and maintain control of DNA samples. The research-ethics board run by the tribal government's department of health is working with tribal officials and traditional leaders and holding a series of public hearings to solicit opinions on the matter from tribe members. The group hopes to deliver a draft proposal by the end of October. Whatever the tribe decides could influence other Native American groups, who have tended to be wary of genetic studies because of past cases of scientists conducting research without consent.

The Navajo Nation's new oncology centre provides part of the impetus for revisiting the genetic-research ban. It will be the first such facility on Native American lands outside Alaska. Allowing some genetic testing at the centre could help physicians to identify the most effective therapies for each patient, says Lynette Bonar, chief executive of the Tuba City Regional Health Care Corporation in Arizona, which will run the facility.

Creating a repository for such genetic material on Navajo land would also enable research into the genetic and environmental factors underlying many diseases, not just cancer.

So far, Phelps says, the idea of allowing some genetic research has not drawn major opposition. Many of the tribe members consulted about lifting the moratorium have generally supported the idea after learning how physicians could use genetic data to diagnose disease and tailor treatments. And the number of Navajo tribe members who are geneticists and medical experts has grown since 2002, bolstering the tribe's ability to evaluate proposed protocols and represent its own interests.

Still, some Navajo have lingering questions about whether the tribal government can protect the privacy of their genetic material and maintain control over its use. Such concerns helped to shape the current ban back in the early 2000s, when the Navajo Nation's department of health conducted an outreach campaign about genetics and medical research.

"In the absence of a research code and lack of expertise at the time, they decided it was not a good time to move forward with genetic research until they were able to develop a research policy," says Nanibaa' Garrison, a member of the Navajo Nation who is a geneticist and bioethicist at Seattle Children's Hospital in Washington.

"As Native Americans, we have a problem with trust because we have been violated so much."

The tribe had reason to be cautious. "As Native Americans, we have a problem with trust because we have been violated so much," says David Begay, a pharmaceutical scientist at the University of New Mexico in Albuquerque and a member of the Navajo Nation's human-research review board. "In the past, our data have been misused."

Native Americans in the southwestern United States want to avoid repeating the experience of the region's Havasupai tribe. In 2004, the group sued Arizona State University in Tempe over alleged misuse of tribe members' blood samples. The Havasupai said that the samples, which had been collected for diabetes research, had later been used in studies of schizophrenia, migration and inbreeding without their consent. The university reached a settlement with the tribe in 2010, paying US$700,000 and returning the blood samples.

Sara Hull, a bioethicist at the US National Human Genome Research Institute in Bethesda, Maryland, says the case helped to change how researchers engage with the people they study, by raising awareness of the complexities of dealing with vulnerable minority populations. For Native Americans, privacy is a pressing concern. Science-funding agencies and journals often require researchers to put the genetic data they collect into public repositories, but the relatively small size of many tribes can make it easy to identify individual members in a genetic database. In recognition of this, the US National Institutes of Health sometimes works with researchers it funds to develop methods for sharing data on a minority group without compromising its privacy.

Garrison, who is helping the Navajo Nation to develop its new policy, says that the plan is likely to include rules on what types of research will be allowed, who will have access to tribe members' genetic material and information, and who will provide oversight. It is also likely to require that the tribe maintains ownership of its members' DNA samples and data.

The policy that the Navajo Nation ultimately produces could serve as a template for other Native American groups, says Ellen Clayton, a bioethicist at Vanderbilt University in Nashville, Tennessee. "If they reach an agreement, I think it will be influential." ■

FUNDING

Brazil's scientists plead to save funds

If budget levels do not increase soon, research institutions could start shutting down next year.

BY CLAUDIO ANGELO

Anxiety is growing in Brazil over the country's collapsing research budgets. President Michel Temer slashed funding for science by 44% in March and has proposed additional decreases for 2018 — even as some science institutes run out of money for basic needs, such as paying electricity bills. The 2017 science budget, at 3.2 billion reais (US$1 billion), is the lowest the country has seen in at least 12 years.

On 3 October, the government announced that it will release 440 million reais to science agencies to help keep them afloat until the end of this year. But that is only about 20% of what's needed, said the Brazilian Society for the Advancement of Science in a statement.

Researchers held a march on 8 October in São Paulo — the third such demonstration this year — protesting against the shortfalls. And in late September, 23 Nobel laureates and 9 of Brazil's scientific societies warned Temer that the ongoing funding uncertainties risk dismantling research groups and prompting a brain drain.

They hope to influence Temer's administration as it revises the 2018 budget proposal (see 'Drastic cuts'), which was submitted to Congress by the executive branch in August. It included a 16% cut to the Ministry of Science, Technology, Innovations and Communications (MCTIC). The Temer administration has promised to release a revised budget in the coming weeks.

If the 16% cut remains, it would leave about 2.7 billion reais for 22 federal laboratories, 73 National Science and Technology Institutes and Brazil's major science-funding agencies — the National Council for Scientific and Technological Development (CNPq) and the Funding Authority for Studies and Projects. "This means institutions will shut down by August next year," says Luiz Davidovich, president of the Brazilian Academy of Sciences.

His estimate is based on what happened this year. The MCTIC started 2017 with 5 billion reais. In March, after the 44% cut, the ministry was left with 2.8 billion reais, or 3.2 billion reais if money for special projects such as the Sirius synchrotron is included. As a result, institutions began running out of cash in September.

