





A WINDOW *ON* THE PAST

*a paleontological treasure trove
is revealed in the Tatacoa Desert
of south-central Colombia*

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The crack of dawn at the Tatacoa Desert in south-central Colombia announces this will be an exceedingly hot day to go searching for fossils. Still, I walk in the footsteps of a group of specialists as we traverse the undulating terrain of gullies and loose ochre clays where water once flowed. Finding fossils in the tropics is not easy, as the rocks that house them tend to be cloaked in exuberant vegetation. This desert landscape, however, is one of the few places where that rule doesn't apply.

It is May 2023, and I have joined the largest paleontology expedition undertaken in Colombia in recent years, with no fewer than 50 paleontologists, geologists, fossil preparators, cartographers, science illustrators, graduate students, and other field personnel, all assembled here for a week-long campaign. Hailing from Colombia, Peru, Venezuela, Mexico, and Panama, they represent leading research institutions in those countries, as well as in the United

States, France, Canada, and Switzerland. Given the importance of the expedition, we were awarded an Explorers Club Flag. Unfortunately, the flag did not reach me in time for a host of logistical reasons.

Nestled in a valley formed by the eastern and central ranges of the Andes mountains, the Tatacoa Desert covers some 330 square kilometers around the hamlets of Villavieja and La Victoria. While Tatacoa has been visited by foreign paleontologists for at least a century, it has been more than three decades since the last major expedition undertaken here, with research halted by political unrest. Fortunately, a treaty signed a few years back has brought peace to this region of Colombia, allowing a formidable cadre of scientists to return to the field. Their quest: finding micro- and macrofossils from the Middle Miocene, a slice of time between 16 and 11.6 million years ago when this patch of South America was part of the Amazonian rainforest—home to the most diverse fauna ever to have existed on the continent prior to the emergence of the northern tip of the Andes range. The tectonic event completely modified the topography of northern South America, redirecting the course of several rivers and

OPENING SPREAD: A COMPARISON OF THE MAXILLA TEETH OF A PRESENT-DAY CAIMAN (ABOVE) AND THAT OF A 12-MILLION-YEAR-OLD SPECIES YET TO BE IDENTIFIED. FACING PAGE: AN 11.6-MILLION-YEAR-OLD CRANIUM OF A "PRODOLICHOTIS" PRIDIANA RODENT FROM THE VILLAVIEJA FORMATION, A LINEAGE NATIVE TO SOUTH AMERICA.









transforming the ancient ecosystem into a fantastic martian-like landscape.

Tatacoa is part of La Venta formation, the richest-known and best-preserved *lagerstätte*, or repository, of Miocene fossils, anywhere in the world. There is no other place even remotely like it in terms of its ability to show us what the fauna was like in the region before the main wave of the Great American Interchange of creatures, when South America was a giant island, independent from the rest of the Americas. In recognition of its paleontological importance, the region has been officially honored with a term for the distinctive geological moment it represents—the “Laventan.”

Today, Tatacoa is a magnificent labyrinth of red trenches and a dry tropical forest punctuated by acacias, cacti, and a variety of thorny shrubs. Goats juggle the impossibly thin crests of eroded soil, oblivious to the bizarre terrain. Temperatures oscillate between 21°C at night to nearly 43°C by midmorning. It does rain during the spring and fall, which sometimes washes the soil away, exposing the fossils. Most of the time, however, what little precipitation there is evaporates quickly, before it even reaches the ground. Despite the presence of an aquifer down below those rocks, the terrain is bone-dry. Given these harsh conditions, the Spanish conquistadors dubbed this place the “Valley of Sorrows.”

“Nothing in the tropics comes close to this place, in South America, Asia, or Africa,” says Carlos Jaramillo, our expedition leader, who works with the Smithsonian Tropical Research Institute in Panama. (Colombia’s foremost geologist and paleobiologist,

Jaramillo was named to this year’s EC50 list of explorers the world needs to know about.) Along with his international collaborators, several of whom are on this expedition, he has carried out immense field exploration projects, such as the search for and excavations of the fossils that came to light during the expansion of the Panama Canal; and the exceedingly difficult digs at El Cerrejón in Colombia, the largest open-pit coal mine in Latin America, which produced the biggest snake fossil of all time, the fabled *Titanoboa cerrejonensis*.

“Follow the same layer of rocks for several kilometers,” says Jaramillo, “and you never know what you might find—from snakes to gigantic skulls of animals that no longer exist.” Furthermore, he explains, the fauna and flora in these beds is key to understanding what life was like in the tropics during the global warming event that occurred in the Middle Miocene, a period that turns out to be the best analog for future Earth under climate change exacerbated by human activity.

Deep-time reconstruction of tropical ecosystems is one of Jaramillo’s main interests, and it is expected that the fossils in La Venta will provide him with far more evidence to keep writing the history of the neotropical forests and their response to global warming and changing carbon dioxide levels. A few years ago, Jaramillo and his colleagues published an article in *Science* showing that when the planet heated up, tropical biodiversity increased, and vice versa. The key, he found, was that carbon dioxide rose as well, increasing biomass and triggering diversity. His mantra is that looking back at the past in the tropics is the way to discover what can happen in the future.

