

AIMS FOR AFRICA

THE AFRICAN INSTITUTE FOR MATHEMATICAL SCIENCES (AIMS), A CENTRE DESIGNED TO RAISE THE LEVEL OF MATHEMATICS AND SCIENCE IN AFRICA, WAS RECENTLY LAUNCHED IN CAPE TOWN, SOUTH AFRICA.

From communications technology to finance, from environmental studies to epidemiological evaluations, from space research to oil and natural gas explorations, modern society is increasingly dependent on the knowledge and know-how of mathematical scientists.



It may not be a topic at the top of the development agenda but the truth is that the severe shortage of home-grown mathematicians poses a major obstacle to economic growth in many developing countries. That shortage is most acute in sub-Saharan Africa.

Just three years ago, institutions of higher education in the United Kingdom, France and South Africa – specifically, the universities of Cambridge and Oxford, the University of Paris-Sud-XI, and the universities of Cape Town, Stellenbosch, and the Western Cape – joined together to seek ways of reversing Africa's debilitating deficit in mathematics. The result was the creation of the African Institute for Mathematical Sciences (AIMS), which was officially launched in September 2003 at the AIMS headquarters in Muizenberg, a suburb of Cape Town, South Africa.

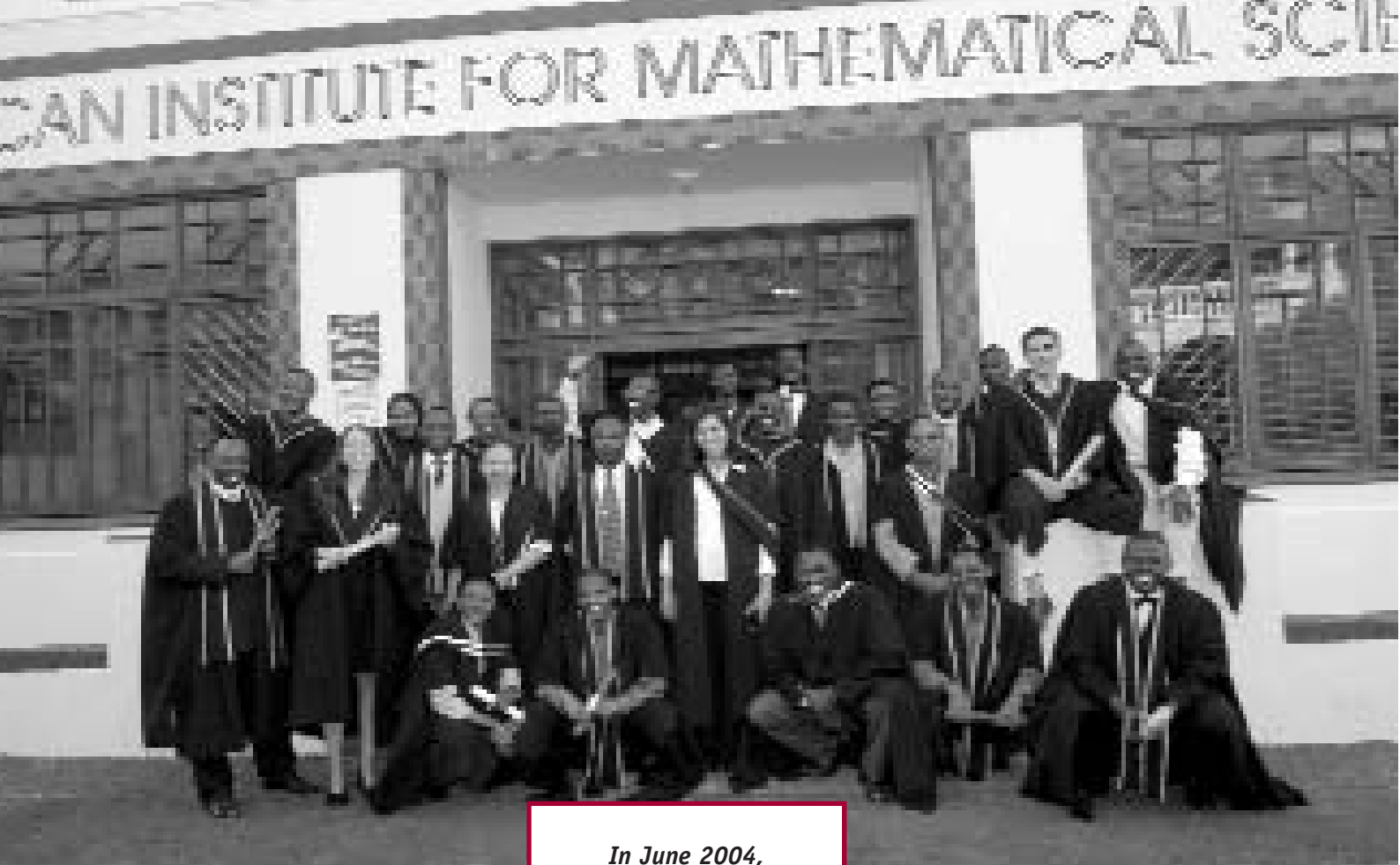
South Africa's Muizenberg Educational Trust donated an exquisite 1920s art-deco hotel to serve as AIMS' home. Nearby Stellenbosch University oversaw the refurbishing of the hotel, transforming its spacious liv-

