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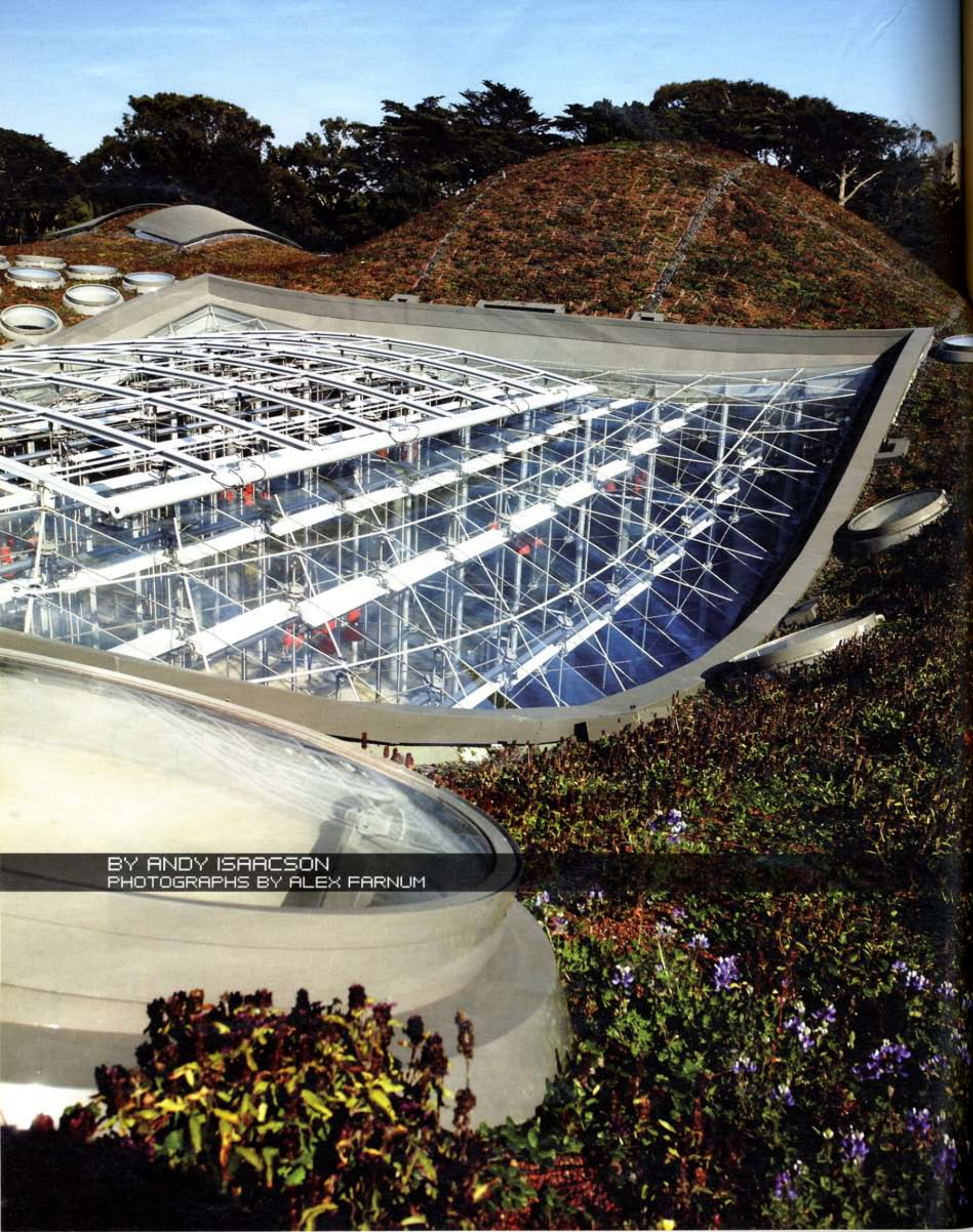


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BY ANDY ISAACSON
PHOTOGRAPHS BY ALEX FARNUM



THE ACADEMY OF VERY CONCERNED SCIENTISTS

Before it even opened its doors, the Academy of Sciences' convention-defying new home was already famous for being the greenest building on Earth. But few are aware that it houses 46 well-traveled researchers who are also toiling 24/7 in the fight against global warming. **The question is...**



...how can a bunch of specimen-gathering wonks in a natural-history museum help solve the most urgent environmental crisis of our time?



