

PANAMA'S BIG AMBITION

Researchers in Panama suffered under a dictatorship and were overshadowed by the United States. Now the country is attempting a scientific renaissance.

BY REX DALTON

When Carmenza Spadafora Mejía left Panama in 1997, she walked away from a bloody history. In 1985, her brother Hugo had been decapitated by henchmen of the military dictator Manuel Noriega, after Hugo publicly denounced him. For years, Spadafora and her family fought to identify the killers. But the brutal murder helped to spark an uprising that culminated in a US invasion and the imprisonment of Noriega in 1990. After her family won convictions against some of those responsible for the murder, Spadafora felt ready to leave to start a PhD in Spain.

Since 2008, when Spadafora returned to Panama, life for her and her country has been on the up. Now with a US postdoctoral position in infectious diseases under her belt, Spadafora coordinates a cellular and molecular biology centre at INDICASAT-AIP (the Institute of Scientific Advances and High-Technology Services) in Panama City. Last June, she and her colleagues revealed a long-sought receptor that the malaria parasite *Plasmodium falciparum* uses to invade red blood cells¹, a discovery that could help development of vaccines. A few months later, they won a US\$1-million grant from the Bill & Melinda Gates Foundation in Seattle, Washington, for a scheme that Spadafora concedes may sound outlandish: developing a full-body microwave scanner to cure malaria by killing the parasite. With developments such as these, “we are showing we can compete with anyone worldwide”, she says.

And that is exactly what the Panamanian government wants to do. The country is one of many in Central America that have struggled under dictatorship and political turmoil in the past few decades. Now it is the first to make a significant investment in science part of its recovery, thanks mainly to its past two democratically elected governments, which have seen research as a route to economic growth. “Science and technology are key components for competitiveness,” says Rubén Berrocal Timmons, Panama’s science secretary, adding that he wants to make Panama “an international scientific hub”. To that end, the country’s leaders are intent on increasing investment in science and technology from less than 0.2% of the gross domestic product, as it was in the mid-2000s, to 0.6% by 2014.

The investment is already in evidence. In March, ground is to be broken on a \$20-million science and technology innovation park near Panama City; construction of a \$5-million vivarium for the country’s research animals is planned for this spring; the government is funding

about 100 Panamanians to undertake doctoral studies at universities abroad, with incentives to return to Panama for research careers; and the first complete in-country PhD research programme — in biotechnology — has just begun at INDICASAT-AIP. Observers say that the country’s efforts at a scientific renaissance could even serve as a model for other nations seeking new life after conflicts.

The change in Panamanian science amazes some, including Ira Rubinoff, who led the US Smithsonian Tropical Research Institute in Panama for 34 years until 2008. “If you told me this would happen 25 years ago, I would say you were smoking something illicit,” he says.

BUILDING AN IDENTITY

Panama is inextricably associated with its canal, which bridges the Atlantic and Pacific oceans. It was built at the start of the twentieth century by the US Army Corps of Engineers, which had to battle malaria and yellow fever to complete its task (see ‘A century in Central America’). Ever since, Panama’s research community has lived in the shadow of the United States, which — in governing the canal — virtually militarily occupied the nation until 1999, when Panama won full control of the waterway under a controversial 1977 US treaty.

During much of the twentieth century, Panama was a US laboratory of sorts for secret military research on mustard and nerve gas, dioxin and depleted-uranium weapons. But after the Second World War, the US presence also allowed the blossoming of the Smithsonian Tropical Research Institute, a branch of the Smithsonian Institution in Washington DC and now a world-class ecological research facility.

Panama’s push to build its own science began with former President Martín Torrijos Espino, who took power in 2004 and saw science as a way to forge a new era independent of the United States. He named Julio Escobar Villarrue, a computer scientist trained at Massachusetts Institute of Technology in Cambridge, as science minister. Escobar’s team initiated a grant programme that awarded at least \$15 million during his 5-year term, provided scholarships for several hundred graduate students to study abroad, and established a system that rewards well-published researchers with stipends worth \$1,000–\$2,000 per month. “He turned things around,” says Rubinoff. Spadafora agrees. “He is awesome,” she says. “He called me to say we are building a new enterprise, please come back.”