So far, the fossilized remains found here are allowing explorers to understand that 13 million years ago this was a rather flat landscape, a patchwork of interconnected swamps, shallow lakes, rivers, and floodplains, at a time when the Andes did not yet

PREVIOUS SPREAD: THE RED GULLIES OF PARTS OF TATACOA ARE THE RESULT OF MILLENNIA OF EROSION AND DECADES OF CATTLE GRAZING. FACING PAGE, FROM TOP: PALEOBIOLOGISTS JAVIER LUQUE AND CAMILA MARTÍNEZ STUDY A MINERALIZED TREE STUMP. GEOCHEMIST JULIA TEJADA AND PALEONTOLOGIST FREDDY PARRA LOOK FOR MICROFOSSILS.

exist—nor did the Magdalena, Amazon, and Orinoco rivers for that matter. Jaramillo and his colleagues refer to this proto-Andean ecosystem as “Pebas,” which was more of a proto-Amazonian jungle than anything else, teeming with an amazing number of species, including a genus of freshwater fish that was able to live under and above water because it had lungs, beautiful giant tortoises, snakes, armadillos, birds, crustaceans, glyptodonts, ungulates, marsupials, rodents, and more bats and New World monkey species than in any fossil region of South America.



Of particular interest, says Jaramillo, is the astonishing variety of extinct crocodile, caiman, and gavial species—both terrestrial, a true rarity, and aquatic—to be found here. Peruvian expedition member Rodolfo Salas-Gismondi explains that La Venta—along with fossil beds in the vicinity of Iquitos in Peru—bears witness to the largest diversity of crocodylians of all times anywhere on the planet. From the gigantic *Purussaurus*, the most fearsome of the prehistoric crocodylians measuring more than 10 meters long, to a large enigmatic land crocodile with shark-like teeth that walked like a feline, to name a few.

All these specimens—along with another 3,000 fossils that are products of recent and past expeditions, which are still being described—are stored and displayed at the Tatacoa Natural History Museum in

La Victoria. The town, which has a population of around 2,000, was little known to the outside world until 2016, when Andrés Vanegas, a young amateur paleontologist who had been collecting fossils on his own, managed to get hold of Jaramillo via email. He had formed a group of kids who called themselves “Tatacoa’s Guardians,” with the mission to instinctively protect the fossils they knew so little about. But now he felt it was time to ask for professional help. Jaramillo’s mouth was agape at what he saw upon arriving in La Victoria and wasted no time in supporting Vanegas and his brother, Ruben—providing training, contacts, and funding from the Smithsonian.

The small museum has a lab largely financed by astronaut William Anders, the Apollo 8 lunar module pilot who took the famed *Earthrise* image from space. In a lovely union of space and terrestrial exploration, that lab is the meeting place of expedition members anxious to show one another what they’ve just found in the field, while others prefer to spend the day discovering the treasure trove of fossils still in cardboard boxes in dire need of description and publication.

This Tatacoa 2023 expedition has yielded a couple of glyptodonts—a genus of large herbivore armadillos protected with bizarre osteoderms; a beautiful tiny snake with all its minute vertebra in place; lots of microfossils, such as fish vertebra, otoliths, and skull fragments that paint a rich story of the ancestors of those giant catfish swimming in today’s Amazon and Orinoco rivers. On the last day, we found an interesting 13-million-year-old freshwater turtle of the genus *Podocnemis*, “which validates the evolutionary history

PALEONTOLOGIST RODOLFO SALAS-GISMONDI WITH MUSEUM DIRECTOR ANDRÉS VANEGAS NEXT TO A MASSIVE *PURUSSAURUS NEIVENSIS* CRANIUM. FACING PAGE: SALAS-GISMONDI POSES ALONGSIDE A WELL-PRESERVED GAVIAL OF THE SPECIES *GRYPOSUCHUS COLOMBIANUS*.





of the turtles that inhabited the lakes and rivers of South America,” according to renowned turtle expert, and Explorers Club fellow, Edwin Cadena of the Universidad del Rosario in Bogotá, who previously found the oldest and the largest fossil turtles in the world at other sites in Colombia.



It takes several of us many hours of digging around the turtle, protecting it with plaster and wet paper. Long after nightfall, we are finally able hoist the enormous weight of the fossil over the broken slope terrain, up to our jeep for transport. I turn to look at Jaramillo. He is smiling under his headlamp. Restless explorer, no-nonsense scientist, prolific writer, inspiring teacher, and supporter of a whole generation of paleontologists. His mind is always busy with thoughts and images of how the tropics have evolved in geologic time, what exactly makes the landscape change, and the mysteries of what really generates tropical mega-biodiversity. The continuous exploration of the Tatacoa and La Venta fossils is poised to provide a large piece of that puzzle. ▲▼

THE EXPEDITION TEAM EXCAVATES A 13-MILLION-YEAR-OLD TURTLE OF THE GENUS *PODOCNEMIS*, CONSIDERABLY LARGER THAN ITS MODERN-DAY RIVER COUSINS. FACING PAGE: THE DERMAL PLATES OF A 12-MILLION-YEAR-OLD UNIDENTIFIED CAIMAN SPECIES IN A FINE STATE OF PRESERVATION.