Peter Roopnarine, a soft-spoken paleontologist, is standing beside the hardened shell of an ammonite, a prehistoric squidlike beast that went extinct with the dinosaurs. "Everybody makes a big fuss about the dinosaurs, but some of us really cry about these guys," says the 44-year-old, as he leads me past gleaming metal shelves stocked with ancient fossils and skulls to his office in the new California Academy of Sciences. There, a 290-million-year-old fossil of a lizard-looking creature lies on a table, imprinted on a yellow-gray stone slab. The amphibian lived at a time before volcanic eruptions in Siberia most likely obliterated 90 percent of the species on the planet—the largest mass extinction in the fossil record.



Roopnarine is investigating the planet's recovery from that episode to guess how our world might look after 100 years of climate change. The comparison sounds apocalyptic, but it's actually quite instructive. Much like past catastrophes, climate change is effectively shaking up natural communities and leading to the formation of new ones. As temperatures warm and weather patterns alter, species are dying or moving to new homes in order to survive, resulting in communities with neighbors that have

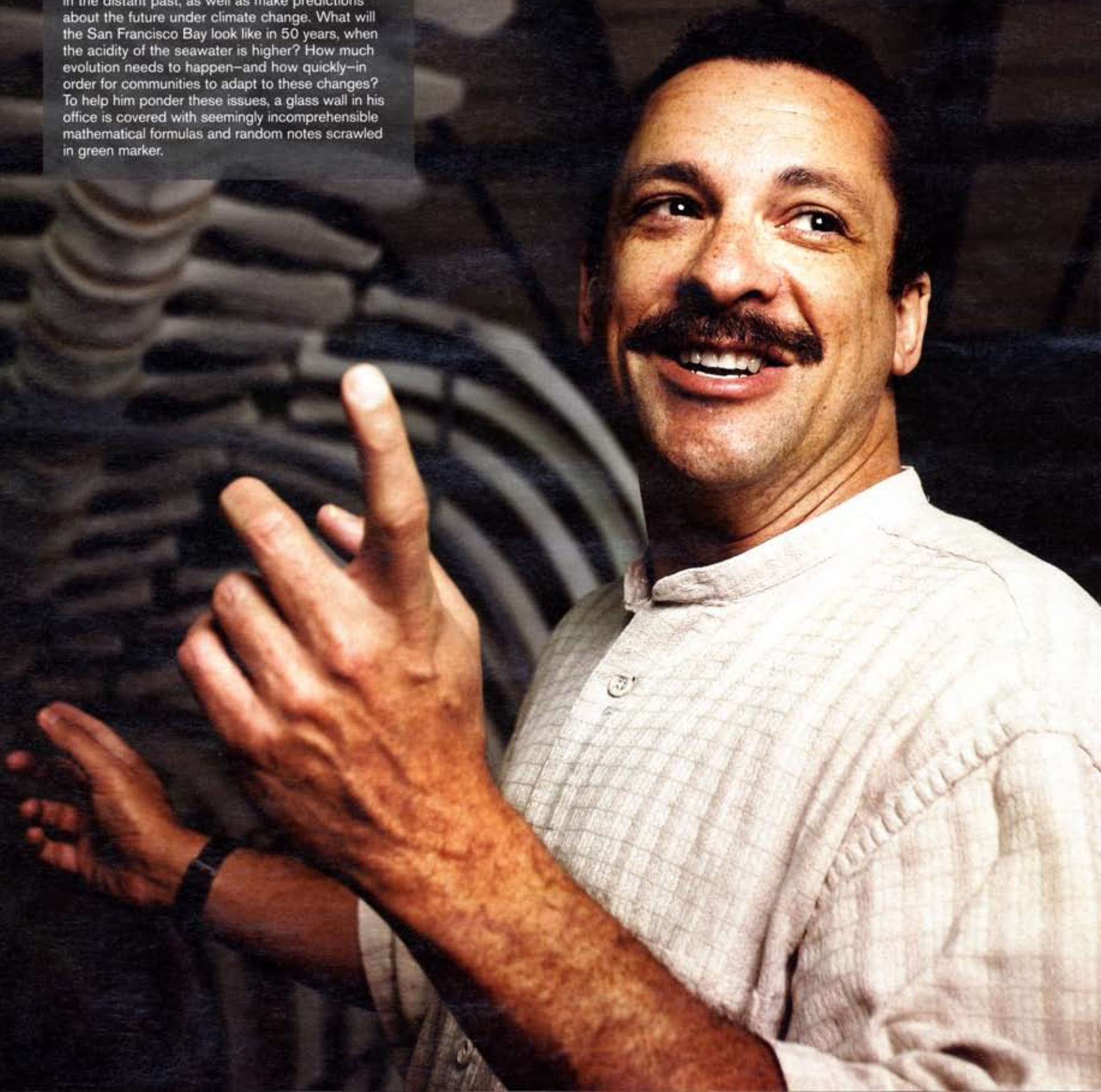
PREVIOUS PAGES, LEFT: On the academy's living roof, skylights also function as part of the building's natural ventilation system; RIGHT: The Hunter's hartebeest antelope, which appears in the African Hall diorama, is endangered, mostly because of poaching. THIS PAGE, TOP LEFT: Collection boxes hold thousands of test tubes full of microfossils; ABOVE: a fossil of an extinct ammonite; LEFT: an ancient fossil of a lizardlike creature. OPPOSITE: Peter Roopnarine studies fossils, like this 87-foot blue whale skeleton that hangs in the "Altered State" exhibit, to determine how past communities responded to natural catastrophes.



