

Developing world: The minority minority

Women are under-represented in physical sciences and in science in the developing world. Meet three who beat both sets of odds.

- **Katia Moskovich**

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Patchanita Thamyongkit was waiting patiently near the stage at a conference on the importance of science for Thailand, when the organizer rushed up to her and asked whether she had seen the next presenter, Professor Thamyongkit. “That’s me,” she replied. An awkward pause followed. “Oh, I thought you were his secretary,” came his reply.

The presenter was probably more embarrassed by the 2008 incident than Thamyongkit, who is used to being taken for a secretary. She is a physical organic chemist at Thailand’s biggest scientific establishment, Chulalongkorn University in Bangkok, where she has won several awards for her work. But senior female scientists are a rarity in Thailand: top science positions are scarce, and many women are forced out of research because of cultural expectations that they will take care of their households, raise children and help ageing parents.

Women around the world continue to face major challenges in pursuing a research career — particularly in the physical sciences. In the United States, women make up nearly half of college-educated workers and working life scientists, but only 30% of physical scientists. The gender gap widens higher up the professional scale. There is much debate about why: discrimination, conscious and unconscious bias in hiring and promotion, lack of role models and the demands of bearing and caring for children are all thought to play a part.

In developing countries, female scientists can face even higher cultural and societal barriers, such as overt sexism, and a lack of contraception, reproductive choice or access to education. Many live in regions with desperate poverty, few high-quality schools, political instability and sometimes civil conflict. “There is a great, growing interest in science and engineering among women in developing countries,” says Romain Murenzi, a physicist and former Rwandan science minister who is now executive director of TWAS, the World Academy of Sciences, which promotes the advancement of science in developing countries. Yet, he says, “women face obstacles from their earliest years, and across the landscape of their lives”. The situation varies enormously from one place to the next: figures from the United Nations Educational, Scientific and Cultural Organization (UNESCO) show that women in Thailand make up just over half of science doctoral students and researchers, whereas in Nigeria, those figures are 24% and 23%.

Nature talked to three women who are in this minority of minorities — working in physical sciences in developing countries — to find out what challenges they have faced and how they overcame them. Their stories highlight two of the ingredients for success: a supportive family

and a huge dose of determination. Becoming a leading scientist involves “convincing your family first”, says Thamyongkit, “and then, for the rest of your life, going out of your way to prove to everyone that you’re actually really good”.

A CHEMIST IN THAILAND

Patchanita Thamyongkit found that the academic pipeline for women is leaky.



Patchanita Thamyongkit is a physical organic chemist at Chulalongkorn University in Bangkok.

Thamyongkit lives with her elderly parents in a narrow, three-storey house in blaring central Bangkok. The neighbourhood is a sea of concrete, with wall-to-wall houses. When she was young, her parents ran an automobile-parts shop and a book store. They were ambitious for their daughter, and wanted her to become a doctor. “I am lucky in the sense that my parents have always supported me,” says Thamyongkit — even when she chose to study physical sciences instead of medicine at Chulalongkorn University.

Thamyongkit embarked on an academic world tour: she did a PhD in Germany and took a postdoctoral post in the United States before returning, speaking two foreign languages, to join the chemistry department at Chulalongkorn in 2005. She researches novel organic materials for optoelectronic applications, such as energy-efficient solar cells. Last November, she won a L’Oréal–UNESCO prize for women in science.

Equal proportions of men and women participate in Thai science education and scientific research as a whole. At Chulalongkorn, roughly 25% of faculty members are women in physics and 35% in chemistry, proportions roughly similar to those in the United States. Many universities have nurseries and schools on campus, and some researchers say that they do not perceive a gender gap at all. The country elected its first female prime minister, Yingluck Shinawatra, in 2011.

But as in other nations, the academic pipeline for women is leaky. “Really, really few actually reach the top,” says Supot Hannongbua, dean of the faculty of science at Chulalongkorn. “Researchers maybe publish one paper a year — it’s very difficult for them.” Out of 80 faculty members in the department of chemistry, he says, there may be between 5 and 7 people doing outstanding research or in senior positions, and rarely is one a woman.

