



# Brazilian Science: Riding a Gusher

A fast-growing economy and oil discoveries are propelling Brazil's research to new heights. But scientific leaders must overcome a weak education system and a low-impact track record

**NATAL**—Miguel Nicolelis stands with his arms spread, pointing out a rectangular pit carved into dry earth on the outskirts of the Brazilian beach city of Natal. “That is where the supercomputer will go,” he says. And, pointing to an area still thick with shrubbery, “that is the sports complex.”

Nicolelis is Brazil's best-known scientist. A neurobiologist at Duke University in Durham, North Carolina, he is renowned for spectacular experiments that use signals tapped from the brains of monkeys to make robots walk. But when Nicolelis launched plans in 2003 for a neuroscience institute in Brazil's backward northeast districts, few thought it could work (*Science*, 20 February 2004, p. 1131).

The notion was to pair cutting-edge science with a social mission: developing one of

Brazil's poorest regions. Nicolelis, who now spends part of the year in Brazil, is eager to offer a visitor “categorical proof” of success. He's built two hands-on science schools for children and a maternity clinic, and recruited 11 Ph.D. neuroscientists who run labs in a temporary headquarters. Within a few months, he says, \$25 million in Brazilian federal money should begin pouring into his sandy acreage, creating the sprawling neuroscience complex Nicolelis calls his “Campus of the Brain.”

“In Brazil we need science to build a country,” says Nicolelis, an energetic nationalist whose passions include wearing a green Palmeiras soccer club hat and downing pitchers of yellow maracujá juice. “This

place is going to create the next generation of Brazilian leaders.”

Some continue to think Nicolelis's idea is eccentric. But his timing couldn't have been better. Over the past 8 years, Latin America's largest nation has begun to boom. Its economy is growing fast, and it has become a player in world affairs, reveling in an unprecedented bout of self-confidence. It will host the World Cup in 2014 and the Olympics 2 years later.

The good times are lifting science, too. Between 1997 and 2007 the number of Brazilian papers in indexed, peer-reviewed journals more than doubled to 19,000 a year. Brazil now ranks 13th in publications, according to Thomson Reuters, having surpassed the Netherlands, Israel, and Switzerland. Brazil's universities awarded twice as many Ph.D.s this year as they did in 2001, and thousands of new academic jobs have opened up on 134 new federal campuses.

It's a reversal of fortune for a nation that during the 1990s was beset by dire economic problems. Back then, researchers scrounged for funds; Brazil even saw its flag removed from the logo of the International Space Station after it failed to come up with funding

**Online**  
**sciencemag.org**  
Podcast interview  
with author  
Antonio Regalado.



**Proud moment.** Neuroscientist Miguel Nicolelis at the foundations of his “Campus of the Brain” in northeastern Brazil.

**Science hub.** Brazil's richest city, São Paulo, and eponymous state are home to most of the nation's research.

to build six components. "We kept thinking smaller and smaller," says Sérgio Rezende, science minister for the past 5 years. "If we couldn't solve small problems, how could we solve big ones? Now we are in a position to think big again."

The fuel that propels science in Brazil is an R&D tax on big industries; it has swelled the budget of Rezende's ministry to \$4 billion, up from \$600 million a decade ago. The national oil company, Petrobras, is the largest contributor (see sidebar, p. 1308). Brazil restarted its nuclear research program in 2008, after a 20-year lull, and in October, a delegation traveled to Geneva to negotiate associate membership in CERN. With Brazil's economy growing at a pace of 7% this year, the country can afford the dues of \$14 million per year.

Scientists here say their arguments in favor of more education, innovation, and technology have been heard in Brasília, the capital, and they expect budgets to keep growing under Brazil's president-elect, Dilma Rousseff, the first woman to hold that post. By 2020, say officials of the Brazilian Society for the Advancement of Science, Brazil should again redouble or triple output of students, papers, and spending and become a "formidable" force in science. Government officials want to see Brazil among the top 10 science nations.