CONTRASTO/EYEVINE

L TO R: CORBIS; NEWSCOM; B. GENTILE/CORBIS; K. CALVO/AP; A. FRANCO/AP

A century in Central America

1910
Smithsonian Institution starts Biological Survey of Panama, a major inventory of flora and fauna

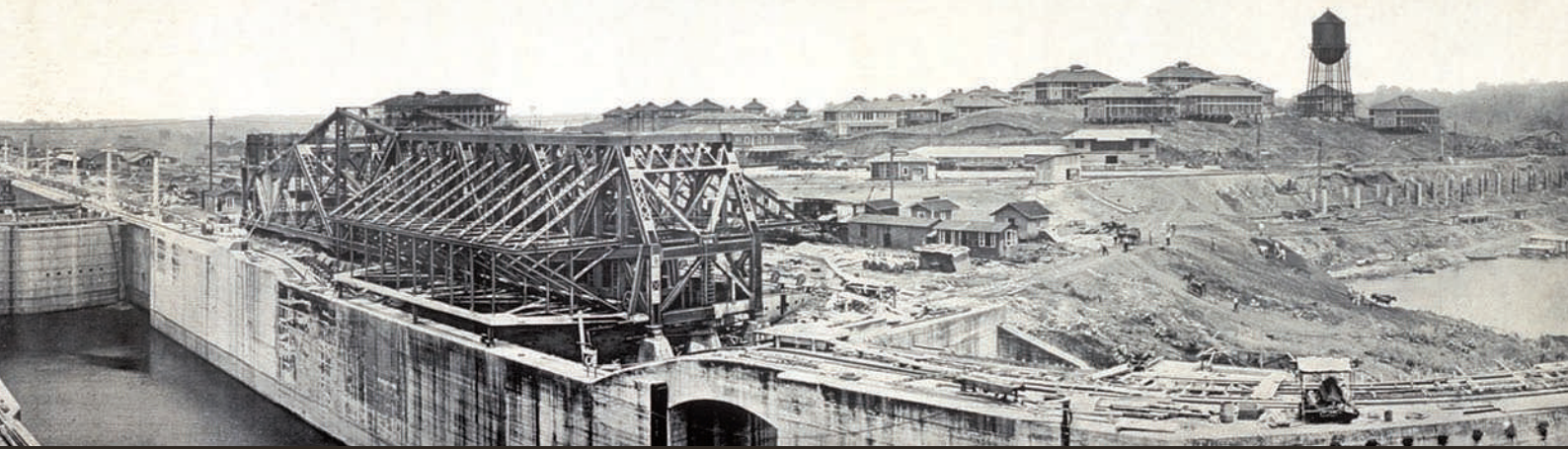
1914
US-financed Panama Canal completed



1923
A field station starts up on Barro Colorado island; it later becomes the Smithsonian Tropical Research Institute



1977
US Senate approves treaty deciding canal to Panama



Construction of the Panama Canal — a huge engineering feat — created a vital shipping shortcut. Canal tolls still help to support the country's economy.

She did — and now can be found in her modern lab in the ‘City of Knowledge’, a former US military base at the Pacific canal entrance that the government is converting into a research centre, housing INDICASAT-AIP and other new agencies. The historic military buildings have been gutted and turned into labs, offices and a conference centre. The new science park and vivarium will be located there.

Spadafora bubbles with excitement when talking about her ‘ray-gun’ idea for curing malaria, devised during a brainstorming session with fellow Panamanian José Stoute Zuriea, a physician at Pennsylvania State University in Hershey. *P. falciparum* invades red blood cells and digests their haemoglobin, then sequesters the iron-rich, toxic remnants in a crystal form called haemozoin. Their idea was to heat these crystals with low-frequency microwaves, fatally releasing their contents.

