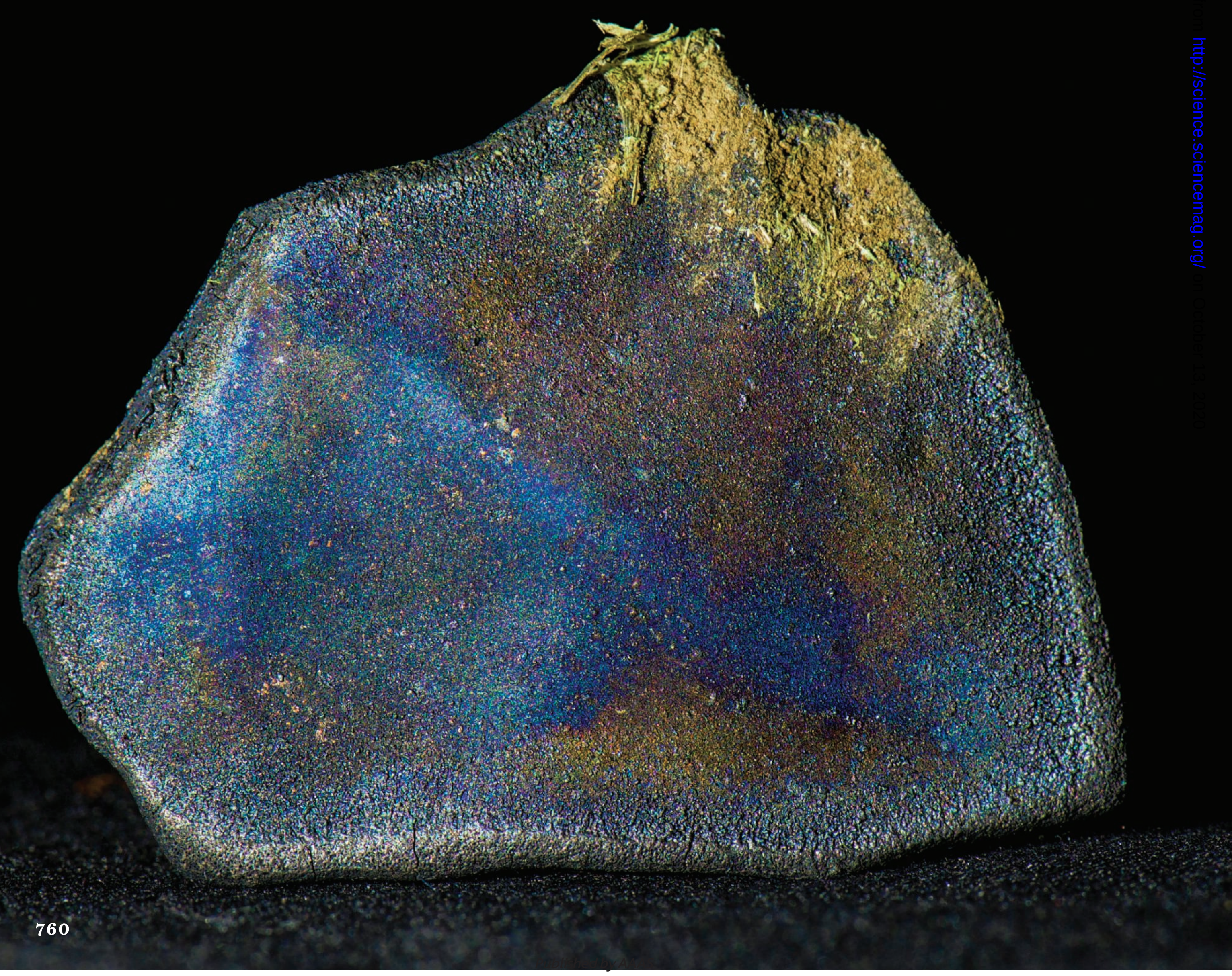
LUCKY STRIKE

Last year, an unusual meteorite crashed in a Costa Rican rainforest. Rich in the building blocks of life, it has captivated collectors and researchers

By **Joshua Sokol**



As the fiery emissary streaked across the skies of Costa Rica, an unearthly mix of orange and green, Marcia Campos Muñoz was in her pajamas, watching TV on the couch. It was 23 April 2019, a bit past 9 p.m., when she heard a foreboding rumble. Heart racing, she tiptoed outside to calm her barking dog, Perry, and to check on the cow pastures ringing her small house in Aguas Zarcas, a village carved out of Costa Rica's tropical rainforest. Nothing. She ducked back inside, just before a blast on the back terrace rattled the house to its bones.

