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Miguel Nicolelis

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Building Up Brazilian Brain Research

Miguel Nicolelis was educated in his native Brazil, came to the United States for his postdoc, and stayed on as a faculty member at Duke University in Durham, North Carolina. After making a splash at Duke, he returned to Brazil -- maintaining his Duke appointment -- determined to use science as an agent of social transformation.

Nicolelis grew up near São Paulo, the largest city in Brazil and, indeed, in South America. In 1984, he received a doctorate of medicine from the university's medical school. Five years later, he completed a doctorate in physiology.

In seeking a site for his new institute, he focused on Brazil's northeastern corner, one of the country's least developed regions and home to one of the largest concentrations of rural poverty in Latin America.

In 1989 Nicolelis came to America, accepting a postdoctoral position at Hahnemann University in Philadelphia. Upon completing his postdoctoral work, Nicolelis faced a stark choice: Return to Brazil, where research positions and funding opportunities were nearly nonexistent, or remain in the United States. He chose the latter, accepting a faculty position at Duke University.

In 2003, Nicolelis's Duke lab gained international attention by showing that monkeys could move robot arms with just their thoughts, feeding electrical impulses from their brains into a computer linked to robotic arms.

Science in Northeastern Brazil

This article is part of a feature focused on doing science in northeastern Brazil. For more information on this topic, read:

- **Science in Northeastern Brazil (http://sciencecareers.science**… (An Introduction)
- **Shifting Sands in Northeastern Brazil (http://sciencecareers.science**…
- **Brazil's Science Culture Shock (http://sciencecareers.science**…

When Luiz Inácio Lula da Silva, the newly elected Brazilian president, announced his intention to double Brazil's research spending, Nicolelis decided to build a state-of-the-art research facility in Brazil. While still working at Duke, he contacted the new government in Brazil to help line up support and began raising money from private sources, including a number of expatriate Brazilians. He later applied for, and received, funding from the Brazilian government.

In seeking a site for his new institute, he focused on Brazil's northeastern corner, one of the country's least developed regions and home to one of the largest concentrations of rural poverty in Latin America. Many local people lack access to educational and health facilities.

Nicolelis settled on a hilly site on the outskirts of Natal, the state capital of Rio Grande do Norte. Natal's approximately 1 million residents have long faced challenges to education, healthcare, and sanitation.

"When we saw this place, we realized that we could have an impact," Nicolelis says. When he opened the International Institute of Neuroscience of Natal (IINN) in 2005, the campus consisted of two rented buildings that were already on the site. Since then, three new buildings have been built. The campus now has a research lab, a science school serving children in the area, and a women's healthcare clinic where free prenatal care is provided.

Today, the women's clinic serves 12,000 women annually and plans to double that number within a few years. Two extracurricular science programs have been developed in the region, serving 5000 children. The retention rate for students in the science program is near 95%, far above Brazil's high school retention rate, which hovers around 50%. "We're seeing

CREDIT: Antonio Regalado

Miguel Nocolelis in 2004, at the site of the new neuroscience institute.

for the first time that kids from this district are capable of passing the rigorous entrance exam and are being admitted into the public universities," Nicolelis says. Next year, another school will open in northeastern Brazil under the direction of IINN, providing educational opportunities to another 5000 kids.

Up and running

There has been progress on the scientific front as well. Since 2005, the institute has employed a dozen full-time researchers to carry out basic neuroscience studies in rats and primates. Research is now moving into the translational realm, as testing begins on a potential therapy for Parkinson's disease. The institute is also working on a robotic "exoskeleton" that could be worn like a suit so that people who lose control of all their limbs might become mobile again.

A new research building is scheduled for completion in 2012. Nicolelis plans to establish a graduate program that will bring more than 70 neuroscientists to Brazil to teach courses and collaborate on research. Eventually, he hopes to build an industrial research park focused on brain-related healthcare.

Not everything has gone smoothly. Last summer, 10 scientists who had been contracted by the neuroscience institute quit, citing delays in getting equipment and supplies. The scientists, who all had ties with a nearby university, returned to their academic posts. *Science* **reported (http://www.sciencemag.org/content/333/6045/929)** that 100 people left the lab but today Nicolelis says that in addition to the 10 PIs, the lab lost only 10 people, all graduate students. He has replaced those researchers with an international group of scientists, he says.

Nicolelis attributes those departures to frustration with the slow pace of progress. "Since the beginning we have made it clear that our institute and our foundation works to follow every single regulation of the country, no matter how difficult it is," Nicolelis says. "In this case, they didn't have enough patience for that." Meanwhile, he's working to make those regulations policies more flexible. Last year, he was appointed to head a commission called "Commission of the Future," which is charged with finding ways to reform Brazil's scientific system.

While some scientists in the region complain about the slow rate of change, Nicolelis sees many positive changes taking place. For example, he notes that last summer, the government announced the creation of 75,000 science and technology scholarships by the end of 2014. "We haven't yet reached our goal," he says, "but we're well on our way."

