

Using two diamonds, scientists squeezed hydrogen to pressures above those in Earth's core.

ature and extreme pressure, succeeding in part because they avoided continuous high-intensity laser monitoring that they say can also cause an anvil's diamonds to fail. Eventually, as they neared 500 GPa, the black sample became shiny and reddish. A low-intensity infrared laser—one that wouldn't risk stressing the diamonds—revealed a strong spike in the sample's reflectance, as expected from a metal. Only then did the Harvard pair use a different laser, in a procedure called Raman spectroscopy, to verify the peak pressure in the diamond cell.

Silvera and Dias concede that their reddish silver speck could be a liquid rather than a solid, and they have not dared to release it from their diamond-tipped vise. But they are confident it is a metal—a “very convincing” claim, says Neil Ashcroft, a Cornell University physicist who predicted the superconductive state of hydrogen nearly 50 years ago.

Eremets and others say they need more proof that the team has created a solid metal or even a metal at all. “We see only one experiment. It should be reproduced,” Eremets says. He also wonders whether the team actually reached the claimed 495 GPa, because that is usually determined through continuous Raman laser monitoring. Except for the final 495-GPa Raman measurement, Silvera and Dias were forced to estimate pressures from the number of turns of the screws on their anvils. Raymond Jeanloz, a high-pressure physicist at the University of California, Berkeley, also wants to be sure the trapped speck is pure hydrogen, because the gasket or the diamond coating could have broken down and reacted at high pressures. “It has fooled people in the past,” he says.

But Silvera remains steadfast. A comparison of reflectance measurements from the center of the hydrogen dot and the surrounding gasket at 495 GPa suggests the hydrogen in the sample is pure, he says. As for the pressure measurement, Silvera insists he and Dias have studied it closely and verified their calibration.

Silvera says they have just one experiment to report because they wanted to announce their result before running further tests that could break their vise. Soon, he says, they plan to run additional Raman laser tests that should reveal whether the sample has the regular atomic lattice expected of a solid metal. Eventually they will unscrew the vice and see whether the metal is metastable.

Then, they will begin the experiment again. Claiming total victory in the “hydrogen wars,” as Jeanloz calls them, will require another round or two of evidence. ■

PHOTO: POOL/NEW/REUTERS

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U.S. POLICY

The Trump era: 10 questions

New president confronts a host of science-related issues

By Jeffrey Mervis

President Donald Trump did not mention science in his inaugural address. That's the norm for recent presidents, although many researchers hold fond memories of Barack Obama's pledge in 2009 to “restore science to its rightful place.” Trump's closest reference was his comment that “we stand ready ... to unlock the mysteries of space, to free the Earth from the miseries of disease, and to harness the energies, industries, and technologies of tomorrow.” Now that the 45th president is on the job, here are 10 questions that loom for science as Trump's rhetoric confronts political realities.

Will Trump shape 2017 spending? He must decide whether to weigh in as Congress divvies up some \$1.1 trillion in discretionary

spending priorities. Will Trump follow his predecessors in devoting about 12% of discretionary spending to research? Will he call for deep cuts to climate and environmental science, and to renewable energy research, as some conservatives have long advocated? No president has ever gotten everything he wants, however, as Congress has the final say on spending.

Who will advise Trump on science? Trump has so far ignored pleas from science groups to speedily select a prominent researcher to be his science adviser. Assuming he staffs the position, will the adviser have direct access, or report through one of several emerging centers of power in the White House? And what will be the makeup of a blue ribbon science panel that has advised presidents since Dwight Eisenhower—Obama called his the President's Council of Advisors on Science and Technology—should Trump decide to name one?

Who will run science agencies? The real work of managing federal research falls not to Cabinet secretaries, but to dozens of less visible senior administrators. None has yet been appointed, although Trump last week asked NIH Director Francis Collins to stay on at least temporarily. Will they be eminent scientists, as were most

of Obama's choices? And if many hail from industry, as has been the pattern in Republican administrations, will they command the respect of the scientific establishment?

Will Trump's infrastructure plan include science? Trump is pushing for massive spending to rebuild the country's transportation infrastructure. Many scientists and some lawmakers have a broader vision that includes advanced computing facilities. But this big-ticket item clashes with demands from many Republicans to reduce the deficit, and its fate is uncertain.



Scientists are anxiously awaiting President Donald Trump's policies.

spending for the 2017 fiscal year that began last October. (Current agency spending is frozen at 2016 levels through April.) The details matter; a multibillion-dollar boost for the National Institutes of Health (NIH) is in the mix, for example. Trump could also signal support for controversial policy riders that would bar agencies from enforcing environmental rules.