Part of the problem is that top research jobs are rare. Just 0.2% of the country's gross domestic product goes on research, and only around 20 of Thailand's 160 or so universities have proper research facilities. With so few opportunities, women often lose out. Most of the 12 female graduate students in Thamyongkit's lab late last year said that they wanted to work in industry, care for their families, or both.

“Thailand has no particular and serious campaign to encourage women in science.”

That efflux is also driven by Thai society's traditional expectations. Many women work, but it is assumed that they will get married and shoulder caring and domestic duties. Although overt sexism is frowned on, discrimination persists. “If a man and a woman candidate with exactly the same characteristics apply for a top scientific position, the man is more likely to get hired,” says Hannongbua. Some advertisements for industrial jobs state that the applicant must be a man.

Women can also struggle to make the right connections, says Tyrell Haberkorn, who studies Thai politics and history at the Australian National University in Canberra. “Women in Thailand face everyday sexism of the boy's-club variety, in which important decisions and relationships are forged outside the workplace and instead in the male-only spaces in which men go out and eat and drink together.” One female chemist at Chulalongkorn, Parichat Vanalabhpattana, says that she had to learn to drink beer to be accepted by her male colleagues.

The Thai government has tried to institute change. Shinawatra promoted gender equality through a National Development Fund for Women, which offers low-interest loans to further women's welfare and occupations; and in 2007, Thailand criminalized domestic violence.

But Thamyongkit, Hannongbua and others say that the government should do more. “I still insist that Thailand has no particular and serious campaign to encourage women in science,” says Thamyongkit. Overcoming entrenched societal attitudes “would take what would amount to a social revolution in how gendered roles are conceived”, says Haberkorn. “But in truth, I think that continuing to open up education, particularly tertiary education, to a broader and broader group of people is the most concrete strategy.”

Thamyongkit has found her own way through. In her twenties, she decided to not have a family. "I did want to have kids before, but if ten years ago I had had a family, I would have never managed to get to the same level in my career where I am now," she says. Now 38, she says that it is probably too late. As she walks through the campus, Thamyongkit passes a temple, where she takes a few seconds to stop, kneel and pray. "I'm not religious," she says. "But I meditate, I say a few words to reinforce all the positive things in my life, to keep the positive energy flowing."

At the end of the day, as Thamyongkit sits down with her family for dinner, her parents say that they would love to have a grandchild. But they don't pressure her, she says, and she is grateful for that. "My relatives want to know why I don't have a family. They say, 'You don't look that bad, so why? Why?' But my parents know I am happy, and for them it's the main thing."

A PHYSICIST IN NIGERIA

Rabia Salihu Sa'id negotiated societal and personal challenges to pursue research.



P. N. Bala Subramanian

Rabia Salihu Sa'id studies physics at Bayero University in Kano, Nigeria.

On a Sunday morning in April 2012, Rabia Salihu Sa'id, a 52-year-old professor of atmospheric and space-weather physics at Bayero University in Kano, northern Nigeria, was at home with her six children when she heard some shocking news. Fighters from the militant Islamist group Boko Haram had stormed a packed church on the university campus, killing 16 people and wounding many others, mostly students and academics. Sa'id lost two of her colleagues and friends in the attack, which was part of Boko Haram's campaign to build an Islamic state and stamp out Western education.

Sa'id knew that she could have been one of those killed — but it did not stop her from teaching or doing research, and neither have further Boko Haram attacks. “There’s a lot of security at the university now, you can’t come in without being searched,” she says. “But we are not afraid.”

Even before these threats, Sa'id's career was riddled with challenges. A growing number of girls in Nigeria receive an education, but in the north of the country — where Sa'id grew up — they often receive little schooling and get married in their teens, says Sa'id's colleague Babatunde Rabiu, director of the Centre for Atmospheric Research at Nigeria's National Space Research and Development Agency in Anyigba. The country is rated poorly in a 2014 index compiled by the Organisation for Economic Co-operation and Development to measure discrimination against women in areas such as law and social norms.