Susan Gaidos writes from near Portland, Maine

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Science in Northeastern Brazil

Brazil is hardly a scientific backwater. The Brazilian government became serious about science several decades ago, and as the Brazilian economy has expanded -- especially over the last 10 or 12 years -- the government has increased support for science even more. According to **an article in *Science,* (http://www.sciencemag.org/content/330/6009/1306.full?sid=f795a258-601a-4556-8d44-64835ef29297)** in 2010 Brazil had moved up to 13th in the list of countries with the most scientific publications. (In the most recent data, they seem to have **dropped back to number 14 (http://www.science20.com/curious_cub/top_countries_2011_scientific_publications-85744)** .)

There's a lot of good science to be done in northeastern Brazil, and -- assuming you speak the language -- plenty of opportunity.

But all is not sun and sandy beaches: Scientists say Brazil has long suffered from an excess of bureaucracy. Quoted in **another article in *Science* (http://www.sciencemag.org/content/303/5661/1131.summary)** , from 2004, Stevens Kastrup Rehen, a professor at the Federal University of Rio de Janeiro, says, "To give you an idea of how bureaucratic the process is, an electrophoresis apparatus that I ordered as an undergraduate was held up by customs until the end of my Ph.D."

Another problem -- hardly unique to Brazil -- is an uneven geographic distribution in the support for science, and the economic and social benefits that come from it. Brazil's scientific wealth is concentrated in the south and southwest, especially in the two big cities, São Paulo and Rio de Janeiro.

But lately that distribution has improved -- first, because Brazil's strong economy has allowed added support for science and, second, because of shifts in the government's priorities. Today, nearly 30% of the country's research funds are directed to institutions in the northern and western states. Another big chunk of cash is being spent on the expansion of the region's educational institutions. Scores of academic jobs have been created on the region's federal campuses.

This package of stories, this introduction and the three related profiles linked below, is part of an experimental series in which a location is chosen at random -- actually using Google Maps and a random-coordinate generator -- to explore what it's like to do science there. Our first random excursion **took us to Namibia (http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2011_07_29/caredit.a110007** . Our latest attempt landed us (after a couple of nautical excursions) at **Latitude -5.88388, Longitude -35.20612 (http://maps.google.com/maps?q=-5.88388,++-35.20612&hl=en&ll=-5.883796,-35.205688&spn=2.884809,4.070435&sll=37.0625,-95.677068&sspn=36.726391,65.126953&vpsrc=6&t=m&z=8)** , near Natal in northeastern Brazil; while small by São Paulo standards, greater Natal is home to more than a million people.

Brazil's new investments and changing priorities have made this part of Brazil a far better place to do science than it used to be. But scientists working there say the bureaucracy and other inefficiencies that have long plagued the nation remain oppressive and difficult to navigate.

Shifting Sands in Northeastern Brazil (http://sciencecareers.sciencemag.org/career_magazine/previous_iss

One such scientist is **Selma Jeronimo (http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2012_01_13/caredit.a**... , who started her research at Natal's Federal University of Rio Grande do Norte in the mid-1990s with "nearly nothing," she says. The contrast in the scientific climate between then and now, she says, is "like night and day." Yet, even as the money flows into her lab, Jeronimo's progress is hampered by continuing inefficiencies that can keep her waiting months for the reagents she and her students need to carry out their studies on leishmaniasis and leprosy, both common diseases in northeastern Brazil.

Brazil's Science Culture Shock (http://sciencecareers.sciencemag.org/career_magazine/previous_iss

Physicist Mauro Copelli (http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2012_01_13/caredit.a... , who studied in the United States and returned to Brazil years ago to start an independent career, says he spends much of his time -- time he'd rather be spending in the laboratory -- dealing with bureaucratic red tape. So he is working to help change state and federal laws that can slow everything from minor purchases to major hires.

Building Up Brazilian Brain Research (http://sciencecareers.sciencemag.org/career_magazine/previous_iss

In northeastern Brazil's scientific circles, **neuroscientist Miguel Nicolelis (http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2012_01_13/caredit.a**... is difficult to miss. Nicolelis made headlines a few years ago at Duke University with his science fiction–sounding experiments with primates and mind-controlled prosthetic limbs, and again when, a few years later, he set up a neuroscience institute in Natal. Nicolelis's ambition, partly realized, is to harness science to support social and economic development in the region.

The verdict: There's a lot of good science to be done in northeastern Brazil, and -- assuming you speak the language -- plenty of opportunity. But you have to be patient. Then again, if you want to change things for the better, you probably shouldn't be too patient: Better to press strategically for change, our sources say.

Susan Gaidos writes from near Portland, Maine.

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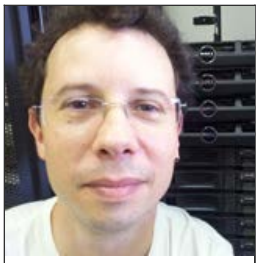

Courtesy of Mauro Copelli

Mauro Copelli

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Brazil's Science Culture Shock

Last year, physicist Mauro Copelli and four other scientists at the Federal University of Pernambuco (UFPE) in Recife, Brazil, received a grant from the federal and Pernambuco state governments to build a neurophysiology lab. Since then, the scientists have acquired new computers and equipment for the lab and are awaiting the building's completion.