The predictor

PETER ROOPNARINE

As lead curator of the academy's "Altered State: Climate Change in California" exhibit, paleontologist Peter Roopnarine hopes to marshal visitors to the cause. Using the academy's enormous collection of fossils from California, along with the tools of network theory, Roopnarine can infer how natural communities responded to major environmental disturbances (such as asteroid impacts) in the distant past, as well as make predictions about the future under climate change. What will the San Francisco Bay look like in 50 years, when the acidity of the seawater is higher? How much evolution needs to happen—and how quickly—in order for communities to adapt to these changes? To help him ponder these issues, a glass wall in his office is covered with seemingly incomprehensible mathematical formulas and random notes scrawled in green marker.





The preservationist
HEALY HAMILTON

Healy Hamilton's curiosities pull her in various research directions, but a passion for conservation guides all her work. At Palmyra, a remote atoll in the central Pacific, she and a consortium of international researchers are studying octopi living amid pristine coral reefs to make the case for coral-reef protection worldwide. Rain forest deforestation sparked her interest in Amazon river dolphins. And back in San Francisco, the biologist is studying the effects of climate change on biodiversity in this country. The academy's specimen collections—a vast storehouse of biological data spanning centuries—provide valuable information about species' historic and current habitat ranges. With computer models, Hamilton uses this data to project likely shifts in response to global warming. Ultimately, this information helps government and environmental agencies decide things like where to create pathways to protect shifting animals and plants. "We are addressing really important questions," Hamilton says.

THIS PAGE, LEFT AND CENTER: Views of the other three floors of the rain forest; RIGHT: an albino alligator from the exhibit "The Swamp." OPPOSITE: Healy Hamilton peers into the Amazonian floodlands portion of the rain forest exhibit.



