



AFRICA'S NEW EINSTEINS:

An interview with Barry Green

Barry Green is the director of the African Institute for Mathematical Sciences (AIMS) South Africa. Ben Turok spoke with him in Muizenberg on 30 April 2015

AIMS is an innovative pan-African centre for postgraduate training, research and public engagement in the mathematical sciences. In partnership with African and international universities, it provides advanced, broadly applicable mathematical skills to talented students from all over Africa. World-class academics teach three-week courses within a residential 24-hour learning environment. Founded in Cape Town in 2003, AIMS has since opened centres in Senegal (2011), Ghana (2012), Cameroon (2013) and Tanzania (2014). Its “Next Einstein Initiative” is working to establish 15 centres across the continent.

AIMS is already making a big difference. Since 2003, it has graduated 748 students – 30 percent of them women – from 42 African countries. AIMS graduates are now strengthening African universities, research centres, government and industry. For example, many of the mathematics lecturers at the Universities of Zambia and Khartoum are AIMS graduates. They in turn are now educating hundreds of students each year.

FORCE OF ATTRACTION

BT: How important is science for Africa?

BG: It's fundamental. If we look at the mining industry, or we look at the problems we face in South Africa with the

energy situation – in all areas, we need new solutions, new ideas. All development in Africa will rest on a scientific foundation of some sort – with a humanistic element in order to use our strengths, our intellect and our ability to solve problems. And mathematical science rests at the basis of this. It is the language of science.

We also need to train young people to engage confidently with problems they've not seen before. One of the differences between what we do at AIMS and what happens in a technical environment is that we train people to be able to think critically about the problems, to come up with

interesting innovative ideas for tackling them, and then to be able to regroup in a network to come up with a solution.

BT: You had an extraordinary number of student applications for 2015.

BG: This year was absolutely astonishing. We had 2 700 applicants from over 35 African countries for the five centres. Over 450 of them have master's degrees already. We are attracting students who are already at a very high level, have already equipped themselves with basic knowledge in the math sciences, and AIMS was a choice for them. We're busy with our selection for the South African centre. Of the 1 400 applicants for this centre, we've shortlisted over 250 to whom we could comfortably offer a place, if our centre was bigger! Each centre can take approximately 50 students.

AIMS-Tanzania opened last year and roughly 450 candidates applied to that centre. The same number applied to AIMS-Ghana. Senegal and Cameroon each had about 250. So there is an enormous need and there is a feeling among young people that AIMS will offer them something which will take them further. It's definitely related to the interesting scientific and international environment we have, but it's also because our visiting lecturers have an innovative cutting-edge approach to what they teach.

BT: Isn't it unusual that someone with one master's degree would want another?

BG: AIMS does something the university doesn't do. For these students, it's an opportunity to link in to the broader scientific community. Our faculty come from all over the world. We have more than 30 lecturers at this centre each year, and a similar number at the other centres. Approximately 70 percent come from outside Africa, and 30 percent from the host country combined with other African teachers and professors. This gives a very lively atmosphere to the environment, but it also leads to other opportunities. A young student coming here from Ethiopia might be interested in biomathematics – disease modelling of malaria or things

like that – and here we have a group of visitors who can actually introduce him or her to those subjects and offer interesting problems to start thinking about. Some will continue working with those people.

AIMS offers the opportunity to see a broad spectrum of mathematical science, something they wouldn't see at their university. Even at universities like Cape Town or Stellenbosch, they don't get this type of exposure. They become very specialised in what they know. They know it very well, and I'm not criticising that! But we do something different. We give them a broader picture of what is out there, and we have some of the best people doing that.



It may not be one person, in the form we think of as an “Einstein”, but it represents the idea of creative energy being unleashed and given an opportunity. That is what AIMS is about.

BT: Is it an interdisciplinary programme?

BG: It is interdisciplinary – computer science, mathematics, applied mathematics, statistics and physics – but we have themes that carry through the course. One theme is mathematical and statistical problem-solving. Another is computational methods, how to use digital tools to change the way we attack problems or simulate better solutions. We may have another in financial math, or modelling, or quantum computing and the physics-related disciplines. A student who comes here with a pure math background should expose himself to more. We insist

on that. They get a bigger picture of where mathematics is involved in society.