After the pair won an initial \$100,000 grant from the Gates Foundation in 2009, they demonstrated that the concept would work. They exposed infected red blood cells from mice to 2.45-gigahertz microwaves for four minutes, and showed that the crystals dissolved, killing *P. falciparum* but not the host cells. Now, armed with the new \$1-million Gates grant, the researchers plan to create a mouse-sized microwave device to radiate infected animals.

Meanwhile, the science drive started by the Torrijos administration continued with the 2009 election of President Ricardo Martinelli Berrocal and the appointment of Rubén Berrocal Timmons, his cousin. The Martinelli administration also appointed a new head of INDICASAT-AIP: Jagannatha Rao, a neuroscientist who arrived in summer 2010 from a national lab at India’s Council of Scientific and Industrial Research in New Delhi. In Rao, Panama has found a tireless advocate for his adopted nation’s scientific community.

Last year, Berrocal and Rao visited Singapore to learn about the country’s major science push of recent years. Rao is now initiating a steady stream of conferences featuring international participants, and he has been adding programmes to INDICASAT-AIP’s portfolio, including the country’s new biotechnology PhD. “Students must have three publications before they can graduate,” says Rao. One of Berrocal’s aims is to build up modern labs and recruit high-quality scientists, creating a thriving research atmosphere that can avert a brain drain of new doctorates. “We don’t want to lose these people,” he says.

Paul Collier, an economist who studies capacity building at the University of Oxford, UK, says that Panama’s science drive “sounds

very positive”. The challenge, he says, is “to concentrate resources in a niche — then be the quality escalator in that niche”. Panama wants its niche to be biotechnology, with a focus on infectious diseases and bioprospecting — the search for drugs developed from its own rich natural resources. (Its neighbour, Costa Rica, has taken a similar tack².) Rao is organizing a drug-discovery meeting in May, which will include discussions of Panama’s plans for a Bioprospecting Natural Product Bank, a resource for screening that already includes 8,000 samples of marine bacteria and fungi.

The drive in biomedicine is evident across Panama City. At Hospital Santo Tomás in the city’s centre, researchers aim to collaborate with pharmaceutical firms on clinical trials, says Juan Miguel Pascale Bellagamba, a physician who directs programmes at the Gorgas Memorial Institute of Health Studies and Columbus University of Medicine and Science. Pascale is one of several researchers who also want to boost the country’s

ability to track and respond to outbreaks of infectious disease or to other public-health concerns.

If there is one thing that might slow down these plans, Panamanians say, it is a lingering resistance to recruiting researchers born outside the country. Few seem concerned that the research investment could dry up; as long as ships continue to traverse the Panama Canal, the country’s major revenue source will flow. A \$5.25-billion project for larger locks on the canal, which will markedly increase its capacity, is set for completion in 2014. (Excavations for new locks proved a boon for palaeontologists, who unearthed fossils of camels, horses,

rhinos and pigs³ that are helping them to understand animal migrations between the North and South American continents.)

Looking back at the Noriega era, Spadafora and Stoute both recall with sadness the country’s lost opportunities. After her brother’s death, Spadafora chained herself to the Vatican embassy in protest. Stoute, too, was traumatized. “I lost many friends,” he says.

Things are better now, they agree, even if many outside the country are not yet aware of it. “Our US colleagues have told us we’re pretty wild down here,” says Spadafora. But if Panama can emerge from the depths of tyranny, maybe a wild idea to fight malaria can emerge here too. ■

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1. Spadafora, C. et al. *PLoS Pathog.* **6**, e1000968 (2010).
2. Dalton, R. *Nature* **441**, 567–569 (2006).
3. Macfadden, B. J. et al. *J. Paleont.* **84**, 288–298 (2010).

1989–90



United States invades Panama and imprisons dictator Manuel Noriega

1999



Panama assumes full control of canal

2004

President Martin Torrijos Espino is elected, and starts to promote research

2009



Ricardo Martinelli Berrocal assumes presidency, continuing science investment