ing quarters into lecture and dining halls, a computer laboratory and library, classrooms, offices, and guestrooms for students and lecturers. Because everything is under one roof, *impromptu* tutorials and discussion

groups often take place from early in the morning to late at night. Think of it as a 24 hour, 7 days a week thinkshop for mathematics and science.

AIMS was inaugurated on 18 September 2003 in a ceremony attended by South Africa's ministers of education, Kader Asmal, and science and technology, Ben Ngubane; university vice chancellors Chris Brink, University of Stellenbosch, Njabulo Ndebele, University of Cape Town, and Brian O'Connell, University of Western Cape; and renowned figures in African and international science and mathematics, including Francis Allotey, Kumasi College of Technology, Ghana, and K.R. Sreenivasan, director of the Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy. Noted speakers included Sir Michael Berry, University of Bristol, UK; James Gates Jr., University of Maryland, USA; Wayne Getz, University of California at Berkeley; and Sir Martin Rees, University of Cambridge, UK.

The goal of AIMS is to promote teaching and research in mathematical sciences across Africa. The primary means of advancing this goal is a nine-month post-graduate diploma course available – through open com-



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petition – to Africa’s most promising young mathematicians and scientists.

Of course, goals are one thing and funding quite another. AIMS has been fortunate to have received financial support from a variety of sources. Start-up funds were given by PetroSA, South Africa’s national oil company, and South Africa’s Department of Science and Technology. Operational and programmatic funds have been received from the Gatsby Charitable Foundation, Vodafone Foundation, Andrew W. Mellon Foundation, Ford Foundation and Cambridge University Press.

In addition, AIMS was awarded a grant from the International Council for Science (ICSU), channelled through the Council’s International Union of Theoretical and Applied Mechanics (IUTAM), that was used to fund a workshop on capacity building in mathematics, held in April 2004, and a two-week training course for secondary school teachers, held in July 2004 – both at the AIMS facility in Muizenberg.

The first group of 30 AIMS students, selected from

more than 85 applicants, arrived at the institute in September 2003. In

June 2004, AIMS held its first graduation ceremony.

The inaugural graduating class included students from 15 African countries, spanning the breadth of Africa from Algeria to Zimbabwe. While complete gender equality was beyond its reach, women comprised 20 percent of the class. About half the students were university lecturers who had taken a leave of absence from their faculty positions; others were part-time teaching assistants in institutions of higher education. Those who had shown an interest in teaching were encouraged to apply under the assumption that good teachers would help instil a sense of enthusiasm among students and thus have a multiplier effect that would increase the number of mathematicians in Africa over the long term.

