But they also require greater administration and tend to be run in a more business-like, and less collegial, fashion.

There are 107 merit-based national science academies in the world today.

Regardless of the framework used for the election of new members, virtually all academies divide their categories of membership between core members and such broader designations as foreign members (scientists from other countries), junior members (scientists less than 35 or 40 years of age who are given term, not permanent, appointments), and honorary members (scholars and researchers who work in non-scientific disciplines but who are making important contributions to science).

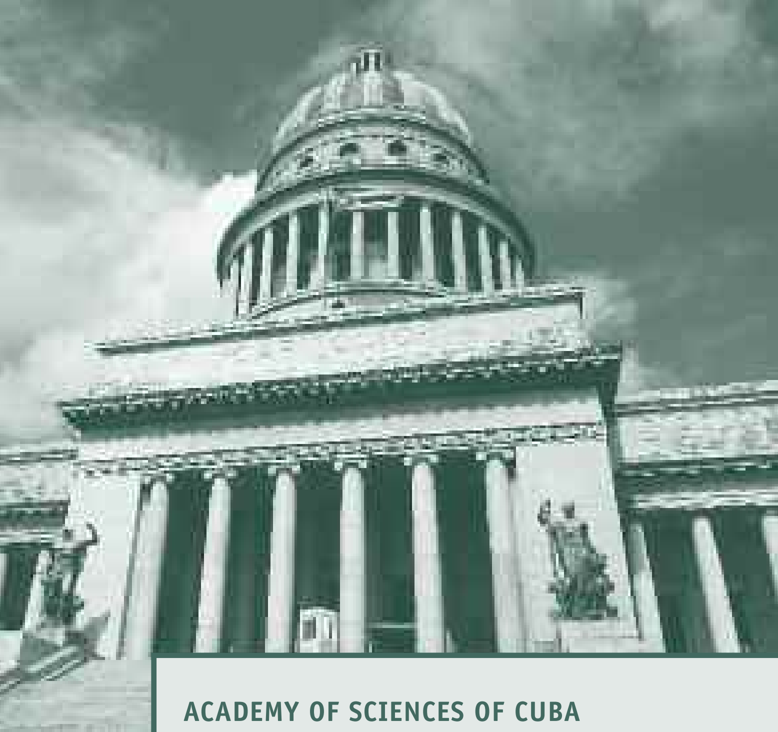
POLICY PERSPECTIVES

One of the most significant recent developments among science academies is their willingness – indeed their growing desire – to provide policy advice to decision makers on science-related issues of significance to society.

We see such efforts in the increased number of meetings that are taking place between academy members and national political leaders. We see this in the willingness of academy members to serve on government committees designed to address issues ranging from climate change to genetic engineering to strategies for addressing the risks posed by pandemics. We see it in IAP's series of statements on, for example, sustainable forest management, ocean acidification, the teaching of evolution and other controversial issues that are driving global debates and shaping today's world. And we see it in the growing participation of science academies in global conclaves such as the World Economic Forum's Conference of Young Champions held each year in China.

THE ACADEMY OF SCIENCE OF SOUTH AFRICA (ASSAF)

The Academy of Science of South Africa (ASSAf) was inaugurated in 1996 in Pretoria with President Nelson Mandela serving as the academy's patron. The launch coincided with the dawn of democracy in South Africa, which had taken place two years earlier. ASSAf's mission is to promote science for the benefit of society. To advance this goal, the academy provides evidence-based advice to the government. ASSAf currently has 338 members. Nearly 30% of its members are black and nearly 25% are women. The academy also oversees a number of awards, including the Science-for-Society gold medals (two are awarded annually) and the Sydney Brenner Fellowship. It has assumed publication of the South African Journal of Science *(SAJS), helped establish SciELO SA, a free, open-access, fully-indexed journal platform, and launched the magazine* Quest*, the country's leading science magazine. In its advisory capacity, ASSAf has released several statements on a broad range of topics, including climate change, xenophobia and ocean acidification, and it has been commissioned to conduct studies on such topics as strategic approaches to research publishing, HIV/AIDS, tuberculosis and nutrition, science for poverty alleviation and low-carbon cities. For additional information, see* www.assaf.co.za.