Within science, physics is still very much considered a 'male' subject, says Rabiu. A report¹ that Sa'id co-authored in 2013 found that 5–20% of students enrolled in physics in Nigerian universities were women, and UNESCO figures show that women make up 24% of doctoral students in all areas of science. “It is common for single women who go for further degrees to be mocked by men and even by some females,” says Rabiu; traditionally, women are expected to marry and stay at home.

“I wanted to be in a position where my opinion will matter, where I will be respected.”

Like Thamyongkit, Sa'id overcame these hurdles thanks to the encouragement of her family. Her father, an officer in the Nigerian Army, encouraged all of his children to pursue education and hoped that his daughter would become a doctor. Instead, she married straight out of school, at the age of 18. When her first son was born with a club foot, she shelved her higher-education plans. Soon, two more children followed. Aged 29, she decided to go to university at last. She did not have a high enough grade in chemistry to enter medicine, so she opted for physics.

But first, there was the pressing question of how to pay for university. She sold a gold necklace from her bridal dowry to pay for the registration, and she ran a nursery school to cover the rest. “Many women would not be able make it like I did, and would have to give up the dream of a university degree if they have no financial support,” she says.

Months after Sa'id began her studies, her fourth child was born with sickle-cell anaemia — an incurable genetic disorder. With two children needing medical care, “It was incredibly

challenging for me”, recalls Sa’id. “I was really in and out of hospitals.” Her extended family and friends helped out, staying with one boy or the other at hospital while she went to lectures.

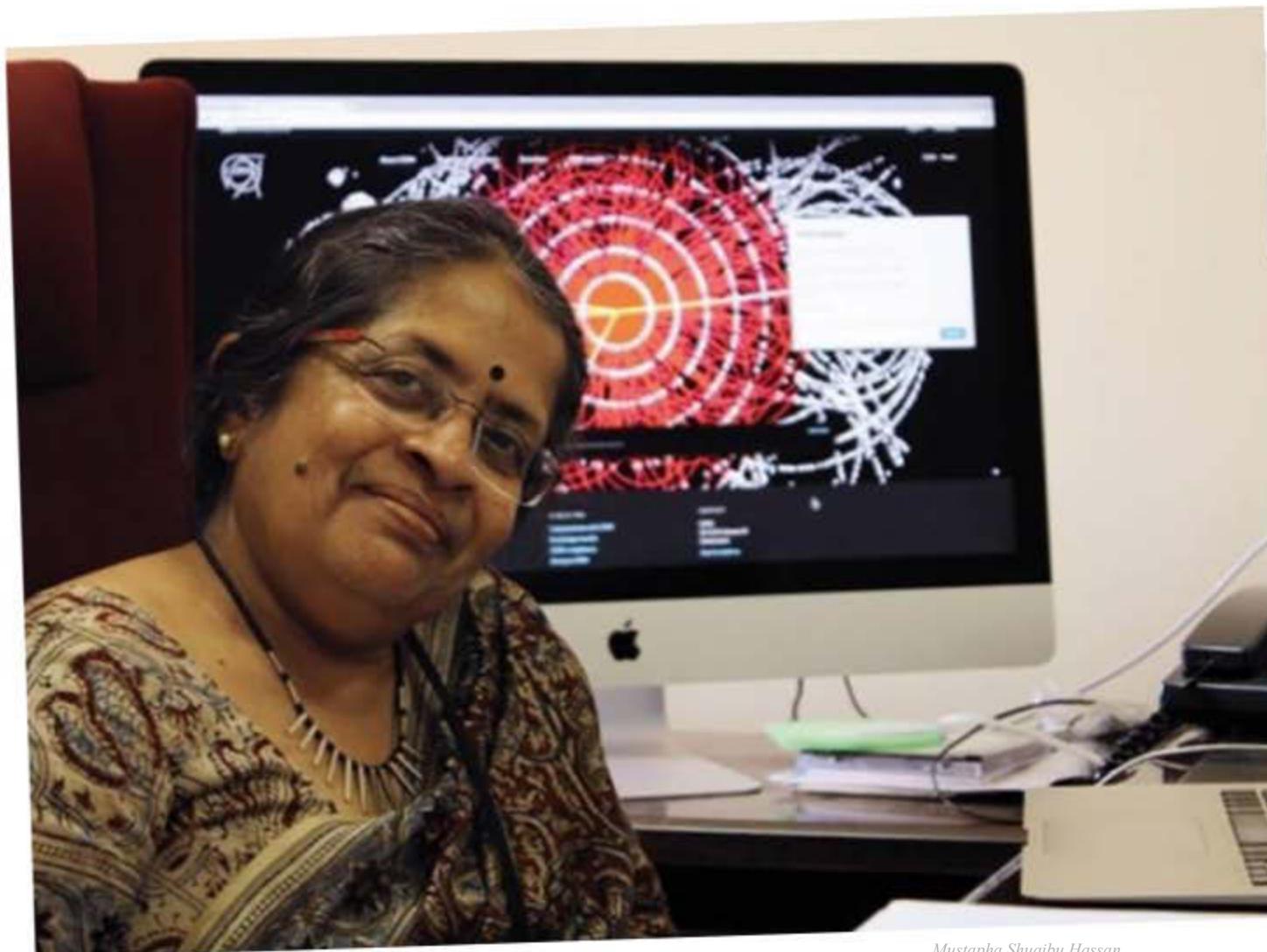
Sa’id was one of 4 women in a class of 21 who graduated in 1996. She says that a streak of ambition kept her going. “I wanted to be in a position where my opinion will matter, where I will be respected, where my children could have the good things in life,” she says. She went on to get a PhD, then a job as a graduate assistant and eventually a permanent teaching and research post. She now studies the effect of dust aerosols on climate — she has shown, for example, how the constituents of Saharan dust aerosols alter the aerosols’ cooling or warming effects². The challenges continue in her research: she has electricity for only four hours each day.