For now, the vast majority of Africa’s brightest young students go abroad for graduate and postgraduate studies. Few ever return. This trend persists in all disciplines but the situation is particularly acute in mathematics,

where 90 percent of Africans earning PhDs in institutions outside Africa do not come back.

AIMS has been designed to counter Africa's chronic brain drain problem by instilling a spirit of long-term commitment to the continent and emphasizing the role that mathematics can play in Africa's development. A key aspect of this strategy is to bring together groups of talented African students who share a common interest in mathematics and who exchange not only their ideas but their personal hopes and fears at a critical juncture in their lives and careers.

If the response of students attending AIMS' first diploma course is any indication of what we can expect in the future, it is fair to say the programme has tapped deeply held sentiments that extend well beyond the students' shared interest in mathematics to a common desire to help Africa solve its critical economic and social problems. Many students, for example, expressed interest in the focus that the New Partnership for Africa's Development (NEPAD) has placed on devising African solutions to Africa's problems. The multicultural, yet pan-African, environment that is part of the AIMS experience provides a unique forum for exploring not just science for the sake of science but potential applications of science for addressing the continent's critical problems.

Upon successfully completing their nine months of training, AIMS students are encouraged to proceed to master's or doctoral degree programmes in African universities. On the one hand, this post-AIMS strategy is designed to provide a framework for keeping young African mathematicians at home. On the other hand, it is intended to strengthen AIMS' ties with Africa's academic community as part of a larger effort to ensure the long-term sustainability of the initiative.

AIMS' officials have also invited local researchers and executives in Africa's emerging private sector to visit the institute and for students to visit research institutions and private-sector companies in Africa. The goal here is to expose students to potential non-academic employment opportunities that will not only increase their job prospects but also broaden the role that mathematicians can play within their societies.

While the primary goal of AIMS is to build science and mathematics expertise in Africa, several first-round AIMS students have applied and been accepted for post-graduate studies outside of Africa – for example, in the

ADDING LONG-TERM VALUE TO CAREERS

My parents thought it was bad idea. My professors thought it was bad idea. But I did it anyway. I studied mathematics at the University of Kinshasa.

"A degree in mathematics will lead to few jobs apart from teaching," they told me. "You will die poor," they ominously warned.

My only retort was: "What do you know about mathematics?" – although I must confess I was concerned about my job prospects as well.

When I completed my studies, I was delightfully surprised by the number of job offers I received: for example, from such international organizations as the World Food Programme and from such private companies as Vodacom. My parents weren't just surprised. They were relieved.

Yet, instead of entering the world of work, I decided to enrol in AIMS' first diploma course – truly honoured to be one of 30 students chosen from a pool of 85 applicants. My friends and relatives thought I was crazy to turn down several excellent job opportunities to continue my studies in mathematics. "Do you think you will solve all (any?) of the world's problems with mathematics? Do you think your own career prospects will improve?"

Having proven them wrong before, I firmly believed I would prove them wrong again. In fact, I was confident that I would learn how to contribute to the development of Africa while enhancing my skills and employment prospects. That's why I decided to come to AIMS.

At AIMS I discovered applications of mathematics in such fields as epidemiology, information theory, fluid dynamics and mathematical finance. And I learned in ways unlike anything I'd experienced before.

At AIMS we were not given thick books to plough through. Instead we were taught the basics and then encouraged to discover how to assemble these building blocks into larger, more complex constructs. Instead of teachers writing theorems and proofs on blackboards and having us take down notes and commit them to memory, AIMS professors encouraged students to interact both with them and their fellow students. Classrooms were noisy, not silent places, as questions from lecturers and students alike filled the air. The goal was to nurture not just mathematical skills but mathematical intuition. During my university days, students learned to get good grades on their examination and usually would forget the material soon afterwards. At AIMS we learned because we wanted to learn

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and not just to pass examinations. Indeed the latter would be the consequence of the former and not an end in itself.

