¿Vive la revolución?

Cuba's socialist science policies are producing top-notch research from scant economic resources. But, as **Jim Giles** reports, they have harsh consequences for scientists who do not fit in with government priorities.

It's mid-afternoon in Havana's cavernous convention centre, and Cuba's leading scientists are extolling the virtues of the revolution. Cuba's vaccine programme, says one speaker, is the fruit of socialism. Another tells us that the revolutionary leaders have saved the country's environment. Behind him, and not for the first time this afternoon, the giant screen is filled with an image of the commander-in-chief, the bearded one: Fidel Castro.

It's classic propaganda, of course. But this impoverished Caribbean nation does punch above its weight in science, boasting achievements such as the world's only effective vaccine against meningitis B. Despite suffering decades of crippling US sanctions (see 'Neighbourhood dispute', overleaf), and an economic meltdown since the collapse of the Soviet Union, Cuba has achieved first-world levels of education and trained a skilled scientific workforce. But it has done so while restricting the ability of scientists to work in other countries — a freedom that academics in many other nations take for granted.

For an outsider, it is a strange and confusing environment. "You'll never understand Cuba," jokes William Edmundson, director of the British Council in Havana, who has organized numerous UK–Cuban science exchange programmes. "I'm much more relaxed now that I've given up trying."

But after spending a week visiting the country's research institutes, the logic that underpins Cuban science begins to fall into place. Government-funded science is more like a corporate research programme than an academic pursuit; scientists' individual interests are subservient to goals determined from above. But instead of being driven by profits, these goals are set according to the social priorities of Castro's revolutionary government. With Cuba's economy in desperate trouble, this approach has increasingly concentrated resources on applied biomedical, environmental and agricultural projects,

IMAGE
UNAVAILABLE
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REASONS

leaving basic research out in the cold.

Cuba's science model has its roots in the 1959 revolution. Over the 30 years that followed, Castro built strong links with the Soviet bloc, sending young researchers to the Soviet Union for training. But unlike Soviet science, which had a strong bias towards projects that strengthened the military-industrial complex, Cuba focused on health and social benefits. "We combined applied and basic research, but all of it was for the good of society," says Pedro Valdés Sosa of the Cuban Neuroscience Center in Havana, who helped to establish the country's first brain research lab in 1970.

Dire straits

When the Soviet Union collapsed in 1991, Cuban science reached a crunch point. Cuba suddenly lost its biggest trading partner and source of economic aid. During the 'special period' — the government's euphemistic term for the country's crisis during the early nineties — about a third was sliced off the nation's gross domestic product (GDP).

Rather than letting all Cuba's labs suffer equally, Castro's government chose to continue investing in applied research projects, while effectively allowing basic research to wither on the vine. Money continued to flow into the Western Havana Scientific Pole — a leafy suburb that is home to 50 or so mostly applied research centres and their industrial offshoots. Official statistics are hard to come by, but around US\$1 billion is thought to have been invested in the Scientific Pole during the 1990s. It was to celebrate the fortieth birthday of one of the pole's institutes, the National Center for Scientific Research, that the convention-centre conference was organized.

The Scientific Pole can claim some impressive biomedical achievements: in addition to the meningitis B vaccine, it has produced a cancer vaccine that, despite considerable opposition from anti-Castro politicians, has been licensed for use in the United States. And about two dozen foreign drugs firms are considering exploiting other Cuban products, says George Morris, chief operating director of the London-based Beckpharma, which commercializes drugs developed in academic institutes. Not bad for a nation whose GDP per capita is around a tenth of the European average, and where scientists earn just a few hundred dollars a month.

Standing in a muddy field in wellington boots and a grubby sleeveless top, Osvaldo Franchi-Alfaro Roque embodies another Cuban enterprise that is attracting foreign interest. Although agricultural research hasn't enjoyed the same high-tech success as biomedical research, it is noted for its innovation and environmental friendliness — both enforced through economic necessity. Franchi collaborates extensively with the University of Agriculture of Havana, and his farm in San José is like an open-air inventor's workshop: his device to control irrigation flows, built mainly from a

Green glade: ecotourists and a forestry project provide income for people living in Las Terrazas reserve.

plastic bottle and parts scavenged from old cars, has been adopted by farmers across Cuba and neighbouring countries. A large tank next to his avocado trees contains homemade organic pesticide — a mixture of water and local natural products, including seeds from the neem tree (*Azadirachta indica*).