HEALY HAMILTON'S OUTLOOK FOR CALIFORNIA, UNDER THE GRIMMEST OF SCENARIOS, DEPICTS A VERY DIFFERENT PLACE THAN THE ONE IN WHICH WE NOW LIVE. OUR ICONIC WOODLANDS, SHE SAYS, COULD BE DEVASTATED: "YOUR KIDS WILL SEE DYING TREES EVERYWHERE, AND NO FOREST."

CONTINUED FROM PAGE 137

never lived in such intimate proximity. Predators are encountering new prey. Plants are finding themselves with out pollinators. How stable will these new communities be? The academy, Roopnarine says, is uniquely equipped to provide clues. "Our vast collection is a storehouse of knowledge about the biological world," he says, which gives academy researchers a perfect perch from which to evaluate dramatic shifts that are now under way because of global warming. "You can't work on this and not see the effects," he adds.


The world has certainly changed during the academy's five years away from Golden Gate Park. The 155-year-old institution, which also houses the Steinhart Aquarium, reopened in its longtime habitat on September 27, squarely in the midst of the defining environmental challenge of our time. The academy's radically green home—

from its planted roof to its insulation made of old blue jeans—embodies its invigorated engagement with global warming, and also renders anachronistic its forbidding former edifice, which seemed to represent the notion of scientists as unaffected observers of the natural world. Indeed, climate change now figures prominently—and inescapably—into the work of the organization's 46 scientists, the academic backbone of the institution whose behind-the-scenes research informs many of the academy's public exhibits.

It wasn't always this way. For years, the researchers focused on the more traditional work of a natural history museum: to document and make sense of the biodiversity that evolution has engineered. (It's easy to imagine this former era when walking into the African Hall, its vaulted ceilings and 1930s Impressionist-style ▶

RED PLUMED BIRD OF PARADISE
Paradisaea raggiana

Dept. of Ornithology # 173



AT A TIME WHEN CLIMATE CHANGE IS BLURRING THE BOUNDARY BETWEEN SCIENCE AND ACTIVISM EVEN FURTHER, ACADEMY EXHIBITS WILL ALSO FUNCTION AS A CALL TO ACTION. VIEWERS CAN PULL UP A STOOL AT THE CARBON CAFÉ TO LEARN ABOUT THE ENVIRONMENTAL FOOTPRINT OF THEIR FOOD CHOICES.

THIS PAGE: The Morrison Planetarium cantilevers out over the Philippine coral reef exhibit.
OPPOSITE: This red-plumed bird of paradise, from Papua New Guinea, is part of the academy's attempt to create a master list of every bird on earth—and then be able to track their extinction or survival.

A man in a dark shirt and jeans is climbing a green roof. The roof is covered in lush green plants and red flowers. Several large, white satellite dishes are visible on the roof. The sky is a clear, bright blue.

The species tracker
JACK DUMBACHER

"We like to find those parts of the globe that haven't been explored, that are still untamed," says ornithologist and mammalogist Jack Dumbacher. His 28 research expeditions have spanned the world, from the Namibian desert—to investigate the evolution of elephant shrews across Africa—to the remote mountains of Papua New Guinea, where he recently discovered a poisonous bird by accident. He was holding a bird called a pitohui when the bird scratched his hand, and it began to burn. It turned out that a local beetle pitohuis like to eat contains a toxin that scientists had only seen before in South American poison dart frogs. The race to discover new species is invaluable for Dumbacher's academy colleagues who work more directly on global warming. His cataloging forms a kind of databank that they can draw on to understand how the world is changing. "One reason we were able to show that DDT thinned bird eggs was that we had many eggs from many different years," Dumbacher explains. "So we were able to pinpoint when the dioxins first appeared."