But Brazil is not formidable yet. Like Nicolelis's institute—where construction is several years behind schedule—Brazil's scientific output trails its ambitions. The country produces few high-impact papers and



## Highlights

**Amazon:** Half as large as Europe, the Brazilian Amazon is home to fewer than 3000 Ph.D. scientists. Government incentives seek to increase Brazil's scientific presence in the forest region.

**Brasília:** Brazil's rapid economic growth means rising budgets at the Ministry of Science and Technology. It now spends about \$4 billion a year.

**Natal:** Construction is beginning on a \$25 million "Campus of the Brain" conceived by Miguel Nicolelis, a neuroscientist at Duke University.

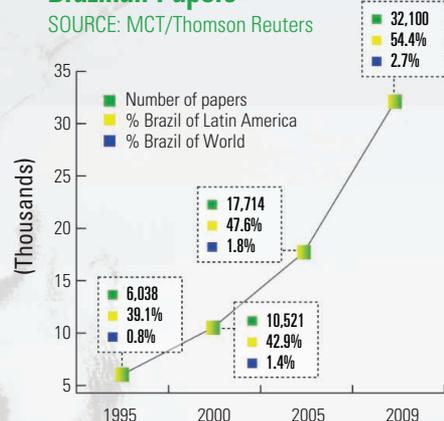
**Rio de Janeiro:** A massive new R&D facility built by oil company Petrobras is billed as the largest laboratory in the Southern Hemisphere. Workers will explore deep-water oil deposits.

**São Paulo:** The wealthiest state in Brazil is also its science leader. São Paulo researchers publish half of all Brazilian papers.

## Brazilian Science Begins to Boom

### Brazilian Papers

SOURCE: MCT/Thomson Reuters

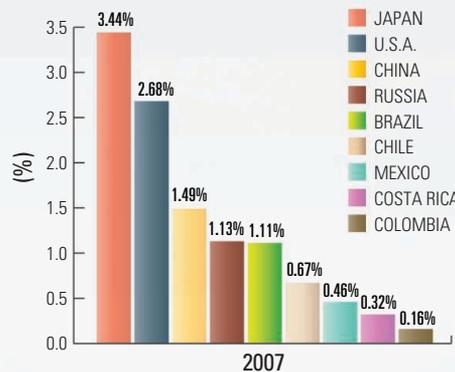


GRAPHIC CREDIT: N. KEVITYAGALA/SCIENCE

2009 figure elevated due to increase in number of indexed journals

### R&D Spending as % of GDP

SOURCE: IADB



### U.S. Patents for Selected Countries

SOURCE: USPTO



only a trickle of patents. Its primary and secondary public education system is in shambles, leaving the nation of 195 million chronically short of technical workers. “We need to be lucid and not fall into a victory discourse,” cautions Sidarta Ribeiro, a neuroscientist trained at Rockefeller University in New York City and co-founder of Nicolelis’s brain institute. “In terms of impact we are marginal. The external discourse for the world should be that we are interested in science and we are growing. The discourse internally should be, ‘Let’s improve. Let’s focus on merit.’”

### Boom times

Brazil is clearly breaking away from the pack in Latin America, indicators show. Brazil now accounts for over 60% of all research spending in Latin America, and Brazilian scientists write half of the papers. Brazil’s science bureaucracy is influential, too, having had its own ministry since 1985. That’s a step Argen-



**Tweaking nature.** Researcher in a government research lab in Brasília inspects a transgenic cotton plant.

tina took only 3 years ago and which neighbor Bolivia is still debating. “Brazil is the only example in Latin America where 1% of GDP goes into R&D and the science minister is a physicist that still publishes. So Brazil is the beacon,” says Juan Asenjo, president of the Chilean Academy of Sciences.