GOOD WILL HUNTING

BT: Give me a few examples of the kind of person who comes to teach here.

BG: There are those who have been involved right from the start, like Alan Beardon [Cambridge], who inculcated the problem-solving idea that we really took up, and his wife Toni, also from Cambridge, who is a great enthusiast for teacher training and has helped us with the development of AIMSSEC [AIMS Schools Enrichment Centre]. In fact, she introduced us to Alan.

Others teach courses together with local academics. AIMS didn't ever want to stand apart from the local educational environment. In fact, that's our strength. That's why we can go into other parts of Africa: we want to interact and link with academics there. We have Grae Worster, also from Cambridge, who worked together with Daya Reddy [UCT], who is one of our council members. From Canada [British Columbia], Douw Steyn, mathematics of ocean science. From Paris, Vincent Rivasseau in physics, and Babette Doebrich [particle physics] from Germany...

BT: Even Nobel laureates.

BG: Yes, George Smoot and David Gross have visited. Stephen Hawking came to open our research centre – that was a wonderful occasion. The head of NASA [US National Aeronautics and Space Administration] was there as well. AIMS has attracted a lot of people of goodwill who also see the opportunity to help Africans make a change themselves.

And the more we do here, the more African governments are approaching us to open centres. We are currently trying to consolidate the five established centres, but already we have two or three countries saying “Open now! Open next year!” We don't want to do that without having done our homework. It's very hard, when you get 200 students applying from Nigeria or from Sudan, to say that there's no place for an AIMS centre close by. Certainly there's a need. ➤➤

Professor Nick Katz (pictured right during a special lecture at AIMS South Africa) is an American mathematician, working in the field of algebraic geometry.



BT: This network is now called the Next Einstein Initiative (NEI).

BG: The idea was put in Neil's ear – Neil Turok, your son, the founder of AIMS – by a student, when he was giving a talk here: “Why can't the next Einstein come from Africa?” It's symbolic of innovative intelligence tackling the unknown. It may not be one person, in the form we think of as an “Einstein”, but it represents the idea of creative energy being unleashed and given an opportunity. That is what AIMS is about.

HARDSHIP AND DETERMINATION

BT: Are you seen as an elite institution on the continent?

BG: We're seen as an institution that can close a gap, can take talented young Africans to the next level. I wouldn't like to say “elite” in the sense that we reserve places for a select group. We select based on talent, but we know that talent is everywhere, amongst the poorest communities, in all the religious groups. We want to attract students who want to make a difference, that's the first thing, and who have experience in a mathematical science, because that's the area we work in. And we want to empower them to go further. If you look at the results, many of

the students get progressively better. This is often because the hardships they've faced have equipped them with other strengths: they're resolute and they know what they want. And that is one of the strengths of AIMS. The students who come here have made a choice for something different, for putting themselves on the line, and working with others to solve problems. They're determined.

BT: Some visiting professors have told me that AIMS students often work much harder than those, for instance, at Cambridge or elsewhere.

BG: That has to do with their determination, but also with the 24/7 environment we've given them.

BT: This building is a hothouse. You have a computer centre here...

BG: And a library, and we're digitally linked up. But it is a hothouse. It's the advantage of the lecturers living here for three weeks, working with the students, enjoying meals together and then having discussions in the lounge. Having lecturers walk through the computer lab at nine o'clock at night and looking over the shoulders of students, saying, “Hang on, how did you do that?” Or a student knocking on the lecturer's door in the

evening to get a bit more advice. It's like a monastery, very intensive. This doesn't happen in a university environment.

Each lecturer has full responsibility for their course and they are supported by a very strong group of tutors. Tutors usually stay for one or two years. All have a master's degree and many have a PhD or are post-docs. They give continuity, as they are a link to the students and know who might need a bit of extra support, for example, in the area of language. Our programme is offered in English and we have an English teacher to offer extra support to students.