THIS PAGE: Ornithologist Jack Dumbacher's collections of extinct Carolina parakeets (TOP), birds of paradise from Papua New Guinea (BOTTOM LEFT), and the nearly extinct ivory-billed woodpeckers (BOTTOM RIGHT), provide clues for researchers studying which factors—including climate change—affect animal evolution; BOTTOM CENTER: skylights on the roof. OPPOSITE: With plants designed to attract insects and birds, the academy's living roof is Dumbacher's new stomping grounds.



“ONE PERSON’S LIFETIME IS SO SHORT THAT YOU DON’T REALLY HAVE ANY PERSPECTIVE,” DUMBACHER TELLS ME IN FRONT OF A CABINET OF BYGONE CREATURES. “BUT WHEN YOU HAVE ALL THESE SPECIMENS, YOU REALIZE HOW MUCH HUMANS HAVE CHANGED THE WORLD.”

painted dioramas calling to mind khaki-clad researchers sipping gin in the Serengeti.) The Academy of Sciences harbors the world’s largest collection of Darwin’s fabled finches, which helped launch the field of evolution and which academy researchers first gathered on an expedition to the Galápagos in the early 1900s. The collection contains some 9,000 specimens, including nests, eggs, and, according to one researcher, “some other, weirder things.” It continues to prove invaluable in evolutionary studies here and around the world. An ornithologist from the University of Missouri–St. Louis is currently sequencing the DNA of pox lesions sliced from the finches in order to understand how pox first arrived in the Galápagos, an important step in learning how to fight the disease.

Today, that cataloging effort is still at the core of the academy’s work, but it has acquired real urgency because of global warming. “If we want to preserve species that are going extinct all around us, we need to have lists of what was—and is—there,” says mammalogist and ornithologist Jack Dumbacher. “We’re losing things so quickly.” Indeed, almost all of the academy’s scientists have noticed the effects of climate change over the past several years. Entomologist Dave Kavanaugh, for example, returned a year ago to the same site in the Sierra Nevada where, in the 1970s, he discovered several new beetle species that live on ice fields. The beetles are now gone, having moved to higher ground. Botanist Frank Almeda has observed that many local plant species are starting to bloom at different times of year than they have previously. Terry Gosliner, the academy’s senior ▶



The slug master TERRY GOSLINER

Terry Gosliner is one of the world's foremost experts in nudibranchs, the brilliantly colored sea slugs that he studies primarily off the coast of the Philippines. His passion for the slugs began when he was 14 years old and found his first nudibranch in a tide pool off the coast of Bolinas. He brought the creature to an academy researcher—but it was the summer of 1967, the Grateful Dead were playing in Golden Gate Park, and he was late for his appointment. ("I got distracted," he recalls.) Why nudibranchs, you might ask? "I thought to myself, 'This is the weirdest-looking thing I've ever seen in my life. I need to find out more about them,'" he says. "And I'm still learning more." One of his latest discoveries is that some species seem to be disappearing off the California coast—victims of climate change. "Nudibranchs are like the canaries in the coal mine," Gosliner says. "They feed on so many different things that if they start disappearing, you know there's a problem."

THIS PAGE, CLOCKWISE FROM LEFT: *Naso tangs* are among the tropical fish that live in the reefs; a catwalk over the tank fitted with lights that help the coral grow; a stingray skims the surface of a separate section of the coral reef tank; Terry Gosliner emerges from a dive. OPPOSITE: Gosliner dives in a tank modeled after the Philippine coral reefs he's been studying for more than 20 years.



ORGANIZATIONS LIKE SAVE-THE-REDWOODS LEAGUE, AS THEY CONSIDER WHAT LAND TO ACQUIRE FOR THE LONG-TERM PROTECTION OF COASTAL REDWOODS, CAN MAKE USE OF RESEARCHERS' ESTIMATES THAT THE TREES WILL SHIFT NORTH BECAUSE OF GLOBAL WARMING.

curator of invertebrate zoology and one of the world's foremost experts in nudibranchs (brilliantly colored sea slugs), says the animals are disappearing off the California coast, while southern, warmer-water species are moving up to take their place. "Nudibranchs are great indicators of the health of an ecosystem," he says. "If they start disappearing, that's an important early warning sign that something is going on."