Globalization of markets is also working in Brazil’s favor. Like other Latin Ameri-

can countries, Brazil’s research base is heavily skewed toward agriculture, ecology, and infectious diseases—it is first in the world in publications related to sugar, coffee, and orange juice. Brazil’s cattle industry produces 33% of the world’s cow embryos. Once a sideshow, such research is increasingly well placed to address global preoccupations over food production, climate change, and conservation.

Nicolelis says he sees an “emerging tropical way of doing science” driven by research on renewable energy, agriculture, water, and animal and plant genetics. “These are the issues defining the planet, and, believe it or not, the players are down here,” says Nicolelis.

Biological research is a hot area of growth. The Empresa Brasileira de Pesquisa Agropecuária, the government-owned agricultural research company known as Embrapa, plans to hire 700 new researchers this year. Embrapa is considered one of the world’s premier agricultural units, and its budget

## Tapping a Deep, ‘Pre-Salt’ Bounty

Three years ago, a drill bit struck immense oil deposits deep off the coast of Brazil. Petrobras, the national oil company, tapped undersea fields now estimated to hold about 80 billion barrels of oil and natural gas—about three times the size of the reservoir under Prudhoe Bay, Alaska. It brought the promise of new wealth and expectations that Brazil will climb to the world’s top rung of achievement in science and technology.

Brazilian President Luiz Inácio Lula da Silva once termed the oil strike “a second independence for Brazil” and promised to use the oil revenue for education and public health. But Brazil’s R&D sector has been first to benefit. This

October, Petrobras inaugurated a sprawling new \$700 million research center in Rio de Janeiro. At the event, da Silva, a former union leader with a fourth-grade education, left no doubt what the vast R&D complex represents to him: “Brazil will never have to lower its head to anyone again,” he roared to a boisterous crowd of oil workers.

Deep-water petroleum exploration is Brazil’s largest technology project, and Petrobras’s money is pouring into research labs throughout the country. In order to retrieve the oil, which lies a daunting 7 kilometers below the ocean surface, Petrobras has opened a fire hose of funding that is “changing the face of science in Brazil,” says Angela Uller, dean for research at the Federal University of Rio de Janeiro, whose campus on an island outside the city also houses Petrobras’s R&D Center, known as Cenpes.

Petrobras now spends about \$1 billion a year on R&D, including some \$225 million that goes directly to universities, for which Petrobras has been rushing to outfit laboratories, erect new geophysics centers, and train a new generation of engineers. “We want to transform the technological capabilities of Brazil and help build university labs equal to any in the world,” says Carlos Tadeu da Costa Fraga, head of Petrobras R&D operations.

Rio’s engineering school, known as COPPE, is the biggest single beneficiary of the oil gusher. Petrobras has paid for the construction of numerous laboratories on campus, including the world’s deepest wave



**Oil money.** National oil company Petrobras inaugurated a \$700 million research center in Rio de Janeiro in October.

of \$1 billion is now the same size as that of the U.S. Department of Agriculture's Agricultural Research Service. "I've never seen so many resources for science as in the last 5 years," says Maria Fátima Grossi de Sá, a plant geneticist who recently received \$1.5 million to develop a transgenic cotton plant.

De Sá works at Embrapa's research station in Brasília, which is also finishing tests on a herbicide-resistant soybean that will be the first genetically modified crop designed by Brazilian scientists to reach the market. Demand for Ph.D. scientists is running so high that de Sá says it's difficult to find people to take postdoc positions. "We've gone pretty rapidly from having trouble placing Ph.D.s to having stipends that don't have takers."

Embrapa has nearly completed a four-story, \$15 million agro-energy center that will employ 100 researchers on the campus in Brasília. One goal is to turn Brazil's 22 million hectares of soybeans into more valuable products, such as biodiesel. "We capture solar energy and turn it into other forms of energy. We think we can move very quickly from agriculture for food to agriculture for energy. We can be a player," says Frederico Ozanan Machado Durães, general director of the new

unit. Countless shiploads of soybeans that embark for Asia every day from Brazilian ports could instead, he says, power domestic industries in lipochemistry and plastics that produce "value-added products."