Campos Muñoz phoned her father, brother, and oldest son, who rushed to the house. On the terrace, they found a grapefruit-size hole in the corrugated zinc roof and a smashed-up plastic table, last used for the quinceañera of Campos Muñoz's daughter. The culprit was scattered on the floor, in pieces as black as coal.

She picked up the biggest fragment, still warm to the touch. Already, her phone was chiming with WhatsApp messages from friends telling of blazing fireballs and rocks raining down on farms and fields. The family added its own viral messages to the mix: photos of Campos Muñoz and her son holding the big stone that crashed through her roof. Within hours, a local journalist visited the house and streamed videos of the damage on Facebook Live.

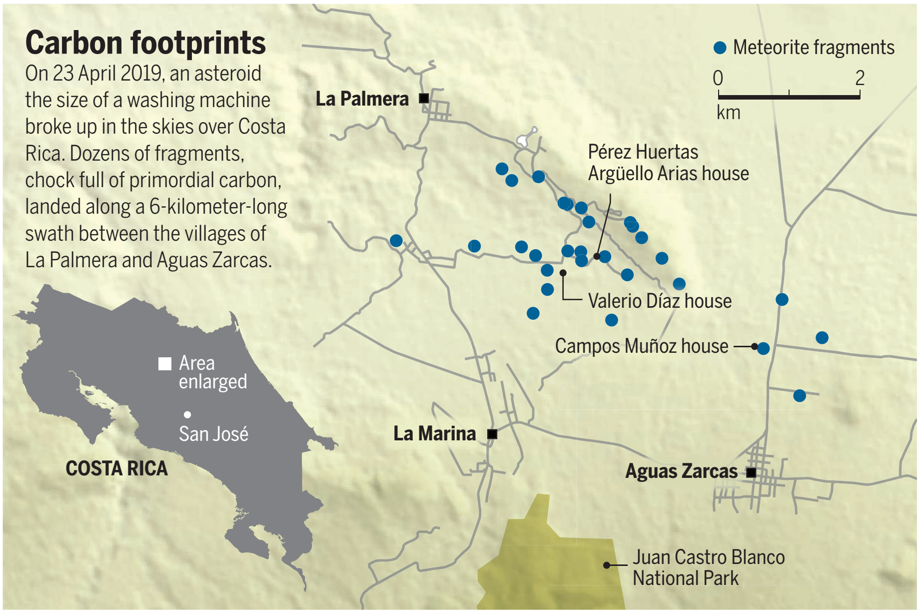
It was only the beginning. A space rock the size of a washing machine had broken up in the skies over the village, and the excitement was about to spread globally.

Meteorites are not uncommon: Every year, tens of thousands survive the plunge through Earth's atmosphere. More than 60,000 have been found and classified by scientists. But meteorite falls, witnessed strikes that take their name from where they land, are rare—just 1196 have been documented. And even among that exclusive group, there was something extraordinary about this particular meteorite, something anyone with the right knowledge could know from the first pictures. The dull stone was, as far as rocks go, practically alive.

Aguas Zarcas, as the fragments would soon collectively be called, is a carbonaceous chondrite, a pristine remnant of the early Solar System. The vast majority of meteorites are lumps of stone or metal. But true to their name, carbonaceous chondrites are rich in carbon—and not just boring, inorganic carbon, but also organic molecules as complex as amino acids, the building blocks of proteins. They illustrate how chemical reactions in space give rise to complex precursors for life; some scientists even believe rocks like Aguas Zarcas gave life a nudge when they crashed into a barren Earth 4.5 billion years ago.

Clays in an Aguas Zarcas fragment may hold amino acids and stardust that predates the Sun.

From the beginning, the inky Aguas Zarcas resembled a legendary carbonaceous chondrite that exploded in 1969 over Murchison, an Australian cattle town. Geology students helped collect about 100 kilograms of Murchison, and a local postmaster mailed pieces of it to labs across the world. To date, scientists have recognized nearly 100 different amino acids in it, many used by organisms on Earth and many others rare or nonexistent in known life. Hundreds more amino acids have been inferred but not yet identified.