Sa’id and other female scientists in Nigeria have found forms of support. Some research-funding agencies give female applicants particular encouragement or priority, and the Nigerian government has taken steps to reduce discrimination and increase opportunities for women overall. Four years ago, Sa’id and her colleagues formed Nigeria’s Association of Women Physicists, to encourage more women in the country into the field. At their first conference, it became clear that all the women had had similar experiences. The group agreed to try to improve representation of women through mentoring, prizes for female students, efforts to improve school physics teaching and a meeting twice a year.

Last month, at the annual meeting of the American Association for the Advancement of Science in San Jose, California, Sa’id received an Elsevier Foundation Award for Women in Science in the Developing World — she was one of five women honoured for work in physics and mathematics. “I have learnt that with high motivation and hard work, one can succeed,” she says. But women cannot progress without improvements in the country’s research infrastructure as a whole, she says. “This is very important.”

A PARTICLE PHYSICIST IN INDIA

Rohini Godbole is one of her country’s few leading physicists.



Mustapha Shuaibu Hassan

Rohini Godbole, a physicist at the Indian Institute of Science in Bangalore.

“I have read your husband’s papers — great work!” exclaimed a German physicist as he shook hands with Rohini Godbole. The seminal papers on particle physics, he assumed, had been written by a man. But the author was Godbole herself — and the remark was one of many that she has deflected throughout her career.

Based at the Indian Institute of Science in Bangalore, Godbole is one of her country’s few leading physicists. In 1991, she discovered a way to describe the complex interplay of high-energy particles in linear colliders³ with Manuel Drees, now at the University of Bonn in Germany. Godbole is now one of the 16 members of the International Detector Advisory Group for the proposed International Linear Collider.

She has received numerous awards and honours, and is an elected fellow of all three academies of science in India, a nation where about 37% of science PhD-holders, 20% of working scientists and less than 10% of professors are women. Even today, says Anuradha Misra, head of physics

at the University of Mumbai, “most promising women scientists in India, in spite of having immense potential, are not able to achieve as much due to societal and cultural constraints”.