The project represents an important shift in Brazilian thinking: namely, that science can transform the nation's economy, currently dominated by commodities like soy, beef, sugar cane, iron ore, and petroleum. "The new Brazil will be a natural knowledge economy," says Gilberto Câmara, head of Brazil's space agency.

With more money and an emerging green-science mission, Brazilian researchers say they're being taken more seriously. Most of Embrapa's senior scientists were trained in the United States, like Executive Director José Geraldo Eugênio de França, who in 1987 traveled to Texas A&M University to study sorghum genetics. De França says he noticed a change during a mission to Washington, D.C., last November, where he met U.S. science adviser John Holdren and other officials. "For the first time in history, we had a recognition that something was changing in Brazil. They didn't ask us how many postdocs we needed to send, or where

we needed help, but where could we work together," de França says.

### Private money

The most important goal right now, by Rezende's reckoning, "is for science to make a difference in the productivity of industry. I'd have to say that is our great challenge." Other goals are to increase the number of scientists, invest in strategic areas, and solve key social problems.

The disconnect between science and business is almost total in Brazil, researchers say. In the United States, about 80% of research personnel work in industry, according to OECD data, whereas in Brazil, that figure hovers near 25%. Brazil produces hardly any patents—just 103 U.S. patents were issued to inventors in Brazil in 2009—and Brazilian companies spend half of what European ones do on R&D. When they do spend, it's often to import technology rather than develop it.

Researchers say Brazil's 20-year dictatorship, which ended in 1984, is partly to blame for the lag. Universities became redoubts of political opposition and Marxist reading lists, where patents were viewed as oppressive. "We isolated ourselves from

pool, used to test automobile-sized models of oil platforms. "It's starting to look like Dubai around here," says Segen Farid Estefen, a director of COPPE, which gets about \$60 million a year from Petrobras. He says the industry-academic complex on the island is the "largest offshore oil research cluster in the world."

Petrobras, founded in 1947, began to follow the scent of oil offshore in the mid-1970s, investing in R&D to extend its reach. Brazil was importing equipment from the North Sea and the Gulf of Mexico and adapting it to tropical conditions. But Brazil's decision to pump its own oil demanded growing investment in R&D.

"You cannot simply cut and paste," says Martin Landrø, deputy chair of petroleum engineering and applied geophysics at the Norges Teknisk-Naturvitenskapelige Universitet in Trondheim, Norway. "You have to build up competence, and the easiest way to do that is to build up research. You have to bite the apple, so to speak."

Landrø, who has visited Brazil three times to give courses to Petrobras geophysicists, says he's noticed an accelerating change in Brazil. "They have maneuvered from the position of being not so competent to being on the cutting edge in 10 years," says Landrø.

Petrobras, the world's largest deep-water oil producer, is reaching depths where experience is scarce or nonexistent. At the Laboratory for Non-Destructive Testing, Corrosion and Soldering, for instance, four COPPE professors work alongside 30 Petrobras engineers to submit steel to corrosive hydrogen sulfide gas at extreme pressures. "At 7000 meters [below sea level], we don't have any information about how materials perform, or how long they can last," says Oscar Rosa Mattos, director of the lab, which Petrobras paid \$30 million to build in 2008. "My foreign visitors are surprised when they encounter a facility like this in Brazil."

The superdeep petroleum deposits now being discovered are in the "pre-salt" zone, an area where organic matter was deposited 125 million years ago



**Petro power.** With workers in 2008, President Luiz Inácio Lula da Silva celebrates the "second independence" oil discoveries will give Brazil.

and later encased beneath thick layers of salt. These are "a new kind of geologic play. They are new types of reservoirs and there are lots of things being learned," says William Fisher, a geologist at the University of Texas, Austin. One critical difficulty is spotting the oil reservoirs beneath the salt domes, frequently over a kilometer thick; seismic signals are hard to interpret. "As far as the potential discoveries—what is the potential volume of oil and gas—well, you can hazard all kinds of guesses, but it's going to be big," says Fisher.