ACADEMY OF SCIENCES OF CUBA

The Academia de Ciencias de Cuba*, founded on 19 May 1861, is the oldest continuously active merit-based national science academy outside of Europe. It will be celebrating its 150th anniversary next year. Originally named 'the Royal Academy of Medical, Physical and Natural Sciences of Havana' under the Spanish crown, the academy remained in place through the birth of the Cuban republic in 1902 and the Cuban revolution in 1959. The academy further evolved in 1994 when its administrative structure, together with the National Commission for Environment and Natural Resources, and the Executive Secretariat for Nuclear Affairs, became an integral part of the Ministry for Science, Technology and Environment. In April 1996, the academy was established by law in its current form. Its primary objectives are fostering Cuban science, disseminating national and universal scientific progress, recognizing the scientific research of excellence in the country, raising ethical professional standards and social recognition of science, and strengthening links among scientists and their organizations both in and outside Cuba. With a current membership of 265, it bestows various awards such as the National Award of the Academy of Sciences of Cuba, the Young Cuban Scientists award jointly given with TWAS, and the National Award of Social Sciences, established jointly with the Cuban Publishing Houses. It also oversees the Carlos J. Finlay National Museum of History of Science and Technology and the Cuban Observatory of Science and Technology. For additional information, see* www.academiaciencias.cu.

Science academies enjoy a number of significant advantages in pursuing these activities. Their independence, transparency and apolitical nature make them ideal candidates for presenting unbiased information to decision makers (following the adage "speaking truth to power"). They are also well positioned, both in experience and temperament, to serve as a key group for mentoring the next generation of scientists, helping in the process to ensure that the academy's key tenets remain firmly in place.

There are currently 107 merit-based national academies in the world. Recent activities suggest that academies are entering a new phase in their long history – a phase that will bring higher levels of visibility and social and political engagement to institutions that in the past largely remained hidden from public view.

Such presence will require science academies to reform their ways without reforming their principles. It will entail learning more about the world beyond science. And, it will require academies to collaborate more closely with their societies as well as among themselves through such networks as IAP.

The best news of all may be that academies are actively pursuing these reforms on their own. More than anything else, this suggests that the changes that are unfolding will not be fleeting but are here to stay. ■

SCIENCE IN PALESTINE

WORKING UNDER DIFFICULT CIRCUMSTANCES, THE PALESTINE ACADEMY FOR SCIENCE AND TECHNOLOGY (PALAST) HAS NEVERTHELESS MANAGED TO TAKE A NUMBER OF NOTEWORTHY STEPS TO PROMOTE SCIENTIFIC TRAINING AND RESEARCH. PALAST'S ULTIMATE AIM IS TO STRENGTHEN BOTH THE SCIENTIFIC COMMUNITY AND THE PROSPECTS FOR SCIENCE-BASED DEVELOPMENT IN PALESTINE.

Imagine a scientific organization operating under forbidding conditions marked by relentless political instability, economic distress and social tension.

Now imagine this organization arduously moving forward, despite limited funds, unyielding isolation and even the ransacking of its offices.

Such incongruous circumstances accurately describe the brief history of the Palestine Academy for Science and Technology (PALAST), which was established in 1992 by the Palestine Liberation Organization (PLO) as an independent, non-governmental public agency.

The Palestinian Authority deemed PALAST its foremost scientific and technological "coordinating" agency and granted the Academy a leading role in fostering scientific capacity building and exchange. Specifically, PALAST's mandate focuses on defining Palestinian science priorities, advancing scientific and technological research through cooperation, promoting innovation, and fostering applications of science and technology for the benefit of society. Academy members, currently totalling 45, are among Palestine's most distinguished scientists.

SCIENCE SURVIVAL

Established just one year before the signing of the Oslo Accords in 1993, PALAST was inactive until 1997, when a presidential decree officially confirmed its status and assigned the Academy strategic tasks for advancing scientific research and promoting innovation in Palestine.

PALAST opened its first office in Ramallah on the West Bank in 1998 and a second office in Gaza in 2000. A third office in East Jerusalem serves as the Academy's headquarters.

Two years later, PALAST's staff and members were shaken and dismayed when Israeli soldiers pillaged the Academy's office in Ramallah.

As Imad Khatib, Secretary General of PALAST, recalls: "The deliberate targeting of scientific institutions, including PALAST offices in Ramallah, often forced us to work at home. A lack of funds, moreover, handicapped our efforts."