This make-do-and-mend approach is a Cuban tradition, but became vital during the special period. Franchi and other small farmers were forced to experiment with organic pesticides and fertilizers, thanks to the collapse of agrochemical imports from the Soviet Union, and the continuing US trade embargo.

Such small-scale and organic local production is now attracting the interest of some US researchers, who are keen to explore environmentally friendly alternatives to industrial farming. "I take my students to Cuba because of the contrast with US agricultural systems," says Catherine Badgley of the University of Michigan in Ann Arbor, who studies small-scale farming systems.

Badgley admires the way in which Cuban researchers are helping the country's growing number of small farmers develop new crop varieties and cheap methods of pest control that are free of synthetic chemicals. "People in Cuba are going into farming from other professions," she notes. "The opposite is happening in the rest of the world." Indeed, Franchi only took up agriculture when his construction business began to struggle in the early 1990s.

Franchi's farm and the gleaming labs of Havana's Scientific Pole seem worlds apart, but

Cuban scientists see a common theme. Neither would exist, they say, without socialist policies for applying science to local communities and setting research agendas in terms of public need. Franchi and his academic collaborators, for example, enjoy close ties with village mayors, and advise them on how to deal with everything from hurricane damage to energy efficiency. Cuba's biotechnology institutes, in turn, take advice on priorities from the country's extensive network of family doctors.

For the people

Up in the hills of Las Terrazas, a 250-square-kilometre evergreen forest reserve that is home to more than a hundred bird species, the tight links between science and the government's social policies are particularly clear. When Castro came to power, the hillsides of Las Terrazas had been stripped practically bare for agriculture and fuel. Since then, forestry scientists and conservation biologists have overseen the planting of some 6 million trees — mostly indigenous species such as teak and mahogany. The residents of a new town built in the heart of the reserve were recruited to run the forestry projects and, since the 1990s, ecotourism schemes that bring in around 25,000 visitors a year. "Las Terrazas is a remarkable place because people live here and support the mission of the reserve," says Badgley. "There are terrible confrontations between conservationists and indigenous people in other parts of the developing world."

Visiting model initiatives such as Las Terrazas and the Scientific Pole, it's easy to think that Cuba is working miracles in science. But a trip to Roberto Cao Vazquez's chemistry lab at the University of Havana reveals the grim reality for researchers whose interests don't chime with the government's priorities. I enter on a steamy afternoon, having picked my way down the rubble-strewn passage outside. In

"I lost my position in the university and realized that my name had been erased from presentations I used to co-author." — Cuban expatriate

Neighbourhood dispute

Cuba has no commercial advertising, so billboards are rare in Havana. But several can be found facing the US Interests Section, the closest thing the United States has to an embassy in the capital. Each displays a strongly worded anti-US sentiment. The one pictured here translates as: "Imperialists, we have absolutely no fear of you."

Few subjects unite Cuban scientists as much as frustration with the policies of Cuba's superpower neighbour towards the island. A trade embargo, imposed in 1962 in response to the nationalization of US-owned businesses and Cuba's links with the Soviet Union, forces up the cost of scientific equipment. And most

scientists have given up applying for visas to visit the United States, saying they are tired of being refused by staff at the US Interests Section.

Slow Internet access is another consequence of the embargo. Cuban computer networks

cannot tap into the optical fibres that run past the island, because the connections are run by US companies. As a result, the University of Havana uses a satellite link. Because it is

expensive, the whole university is forced to share a connection that is about the same speed as the broadband links available to home users in developed nations.

Other US restrictions disrupt the flow of research funds into Cuba. Last year, for example, a team at the Center for Genetic Engineering and Biotechnology in Havana was awarded US\$700,000 by the Pediatric Dengue Vaccine Initiative. The initiative is based in South Korea, but funded in part by the US-based Bill and Melinda Gates Foundation — which must obtain clearance from the US government. Nearly a year after the grant was awarded, this permission has yet to be granted.

the lab, the air-conditioning barely functions. A torn and yellowing periodic table hangs on the wall. The chemicals stores look pitiful. Cao, who works on fundamental aspects of supramolecular chemistry, is one of the have-nots of Cuban science.