Estefen hopes that Brazil's exploration of the ocean does not stop at oil. He says the country could use its deep-water expertise to be at the forefront of wave energy and undersea communications, too. "The analogy I use is that deep-sea exploration can do in Brazil what the space race did for the United States," Estefen says. "If Brazil only pumps oil, it would be a big loss." —A.R.

the big industries, which supported the military. They couldn't come in the university. The university became closed, hermetic, and now we have to change that," says Maria Bernardete Cordeiro da Sousa, dean for research at the Federal University of Rio Grande do Norte.

Officials have been trying to close the innovation gap. In 2004 and 2005, Brazil passed laws giving R&D tax breaks to companies and began allowing the Ministry of Science and Technology to give companies grants, even pay salaries of industrial researchers. In August, the ministry announced a major industrial R&D program, offering \$294 million in grants to back innovation projects inside companies in "strategic areas" including electric cars, pacemakers, and genetically engineered crops.

It's too early to say if the government incentives are working; only a small number of companies signed up for the tax breaks. But U.S.-style, risk-taking innovation, once viewed as alien, is increasingly seen in favorable terms. Venture capitalists have begun setting up shop in Brazil, and in 2010 both IBM and General Electric announced plans for research centers in the country.

"We lack a culture of innovation and entrepreneurship. There is a long path ahead to change that," says Luiz Mello, a physician who last year was tapped by Brazil's second largest company, the iron-ore miner Vale S.A., to spend \$180 million establishing three new corporate science institutes. Mello says he was hired after approaching Vale's CEO, Roger Agnelli, to raise money for an engineering program. "It turned out to be a meeting for him to say what he wanted. And



**Ph.D.-in-chief.** Physicist Sérgio Rezende has kept publishing while running Brazil's science ministry.

he wanted the MIT [Massachusetts Institute of Technology] of Vale," recalls Mello. "I was being invited to lead something that would be a new Bell Labs or Xerox PARC."

Mello traveled this fall to Silicon Valley to get ideas. Although Vale's business is low-tech, the commodity company, which ships vast amounts of ore to China and Europe, wants to spend heavily on research partly because it faces a sharp shortage of skilled labor, increasing pressure from environmentalists, and competition from global companies. Vale's three labs will work on biodiversity, renewable energy, and mining technology. "This is the biggest spontaneous investment in R&D that I know of in Brazil," says Mello.

The new laws also encourage Brazilian universities to file patents and set up technol-

ogy transfer offices, which many are doing for the first time. At the Federal University of Minas Gerais, the number of patent applications has reached 356, including one for a canine vaccine against leishmaniasis, now on the market. "All these things are leading to resonance in the system," says Ado Jorio, the professor who coordinates the university's patent efforts. "There has been an explosion in publications, and this is also going to happen in innovation."