"We don't have money for electricity bills or

for buying radiopharmaceuticals," says José Augusto Perrotta at the federal Institute of Nuclear and Energy Research in São Paulo. Perrotta is coordinator of a multipurpose reactor that was supposed to receive 106 million reais this year, but got nothing.

The Brazilian Center for Physics Research in Rio de Janeiro isn't doing much better. "We'll be able to see it through December without lay-offs, but next year I'll have to cancel all equipment-maintenance contracts," says centre director Ronald Shellard.

Brazil's 1.6-billion-reais Sirius synchrotron is also in jeopardy. The facility's construction is still on schedule after the science minister unfroze 85 million reais this month, says Antonio José Roque da Silva, director of the Brazilian Synchrotron Light Laboratory in Campinas and head of the project. But Sirius needs an additional 331 million reais to be completed, which the proposed 2018 budget does not provide.

The biggest threat, however, is to CNPq. The funding agency has not paid out the grants it approved last year, did not launch its annual call for project proposals this year and is 400 million reais short of what it needs to honour its commitments in 2017. If the situation is not sorted, Marcelo Morales, a CNPq executive director, fears a repeat of 2016, when scholarships for undergraduates and scientists abroad were suspended.

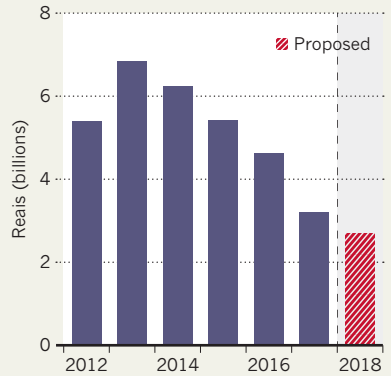
The continuing crisis is already driving away students and young scientists. Sergio Ferreira, a neuroscientist at the Federal University of Rio de Janeiro, runs a lab whose annual budget is now an average of 85,000 reais — one-tenth of what it used to be. This year, five of his graduate students spent six months abroad working with his collaborators because Ferreira couldn't afford materials for their research.

"In my group I have several people who have left or are about to leave for good, with no plans to come back," Ferreira says. "I can't keep a skeleton colony of students." ■

SOURCE: MCTIC

DRASTIC CUTS

The budget of the Brazilian Ministry of Science, Technology, Innovation and Communications (MCTIC) continues to fall.



L–R: MARIETTA SCHUPP/EMBL; JORG MEYER; LMB-MRC

From left: Jacques Dubochet, Joachim Frank and Richard Henderson developed cryo-electron microscopy.

AWARDS

Molecular-imaging pioneers scoop Nobel

Chemistry prize hails work on cryo-electron microscopy.

BY EWEN CALLAWAY

Three scientists whose work has helped researchers to see what biomolecules look like were awarded the 2017 Nobel Prize in Chemistry last week.

Jacques Dubochet, Joachim Frank and Richard Henderson received the prize on 4 October for their part in developing cryo-electron microscopy (cryo-EM), a technique that fires beams of electrons at proteins that have been frozen in solution, to deduce the biomolecules' structure.

For decades, biologists have used X-ray crystallography — blasting X-rays at crystallized proteins — to image biomolecular structures. But labs are now racing to adopt the cryo-EM method, because it can take pictures of proteins that can't easily be formed into large crystals. The tool has "moved biochemistry into a new era", said the Royal Swedish Academy of Sciences, which awards the prize.

In the 1970s, Henderson, a molecular biologist who works at the MRC Laboratory of Molecular Biology in Cambridge, UK, and his colleague Nigel Unwin were trying to determine the shape of a protein called bacteriorhodopsin. The molecule, which uses light energy to move protons across a cell membrane, was unsuitable for crystallography. So the researchers turned to electron microscopy and, in 1975, produced their first 3D model of it (R. Henderson and P. N. T. Unwin *Nature* **257,** 28–32; 1975).

During the same decade, Frank, a biophysicist who is now based at Columbia University in New York City, and his colleagues developed image-processing software to make sense of the fuzzy pictures that are produced when an electron microscope is aimed at a protein, and to convert these two-dimensional blurs into 3D molecular structures.

In the early 1980s, a team led by Dubochet, now an honorary professor at the University of Lausanne in Switzerland, worked out how to stop water-soluble biomolecules drying out in the vacuum of an electron microscope, allowing the molecules to retain their natural shape. His team found a way to flash-freeze solutions of proteins using liquid ethane, thus keeping the molecules relatively still when they were pummelled with electrons, and greatly improving the resolution of protein imaging. These and other improvements enabled Henderson to create the first atomic-resolution images of a protein using cryo-EM in 1990 (R. Henderson *et al. J. Mol. Biol.* **213,** 899–929; 1990).

Although the research recognized by the Nobel Committee was conducted in the 1970s and 1980s, it laid the groundwork for what many scientists have dubbed a revolution in recent years. Subsequent improvements in the sensitivity of electron microscopes and in software used to transform their images into 3D structures have caused many labs to favour the technique over X-ray crystallography.

"It's a great recognition for all the developments that have happened in the past. It's fantastic," says Sjors Scheres, a cryo-EM specialist who works alongside Henderson. "It's a well-deserved trio." ■