Worlds apart

A jovial man with a pronounced American accent — the result of studying in a US-run school in Venezuela — Cao smiles wryly as he describes his plight. Journals: he doesn't have access to any, and relies on colleagues to send copies of interesting papers by e-mail. Chemicals: his budget is just US\$1,500 for the year. Equipment: his group has the country's only nuclear magnetic resonance machine, but it is so old that foreign researchers would laugh at it. "We're trying to do first-world science under third-world conditions," he says.

Cao and his colleagues survive by scraping together grants from abroad and through gifts of supplies brought by visiting foreign colleagues. As a result, they are able to publish in good journals, although progress in their labs is slow. "When I go and work with colleagues in Spain I am three times more efficient," says Cao.

Further evidence of Cuba's scientific divide comes from a visit to the University of Havana's marine biology lab. The team is respected by foreign conservationists, who admire the close links and influence the biologists have with Cuban leaders. But in the grand government scheme, studies of marine biodiversity rank well below vaccine development, and the scientists are often kept from their field sites because they can't afford fuel for their research boat.

"Our vessel is a Cuban innovation," adds group member Gaspar Gonzalez Sanson, to the laughter of his colleagues. "It's made of stone." Because carbon fibre is an expensive commodity in Cuba, the vessel's builders instead bent an iron-mesh frame into the shape of a hull and covered it with cement. It's

not pretty or easily manoeuvrable — but it works. "They're a wonderful group," says David Guggenheim, a marine biologist at Texas A&M University in Corpus Christi, who is working with Gonzalez to survey the biodiversity of Cuba's western shores. "But they're strapped for cash."

Scientists at Cuba's better-heeled institutes have little to say about the plight of researchers such as Cao and Gonzalez. And many Cubans are reluctant to discuss factors that hinder their work — such as rules governing foreign trips. Relative to most of Cuba's citizens, it is easy for scientists to travel. But if a researcher outstays the time permitted by the government, their status at home changes radically. "Then you can come back but only for short periods," says Cao. "It's a one-way ticket."

These restrictions present young researchers with a horrible dilemma. "Young people are very impressed when they come and see a big lab abroad," says one Cuban researcher working in Europe, who asked not to be named. But with many travel permits valid for just a few months, she explains, they then face a choice between sacrificing an opportunity to stay longer and do good research, or being separated from their families. A former professor from the University of Havana has first-hand experience of this, having overstayed his permission to work in Spain: "I lost my position in the university and realized that my name had been erased from presentations I used to co-author."

Given the hardships suffered by researchers outside the charmed circle of priority applied research projects, it is surprising not to hear more complaints from Cuban researchers.

"Cuba has become an experiment in scientific planning for countries that cannot afford to match the rich world's approach."

Government control may be one factor; open dissent is a risky policy in a non-democratic country. But equally important is an awareness that Cuba has battled against the odds to avoid the chaos and privations suffered by neighbouring countries such as Haiti. Older Cuban scientists, who remember the right-wing dictatorship that preceded Castro, are especially proud of what's been achieved.

The generally positive spin favoured by Cuban researchers is also reminiscent of first-world corporate culture. And to my surprise, many Cuban scientists and research managers are comfortable with this comparison — although quick to stress the differences. "The success is not sales, it's the impact on society," says Manuel Raíces Pérez-Casteñeda, a business development manager at the Center for Genetic Engineering and Biotechnology, the premier institute in the Scientific Pole. "We're chasing problems, not profits."

Setting an example

But can Cuba continue this chase in the longterm, having effectively turned its back on basic research? Halla Thorsteinsdóttir, a public-health expert at the University of Toronto in Canada, who has studied Cuban biotechnology, suspects that the lack of dedicated fundamental research may not be a huge problem. "It's hard to generalize across fields, but in biotech the boundaries between pure and applied research are fuzzy," she says. "And Cubans also have the expertise to take advantage of basic research done elsewhere."

Having so decisively concentrated its resources on a relatively small number of priority projects, Cuba has also become an experiment in scientific planning for countries that cannot afford to match the rich world's across-the-board approach. If it works, other nations are likely to go down the same route. "Developing countries can learn a lot from Cuba," Thorsteinsdóttir argues.

Jim Giles is a senior reporter for *Nature*, based in London.