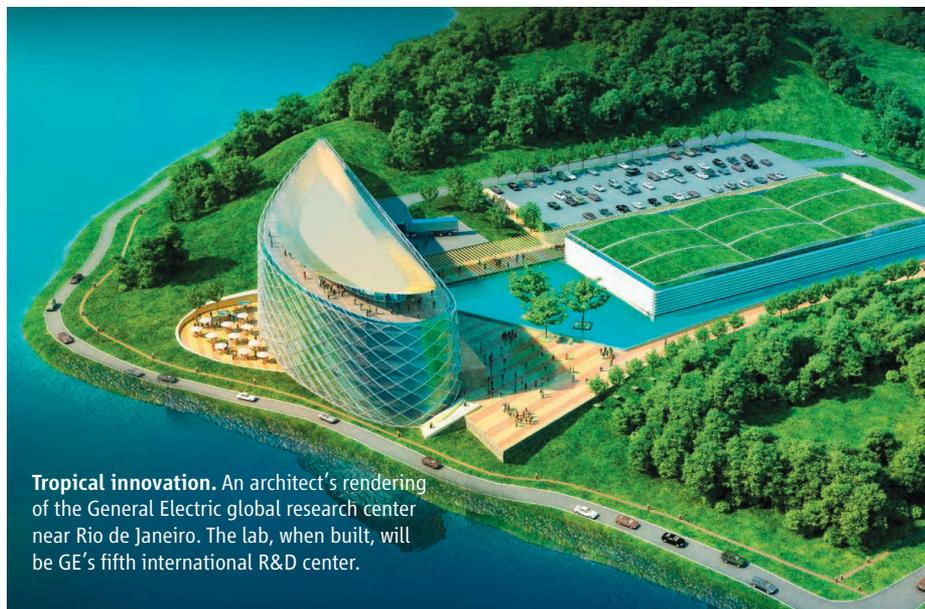
### Share the wealth

Brazilian science suffers another imbalance, between the wealthy south and the poor northern regions, that officials have put a priority on trying to correct. Most science still occurs in just three southern states, with the University of São Paulo alone accounting for nearly a quarter of all scientific publications. "One of the great questions we face is that Brazilian asymmetry, the inequality of the regions," says Lucia Melo, head of the Center for Strategic Studies and Management in Science, Technology and Innovation, a government science policy think tank in Brasília.

To push science out into Brazil's neglected hinterlands, Brazil's government has gone on a binge of university construction and earmarked 30% of research funds for poor northern and western states. Under a 2009 program called "Stipends for Everyone," officials in Brasília said they would give study grants to all graduate students in distant regions, regardless of academic merit.

The idea flows from Brazil's governing Workers' Party, which has made improving conditions in poor areas a priority. A greatly expanded welfare program has helped move several million Brazilians out of poverty. It has given researchers breathing room, too. "Before, we'd face the question, 'Why are you giving a monkey food and milk when there is a hungry child next door?'" says Cordeiro da Sousa, who is also a primate researcher. But she sees a tradeoff: Researchers feel increasing pressure to spend time solving local problems. She's considering creating a salt institute to support the local salt-mining industry. "You have to have a vocation, because in the future we could be called to answer in a big way."

Nowhere is the dearth of Brazilian-led science of greater concern than in the Amazon, the tropical forest that accounts for about 49% of Brazil's territory but is home to only about 3000 Ph.D. researchers, very few of whom do bench science. "Imagine what a totally irrelevant number that represents for this immense region," says Odenildo Teixeira Sena, secre-



**Tropical innovation.** An architect's rendering of the General Electric global research center near Rio de Janeiro. The lab, when built, will be GE's fifth international R&D center.

tary of science and technology in the state of Amazonas. Although larger than France and Spain combined, Amazonas has only a single resident Ph.D. archaeologist, and despite its vast river systems, no naval engineers, Teixeira says.

Increasing scientific labor power in the region could help find alternatives to slash-and-burn agriculture. But national anxieties figure into the calculation as well. “The majority of publications on the Amazon don’t have a Brazilian author. That is a worry for us,” says Jorge Guimarães, the Ministry of Education official who oversees higher education in Brazil. “We need more Brazilians participating.”

Brazil has never felt secure in its control over the vast region, which Spain ceded to Portugal under the 1750 Treaty of Madrid. With the Amazon a focus of international maneuvering on carbon credits, Brazil’s dependence on foreign knowledge production has become a “very delicate question,” says Adalberto Val, director of the Instituto Nacional de Pesquisas da Amazônia in Manaus. During a national science and technology conference last May, Val called for Brazilian “informational hegemony” over the forest biome. “There is a question of national sovereignty,” he says.

Such nationalist tones may sound harsh outside Brazil, but they play well at home. Physicist Luiz Davidovich, who chaired the May conference, says Brazil’s scientific community needs to raise “big flags” to rally the country around. “‘The Amazon is Ours’ is one of those,” he says.