With the skills I acquired at AIMS, I am confident that I can meet the challenges set not only by mathematics but by other scientific disciplines as well. I will be pursuing a master's degree in computer science at the University of Stellenbosch in South Africa, specializing in network communication.

AIMS is a wonderful place for motivated and hard-working students. And, yes, mom and dad, the experience has truly brightened my job prospects both now and in the future. ■

◆◆◆ **Pierre Abraham Mulamba**
AIMS Diploma Course 2003
Democratic Republic of Congo

University of Cambridge and University of London in the United Kingdom, and Syracuse University in the United States.

We fully appreciate a student's desire to maximize his or her career prospects and rather than seek to keep them in Africa we hope that AIMS, once proven successful, will encourage them to return to Africa after their studies abroad.

Indeed AIMS has already begun to act as a magnet, drawing African scientists back to the continent. For example, a grant from the Victor Rothschild Memorial Fund enabled four young African doctoral and post-doctoral research scientists, who had been studying abroad, to visit AIMS for two months to serve as guest lecturers for the diploma course.



NORTH-SOUTH COOPERATION

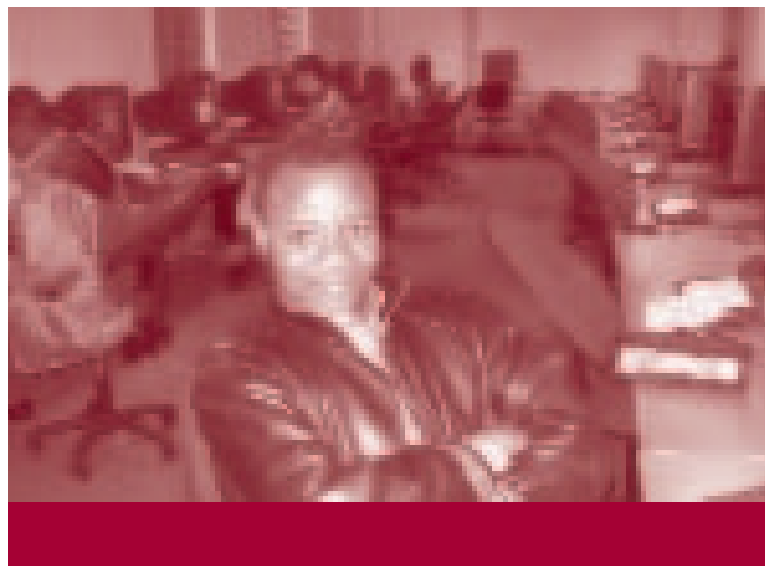
AIMS novel diploma course consists of three sections: a skills section covering mathematical and computing research methods that include such fields as estimation and approximation, inference and information theory, and modelling and data analysis; an interdisciplinary review section covering such fields as biological systems, statistical physics, numerical analysis, astrophysics, quantum physics, geometry and topology, fluid dynamics and financial mathematics; and a section on science writing in which each student receives close supervision from a local academic in writing an essay on a scientific topic in which they are interested.

The structured learning environment consists of a series of lectures, often divided into themes, each of which lasts from three to four weeks. Visiting mathematicians and scientists from universities in Africa, Europe and the United States serve on the faculty. To date, more than 100 lecturers have volunteered to participate in the AIMS visiting lectureship programme. Because their services are often provided free-of-charge, we have been able to provide world-class instruction at a very low cost.

AIMS also organizes specialized shorter term courses. For example, in December 2003, the South African Centre for Epidemiological Modelling and Analysis partnered with AIMS to hold a one-week course on epidemiological modelling.

