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.

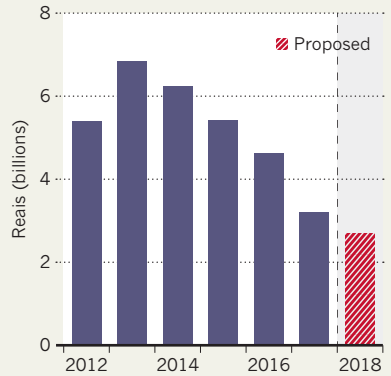
The continuing crisis is already driving away students and young scientists. Sergio Ferreira, a neuroscientist at the Federal University of Rio de Janeiro, runs a lab whose annual budget is now an average of 85,000 reais — one-tenth of what it used to be. This year, five of his graduate students spent 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." ■