Even some foreign experts have responded to the call. Daniel Nepstad, a prominent American tropical forest ecologist, dropped his job in October at Woods Hole Research Center in Massachusetts to become a Brazilian resident and full-time employee of the Instituto de Pesquisa Ambiental da Amazônia, a nonprofit he co-founded, based in the city of Belém. Nepstad says his U.S. affiliation “was interpreted that I am less committed to the scientific agenda in Brazil.” Brazil’s forest policy is evolving rapidly and, Nepstad says, “as long as the science is led by Northerners, we are missing the opportunity to get really good information into policy decisions.”

### Making it real

Despite its growing ambitions, Brazil has yet to prove it can do world-class basic research. The impact scores of its scientific papers are modest, about two-thirds the world average, and have slid in some areas. No Brazilian has won a Nobel Prize in sci-



## Talented But Underfunded: Brazil’s Future Scientists

It’s an unusual prelab routine. Wake up in a below-ground apartment where five people sleep (four on the floor), grab your books, then head out past the machine gun–toting gangsters who guard your street against police vehicles. That’s been reality for 25-year-old Reinaldo Sousa dos Santos, a Ph.D. candidate in biochemistry at the Federal University of Rio de Janeiro (UFRJ) and a resident of Parque União, a crowded favela where residents live under the thumb of a drug gang.

Dos Santos owes his journey from shantytown to lab bench to his mentor, Leopoldo de Meis, a 72-year-old professor of biochemistry at UFRJ. In 1985, de Meis began offering a hands-on science course for low-income adolescents called Young Talents. Dos Santos enrolled when he was 14, a year after his father died, leaving him orphaned.

“I don’t want people to think I am the poor little kid from the favela,” says Dos Santos, a fast, concise talker who is studying the metabolic response of goldfish to low temperatures. Although he may sleep some nights on the laboratory couch, “intellectually I don’t think I am below anyone.”

Brazil must write thousands more stories like Dos Santos’s if it is to overcome deep social divisions and achieve its dream of becoming a major player in scientific research. Many say the task must begin with improving public schools, where poorly paid teachers offer rote lessons.

Brazil’s math and science scores vie for the worst among 57 countries ranked on the so-called PISA scale by OECD, barely edging out Tunisia. College is mainly for the elite. Prestigious federal universities in Brazil offer free education, but it’s difficult to pass tough entrance exams unless families have paid for private secondary schools. “We have had a perverse system of social apartheid, where the poor don’t have access to higher education,” says Luiz Davidovich, a physicist at the university who sits on the board of the Brazilian Academy of Sciences. Only 14% of 18- to 24-year-olds are in college, not enough to meet Brazil’s growing demand for researchers and engineers. “We’re working with just a sliver of the population,” Davidovich says.

In recent years, the government has tried to broaden access to education. Scores of state technical schools have opened; since 1979, Brazil has hosted what is now billed as the world’s largest math olympiad. Another national program, ProUni, since 2005 has paid for 748,000 lower income students who can’t get into federal schools to attend private, for-profit universities. Davidovich says the efforts fall short: “Brazil needs a revolution in education at all levels, especially at the most basic levels.”

Dos Santos recognizes that his life is exceptional. “Most Brazilians don’t know any scientists and don’t know what a scientist does,” he says. For him, science has proved both an intellectual and financial life belt. His state stipend of \$1000 a month (he gets another \$180 for supplies) makes him his family’s top earner, and this summer he helped his grandmother, uncle, and cousins move into a larger house. Now that he has his own room, he hopes to decorate it with a metabolic chart like one he saw at a conference.

“I like to see the molecule in vivo doing something,” says Dos Santos of his career choice. “The lab is really a psychological escape from all the situations I live through. It’s my ideal place.”

—A.R.



