

# COMMENT



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"Education is the husband that will never let you down," says Daphney Singo, a graduate of the African Institute for Mathematical Sciences (AIMS).

## Africa AIMS high

Eight years ago, physicist **Neil Turok** set up the African Institute for Mathematical Sciences in South Africa. The initiative is now set to expand across the continent.

As a native South African and son of anti-apartheid activists, I was electrified by the country's first democratic elections in 1994. When I voted for Nelson Mandela at the embassy in New York, I knew it was a breakthrough moment, for South Africa and for the whole continent. I wanted to do my bit. But as a theoretical physicist in the United States working on the origins of the Universe, how could I possibly contribute to Africa's future?

My chance came in 2001. Visiting Cape Town on a sabbatical, I learned of the shortage of well trained graduates in maths, engineering and physics. In part, this is a legacy of

apartheid, which deliberately excluded black people from technical fields. There is no scarcity of talent: as a child in East Africa, and as a volunteer teacher in Lesotho, I had seen many kids who were eager to learn but starved of opportunity. Africa's 700 universities have faced decades of underfunding, isolation and loss of morale. Nevertheless, among their million graduates a year are many young people capable of transforming the continent.



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So I decided to start a new institute, the African Institute for Mathematical Sciences (AIMS), to help prepare Africa's top maths and science graduates for careers in research, industry and government. South Africa, with its new democracy, strong economy and science base, seemed the ideal location. My parents found a suitable building — a derelict, art-deco hotel in Muizenberg, a suburb of Cape Town. We set up an educational trust and, using our inheritance, bought the building for the bargain price of 1 million rand (US\$118,000). With friends and colleagues, including the institute's first director, Fritz Hahne, from South Africa's Stellenbosch ▶

► University, we set about building AIMS as a partnership between three universities in Cape Town and three in Europe.

Why mathematical sciences? First, they are the backbone of modern society. Fields from information technology and engineering to finance, public health, transport, energy and resource management are all underpinned by modelling, data analysis and computation. Second, mathematics is a universal language. Whether you are Japanese or Nigerian, Paul Dirac's equation describes the electron with the same exquisite accuracy. Third, the infrastructure required is cheap. All you need is a library, a computer lab and a lecture hall.

Furthermore, an appreciation of science crosses national boundaries, focuses people on the future and brings them together. In Africa, which has 54 separate nations, such bridges are invaluable. China and India wrought their 'economic miracles' by educating millions and building strong communities in science and technology. China will soon overtake the United States in scientific publications, but Africa barely registers. Being sidelined from scientific discovery is bad for Africa and bad for science.

So our goal was ambitious: to turn Africa's brightest students into thinkers and problem-solvers of the first order, capable of leading the continent to scientific, technical and educational self-sufficiency. As an academic, I had no fund-raising experience so it was a steep learning curve, but we got people excited and won funding from private foundations, companies and the South African government. We hired exceptional staff. We recruited excellent lecturers from around the world and the first batch of 28 students were selected from 85 applicants from across Africa.

Eight years on, AIMS receives more than 350 applications a year and we are preparing to roll out similar institutes across the continent.

### HOUSE OF NO SLEEP

Africa turned out to be an ideal place to reinvent the ways in which advanced knowledge is shared. At heart, AIMS is very simple: it is a space in which Africa's brightest graduates can be taught by the world's best lecturers. At any one time the institute has around 75 students, most of whom are taking a one-year postgraduate diploma preparing them for higher degrees. Some are completing specialized honours courses, and some are pursuing master's and PhDs under the supervision of resident researchers. We get outstanding visiting lecturers to teach intensive three-week courses, supported by resident tutors. There is no shortage of volunteer lecturers — we have 500 offers, and only 25 are needed each year.

Since opening in 2003, AIMS has graduated 361 students, one-third of them women, from 31 countries. At the last count, 224 master's degrees and 125 PhDs had either been

completed or were under way. Some AIMS alumni are pursuing careers abroad: one won a top postdoctoral fellowship at the National Institutes of Health centre for HIV/AIDS in Rochester, New York; another works on the Large Hadron Collider, Europe's particle accelerator; a third works for a top financial-modelling group in London. And the 78% who remain in Africa are filling teaching and research positions across the continent. One is now head of statistics at the University of Khartoum in Sudan. Another won a fellowship from the Organization for Women in Science in the Developing World and is working at a malaria research centre in Tanzania.

What makes AIMS special? First, it is the wonderful students. Almost all have struggled through challenging circumstances. Exposed to the modern world through Africa's ubiquitous Internet cafes, they have a voracious appetite for learning. For them, AIMS is the chance of a lifetime. They feel like 'ambassadors' for their cultures, and their shared interest in science, and Africa's future, quickly overcomes language and religious barriers.