Carbon footprints

On 23 April 2019, an asteroid the size of a washing machine broke up in the skies over Costa Rica. Dozens of fragments, chock full of primordial carbon, landed along a 6-kilometer-long swath between the villages of La Palmera and Aguas Zarcas.

Murchison also contained nucleobases, the building blocks of genetic molecules such as RNA, and in November 2019, researchers found a major component of RNA's backbone: the sugar molecule ribose. This half-century parade of discoveries jump-started the now-flourishing field of astrobiology. "We're not detecting life itself, but the components are all there," says Daniel Glavin, an astrobiologist at NASA's Goddard Space Flight Center. "I wouldn't have a job without Murchison."

The 30 kilograms of primordial leftovers from Aguas Zarcas hold similar promise. But these new pieces are 50 years fresher than Murchison, allowing scientists to apply modern techniques to preserve and probe what amounts to fragile lumps of unspeakably old clay. They could sniff out delicate organic compounds long evaporated from Murchison. They could hunt not just for amino acids and sugars, but also proteins, which have long been suspected but never confirmed in a meteorite. And if they were clean and careful, they could hedge against a perennial criticism of the Murchison finds by ensuring the molecules discovered inside were native, and not contamination from Earth's own microbes.

"If I had to start a new museum collection for meteorites, and I could only select two, I would choose Murchison and Aguas Zarcas," says Philipp Heck, who curates the meteorite collection at Chicago's Field Museum. "If I could choose only one, I would choose Aguas Zarcas."

FROM THE INSTANT the rock entered the atmosphere, however, the clock began to tick. Clays—its major constituent—soak up surrounding air and water like a sponge; earthly amino acids and other organic compounds intrude, layer by layer, followed by the microbes that produced them. Each second in contact with moist rainforest soil or human hands destroys more information. "Ideally we pluck it from the air while it's coming down," says Ashley King, a planetary scientist at London's Natural History Museum, "whilst wearing gloves."

For billions of years, Aguas Zarcas had avoided such contaminating influences. If it could stay that way just a little longer, scientists would be able to recover information from three ancient, otherwise inaccessible periods.

The first predates the Solar System. Some 7 billion or 8 billion years ago, specks of stardust were ejected from supernovae and the outer atmospheres of aging stars, some made of hardy materials such as graphite, diamond, and silicon carbide. The size of smoke particles, they drifted in space, settling in a

CREDITS: (PHOTO, OPPOSITE PAGE) LAURENCE GARVIE/CENTER FOR METEORITE STUDIES/ARIZONA STATE UNIVERSITY; (MAP) V. ALTOUNIAN/*SCIENCE* AND A. CUADRA/*SCIENCE*; (DATA) LUCKE *ET AL*., *REVISTA GEOLÓGICA DE AMÉRICA CENTRAL*, 61, 9-22 (2019); LILLIANA RODRÍGUEZ/NATIONAL TECHNICAL UNIVERSITY; WILFREDO ROJAS; LUIS ALONSO ZELEDÓN nameless interstellar cloud.

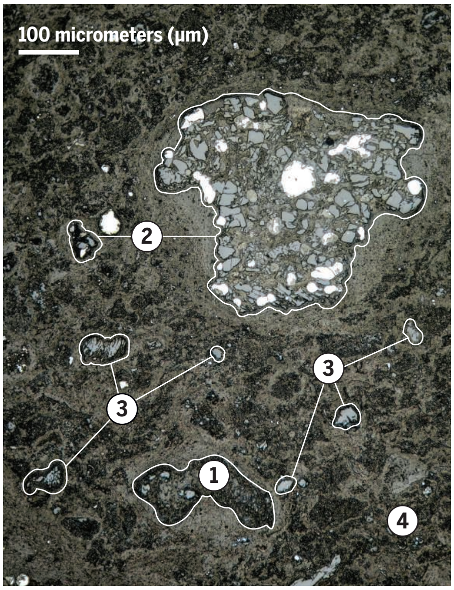
In the next phase, that formless cloud collapsed into a disk swirling around the newborn Sun, generating frictional heat that roasted everything but those presolar grains into a seething vapor. As the disk cooled, the first solids condensed out like frost on a window-pane: crystalline clumps of aluminum and calcium as big as poppy seeds. These fragments date back 4.56 billion years, defining the age of the Solar System. Within a few million years, molten drops of rock cooled into glassy spheres—the "chondrules" that give chondrites their name.