One student from Sudan came to me, this was three years ago, said he can't make it, the language is too difficult. I said, “Well, let's give it a month.” The day after, he said, “Could you pair me up with somebody who's not Arabic-speaking? Put me with somebody else.” So he shared a room with, I think, somebody from Uganda, and they would communicate in English. It was remarkable to see. They each give two or three presentations during the year and then the big oral [examination] at the end. By the end of the year, he was fine. There was nothing wrong with his mathematics. He was a good student and he worked well, but he had to be able to communicate it and he had to be able to write it. It's not easy.

BT: What about South African students?

BG: We have faced some problems. First, there is a well-developed network of universities in South Africa, with very good programmes. The second is that AIMS' academic year started in September and ended in June, which didn't fit with the university calendar here. Another was that AIMS students were originally getting a diploma and would often be encouraged by their universities to go straight from a four-year honours' into a master's programme.

We made a number of changes. The first was to realign the programme into a master's – with the proviso that we would not compromise our innovative and flexible approach. We were quite happy to have the qualifications people evaluate what we do, but we didn't want to be put in a straitjacket. We have to explain why this

environment works and what is different about it. Our council supported that. Our local partners supported that.

BT: Was the quality of students good enough?

BG: Two years ago, we had an exceptional student who came down from North West province. We had a woman from Venda who did her master's and research with us, went on to a PhD, and is now back lecturing there. We've had good South African students, but they are competing with the rest of Africa – and when you've got 2 700 candidates, certainly there's a very high standard.

We're pleased that the number of South Africans who apply to our programme is growing. Opening a second intake in January has made a big difference. Last year we had 25 applicants to the January intake; we accepted 14, and 10 came. We've got a couple in the regular June intake as well. AIMS wants to be a pan-African organisation and each centre should have a maximum of 30 percent local students. So if we have 11 or 12 South Africans out of the 50, that is 22 percent. We're getting there. Full bursaries make a big difference to South African students as well.

FINANCIAL MATHS

BT: Who funds AIMS?

BG: It's a partnership. At this centre, we're very fortunate that the South African government, through the department of higher education and training, has made a very big contribution to our operational costs. The department of science and technology has also contributed strongly to our research centre and our public involvement. When it comes to special projects and student bursaries, we've always had donor funding. An enormous number of donors over the years have contributed. AIMS wouldn't have managed without that. The most notable among them would be the Canadian government, the British government and Google. People in South Africa have donated as well. A number of people had the imagination to give it a chance at

first. AIMS didn't exist when they started funding and it was hard mettle to get that to happen.

There's agreement among all our partner countries and institutions that AIMS should be funded locally as well as internationally. Senegal has made a big contribution, and, as that centre grows, the government has committed more money to its development.



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BT: I believe they've offered US\$1 million.

BG: Yes, and they're also busy contributing to the Next Einstein Forum, which is a big, big conference where Africa can showcase its science. The Cameroonian government has funded generously as well.

South Africa has done something a little bit different: not one big injection, but a sustainable way of funding the centre within a framework. We didn't have that to start with, but AIMS South Africa is now listed with universities as a [government] budget line item. We have to be evaluated, of course, and show that we're doing good

work. This is what we need in our centres all over Africa. And then we need external funding for special projects, for student support, and probably for research endeavours.

REAL PROBLEM-SOLVING

BT: What does the research centre do?

BG: Alongside any serious postgraduate programme, you need an active group of researchers. We're not big like the universities, but if we choose a couple of themes in the mathematical sciences, we can build an institute that enhances what we do in our training programme but also is positioned to attack leading questions. For example, in astrophysics, we have people doing research related to the SKA [Square Kilometre Array] project here in South Africa. We have people linked to biomathematical disease modelling.

One example: Phillip Mashele is a professor at North-West University. He originally studied at Wits [University], then went and spent a year of two in Hungary, came back to the University of Stellenbosch, then went up to North-West, and has worked in the financial sector as well. He's spending his sabbatical here right now. Often we have a South African pairing up with another African or overseas scientist working here.