The Academy, he says, has received little financial backing from the Palestinian Authority to conduct research activities. "From 2001 to 2004, Academy staff worked on a voluntary basis. Such obstacles," he is quick to add, "while discouraging, have never stopped us from pursuing our goals."

PALAST functions as a crucible for scientific collaboration.

Since then, PALAST has literally emerged from the chaos and debris to become a focal point of scientific activity in Palestine as well as a respected member of the international scientific community. In 2004, a second presidential decree reaffirmed its status as an independent, non-governmental public body.

FIGHTING FOR SCIENCE

What is it like to operate in a war zone? There is fear and tension, and constant worry about being caught in the wrong place at the wrong time. There is irritation and annoyance created by checkpoints and detours imposed by the Israeli forces. There is dreariness and frustration due to a lack of funds and continual isolation. There is violence, sometimes deadly. Yet life goes on.

As PALAST member Radwan Barakat, a plant pathologist and dean of academic research at the University of Hebron, observes: "While it has not been easy, I have continued to conduct research on the biological control of plant diseases as an environmentally safe alternative to the use of agrochemicals."

"I have often had limited access to the scientific literature and laboratory materials," he continues. "My ability to move from place to place, moreover, has been severely constrained. From time to time, my university has even been forced to shut down." In 2003, during one of these closures, Barakat and his colleagues hopped the walls and slipped into the laboratory through the backdoor to water the plants that were essential to their research.

Science struggled but never succumbed to the disheartening circumstances in Palestine. With more than 40 universities, colleges and research institutions serving over 150,000 students, science in Palestine spans a full spectrum of fields that ranges from medicine to water management and from environmental studies to engineering.

"We know that research efforts need to focus on such critical societal concerns as water and soil management, agricultural productivity, public health, energy and desertification," notes Khatib. "Fortunately, Palestinian scientists are conducting research in these and other areas."

"One of the critical roles of PALAST," he adds, "is to help boost the impact of these research efforts by strengthening coordination among individual scientists and scientific institutions and by cultivating ideas and lending support to initiatives that arise from

research and have commercial potential. With limited resources, it is also essential that we avoid duplicating each others' efforts."

PALAST has forged connections with a broad range of national and international institutions that support scientific and technological capacity building, especially in the developing world. These institutions have included IAP, the global network of science academies, and the InterAcademy Medical Panel (IAMP) in Trieste (organizations that work closely with TWAS), the European Union (EU) and the US National Academy of Sciences (NAS).

PALAST does not do research on its own. This is the responsibility of Palestine's universities, colleges and research centres. True to its mandate as a coordinating agency, however, the Academy functions as a crucible for scientific collaboration, Khatib notes, "both in Palestine and between Palestine and the global scientific community."

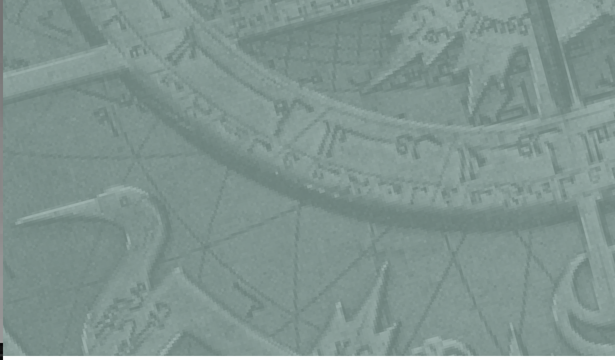
ON THEIR OWN

Palestinians recognize the value of higher education in their efforts to improve social and economic conditions. However, creating quality institutions of higher education has not been easy given the difficult – some would say, debilitating – political and economic conditions that have prevailed in Palestine for decades.

To assess the situation and develop a strategic plan of action, PALAST, with funds from the British Foreign Department Fund, organized a series of meetings in Ramallah and Gaza in 2001, attended by representatives from government ministries, universities, research centres and stakeholders both in the private and in the public sector. Attendees met to discuss the obstacles that were impeding progress in scientific capacity building and science-based development, and to examine and discuss potential strategies for future success.

The plan included three distinct scenarios that could potentially have a direct bearing on the range of activities under which PALAST could operate.