Then, in the third phase, these small particles started to stick together into boulders, among them the hodgepodge of rocks that would become Aguas Zarcas. Planets began to sweep them up, but the future meteorite avoided that fate, remaining part of a small asteroid in the cold void beyond Jupiter. In that early home, it avoided being melted by the Sun or in the hot interior of a planet.

Instead the asteroid grew modestly, amassing specks of ice and carbon, the latter already morphing as sunlight drove chemical reactions. In its interior, the presolar stardust, the first solid minerals, the glassy spheres, and the carbon compounds all crowded together. Heat from the radioactive aluminum melted the ices. Liquid water gushed out, kicking off another wave of chemistry that would go on for a few million years more. Simple compounds such as hydrogen cyanide and ammonia dissolved and were transformed into amino acids and other complex forms.

Heavenly messenger

Aguas Zarcas belongs to a rare class of meteorites, rich in complex organic molecules, including amino acids. Some scientists believe they gave life a nudge when they slammed into a barren Earth 4.5 billion years ago.



Mix and match

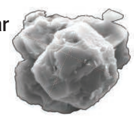
The meteorite is a breccia—a mashup of different primordial bodies. A close-up of a cross section reveals key ingredients.

1 Calcium-aluminum–rich inclusions (CAIs)
Dates from 4.56-billion-year-old CAIs, the first solids to condense from a disk of hot gas, define the age of the Solar System. Isotopes in the clumps record the early Sun's activity levels.

2 Chondrules
Soon after the CAIs, glassy spheres solidified. Chondrules were first described as "droplets of fiery rain" in 1877, but theorists cannot agree on how they formed.

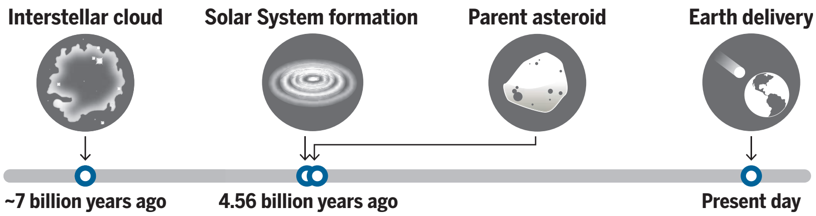
3 Calcite
Crystals of calcite are a sign of aqueous alteration—the watery chemistry that drove the creation of complex organic molecules.

4 Matrix
The dark, surrounding matrix is made of clay and holds the organic molecules. It may also contain a precious few presolar grains: hardy specks of stardust that predate the Solar System.



Time capsule

Aguas Zarcas holds minerals and molecules forged billions of years ago in three distinct periods. Light, heat, and water drove chemical reactions that created increasingly complex organic molecules.



	Interstellar cloud	Solar System formation	Parent asteroid
Key minerals	Presolar grains (silicon carbide, graphite)	CAIs, chondrules	Carbonates
Key molecules	Water, methanol, hydrogen cyanide, formaldehyde	Alcohols, carboxylic acids, hydrocarbons	Amino acids, purines, sugars
Chemical driver	Starlight, cosmic rays	Sunlight, heat	Radioactive heat, water

Increasing complexity →

Many carbonaceous chondrites crashed into early Earth, perhaps delivering not just a sprinkling of organics, but also a portion of the planet's inventory of water. Aguas Zarcas itself endured several billion more years of solitude, save for occasional smashups with other wayward space rocks. Based on its fiery trajectory through Earth's atmosphere, caught on dashcams and volcano-monitoring cameras, researchers believe the unknown body ended up in the asteroid belt between Mars and Jupiter. Then one last collision splintered off a chunk, which spiraled in toward Earth, nearing the rotating globe just as Costa Rica spun into view on 23 April 2019.

Surviving its passage through the atmosphere was one test, but now another threat loomed: the country's formidable rainy season, which could erode and contaminate much of that preserved history. The most important meteorite in half a century had landed on one of the last dry nights of the year.

Nobody knew it then, but the first hard rain was 5 days away.

ON 24 APRIL 2019, the day after the Aguas Zarcas fall, meteorite dealer Mike Farmer wasn't planning on doing much, maybe relaxing with his son or doing some yardwork outside his house in a Tucson, Arizona, gated community. His bags were already packed for a flight the next day to hunt for a meteorite that fell in Cuba. But soon after he woke up, the Facebook picture from Campos Muñoz flashed across his screen. "It was like, oh, Jesus Christ," he says. "I knew immediately what it was." So much for Cuba.

