

# AFTER THE FLAMES

*Nearly a year after Brazil's biggest natural-history museum burnt down, researchers are struggling to revive their work and resume their lives.*

BY EMILIANO RODRÍGUEZ MEGA

The fire had already chewed up the front half of Brazil's National Museum in Rio de Janeiro by the time zoologist Paulo Buckup drove up. The blaze was surging into the rest of the museum as firefighters stood by looking helpless. "Then I realized why," says Buckup. "They had no water." The two hydrants next to the museum were dry, and engines had to race to a nearby lake to fill up. Buckup knew that the museum's precious collections wouldn't last long.

On the night of 2 September 2018, he and around 40 other scientists, administrators and volunteers checked their fear and broke into the burning building — forming human chains to rescue specimens, computers, freezers and microscopes.

Inside, the museum felt surreal. The only

light in the building came from the progressing fire. Buckup rushed through the dark hallways into the inner courtyard, where a lone firefighter tried in vain to extinguish the flames consuming the top floors. The courtyard echoed with loud cracks, and shards of glass rained down, while "a tornado of smoke" erupted out of some interior windows.

Buckup didn't know it yet, but he was witnessing the biggest scientific tragedy ever recorded in Brazil. Soon, hundreds of years of natural history would turn to ash — including much of the nation's most prized records of its past. The fire claimed tens of thousands of the museum's 20 million fossils, animal specimens, mummies and Indigenous artefacts, including recordings of chants in native languages that are no longer spoken. More than two-thirds of the 90 resident researchers lost all of their work and belongings.

Classes for the museum's graduate students resumed a few days later in one of the annex buildings, and admission exams for new students happened on schedule in November. But ten months after the fire, the research community is still struggling to recover. Many scientists have had to shift research topics entirely — often as visitors at institutions in other countries. Buckup and other researchers whose laboratories did not burn have taken in colleagues seeking space for their students and any surviving specimens. And some have begun the painstaking process of restarting collections that had taken two centuries to build. Together, these scientists are trying to revive what once was one of Latin America's largest science collections.

Brazilian researchers are no strangers to this type of misfortune. Fires have consumed



**Maria Elizabeth Zucolotto with a massive meteorite that survived the fire.**

message at 7:55 p.m. alerted him to the fire raging at the museum.

He scrolled through his social-media feeds, where people were already posting pictures, and felt strangely relieved by what he saw.

The fire was ripping through the museum's main building, but had not reached the botanical gardens to the south. That area houses a series of buildings, including the herbarium, the library, the archaeology laboratory and the vertebrate department in which Buckup has worked for 25 years. The department's archive of 600,000 fish specimens floating in yellow-tinged alcohol was the only thing keeping him in Rio de Janeiro, an expensive city known for its rampant violence and poor infrastructure. The fish collection would remain untouched by the fire.

Buckup jumped into his SUV and drove. When he got within a kilometre of the museum, he started to see flames. "The sky was full of sparks."

At around 8:40 p.m., he and others decided to kick open a door to enter the rear part of the museum, which had not yet caught fire. They started removing what they could from the teaching department. Another group went to the crustacean laboratory to recover materials. As the blaze slowly ate its way towards them, a technician from the mollusc collection, Claudio Costa, asked Buckup to help him retrieve the precious type specimens — those that serve as the basis for describing new species.

That night, Buckup and Costa carried drawers full of preserved snails, clams and other molluscs to safety. In total, they rescued 760 boxes and vials, including all 664 that contained the type specimens. But they couldn't continue. By around 10 p.m., pieces of burning wood were falling on the volunteers, driving them from the building.

For researchers and students, the museum was more than a workplace, and its destruction has left them reeling. In the competitive world of academia, scientists tend to hide their emotions, says Buckup, but that is no longer true at the museum. Since last September, Buckup has found students and senior colleagues — researchers "that you think you'll never see lowering their defences" — crying. "The tears from all those people are still more disturbing to me than the tragedy itself," says Buckup, who sometimes pauses his story to stop his voice from breaking.

Before the fire, months would go by without him running into researchers from other departments. The building was so massive that they could immerse themselves in their work. Now, nine professors have taken refuge in the ichthyology section. "They lost everything — even their birth certificates," he says.

