"actually a big step," Lewin said. Søgaard and co-workers now plan to repeat the clinical experiment with both the drug and an HIV vaccine that, they hope, will boost the immune response against the virus and help deplete reservoirs.

A major hurdle facing shock and kill: Available tests can't reliably determine whether an intervention has actually reduced the reservoir's size. "Right now, the assays we have are pretty expensive, they require a lot of blood, and we're not exactly sure what they measure," said immunologist Nicolas Chomont of the Vaccine & Gene Therapy Institute of Florida in Port St. Lucie. Chomont presented a novel assay his team has developed that is relatively cheap, requires only 10 milliliters of blood, and, he contends, more meaningfully quantifies small amounts of virus than anything available. He designed it to overcome problems with the two most commonly used tests to measure reservoir size. One, which cultures blood from an infected person with uninfected cells and measures production of new viruses, vastly underestimates the reservoir. The second one grossly overestimates the size because it uses the polymerase chain reaction (PCR) to detect HIV genetic material—including hordes of mutated viral DNA that produces "dead-end" viruses, which are not viable and thus of little concern.

Chomont's new assay, dubbed TILDA, also relies on PCR but selects critical HIV genetic signatures needed for replication that often are missing in the DNA that codes for dead-end viruses.

Steven Deeks, an HIV cure researcher at the University of California, San Francisco, says if TILDA proves its worth in rigorous studies, it could spur investment in the field from wary pharmaceutical companies. "Industry is not engaged because there's no validated way to measure the reservoir," Deeks said. "How are we going to define cure, and how are the regulators going to define cure?"

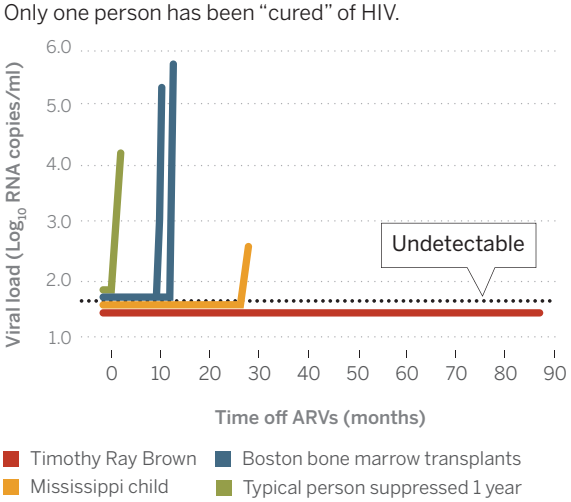
Measuring the reservoir in blood isn't enough, however, because virus can often lurk in harder to access tissues like the lymph nodes, gut, and spinal fluid. (Timothy Ray Brown had each of these assessed, and the Boston patients and the Australian transfusion recipient had gut biopsies, but none of these tissues was tested in the Mississippi child.) It's possible that remote sites offer reservoirs safe harbor from ARVs or immune attack. With that in mind, virologist Brandon Keele of the National Cancer Institute in Frederick, Maryland, described a new strategy to track reservoirs in different parts of the body. Working in a monkey model, Keele and his co-workers engineered thousands of nearly identical versions of SIV, the monkey AIDS virus, which they can distinguish by means of small genetic differences that serve as unique barcodes.

The researchers have injected swarms of these SIVs into monkeys, which they plan to treat with ARVs to reduce the viruses to undetectable levels. After several months, they'll stop treatment and perform blood tests, biopsies, and, ultimately, necropsies on the animals to see if the barcodes can reveal the source of the rebounding virus.

Just where the virus hid during the Mississippi child's 27 months of remission is one of the case's baffling mysteries. In the wake of the setback, the National Institute of Allergy and Infectious Diseases (NIAID) is redesigning a study of HIV-infected newborns that would use a similarly aggressive ARV regimen shortly after birth and then, at some point, take them off drugs and see whether the virus rebounds. Trial designers have heatedly debated whether to add tissue sampling to the protocol, but sensitivities about subjecting children to the procedures have nixed it for now. "We've got to rethink that," says NIAID Director Anthony Fauci, who is not on the trial design team. The field needs answers, not more anecdotes of cures, he says. "I'm maintaining a deep degree of humility." ■

ARVs stopped, HIV rebounds

Only one person has been "cured" of HIV.



Source: Adapted from Diana Finzi, U.S. National Institute of Allergy and Infectious Diseases

CLIMATE CHANGE

Warming may not swamp islands

Studies suggest that atoll islands will rise in step with a rising sea

By **Christopher Pala**, *on South Tarawa*

As the minibus wobbles over the dusty, pothole-filled road that runs the length of South Tarawa island, a song blasting over Kiribati's state radio envisions an apocalypse for this fishhook-shaped atoll halfway between Honolulu and Fiji: "The angry sea will kill us all."