The first and most optimistic scenario envisioned an environment in which political stability prevailed and the Academy received adequate funding from the



government. The second scenario envisioned political stability but insecure government support. And the third scenario envisioned continual political turmoil and scarce government funding. Unfortunately, it is the third scenario that most resembles reality.

One year after laying out these scenarios, PALAST published the results of a survey on the state of scientific research in Palestine. The survey was intended not only to provide a snapshot of current conditions but also to serve as a baseline for measuring the impacts of subsequent actions.

One goal of PALAST has been to instil a sense of normality into the affairs of scientists.

Survey findings called attention to the lack of both political and financial stability as a major impediment to scientific research. Indeed more than half of the institutions participating in the survey said that they did not receive any government funding for research. Funds from foreign donors, they noted, represented the main – and, in many instances, the only – source of money for research.

While grateful for the assistance from benefactors outside of Palestine, survey participants observed that most research agendas, not surprisingly, were largely shaped by the donors, and that the agendas of the donors sometimes differed from their own. In addition, survey participants observed that fierce competition for external funds tended to impede cooperation among Palestine's scientific institutions.

In addition to providing insights into the prevailing attitudes of researchers, the survey generated a wealth of facts and figures that has enabled PALAST to assemble a database of Palestine's scientific institutions comprised of information about the staff, equipment and research activities. "The data base," Khatib observes, "has helped to spur the creation of networks based on shared interests and complementary strengths. It's been an excellent resource for fostering collaboration among our scientific institutions."

For example, working closely with the Palestinian Ministry of Health and the Palestinian Red Crescent Society, PALAST helped to improve treatment for dia-

WATER DIVIDES

Imad Khatib notes that Palestine "needs to pay special attention to its serious water problems," and in 2009, it participated in a series of initiatives to address this issue. For example, the Academy joined with the Palestinian Water Authority in organizing the Second International Conference on Water Values, which was co-sponsored with funding by the United Nations Development Programme (UNDP). International experts, decision makers, scholars and stakeholders participated in the event. Discussions focused on water and wastewater management and water rights within the regional context in which the water is distributed. According to local experts, Palestine's water resources should be sufficient to meet future demand, but only if measures are put in place to ensure the more equitable sharing of these resources with Israel, and only if Palestine pursues policies that increase the efficiency of water distribution and use. "Research," says Khatib, "could be crucial to these efforts" by, for example, improving irrigation techniques, curbing water pipeline losses, helping to develop state-of-the-art technologies for desalinization and implementing effective programmes for wastewater treatment. For additional information about the Palestine Academy of Science and Technology, see: www.palestineacademy.org.

betes through more reliable and consistent medical care and the distribution of insulin to growing segments of the affected population. Another important PALAST-led public health initiative has encouraged efforts to curb micronutrient deficiencies among infants and adolescents through greater access to iodine-fortified table salt and wheat. Both efforts required a level of coordination that reaches well beyond the scientific and medical communities.

MEETINGS MATTER

Conferences and workshops are the lifeblood of science in countries with vibrant scientific communities that are fully knitted into the country's political and social fabric and are active members of the international scientific community. But in Palestine, political tensions, limited resources, restrictions on movement, and the potential for violence have often made it difficult for Palestinian scientists to meet and exchange information and ideas on a regular basis. The "security wall" built by Israel, for example, cuts through Al-Quds University in Jerusalem, forcing faculty and students to take hour-long detours to move across the campus.

One of the goals of PALAST has been to instil a sense of normality into the affairs of scientists by sponsoring conferences and workshops. These efforts have usually been funded by outside donors and have thus carried the added value of promoting international exchange. But such sponsorship has also engendered concerns that support for science is greater outside Palestine than inside.

With funds from the EU, in 2003, PALAST participated in a conference exploring potential strategies for forging scientific co-operation with EU member states

and Mediterranean partner countries. In 2004, it joined an EU project designed to promote innovative environmental management, especially among small- and medium-sized industries. In 2006, PALAST participated in a series of EU-sponsored multi-lateral conferences examining ways for Palestine to participate in the EU's 7th Framework Programme. And in 2007, PALAST, again with EU support, participated in a conference to develop a research agenda for strengthening Palestine's information and communications infrastructure, especially for improving environmental management and promoting innovation. Another EU-funded conference focused on water management research issues.