Palaeontologist Antonio Carlos Fernandes knows the feeling. He spent more than

40 years studying the fossils of corals and other invertebrates, and has continued working as a volunteer researcher at the museum since retiring in 2016. But when a century-old skeleton of a humpback whale fell through the ceiling and into his office during the fire, he lost most of his research materials. Fernandes still finds himself "wanting to believe it was all just a big nightmare". But he has no plans to abandon his work. "Once a researcher, always a researcher," he says.

That's a common sentiment. Members of the entomology department have started to replace their destroyed collections by retrieving some of the specimens that were loaned to other institutions. They have also received generous donations from collectors, and have begun venturing into the Amazon and other regions around Brazil to collect fresh samples. But it will be a challenge to resurrect an inventory that once totalled some 5 million insects — not least because many of the forests that yielded those specimens have since been transformed into farmlands and cities, says museum entomologist Pedro Souza-Dias. "We don't know if we'll find them again."

He has organized six expeditions to the Amazon, Paraná and nature reserves in Rio de Janeiro in the hope of adding more crickets, grasshoppers, mantises and stick insects to the recovering collection. The newly amassed invertebrates are now temporary residents in the already cramped vertebrate department. "We are not in our best conditions right now, but we are fighting," says Souza-Dias. "We don't have another option."

## NORTHERN REFUGE

After the fire, Thaynara Pacheco had trouble sleeping. The entomologist was haunted by a burning smell and by the fear that her apartment, like the insect collection, had caught fire. In March, she traded the odour of smoke for the fumes of naphthalene preservative, when she took a fellowship at the Smithsonian National Museum of Natural History (NMNH) in Washington DC.

On a day last March, Pacheco opens a wooden box and reveals hundreds of tiny beetles pinned in place. They belong to the Sericini tribe, which she's trying to catalogue. She brought them all the way from her home state, where they are part of the collection of the Federal University of Mato Grosso in Cuiabá. Others are from Nebraska and Florida. And more will come from California and Canada. Surrounded by trays full of insects, Pacheco removes her glasses to peer into a microscope. Up close, a glossy wing cover adorns the greenish-brown body of a beetle. "That's the beautiful one," she says.

A PhD student from the UFRJ and the National Museum's graduate programme, Pacheco is one of 14 fellows selected to continue their studies at Smithsonian institutions

at least four other science museums and research centres there over the past ten years; and scientists worry that other natural-history collections are also at risk — thanks to a combination of ageing buildings and budget cuts that have put off essential renovations for years.

Many had warned that a similar fate would befall the National Museum, which was established in 1818. "The museum in Rio was a matchbox," says population geneticist Kelly Zamudio at Cornell University in Ithaca, New York, who grew up in São Paulo and typically travels to collections around Brazil for her research. "It was just waiting to happen."

## A NIGHT ABLAZE

Buckup, a fish scientist at the Federal University of Rio de Janeiro (UFRJ), was in the middle of writing a grant proposal when an urgent voice

through a US\$250,000 emergency exchange programme. “It gives them a boost, I think,” says NMNH ichthyologist Lynne Parenti, who coordinates the programme.

For Pacheco, that meant completely changing her thesis project. Back in Rio de Janeiro, she had been reviewing the taxonomy of Chelonariidae, or turtle beetles, a little-studied family of almost 300 species. But her notebooks, sketches and more than 1,500 specimens from the National Museum and other institutions disappeared in the fire. “It was a general sense of grief, you know? Like losing someone very dear,” she says.

To continue her new project, Pacheco needs to visit the Zoological Research Museum Alexander Koenig in Bonn, Germany, which houses most of the type specimens for the Sericini tribe. But first she intends to take a step to memorialize the National Museum — by getting a tattoo of the logo of her destroyed lab, or maybe even one of the turtle beetles she used to study.

She’s not the only one. Beatriz Hörmanseder, another NMNH fellow, says that getting inked has helped others to cope with the trauma of the fire. Museu na Pele, or Museum on the Skin, is a project she conceived with a Brazilian tattoo artist, Luís Berbert, to give professors, officials and students a free and indelible memory of their institution. A group of 140 people, including some needle-phobes, have already signed up. “When I started Museu na Pele, everybody was smiling more. They talked about their tattoo, not about their loss,” says Hörmanseder, rolling up her left sleeve. The outline of the museum’s façade drawn in black ink runs across her forearm. Below it is a code, MN 7712-V.