**Missed opportunity?** Many researchers have published studies involving the Amazon region; most are not Brazilian.

ence or medicine, whereas regional rival Argentina has three. Researchers blame structural problems at Brazil's state-run universities. Critics say they discourage competition, for example, with automatic tenure after 3 years on the job and evaluations that reward Portuguese-language publication. "The attitude for many years was to avoid competition, keep your head low, and choose a marginal subject," says Ribeiro. Instead of competing head-to-head on hot topics with big labs overseas, he says, Brazilian researchers have sometimes been content to study local questions. "The thinking was, 'The anteater is yours so don't worry about the gringos.'"

Brazilian researchers returning from overseas, drawn by jobs and start-up funds, complain that there are still many obstacles that make producing world-class science nearly impossible. After 11 years in the United States, biologist Luciana Relly Bertolini returned to Brazil in 2006 with her husband, Marcelo, to start a laboratory that aims to clone transgenic goats. Although the effort is adequately funded, Relly Bertolini says a heavy teaching load required of professors and lack of trained staff means "it's science by persistence here."

Also notorious are Brazil's Kafkaesque importation regulations. Even simple reagents can take months to arrive, with radioactive or biological samples often in doubtful condition. Relly Bertolini says a cell-fusion instrument she ordered from Hungary

**Returnee.** Tropical ecologist Dan Nepstad studies a controlled fire in Tanguro Forest, Mato Grosso, Brazil, in August.



has been trapped in customs for 4 months. "You can have the best head in the world and you will never be competitive because the government works against us," says Bertolini. "When we begin thinking that way, we want to go back."

Some say the prospects will remain bleak until such problems are solved. "I know of no extraordinary science in Brazil," says Andrew J. G. Simpson, scientific director of the Ludwig Institute for Cancer Research in New York City. A naturalized Brazilian citizen, he lived in São Paulo for 7 years and coordinated one of Brazil's memorable triumphs, the sequencing of the plant pathogen *Xylella fastidiosa*, which landed on the cover of *Nature* in 2000. But when Simpson returned this year for a 10th-year celebration of the feat, he noticed that, at least in the field of genomics, "there was never again a big impact paper. There was no upwards process. It was a blip."

Brazilian officials have instead focused on beating another problem: the insecurity of research funds. In 2008, in its largest-ever funding round for basic research, Brazil's Ministry of Science and Technology offered \$350 million over 3 years to fund 122 national institutes to tackle subjects from quantum computing and stem cells to an upgraded Antarctic research station. "They saw that we needed long-term programs with stability," says Davidovich, who co-leads the program on quantum computing.

Other scientists privately express doubts about the grandiosely named institutes, noting that in reality they are virtual networks with an average of 20 university investigators each and money spread too thin to achieve much. In position papers, the Brazilian Society for the Advancement of Science has said that Brazil needs to focus on creating more pure research jobs outside of the university system. It wants a new, heavily staffed state institute to study the oceans, and another for the Amazon, modeled on the agricultural agency Embrapa—in this case with funding to match the grandiose vision.

In the city of Natal, Nicolelis's neuroscience institute, currently housed in a converted hotel, has also yet to produce a Brazilian breakthrough. But it's increasingly well-positioned to do so. It has reasonably equipped laboratories, a primate facility, and a crowd of young professors with promising track records who have signed on, including two recruited from a Max Planck center in Germany. In August, the École Polytechnique Fédérale de Lausanne in Switzerland donated an IBM Blue Gene/L supercomputer, which Nicolelis says will be the fastest in South America.

Ribeiro, the Brazilian who returned from a postdoc at Rockefeller to be the institute's scientific director, says the year of science he expected to lose while organizing the center has dragged into three, as he faced down customs officials and coped with large numbers of poorly trained students. "Now I'm finally starting to fight reviewers again instead of bureaucrats, which is a sign the plan worked," says Ribeiro, whose work includes experiments to look at the effect of sleep and dreaming on motor and perceptual skill retention.

The dirt road outside his building that leads to a nearby shantytown, he says, reminds him of a photograph he saw of Rockefeller's Founder's Hall after it was built in 1906 and still surrounded by muddy fields and horse-drawn carriages: "They didn't start as the best place to do science either."

—ANTONIO REGALADO