Healy Hamilton, director of the academy's Center for Biodiversity Research, is also studying California. Her outlook for the state, under the grimmest of scenarios, depicts a very different place than the one in which we now live. Our iconic oak woodlands, she says, could be devastated. ("Your kids will see dying trees everywhere, and no forest.") The hardy redwoods will take a long time to die off, but they,

like the sequoias, won't regenerate. Meanwhile, Joshua Tree National Park will eventually become free of its namesake trees; they are already moving to higher elevations in the park, chasing the cooler climate. There will be less water in the state, and what precipitation does come will arrive more as rain than melted snow.

This forecast, which will be showcased someday in the academy's new exhibit "Altered State: Climate Change in California," has real-world applications for public land managers and conservation groups, whose job it is to ensure that shifting plants and animals have safe and open pathways, called "corridors of connectivity." For example, Hamilton's projections for the ranges of the Canadian lynx and the snowshoe hare are helping the Western Governor's Association, which recognizes the vital importance ▶

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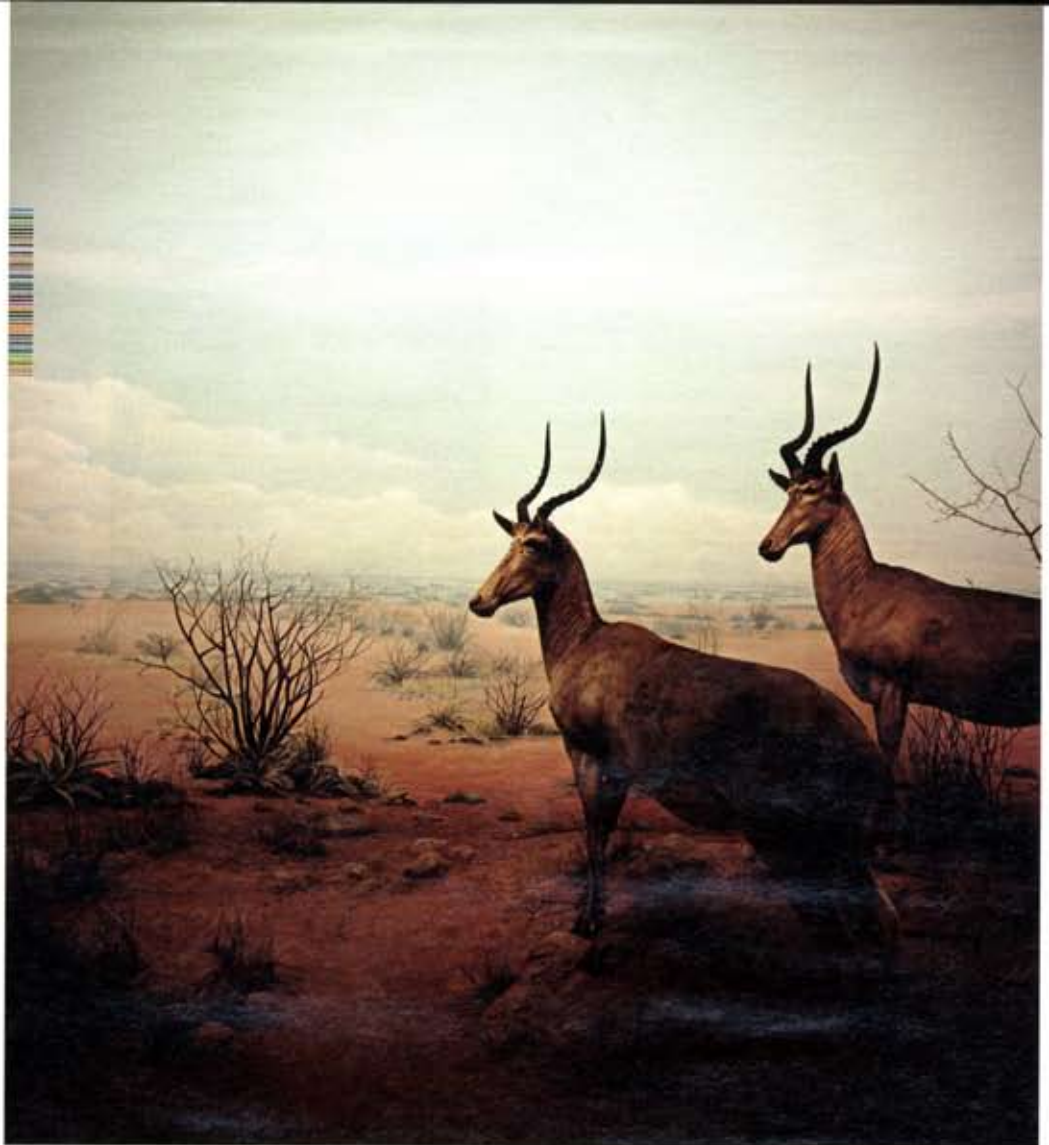
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that healthy wildlife populations have on the economies of western states, plan the Wildlife Corridors Initiative, which they launched earlier this year. Similarly, organizations like the Save-the-Redwoods League, as they consider what land to acquire for the long-term protection of coastal redwoods, can make use of estimates that the trees will shift north.