That’s the catalogue number belonging to a 110-million-year-old dwarf crocodile-like reptile unearthed in Brazil’s northeastern state of Ceará. For some two years, Hörmanseder had been painstakingly extricating it from the

rock with acid, brushes and dental picks at the National Museum. She suspected the opossum-size creature was an unnamed species — or at least evidence that a previously identified extinct genus had survived 10 million years longer than scientists had thought. “It was a big deal for me,” she says. But the Ceará fossil didn’t make it out of the fire.

She is now completing her studies by describing a fossilized crocodile from Utah. It’s a huge switch in focus in terms of evolution. The Utah fossil is much younger, 35 million years old. By that time, crocodiles lived in rivers, swamps and marshes — unlike their earlier relatives, which were strictly marine or terrestrial.

That is why Hörmanseder, who is set to graduate next year, has been trying to learn about groups of crocodiles she had never studied before. During her four-week Smithsonian fellowship last March, she toured three natural-history museums in the United States in search of ancient specimens she could compare against the Utah crocodile.

“It’s kind of suffocating to have so little time and begin from zero,” she says. But she thinks her endeavour will pay off. Having studied all kinds of prehistoric crocodiles will be of help when she starts her doctorate degree elsewhere, in North America or Germany. “I’ll know everything from all around the world,” she says, and bursts out laughing.

#### OUT OF THE ASH

Early in the morning after the fire, while an avalanche of reporters interviewed her colleagues, UFRJ astronomer Maria Elizabeth Zucolotto entered the museum’s ruins.

When she walked into the main entrance, she saw nothing but the Bendegó, a colossal 5,360-kilogram iron meteorite discovered in 1784 in northeast Brazil. The space rock had been barely licked by the flames: “A symbol of resistance,” says Zucolotto, curator of the

museum’s meteorite collection.

Next door, however, the heat had cremated an exhibition of other prized meteorites. Zucolotto went inside, got down on her knees and blindly ran her hands through the ashes that once were display cases. By touch, she found some smaller meteorites, grabbed them and filled her arms with them. But the firefighters didn’t let her stay long. Plaster was still falling from above.

Those fragments from space were among the first objects to be recovered from the National Museum.

On 18 October, more than a month later, the police allowed Zucolotto to return to her old office. Twisted iron beams and cabinets from the upper floors had crashed into the room. That day, she rescued more meteorites, including one called Angra dos Reis, which is valued at \$750,000. It was the second time she had recovered the same rock. The first time was in 1997, after police had seized it from two US dealers who had stolen it from the National Museum and replaced it with a fake.

Zucolotto isn’t the only one sifting through the wreckage. On most days, dozens of trained researchers, armed with brushes and trowels, go through the museum’s debris in search of artefacts. Stationed outside, students sieve the dirt through mesh screens, then clean dusty items and photograph them.

“Incredible as it may seem, we’ve had many happy moments,” says palaeontologist Luciana Carvalho, co-coordinator of the team of nearly 70 people. By the end of June, they had recovered 5,345 objects — pterosaur fossils, ancient human bones, coffee mugs, microscopes, full specimen drawers, Egyptian relics and ceramics from the Amazon.

The effort has taken a physical and emotional toll, says Zucolotto. Some days, she hopes the government will rebuild the museum quickly so she can go back, but she also thinks about retiring and finding a successor to care for the surviving meteorites. In the past few months, she has found joy in adopting a bearded grey dog that had emerged hungry and cheerful around the museum in the days following the fire. “He loves me so much,” she says. “I can’t get rid of him.” Researchers named him Fumaça, or Smoke.

#### A FIRE FORETOLD

The accident last September is only the latest in a long line of fires that have plagued scientific institutions in Brazil. In May 2010, an inferno destroyed the zoological collection of the Butantan Institute in São Paulo — a research powerhouse responsible for most of the venom antisera and vaccines produced in the country. The centre held the largest repository of snakes that Latin America had ever seen, about 90,000 specimens, representing hundreds of species, some endangered or extinct.

“Most of that is now gone,” says Miguel Trefaut Rodrigues, a herpetologist at the University of São Paulo who worked at Butantan as



Students comb through ash to recover specimens and other objects.