With financing from the US National Academy of Sciences, PALAST has held workshops and conferences and issued reports on a number of critical issues, including biodiversity, nutrition and regional water issues.

And with funds from the German Ministry of Education and Research (BMBF), PALAST has led the efforts to create climate change scenarios for the GLOWA-Jordan River project, as part of the Global Change of Hydrology Cycle programme.

GLOWA has five large cluster projects: two in Germany and three in Africa. The projects focus on such climate-related themes as natural and human-induced variability in rainfall and the intricate relationships between hydrological cycles, the biosphere and the land use.

PALAST has also engaged in less conventional research efforts, again with support from external sources. For example, in a project funded by *Un Punto Macrobiotico* in Italy, in late 2009, the Academy organized a workshop on the use of organic food to treat diabetes type 2 that was held at the Red Crescent headquarters in Ramallah.

Members of PALAST have never lost hope for a better future.

EDUCATION FOR ALL

In addition to its efforts to promote research on critical scientific issues, PALAST also seeks to promote science education, especially among students, and to foster public appreciation for science, particularly among adults.

One of its most noteworthy efforts has been its support for an environmental centre in the Jericho Governorate, a political jurisdiction with some 32,000 residents located on the West Bank just north of the Dead Sea. The centre is designed to teach visitors about the region's ecology and biodiversity. It contains a fossil exhibit, a computer centre and even a camp site. The centre serves as an unconventional classroom and field laboratory both for students and researchers, providing a wide range of educational and research opportunities. In addition, PALAST has also played a central role in the creation of a natural history museum in Tal Al-Hawa in Gaza.

FUTURE CHALLENGES

The Academy has prepared an action plan for 2008-2013 that is designed to provide a broad framework for building a system of science, technology and innovation. The goal is to more fully integrate science into

society and to enhance the role of science in Palestine's economic development efforts. The plan calls for strengthening scientific institutions, promoting scientific networks and encouraging the private sector to invest in research. While acknowledging the long-standing struggles in the region, the strategy nevertheless strikes an optimistic plea for "more breakthroughs amidst surviving the abnormal".

All of this, of course, will necessitate money and greater efforts to link science to innovation by forging closer cooperation between the scientific community and society.

That is why, for a number of years, PALAST has pushed for the creation of a science fund that would help coordinate investments in science throughout Palestine. The primary objectives of such a fund would include the creation of better management systems, the promotion of partnerships and networks, and the exploration of opportunities for advancing cutting-edge science and technology. "The fund," says Khatib, "would help direct scientific research to the needs of society."

Over the course of the past decade, PALAST has overcome enormous obstacles to emerge as an active and well-respected organization, and it has gained the admiration of political leaders both at home and among bi-lateral and international organizations abroad. The Academy has developed a wide-ranging portfolio of activities for the promotion of scientific research and training that has contributed in important ways to Palestinian society.

Despite facing extraordinarily difficult circumstances, Khatib says that members of PALAST have never "lost hope for a better future." Such life-affirming persistence in the face of adversity remains an important measure of the Academy's success.

PEOPLE, PLACES, EVENTS

L'OREAL-UNESCO AWARDS

• **Fayzah Al-Kharafi** (TWAS Fellow 2004), **Silvia Torres-Peimbert** (TWAS Fellow 2001) and **Vivian Wing-Wah Yam** (TWAS Fellow 2006) have been awarded the 2011 L'OREAL-UNESCO "For Women in Science" Awards 2011. Al-Kharafi, chemistry professor at Kuwait University, was given the award in recognition of her work on corrosion, a problem of fundamental importance to water treatment and oil industries. Torres-Peimbert, profes-


Fayzah Al-Kharafi


Silvia Torres-Peimbert

sor of astronomy at the Institute of Astronomy at the National Autonomous University of Mexico, was recognized for her work on the chemical composition of nebulae, which is fundamental to our understanding of the origin of the universe. Yam, professor of chemistry and energy and chair of chemistry at the University of Hong Kong, was recognized for her contributions in


Vivian Wing-Wah Yam

light-emitting materials and innovative ways of capturing solar energy. The awards ceremony will take place on 3 March 2011 at UNESCO headquarters in Paris. Each Laureate will receive USD100,000.