Take Daphney Singo (pictured overleaf), daughter of a domestic worker in the Limpopo region of South Africa. She entered

*"The pervasive spirit is that Africa has to catch up so there is no time to lose."*

AIMS in 2005 and is now completing a PhD in nuclear engineering. Last year, at a conference in California held by the TED community, she brought the 2,000-strong audience to its feet with a quote from her mother: "Education is the husband that will never let you down." Then there is Viateur Tuyisenge, from Rwanda. He lost his whole family of 31 to the genocide at the age of 10. After spending time as a street kid, he made it through high school and university before coming to AIMS and going on to a master's in computer science in France. Or the sparkling Esra Khaleel from Darfur in the Sudan, who somehow stays smiling through the desperate hurt her community has suffered: she is now completing a PhD in quantum physics in South Africa.

The women students at AIMS are a particular success. Away from family responsibilities they can focus full time on developing their minds. Many undergo a remarkable transformation, from shy graduates leaving home for the first time, into impressive young scientists and leaders. Their speeches at graduation are spellbinding. And many are committed to going home to create opportunities for others.

AIMS is also special because it is a 24/7 learning environment, so students learn much faster than in a conventional university setting. Students, lecturers and tutors live, eat and work together to encourage constant interaction. The students' enthusiasm and

commitment infects the lecturers and tutors. The computer lab is busy day and night. The pervasive spirit is that Africa has to catch up so there is no time to lose. The students refer to AIMS as the 'house of no sleep', and visiting lecturers often say their time there was their most rewarding teaching experience ever.

The goal is to transform the students into confident, independent thinkers. This means breaking the habits of rote learning and grade chasing that are all too common in Africa, as elsewhere. The greatest challenge is making the teaching truly interactive. Lecturers break every ten minutes, give a small problem and get the students working in groups for an answer. They ensure that the class is keeping up. And the students learn to not be satisfied until they really understand, to think for themselves and to discuss and develop ideas with others.

The curriculum is, I believe, unique. The AIMS diploma course begins by emphasizing universal skills: problem formulation and solving, data analysis, modelling, computing, scientific writing. It moves on to review cutting-edge fields, including many of special relevance to Africa — such as modelling of disease, finance, climate, genomics, materials and communications. The final phase is an essay on a specialized topic, often including original research. Every university should have a similar course, and we are proud that the model was invented in Africa.

### AN AFRICAN EINSTEIN

AIMS is just the beginning. In 2008, with the support of partners across Africa and TED, we launched the AIMS Next Einstein Initiative to "unlock and nurture scientific talent across Africa, so that within our lifetimes we are celebrating an African Einstein". The plan is to open 15 AIMS centres across Africa within a decade. AIMS now receives six applications per place: we need to expand to meet this need. One option would be to grow the centre in Cape Town. But this would not build capacity throughout the continent. A pan-African network of 15 centres would be a powerful symbol, turning out 750 highly skilled alumni a year, feeding academia, industry and government.

This September, AIMS will open an institute near an ecological reserve just south of Dakar in Senegal. Next year, it plans to open one in Ghana. The governments of Ethiopia, Rwanda and Tanzania have also expressed strong interest. Developing a sustainable funding plan is our main challenge. We need to convince national governments that an AIMS centre will be a jewel in their educational system. After four years, AIMS in Cape Town became recognized as a national asset, with a line item in the education budget. We must do the same for every new centre.