He quickly packed $50,000 in cash into the liner pockets of a safari vest, along with more clothes for what would now be a jungle expedition, and got on the first possible flight to Costa Rica. As the plane taxied for takeoff after a layover in Dallas, Farmer's phone dinged. It was another message from Costa Rica with a photo. Would he like to buy some meteorites? "I about had a heart attack," Farmer says.

That message came from the family of Ronald Pérez Huertas, who lives a few kilometers from Campos Muñoz outside of the village of La Palmera. On the night of the fall, Pérez Huertas was leaving his job at a cheese factory when the fireball flashed overhead. At home, his wife, Virginia Argüello Arias, heard a sound like thunder—the sonic booms of the atmospheric breakup. When she looked outside, the neighbor's German shepherd, Rocky, was cowering and trembling. Later, they learned that a fragment had crashed through Rocky's doghouse.

The next morning, Argüello Arias walked to her front gate. She spotted a small stone coated in an iridescent sheen: the fusion

CREDITS: (GRAPHIC) V. ALTOUNIAN/*SCIENCE*; (DATA) LAURENCE GARVIE/ASU; PHILIPP HECK/FIELD MUSEUM; DANIEL GLAVIN/NASA GODDARD

Marcia Campos Muñoz held off selling her largest meteorite chunk, even as values surpassed gold. Mike Farmer bought everything he could, including a punctured doghouse.

crust that forms in the heat of descent. That afternoon, her son and daughters joined in a family hunt through pastures and stands of mango and soursop trees. They found enough fragments to cover a table and snap a tempting photo. After Googling meteorite dealers, they sent the photo to someone they thought might be willing to pay. To their amazement, he was already en route.

The following morning Farmer showed up in person, along with Robert Ward, a competitor and sometimes collaborator in the meteorite business who had arrived on the same flight. Counting out cash, they bought those initial stones—much too cheaply, the family now realizes.

Farmer also bought the fragment that hit Rocky's doghouse. And, for good measure, the doghouse, too. For the next 4 days Farmer and Ward bunked together at a nearby coffee plantation and set up shop each day on the family's front lawn, offering to do business with anyone in town who trekked over.

A gold rush began. On the first of May, a public holiday, the village was crammed with cars as treasure hunters combed the surrounding land. Buses carrying out-of-towners parked on a nearby hill. Ronald Pérez Huertas began to patrol his property, blocking access to anyone but the Americans. His son had a friend cover his shift at the gas station one day so he could go out and search, returning with a bulky chunk weighing almost 1 kilogram.

By this time as many as 30 collectors from Russia, Germany, Belgium, and the United States had set up their own bases under the path of the fireball, which had strewn fragments across 6 kilometers. Demand grew. Prices skyrocketed from the few dollars per gram Farmer had first offered to \$50, even \$100 per gram, passing the price of gold.

Campos Muñoz, meanwhile, had called scientists at the University of Costa Rica (UCR) on the morning after the fall. Only one meteorite is known to have landed in Costa Rica before—in 1857. For Gerardo Soto, the geologist who called her back, it was a "dream come true." When Soto and his colleagues Pilar Madrigal and Oscar Lücke drove up from San José the next day, carrying microscopes and scales, a quick inspection eliminated their doubts. "I can die now because I saw it," Soto says.

Madrigal, a UCR geochemist, put a piece under a magnifying glass. Her eyes sparkled when she saw the glassy, extraterrestrial chondrules. "It is really meaningful to hold a meteorite like this in one's hands: It is at least 4.5 billion years old," she says. Campos Muñoz says she got goosebumps watching the scientists work. "It seemed like they were about to burst into tears," she says. For hours Campos Muñoz and her family sat rapt with attention as the scientists explained what they could see within the rock.

By the time the foreign collectors arrived, the scientists had already left with photographs and a few tiny pieces of the rock. Without the institutional funding to compete, they kept out of the commercial fray. "Unfortunately, many people sold their fragments to private individuals, and they left the country," Madrigal says.