NEW HARVEST

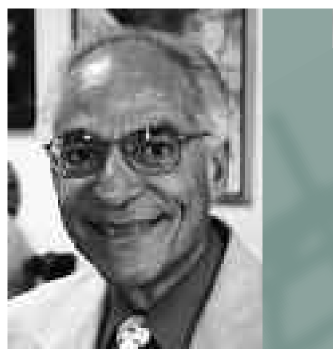
• **Calestous Juma** (TWAS Fellow 2005), professor of the practice of international development and director of the Science, Technology, and Globalization Project at Harvard University, has written *The New Harvest Agricultural Innovation in Africa*, published by Oxford University Press. A ceremony marking the official launch of the book took place on 2 December in Tanzania at a special summit of five East African presidents. The book, which has been praised by Elinor Ostrom, Nobel laureate in economic sciences 2009; Monty Jones, World Food Prize laureate 2004; and the presidents of


Calestous Juma

Nigeria, Liberia, Burkina Faso and Costa Rica, outlines three major pathways for transforming Africa's agriculture into a force for economic growth: advances in science and technology; the creation of regional markets; and the emergence of a new contingent of entrepreneurial leaders dedicated to the continent's economic improvement.

BOARD OF DIRECTORS

• **Farouk El-Baz** (TWAS Fellow 1985), director of the Center for Remote Sensing and research professor in the Department of Electrical and Computer Engineering of Boston University, has been appointed to the Board of Directors of the US Civilian Research and Development Foundation (CRDF). The foundation is a non-profit organization authorized by the US Congress and established in 1995 by the US National Science Foundation. El-Baz was chosen for his research and


Farouk El-Baz

teaching accomplishments, in-depth knowledge of the Middle East, North Africa, and the Gulf regions and his commitment to international cooperation in science and engineering. He will help CRDF in its objectives to promote international scientific and technical cooperation through grants, technical resources and training.

INNOVATION AWARD

• **Pradeep Rohatgi** (TWAS Fellow 1989), distinguished professor of materials engineering at the University of Wisconsin-Milwaukee (UWM), was awarded the 2010 Innovative Research Award in Tribology by the American Society of Mechanical Engineers (ASME) in October. The award is given biennially to an individual who has demonstrated outstanding creativity and original research in the field of "tribology", the study of friction and wear. Rohatgi is recognized for his groundbreaking contributions to improving the production of metal matrix composites and for making his research available to private industry. He synthesized lightweight self-lubricating composites and uncovered the mechanisms leading to the formation of self-lubricating films in these materials. He also developed wear-resistant lightweight composites currently used in transportation applications, including brake rotors. His more recent work involves unique tribological properties of nanostructured materials and self-healing metal composites.


Pradeep Rohatgi

HONOURING KUKU

• **Aderemi Oluyomi Kuku** (TWAS Fellow 1989), William W.S. Claytor professor of mathematics at Grambling State University in Louisiana, USA, will be honoured by the International Conference on Algebraic K-Theory and Its Applications that is being organized on the occasion of his 70th birthday. The conference will take place at Nanjing University, China, from 17-21 March 2011. Discussions will focus on applications in the areas of number theory, algebraic geometry and representation theory. Plenary speakers will include Masanori Asakura from Hokkaido University, Japan, Anthony Bak from the University of Bielefeld, Germany, and Paul Frank Baum from Pennsylvania State University, USA. For additional information, contact H. Qing (hrqin@nju.edu.cn) or X. Guo (guoxj@nju.edu.cn).


Aderemi Oluyomi Kuku

IN MEMORIAM

• **Hector Croxatto**, a Founding Fellow of TWAS and one of Chile's most renowned scientists, died on 28 September 2010. He was 102. Croxatto, who was born in Valparaiso, Chile, on 28 July 1908, studied medicine at the University of Chile (UC) in Santiago. He became a surgeon in 1930 and then went to the University of Basel, Switzerland, for additional study. He returned to Chile to become a professor of physiology at the Institute of Physical and Technical Education at UC. In 1958, he was appointed the academic secretary of the Faculty of Medicine, Catholic University of Chile, serving as interim dean for two years. In 1966, he was named the first director of the Experimentation and Training Centre of the Ministry of Education of Chile, which was created by President Eduardo Frei. He was also one of the founders of the School of Biological Sciences at the Catholic University of Chile. Throughout a long and productive career, Croxatto contributed original research and observations concerning the role of peptides in the pathogenesis of arterial hypertension. His scientific achievements led to numerous honours, including the *Grande Ufficiale*, Italy; the National Award of Science, Chile; the Bernardo Houssay Award; and two honorary doctorates from the Pontifical Catholic University of Chile in 1985 and the Metropolitan University of Educational Sciences in 2002. He was a fellow of numerous scientific societies, academies and institutes, including the Chilean Academy of Sciences and the Pontifical Academy of Sciences.