Meanwhile, we are finding support from many sources. Last year, the Canadian



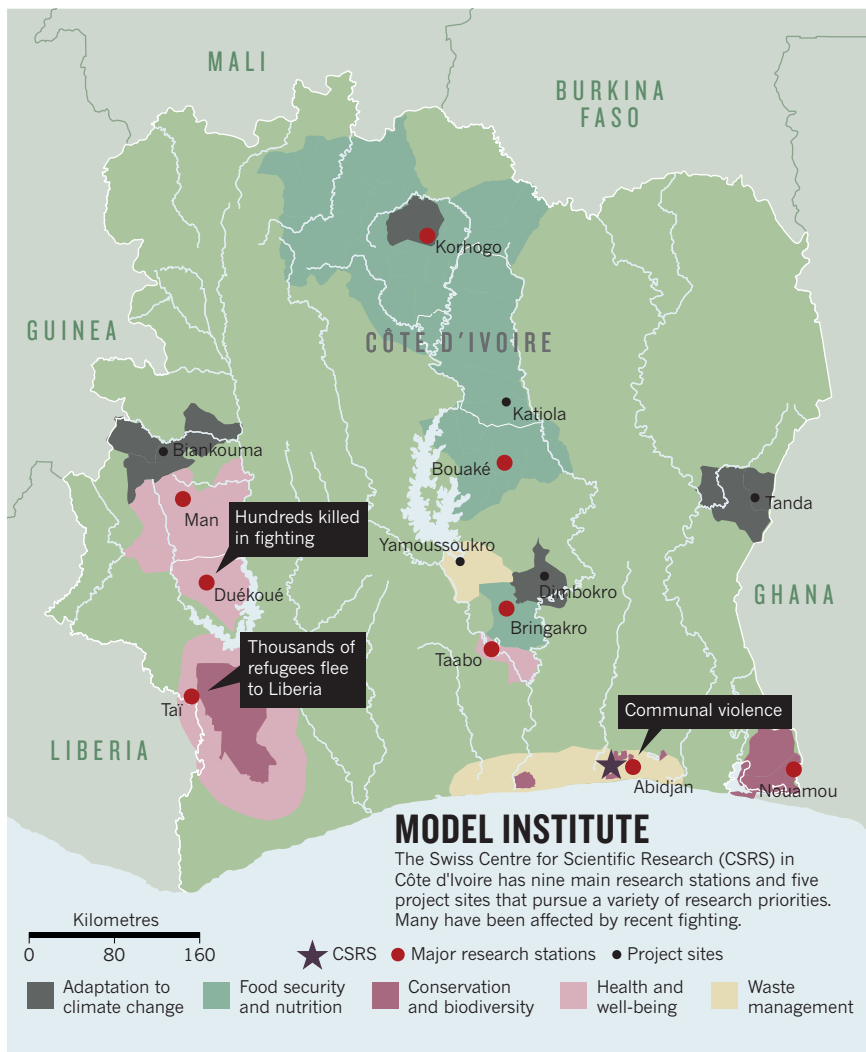
Prime Minister Stephen Harper committed Can\$20 million (US\$20 million) towards AIMS centres in South Africa, Senegal, Ghana, Nigeria and Ethiopia or Tanzania over the next five years. The Next Einstein Initiative also won a Google Project 10<sup>100</sup> award of US\$2 million towards construction costs for the centres. And Google gave US\$1 million dollars for scholarships. The government of Senegal committed 656 million francs (US\$1.4 million) in cash and land towards AIMS–Senegal. In Ghana, 7 hectares of land was donated by a diaspora organization, and the president committed 2.7 million cedi (US\$1.5 million) towards construction of AIMS–Ghana.

A full scholarship at AIMS costs just US\$10,000 a year, one-fifth of the cost of educating a graduate student in Europe or North America. This simple calculation underlies our One for Many programme. The idea is that a university in the developed world contributes the cost of one graduate fellowship on their campus to support many students studying at an AIMS centre. This is an excellent way for the university to engage with Africa at a manageable cost. Its faculty can visit to teach, and it recruits AIMS alumni to its PhD programmes. Just ten institutions are needed to support the entire scholarship costs of a new AIMS centre. So far, five Canadian universities and one French university have joined, and many more have expressed an interest.

Launching 15 AIMS centres will cost US\$120 million over the next ten years. We think this is a bargain — just 0.03% of the projected international aid to Africa over that period. But convincing donors to support advanced education is hard. To them I say, “Who will teach the next generation of teachers?” And “How will Africa ever develop without a technical base?” Without such investments, the long-term prospects for the continent are meagre. When compared with India and China (each of which has half a million science and technology graduates a year), 750 skilled graduates is the bare minimum Africa needs.

The idea for the Next Einstein Initiative came from AIMS students. In 2007, I was lecturing at the Institute on how Einstein described the whole cosmos with an equation. I said, as an aside, “Of course, we hope there will be an Einstein among you.” I explained how Einstein too came from a disadvantaged group, the Jews, and, with his peers, revolutionized physics. Next day, Esra was giving a talk to a prospective donor. She ended by saying: “We want the next Einstein to be an African.” ■ [SEE EDITORIAL P.542 AND NEWS FEATURE P.555](#)

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# Research in a war zone

**Bassirou Bonfoh** and others offer lessons from a West African institute that has survived ten years of conflict.

Côte d'Ivoire, formerly the economic powerhouse of West Africa, slid into a decade of serious civil unrest starting with a *coup d'état* in December 1999. Armed conflict in September 2002, spurred by power struggles for the presidency, split the country into a rebel-controlled central, north and west region, and a government-controlled south and east. Research and development projects ceased for several weeks, and many institutions were closed or looted. Instability and uncertainty became a way of life for those who stayed behind. Then, in November 2010, contested presidential elections led to more than 1,000 deaths and displaced several hundred thousand people. Universities, courts, police stations and banks were closed or plundered

and many enterprises were looted. Only now is stability slowly returning, with the installation of President Alassane Ouattara in May this year.

Over the past decade, many international partners have pulled out of Côte d'Ivoire, leaving the scientific community in tatters. A notable exception is the Swiss Centre for Scientific Research (CSRS), at which several of us work, which was able to maintain essential research and support activities at its headquarters and most of its project sites throughout the recent crisis.

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