Around the world, meteorites are subject to a patchwork of laws, often those governing antiques; Denmark, for example, classifies them as "fossil troves" that belong to the state. Australia, Canada, Chile, France, Mexico, and New Zealand consider meteorites cultural treasures that can't be exported without permission. But in many places, including Costa Rica and the United States, meteorites can be freely bought, sold, and exported.

Meteoriticists are largely content with that arrangement, because the market drives people to scour fields and deserts for rare finds, and the collectors often share samples with scientists. But attitudes are shifting, says A. J. Timothy Jull, editor-in-chief of the journal *Meteoritics & Planetary Science*. "Some countries have lost valuable material," he says. "I suppose over time more of these regulations will be developed."

Costa Rica may soon restrict the trade, as well. "I consider it necessary to generate a policy regarding objects from outer space that fall into Costa Rican territory," says Ileana Boschini López, head of the country's Directorate of Geology and Mines.

In Oman vague guidelines meant for historical artifacts snared Farmer and Ward, who were arrested there with a carful of meteorites in 2011 and sentenced, after a brief trial, to 6 months in prison. Conditions were brutal, with rioting in nearby cell blocks and meager meals. They got out halfway through after an appeal. But by then Farmer had lost almost 20 kilograms and was having recurring nightmares.

That episode and other close scrapes have cemented a strange relationship for the duo, who share a love of seat-of-the-pants adventuring—but have trouble sharing the limelight and the sums of money at stake. "Sometimes they absolutely hate each other," says Laurence Garvie, meteorite curator at Arizona State University (ASU), Tempe. But other times they get together and laugh about it. "They are like an old married couple."

The experience in Oman did not seem to diminish the duo's hard-charging instincts. Around Aguas Zarcas, tensions were rising, along with prices. Stones could fetch \$200, even \$400 per gram. Bidding wars ensued. "I came close to sinking a shovel in one guy's skull," Farmer says.

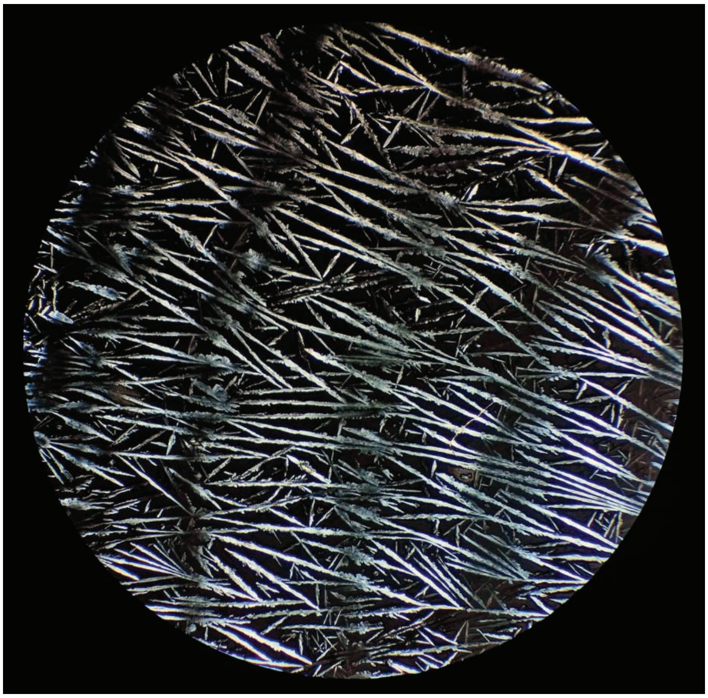
That guy was Jay Piatek, a wealthy doctor and obsessive collector who runs a weight loss clinic in Indianapolis (*Science*, 28 November 2014, p. 1044). He had shown up with his girlfriend, gunning to add to his collection of rare meteorites. With a piece of Murchison already displayed at home, Piatek knew exactly what he was looking

PHOTOS: (LEFT TO RIGHT) ANDREA SOLANO BENAVIDES; MICHAEL FARMER

at—and the prices it could command. "He's screaming, 'I'll pay more!'" Farmer says. "I had a guy rip a bag of rocks out of my hand and rush to him." Piatek remembers it differently. "To me, they were taking advantage of people," he says.

As more collectors swarmed the town and fresh material kept flowing in, other conflicts erupted. Then the first rains fell. Water-logged pieces began to crumble. They emitted a sulfurous reek as the moisture liberated sulfur compounds previously trapped in pores, making remaining fragments easier to find but less precious.