We pair up with Wits University for the Mathematics in Industry Study Group (MISGSA). It's an annual meeting that works on real-life problems sourced from industry. This year there was one from the sugar industry and another on rhinos. The industry partners prepare and present the problem.

There's a five-day graduate workshop first, to get familiar with the problems, and then a week-long workshop to try to solve them. We get experts coming from all over the world to lead that meeting. We allow our students to choose to be part of that workshop in place of one course. That's a great workshop.

BT: It sounds very imaginative.

BG: This is a wonderful building – it's >>

an old hotel. When our students are busy doing their project work and the lecture rooms are free, we can host other activities and we have about ten workshops per year. AIMS offers seed funding through the grants it receives, and then those who propose the workshops go find the rest of the funding. We've just done a biostatistics workshop on the genome project with Nicola Mulder of UCT. That brought people from Stanford, from all over, about fifty people. I would say we have roughly 500 visitors per year now.

BT: Who administers all of this?

BG: At the AIMS centre we've got a small core team of dedicated admin staff, a facilities and logistics manager, IT manager, finance and HR. Our staff complement at this centre is now 50, which includes tutors and researchers, but the staff involved with the day-to-day running of the institute is no more than 15.

AIMS is a small organisation and it needs very dedicated people. Thierry Zomahoun (president and CEO), Dorothy Nyambi (executive vice-president, AIMS secretariat), as well as our council and board – Neil, Keith Moffatt and many others – are outstanding people with absolute commitment. Thierry's based in Canada but travels extensively in Africa to try to promote the AIMS development. He is a wonderful example of somebody from Africa who started from a challenging environment but made an enormous success of his life, in the sense of contributing to society and with vision for what we can do together. Dorothy is very hands-on. She's been involved in many projects of this type. I often receive emails that she is writing at two o'clock in the morning. It's a special team.

ALUMNI SUPPORT

BT: Do you keep in touch with your alumni?

BG: Our alumni are very important to us: they are the proof of our model, of the idea of AIMS. We keep in touch regularly through network emails (AIMS-Chat) and

monthly newsletters. Once a year, we ask them to update us on new achievements, what they are currently doing, any exciting items in their own development.



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BT: Do you think they are an inspiration across the continent?

BG: Absolutely. The reason we have so many applications is because of those who have been here and are perhaps back teaching in Africa or elsewhere and have been an example. We wouldn't receive so much donor support if it weren't for our alumni proving that what we do is making a difference.

Also, the AIMS Initiative provides a visionary way of continuing to support our alumni. For those who were going on to South African universities, we decided to fund half the master's bursary, provided that the university and the researcher guaranteed the other half. This centre helped 35 of the 50. We were

aware that the students wouldn't be able to make that next step without some support. That's true for all the centres.

Now we have to rethink this, because different parts of Africa cannot absorb as many students. We need to be a bit more creative. Some students do stay where they are, others may come to South Africa or go to France, the UK or Germany. We try to support that, but it's far more difficult. Sending a student to Europe costs a huge amount. On the other side, we've got the One for Many programme with Canada, where Canadians support scholarship students here but also accept four or five students at their universities. This has been facilitated for our alumni by AIMS. We've started to do that in the US and it's working well in Germany. The Berlin Mathematical School takes a number of our students. We view this as students gaining experience and developing their own careers, and we hope that many of them will come back.

We also have programmes to bring them back. The Bosch Foundation has generously funded a junior chair – Antoine Tambue is the first recipient – and a second is being funded. To “bring somebody back”, they need an environment that is conducive to what they're doing, so we are linking what they do in their own country to AIMS centres and to international partners. For example, Antoine is working with Daya Reddy's group on computational dynamical systems. In other interactions, he works with a group in Norway. He studied at AIMS and at Heriot Watt University in Scotland, where he still has links. And, being Cameroonian, he has strong roots in that region as well.

BT: It's a massive undertaking and you must surely be one of the busiest people in Africa.

BG: I find it a great challenge after being a university professor – which was also a wonderful job. The wealth of the spirit of the students and the interaction in Africa is very special. To be part of it is a highlight. NA