Zoologists Paulo Buckup and Alexandre Pimenta (left) examine mollusc specimens that were saved from the fire, which singed some description labels (right).

a wide-eyed 16-year-old trainee in the 1970s. Although Butantan constructed a new building with fire-prevention systems three years later, the institution never fully recovered. Today, its snake bank houses only 24,000 specimens.

When that institute burnt down, Trefaut Rodrigues and a colleague published a column in a national newspaper warning that something like this could happen again because of the poor state of many of the country's museum buildings. "May this tragedy serve as a lesson," they wrote. They begged the government to take care of other biological facilities, and then listed the ones they thought were most at risk — including the National Museum.

One cause for concern in the future is the Museum of Zoology of the University of São Paulo (MZUSP) and its 10 million specimens. In the early 2000s, when Trefaut Rodrigues was about to step down as the museum's director, he pushed to transfer the collections from the 1940s-era building into a larger, more modern complex. The project was approved, and construction began in 2012, but the economic crisis in 2014 halted work. Today, the new venue exists only as a concrete skeleton.

"The university budget now is not enough to finish that thing by any means," says ichthyologist Mario de Pinna, the MZUSP's current director. Still, the museum is taking measures big and small to minimize the danger — from placing heat detectors in all its collections to confiscating coffee machines that represent a risk. "I think we're doing well," says Pinna. "Of course, you know, shit happens. Let's hope it doesn't happen here."

The National Museum had been on a downward spiral for decades, according to museum staff. Critics say that the government ignored many requests over the years to renovate and modernize the facilities. And the

financial troubles have only grown. The university's budget, one of the main sources of funding for the museum, has shrunk significantly — from 487 million reais (US\$130 million) in 2014, adjusted for inflation, to 361 million reais in 2019. According to the UFRJ, the National Museum was not given enough funds to preserve its collections (see 'Missing money'). "It's not for lack of asking," says Zamudio. "This is the federal government failing science again. They don't want to invest the money. The money, even if it gets appropriated, ends up not reaching the place it should be reaching."

Brazil's Ministry of Education did not respond to *Nature's* requests to address these criticisms, but did say that it had allocated more than 11 million reais to the National Museum since the fire for response efforts. The ministry also transferred 5 million reais

to support reconstruction of the museum.

But researchers wonder how long the government's commitments will continue. Authorities did not take adequate measures to protect scientific collections in Brazil after the Butantan fire, says Francisco Franco, a biologist and former curator of the institute. "As the flames of the fire cooled down, so did the attention of the government," he says. He now fears something similar could happen with the National Museum. "We must not forget."

Buckup never will. One night in March, the museum was at the front of his mind when he joined some of Brazil's most famous personalities, who were being celebrated by the Brazilian newspaper *O Globo* and Rio de Janeiro's industry federation for having "made a difference" in 2018. Buckup went up on stage to accept the honour for his efforts rescuing specimens was not a triumphal speech. "I see no reason to celebrate," he said as he urged the crowd to support the National Museum. "We've lost a part of the past. We can't lose our future."

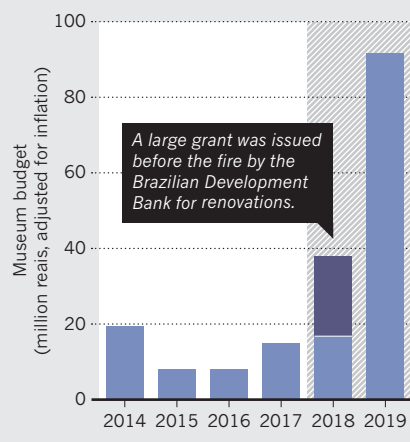
The forecast isn't good. Even before the museum burnt down, Buckup was losing post-docs and research assistants because of funding cuts. Most moved out of the city; at least one left the country. At the fish collection he curates, even basic maintenance has languished. Buckup says the phones stopped functioning long ago, and Internet access goes down for weeks at a time. What's more, the specimens are preserved at inappropriate temperatures, he says, because the air conditioning remains unfixed.

Another problem worries him, too. Despite numerous requests for maintenance, he says, "the fire protection system is not working". ■

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## MISSING MONEY

Critics charge that lack of government support for Brazil's National Museum contributed to the fire risk. Government funding dropped after 2014 — and then surged after the disastrous fire.



**CORRECTION**

The News Feature 'After the flames' (*Nature* **571**, 312–315; 2019) incorrectly stated that Francisco Franco is still a curator at the Butantan Institute.