At a time when climate change is blurring the boundary between science and activism even further, academy exhibits will also function as a call to action. Along with Peter Roopnarine's computer modeling of future ecosystems, "Altered State" will feature interactive displays for viewers who want to get involved. They can pull up a stool at the Carbon Café to learn about the environmental footprint of their food choices, learn which lightbulbs to buy, or find out which native plant species would do best in their gardens.

It makes perfect sense that the natural world's principal documentarians would also be the most ardent champions of its protection. As Hamilton describes her experience netting creatures off the coast of Australia—a project involving sea horse conservation—I can easily imagine her winning over a class of bored seventh graders. "It's so cool, you never know what you're going to get," she says, her blue eyes widening. "Ooh, it's a baby blue-ringed octopus! Ooh, it's a pygmy squid!" Hamilton hopes that the reincarnated academy leaves visitors equally inspired.

In the academy's basement, out of public view, is a special locked cabinet that contains its collection of extinct species. Lying on one shelf is a passenger pigeon, an elegant bird with a pale cinnamon-rose breast and tail feathers that fork well below its body, like a concert pianist's coat. When Europeans first arrived in North America, it was the continent's most abundant bird, but within a century, it was gone—hunted out of existence. Nearby, on another shelf, rest other victims of human-induced environmental changes, including a Carolina parakeet, the United States' only native parrot; the skeleton of a great auk, a penguinlike bird that vanished sometime in the 1800s; and the dinosaur-size egg of an elephant bird, a large flightless animal that once roamed Madagascar.

Peter Roopnarine in a collection room with geological fossils, which form part of his studies predicting the future under climate change. OPPOSITE: The background in this diorama from the old African Hall has been repainted, but the antelope are from the original.



"One person's lifetime is so short that you don't really have any perspective," Jack Dumbacher tells me, as we stand in front of this cabinet of bygone creatures. "But when you have all these specimens, you realize how much we've changed the world."

Today, these stuffed bodies serve as a premonition of what awaits us. In their role as observers, and more, of the devastating effects wrought by climate change, academy scientists are positioned to ring the alarm—and as a visit to the new Academy of Sciences in Golden Gate Park should make abundantly clear, ours is not merely to take notice. ■

ANDY ISAACSON CONTRIBUTES A MONTHLY ENVIRONMENTAL COLUMN TO NATIONAL GEOGRAPHIC ADVENTURE HE HAS ALSO WRITTEN FOR UTIME READER AND THE LOS ANGELES TIMES.




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