Unfortunately, it's taking a long time. There aren't enough engineers to finish the building, Copelli says, and red tape and a shortage of engineers makes it hard to hire new ones.

"We live in kind of a paradox. It's not that we don't have money for research. For the past 10 years we have had an increasing amount of money that allowed people to get projects going. But we lack personnel, and we lack the flexibility of the law to just spend the money." -- Mauro Copelli

Copelli's frustration -- about the difficulty of getting things done in a system that, despite a recent infusion of cash, remains unwieldy and impoverished by decades of neglect -- seems common among scientists working to create or overhaul research programs, especially in the country's less-developed northeast. "We live in kind of a paradox," Copelli says. "It's not that we don't have money for research. For the past 10 years we have had an increasing amount of money that allowed people to get projects going. But we lack personnel, and we lack the flexibility of the law to just spend the money."

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Losing agility

Copelli, a theoretical physicist, grew up in São Paulo, the largest city in Brazil, and completed his undergraduate and master's degrees in physics at the University of São Paulo. He received a doctorate in 1999 from Limburgs Universitair Centrum (now known as Hasselt University) in Belgium and then came to the United States to work as a postdoc at the University of California, San Diego.

There, Copelli explored the physical properties of complex systems. He wanted to return to Brazil, but hiring at Brazil's public universities was (and is) determined by a government-run competition where candidates compete to be hired either as a postdoc or as a tenured professor. "There's nothing in-between," Copelli says. And during his graduate training days, even those contests stopped, Copelli says.

In 2001, those contests started up again. Copelli applied for a postdoc position at the Universidade Federal Fluminense (UFF), a large university located in the city of Niterói, a few miles from Rio de Janeiro. "There was a huge rush of people like me, former Brazilians who wanted to get back in," Copelli says.

In 2003, when the Brazilian government began pumping money into research and education, he applied for his current position at the university in Recife, which ranks among the top 10 Brazilian universities in both size and scientific production. The institution has long been regarded highly for its studies in physics, computer sciences and chemistry, though years of underfunding had left the university short of lab and classroom space.

Soon after his move, Copelli met his wife and started a family. Today he heads a small research group -- himself and three graduate students -- studying how the behavior of neurons in groups differs from the behavior of isolated

neurons.

The move to Recife has worked out well, Copelli says, personally and professionally. But he still feels that he is "fighting everyday." Laws detailing how federal grants are handled and what they can pay for slow everything from minor purchases to major importations and hiring.

Several years ago, when he received a $10,000 equipment grant, Copelli was required to seek quotes from numerous suppliers to prove he was buying from the lowest bidder. He had to show that the seller's state and federal taxes were in good standing -- a time-consuming task, he says. After the purchase, he had to ensure that his receipts conformed to all state and federal laws. "It makes life harder because you lose agility and you lose speed to do whatever you have to do," he says. "You spend less time on research and more time just working through the bureaucracy."

In many other countries, and even at some institutions in the better-developed parts of Brazil, a lab manager might handle such tasks. But the rules governing Brazilian federal universities make it difficult to pay a lab manager with grant money, Copelli says.

Building a scientific culture

The lack of a scientific culture also slows research. UFPE is highly regarded for physics and is considered one of the best universities in northeastern Brazil, Copelli says, but research isn't the top priority: Because the Ministry of Education pays faculty salaries, the emphasis is on teaching. Scientists with tenured positions are required to spend at least 8 hours a week in the classroom, making it difficult to find time for research. And, "There's growing pressure for us to teach more than that because we need more engineers and more high school and elementary teachers," he says. Also, "We have to spend more time teaching because we don't have the culture of teaching large classes in Brazil," he says. "People just don't believe that this is a correct way to teach."

Copelli thinks building a scientific culture in northeastern Brazil will require changes in several areas: the way students are taught, the way faculty members deal with funding agencies, and the federal laws and rules that govern hiring. Recently, foreigners have been allowed to take admission exams to become faculty members in Brazil's federal universities, Copelli notes -- but, "currently, all examinations in the country, including those to apply for a postdoc or faculty position, have to be done in Portuguese," he says. "That means that many talented people cannot come, even if they want to."

A sense of purpose

If it weren't for such obstacles, northeastern Brazil would be an ideal location for young international scientists seeking independence, Copelli says. "We have a lot of academic freedom here, and that could perhaps attract people from abroad who don't want to be working in somebody else's lab."

As a member of Brazil's "Commission for the Future," Copelli is chipping away at the hurdles that slow scientific progress in Brazil. "There's a sense of purpose in what we're doing here," he says. "We're at the point where we have the money, we have a large number of Ph.D.s graduating in each year, and we have a large number of universities. We just need to unlock the system to let it go."

Susan Gaidos writes from near Portland, Maine.

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