Godbole was born in Pune, the first scientist in a family rich in doctors and engineers. Her mother was a teacher, and her father said she could be whatever she wanted. She won a coveted government scholarship to study physics, then did a master's at the Indian Institute of Technology (IIT) in Mumbai and a PhD at Stony Brook University in New York. “Until I finished my PhD in physics, I never really thought that being a woman and doing science was somewhat of a special combination,” she says.

That soon changed, as Godbole encountered discouragements on every score. When she joined the physics department at the Tata Institute of Fundamental Research (TIFR) in Mumbai for a postdoc in 1979, she found that there was a men's toilet on every floor, but a women's only on every alternate one — because there were so few women working there. In some other physics departments, there were no female toilets at all.

At the end of her postdoc, she was told by a senior professor that she should take up teaching in a women's college. “There's no expectation that you could be at the top, leading something, having a lab, directing PhD students,” she says. It was advice she chose to ignore, and soon she had a job as a lecturer at the University of Mumbai.

The subtle — and not so subtle — messages have kept on coming, says Godbole. Five years ago, she was elected a distinguished alumna of IIT, but women were still such a rarity in the group that the letter addressed her as 'Dear Sir'. “These things could have put me down,” she says, but her energy carried her through. At Mumbai, she would usually lecture and work at the university until noon, then go to the TIFR some 30 kilometres away to continue her collaborations there. She would pause for dinner, work until 11 p.m., and then be ready to teach again the next day.

The excitement of discovery was a driver too. “Once in a while you figure out something that, until then, others have missed, and you feel suddenly like, 'Hey, I know something that others did not know!'” she says. By 1994, she was a professor at the Indian Institute of Science.

Meanwhile, Godbole's family had been fretting that she was getting old and would never find a husband. Indian society expects women to put marriage and children first, and to weave their job around the family, says Vinita Sharma, former head of Science for Equity, Empowerment and Development, a Ministry of Science and Technology initiative that promotes science projects to help disadvantaged sections of society.

Perceptions and attitudes are changing. In big cities, it is now considered acceptable for women to study physics. The proportion of women starting a bachelor's degree in science rose from 20% in 1970 to 40% in 2005, the most recent figures available. Half of the students doing a physics master's at the University of Mumbai are now women. In 2003, the Ministry of Science and Technology started a programme to encourage female scientists to return to research after a

career break. And in 2005, the government set up a National Task Force for Women in Science, which made recommendations, but has had limited impact.

Shobhana Narasimhan, a physicist at the Jawaharlal Nehru Centre for Advanced Scientific Research in Bangalore, was on the task force. She says that there are two issues. First, the need to raise women's aspirations — for this, leadership programmes can help, she says. (Godbole chairs a panel to study the issue of women in science, and has undertaken several initiatives, such as mentoring aspiring female scientists.) The second is the need to change the attitudes of men, so that they consider women for leadership positions. “This is hard!” says Narasimhan. “I think it helps for women to just 'hang out' with the guys and get accepted as one of them, but in conservative societies, this can often cause a lot of problems.”

Godbole did get married, but never had children. “I didn't see how I could juggle all the balls,” she says. “If there had been child care at institutions, it would have tipped the balance in terms of my decision not to have children. That's the only regret I have.”

She thinks future scientists should not be forced to make that choice, and she would like to see better child-care provision and extensions to postdoctoral contracts for women who have children during their positions, as is commonly done in Europe.

Murenzi points to the significant cultural evolution that has opened up opportunities for women in places such as the United States and Europe: there is much more awareness of the obstacles than there once was, and greater efforts to minimize them. “For the most part, developing nations have not come so far, so quickly,” he says. “Make no mistake, though — that evolution definitely is under way in many developing countries.”

A few years ago, Godbole co-edited a book of biographies of almost 90 female scientists in India⁴, in which she wrote that a female scientist needs a large dose of luck to have a successful career, a happy family and a happy marriage. Today, she says: “Whatever can be done to take the requirement of luck from this equation will be good.”

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