The song, which won a competition organized by Kiribati's government, reflects the views of President Anote Tong, who has been warning for years of a knockout punch from climate change. In an interview with CNN in June, Tong insisted that rising sea levels due to global warming will mean "total annihilation" for this nation of 33 coral islands spread over a swath of the Central Pacific the size of India, and for other atoll island nations like Tuvalu and the Maldives. In May, Tong announced that Kiribati had spent $8.7 million to buy 22 square kilometers of land on Vanua Levu in Fiji as a haven for displaced citizens, cementing his nation's global reputation as an early victim of climate change.

Many scientists quietly demur.

No doubt, the sea is coming: In a 2013 report, the U.N. Intergovernmental Panel on Climate Change predicted that global sea levels will rise up to 1 meter by 2100. But recent geologic studies suggest that the coral reefs supporting sandy atoll islands will grow and rise in tandem with the sea. The only islanders who will have to move must do so for the same reason as millions of people on the continents: because they live too close to shore.

Paul Kench, a geomorphologist who now heads the University of Auckland's School of

PHOTO: DAVID GRAY/REUTERS/CORBIS

Although Bikeman islet has disappeared beneath the waves, other Kiribati islands are expected to remain habitable as sea levels rise.

Environment in New Zealand, was the first to question the dire forecasts for Kiribati and similar island nations. In 1999, the World Bank asked him to evaluate the economic costs of sea-level rise and climate change to Pacific island nations. Kench, who had been studying how atoll islands evolve over time, says he had assumed that a rising ocean would engulf the islands, which consist of sand perched on reefs. "That's what everyone thought, and nobody questioned it," he says. But when he scoured the literature, he could not find a single study to support that scenario.

So Kench teamed up with Peter Cowell, a geomorphologist at the University of Sydney in Australia, to model what might happen. They found that during episodes of high seas—at high tide during El Niño events, which raise sea level in the Central Pacific, for example—storm waves would wash over higher and higher sections of atoll islands. But instead of eroding land, the waves would raise island elevation by depositing sand produced from broken coral, coralline algae, mollusks, and foraminifera. Kench notes that reefs can grow 10 to 15 millimeters a year—faster than the sea-level rise expected to occur later this century. "As long as the reef is healthy and generates an abundant supply of sand, there's no reason a reef island can't grow and keep up," he argues.

This equilibrium may not mean that all areas of atolls will remain habitable, says Scott Smithers, a geomorphologist at James Cook University, Townsville, in Australia. "The changes might happen at a rate that exceeds the recovery," he says. But the geologic record is reassuring, Kench and others found when they drilled deep cores into reef islands to probe how they responded to past sea-level changes. In a February report in *Geophysical Research Letters*, the researchers found that the island of Jabat in the Marshall Islands emerged on a reef 4800 to 4000 years ago, when sea levels were rising as fast as they are expected to rise over the next century. Other support for the model has come from monitoring how shorelines respond to seasonal changes in wave and wind patterns, investigating how extreme events like tsunamis reshape islands, and analyzing aerial photos and satellite images from the past 60 years, which have shown that the 15-centimeter sea-level rise over the past half-century has had no discernible effect on atolls.

Tong has drawn worldwide attention to evidence of his own: Bikeman islet off South Tarawa, which is already submerged; the washed-away village of Tebunginako on Abaiang island; and ubiquitous broken seawalls. But scientists blame these woes on human activity: causeways, sand removal, and poorly designed seawalls. "Pictures of flooding you see on the news have more to do with poor shoreline management and people settling on marginal land than with sea-level rise," says Simon Donner, a climate scientist at the University of British Columbia, Vancouver, in Canada who has examined sea-level variability in South Tarawa.

Some Kiribati officials agree: "[E]vidence shows that widespread erosion along the ocean and lagoon shorelines is primarily due to [local] human activities," wrote Naomi Biribo, permanent secretary in the fisheries ministry, and her Ph.D. adviser, geomorphologist Colin Woodroffe of the University of Wollongong in Australia, in the July 2013 issue of *Sustainability Science*. "[F]urther encroachment onto the active beach will … increas[e] erosion and susceptibility of the reef islands to anticipated sea-level rise."

Still, people living on lower lying and narrower sections of islands are unquestionably vulnerable to rising seas, especially on islands like South Tarawa, where 50,000 people live elbow-to-elbow in 15 square kilometers. Washover events dump salt water onto freshwater lenses—pockets of rainwater trapped in porous coral below the sand—rendering it undrinkable for weeks, until fresh water floats back to the surface. Areas already prone to flooding during storms will have to be abandoned.

Shore huggers on South Tarawa will be able to find safer land elsewhere in Kiribati, such as Kiritimati, also known as Christmas Island, which at about five times the size of Manhattan is the largest atoll in the world. Most of its residents live in a leeward part of the island that's 7 meters above sea level.

Vanua Levu in Fiji is a less appealing refuge. The purchase was "a publicity stunt," scoffs Teburoro Tito, a former president of Kiribati and member of the opposition party Protect the Maneaba. Already home to 270 farmers from the Solomon Islands, the steep, hilly tract may accommodate only a few hundred more people. If the optimists are right, no one from Kiribati will have to leave their country anyway. ■

Christopher Pala is a writer in Washington, D.C.

No need to redraw the map

The coral reefs underlying many Pacific atolls can catch sediment and grow.