How will science fare in Trump's first budget? Trump is reportedly planning to unveil the outlines of his 2018 budget request next month, with details to follow in May. That will be the first real description of his

Will Obama's science initiatives survive?

Obama tried to tackle a range of societal problems with multiagency initiatives that included major research components. They included efforts to prepare communities to adapt to climate change, the cancer moonshot, research on precision medicine and the brain, a network of advanced manufacturing institutes to recapture industrial dominance, and public-private partnerships to improve science and math education. Many had bipartisan support, but it's not clear what Trump thinks.

Whither space exploration? Space was never a front-burner issue for Obama. Does Trump have a more muscular vision? Is "unlocking the mysteries of space" a tacit endorsement of what some influential Republicans hope will be a costly robotic mission to find life on a watery moon of Jupiter? Does it presage astronauts returning to the moon? And what will be Trump's stance on commercial space ventures?

Will the United States remain in ITER? The United States is one of seven partners building ITER, a fusion research reactor in France. It is a testbed for what someday could become an important source of power. But ITER is almost comically overbudget and behind schedule, and some lawmakers want the United States to withdraw, in part because ITER spending threatens domestic fusion research programs. Trump's views could be decisive.

Will statistical agencies be targets? Federal statistics move the U.S. economy, providing data that governments and companies use in deciding how to invest trillions of dollars. One example is the American Community Survey (ACS), a 72-question annual survey on employment, schooling, housing, and other topics that is an extension of the decennial census. But many congressional Republicans think the ACS is intrusive and unnecessary, and would like to shrink it and make it voluntary. Will a Trump administration support these and other attacks on the work of the 13 federal statistical agencies?

How deep a regulatory rollback? Trump says he wants to cancel two federal regulations for every new one. And he has signaled support for efforts in Congress to cancel up to a dozen major rules issued late in Obama's tenure, including rules that seek to reduce methane emissions from oil and gas operations and protect streams from coal mining. But erasing other Obama-era environmental and health rules could take years and likely require winning in court. ■



Students and teachers protest parlous conditions at Rio de Janeiro State University.

SCIENTIFIC COMMUNITY

Brazil's 'doomsday' scenario

Grants in Rio go unpaid as science coffers are raided

By **Herton Escobar**

Two years ago, Fernanda De Felice was at the top of her game. The biochemist at the Federal University of Rio de Janeiro (UFRJ) was developing a nonhuman primate model for Alzheimer's disease and publishing in top journals. But since then, a state budget crisis has cut off all public funding for her work. In March, De Felice will decamp to Canada for a 2-year stint at Queen's University in Kingston. "Staying in Brazil would mean the end of my career," she says.

Thousands of other scientists in the state of Rio de Janeiro, which includes Rio, Brazil's second biggest city, and many key research institutions, face a similar struggle. Declining federal support for science had sapped funds for scholarships and lab infrastructure (*Science*, 28 August 2015, p. 909). Now, Rio de Janeiro's funding agency, FAPERJ, is bankrupt. It has fallen \$150 million behind on grant payments, and over 2 years has been unable to fund 3670 research projects. Science funding faces similar threats in other states.

A massive brain drain is a real risk. "I know a lot of people who want to leave," says Stevens Rehen, a stem cell researcher at UFRJ and the D'Or Institute for Research and Education. FAPERJ owes him more than \$475,000. Rehen has kept his lab running on cash accumulated before 2015, and his team has published several papers in recent months. However, he says, "We've burned all the fat that we had left."

The federal government still pays salaries at

UFRJ, but at state universities, employees—including some 3000 researchers—just received their November 2016 salaries. Professor resignations are on the rise at Rio de Janeiro State University in Rio, which FAPERJ owes \$20 million in research funds, says Vice Chancellor Egberto Moura.

There is little FAPERJ can do but watch the trainwreck unfold. The agency by law had been entitled to 2% of state tax revenues until last month, when Rio de Janeiro's governor signed a decree slashing FAPERJ's allotment by 30%, to 1.36% of projected revenues. "We hope this will be a temporary situation," says FAPERJ Scientific Director Jerson Silva in Rio.

Red flags are also up in neighboring São Paulo state, where the legislature last month for the first time signaled it won't fulfill the lawful budget allotment of its state science agency, FAPESP. Entitled to 1% of state tax revenues, FAPESP will get 0.89% of projected revenues in 2017—a reduction of \$35 million. FAPESP is attempting to negotiate a reprieve.

The plight of Brazilian scientists "is exactly as bad as it sounds," says Suzanaerculano-Houzel, a neuroscientist who left UFRJ for Vanderbilt University in Nashville last May, and urged others to follow. Some colleagues, she says, resented her doomsday attitude and labeled her a deserter. But she stands by her exhortation: "We have to be honest, and tell people they should leave if they can." ■

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