Hector Croxatto

WHAT'S TWAS?

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

TWAS has nearly 1,000 members from 90 countries, 73 of which are developing countries. A 13-member Council is responsible for supervising all Academy affairs. It is assisted in the administration and coordination of programmes by a secretariat, headed by an Executive Director and located on the premises of the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy. The United Nations Educational, Scientific and Cultural Organization (UNESCO) is responsible for the administration of TWAS funds and staff. A major portion of TWAS funding is provided by the Italian government.

The main objectives of TWAS are to:

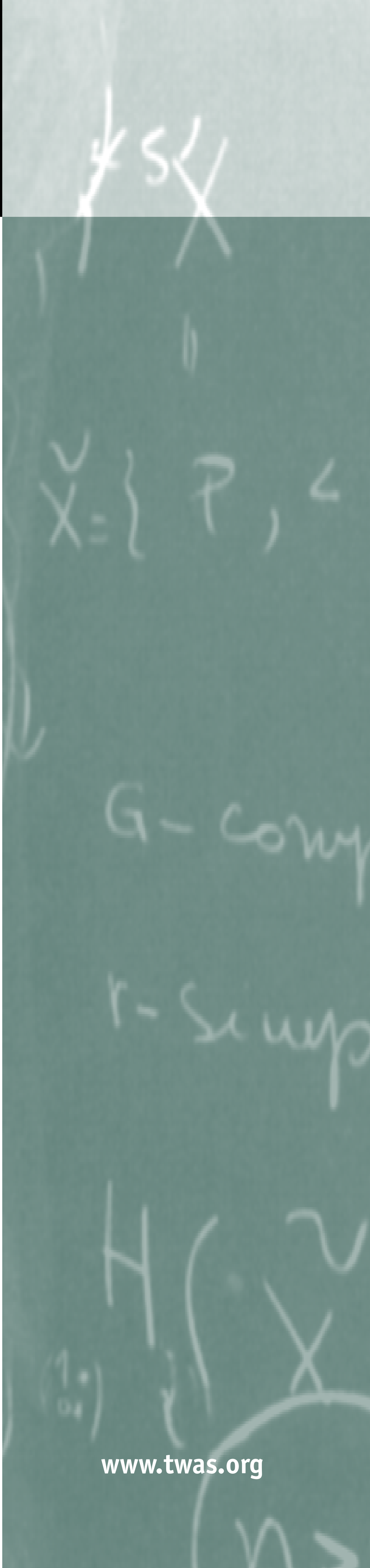
- Recognize, support and promote excellence in scientific research in the South.
- Provide promising scientists in the South with research facilities necessary for the advancement of their work.
- Facilitate contacts between individual scientists and institutions in the South.
- Encourage South-North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

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

TWAS also played a key role in the establishment, in 1993, of the Organization for Women in Science for the Developing World (OWSDW, formerly the Third World Organization for Women in Science, TWOWS). Some 3,200 women scientists from more than 90 countries in the South are members of OWSDW, making it the largest organization of women scientists in the world. Its main objectives are to promote the leadership of women in science and technology in the South and to strengthen the participation of women in science-based development and decision-making. The secretariat of OWSDW is hosted and assisted by TWAS. **www.twows.org**

Since 2000 TWAS has provided the secretariat for IAP, the global network of science academies. IAP, which was established in 1993 as the 'InterAcademy Panel on international issues', unites more than 100 science academies worldwide; provides high-quality independent information and advice on science and development to policy-makers and the public; supports programmes on scientific capacity building, education and communication; and leads efforts to expand international science cooperation.
www.interacademies.net/iap

Since 2004 TWAS has also hosted the secretariat of the InterAcademy Medical Panel (IAMP), an association of the world's medical academies and medical divisions of science academies. IAMP is committed to improving human health worldwide through the coordinated action of its 69 members. **www.iamp-online.org**



www.twas.org