AIMS students tell us that they are “learning to think and to solve problems” for the first time in their lives and that the experience is exhilarating. For many students, rote learning for examinations rather than independent and creative thinking has been the norm. Lecturing in African universities tends to be formal and students are often discouraged from interacting with professors. AIMS seeks to provide a counterpoint to the impersonal learning environment that is so commonplace in African universities and research centres. Its self-contained learning environment, in fact, fosters far greater contact and teaching time than has been the case in conventional universities. AIMS also provides endless opportunities to adjust the curriculum to fit students’ needs.

The goal is to have all students master the course material or, at minimum, to benefit from the course in



some way. Because each lecturer is present only for a brief time, it is vital that students begin to work on problems from the first day of each course. Teaching at AIMS is demanding but lecturers tell us they find the experience rewarding. They report that AIMS students are among the most highly motivated they have encountered.

AIMS also emphasizes the use of new information technologies. All students and most lecturers, for example, have been recruited through email or the AIMS website. Information technologies not only

boost the operational efficiency of institutions such as AIMS but, more importantly, give African scientists an opportunity to overcome obstacles that have long stood in the way of progress, including chronic isolation from others pursuing similar research and lack of access to such intellectual resources as journal articles and text books.

The internet allows rapid and cost-effective access to vast amounts of information. Indeed the electronic information revolution has not only increased the quantity of information readily available but has qualitatively transformed the way in which research is done. Much of modern scientific research involves analysing and modelling data. As a result, students trained to think and use computers creatively can enter a wide range of fields, including astronomy, bioinformatics and finance.

AIMS has begun to act as a magnet, drawing African scientists back to the continent.

The many huge data sets that are freely available on the internet allow African researchers engaged in such analytical work to integrate themselves quickly into the global scientific community.

We envision an important role for AIMS in selecting, training, teaching, and disseminating free software across Africa. Students and visitors are impressed with AIMS' efficient, user-friendly computer network. AIMS staff and students were able to catalogue and label the entire library of 3000 books in a single working night, at no cost, by tapping into the US Library of Congress catalogue system via the internet with software that AIMS had developed. This software will now be made freely available to African universities to facilitate the cataloguing of their library collections.

Because no comparable pan-African institute for postgraduate teaching or research in the mathematical sciences exists, such organizations as the International Mathematical Union (IMU) and the Millennium Science Initiative (MSI) have welcomed the creation of AIMS. So, too, have national and regional organizations dedicated to the promotion of mathematics and science in Africa.

AIMS is committed to working with like-minded organizations to build a strong network of centres of excellence for teaching and research in mathematics throughout Africa. In cooperation with South Africa's Department of Science and Technology, AIMS is currently developing a proposal to create a cyber-network of mathematical institutes in Africa dubbed the African Mathematical Institutes Network (AMI-net).

SUCCESSFUL START

Several factors account for AIMS' early success:

High demand. AIMS has received more than 170 applications to fill 45 places for its second diploma course scheduled to begin in September 2004. That's a doubling of applicants compared to the first year.

Good will. More than 100 professors from around the world have signed up for the AIMS' lecture programme. They provide their services free-of-charge.

Political commitment. South Africa, AIMS' host country, has strongly supported AIMS. NEPAD has also shown

keen interest in the initiative, particularly in terms of the project's potential ties to universities and industry throughout Africa.

With the encouragement and support of so many organizations, proponents of AIMS remain guardedly optimistic about its future. AIMS' ultimate goal is ambitious: Nothing less than building a critical mass of expertise in the mathematical sciences in Africa. Yet the strategy AIMS has devised to advance this goal remains straightforward: To nurture an environment where critical thinking and the exchange of ideas can take place.

Maintaining the quality of the educational experience at AIMS, and thereby proving our value to the governments of Africa and other project supporters, is the best way to ensure that AIMS' efforts to build a bright future for the mathematical sciences in all of Africa remain on target. ■

AIMS' ultimate goal is nothing less than building a critical mass of expertise in the mathematical sciences in Africa.

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*For additional information about
the African Institute for Mathematical
Sciences (AIMS), see*

◆◆◆ www.aimsforafrica.org
or ◆◆◆ www.aims.ac.za.