After blowing through his $50,000 in 4 days, Farmer flew back to Tucson, and drove north toward ASU. In the desert midway between the two cities, he handed over his samples to Garvie. ASU would store some, like the doghouse smasher, on Farmer's behalf. Others were straight donations, Garvie says, eventually totaling a few hundred grams.



In fresh samples of the Aguas Zarcas meteorite, researchers have identified salts, easily washed away by rain. Several are recrystallized on glass, including halite.

IMAGE: LAURENCE GARVIE/CENTER FOR METEORITE STUDIES/ASU

Farmer was eager for Garvie to classify Aguas Zarcas scientifically, because getting an official designation was sure to buoy prices. Feeling "nerve-wracking" pressure that a rival institution had obtained its own fragments, Garvie raced to combine the data obtained by Soto's team in Costa Rica with his own mineral descriptions and an analysis of the object's trajectory from a group in Brazil. Isotopic tests by geochemist Karen Ziegler at the University of New Mexico, Albuquerque, sealed its place in the same narrow class of carbonaceous chondrites as Murchison. Garvie submitted a write-up to the Meteoritical Society, which maintains the world's official space rock database.

The report was accepted and published by the end of May, just 5 weeks after the fall. Now "Aguas Zarcas" was formally Aguas Zarcas, and the world's exemplar specimens, about 40 grams worth, would reside at ASU. "Does it really matter that you got first place?" Garvie says. "No, of course not." He pauses. "But it does matter."

ONE DAY in November 2019, outside ASU's meteorite lab, Garvie approaches me gingerly with a tiny glass beaker filled with water and powdered Aguas Zarcas, leftover from a test. He swirls the gray-black mixture like a sommelier to release its bouquet. I sniff cautiously. "You just smelled something that's 4.5 billion years old," he says.

I pick up the smell of moist soil, with an artificial edge reminiscent of permanent marker. Garvie's official report describes a "Murchison-like" odor with "notes of compost." Others compare it to Brussels sprouts, or describe something sweet and organic, like diesel, cooking gas, even vanilla. Farmer, who has a long-standing tradition of eating a little bit of his finds, says it's the nastiest rock he's ever tasted. "Laurence got mad at me," Farmer says. "He said, 'That's pretty stupid, we don't know what's in this!'"

Few papers have been published on the meteorite so far—but they are coming. At the Field Museum, Heck is analyzing an almost 2-kilogram piece, donated by a retired health care executive, to probe the time before the Solar System took shape. He says his team has found a handful of candidate grains of silicon carbide, likely specks of dust scattered by aging giant stars that were later swept up in the protosolar disk. If confirmed and dated, those grains could add to an emerging picture of galactic conditions in the distant past.

A few similar grains from the Murchison meteorite are as much as 7.5 billion years old. But most of its grains were forged just a few hundred million years before the Solar System. If Heck finds a similar age clustering in Aguas Zarcas grains, it could point to a generation of stars all born about 7 billion years ago, giving them a few billion years to grow old and seed the Solar System with dust. Some astronomers believe the Milky Way went through a wave of starbirth at that earlier epoch, perhaps triggered by a galactic merger or a deluge of fresh gas.

The Field Museum team has also been combing through Aguas Zarcas for the calcium- and aluminum-rich inclusions, the earliest minerals to condense out of the protosolar disk. Drifting around the disk, they gathered a record of the young Sun's unruly outbursts, as surges of particle radiation left telltale signatures of helium and neon in each grain. "They are like flight recorders," Heck says. "We can just count those elements that form and learn about the activity of the Sun."

Several other teams are going after the meteorite's complex organic compounds. They formed millions of years later, as basic carbon molecules reacted in the warm, wet interior of Aguas Zarcas's parent asteroid. Some of the products of that early chemistry are volatiles—compounds, frozen in pockets when the meteorite floated in cold space, that are unstable at room temperature on Earth and escape with their telltale smells. Using electronic "noses" designed for the purpose, researchers at Brown University and ASU are hoping to capture the fleeting chemicals before they fade.

Other carbon compounds are sturdier. At NASA Goddard, for example, Glavin's team ground up bits of Aguas Zarcas with a mortar and pestle, mixed them in pure water, heated the mixture to almost boiling, and, using a mass spectrometer, analyzed the compounds rising off.

The process spat out a graph crowded with unknown organic molecules of different weights. "It's like, oh my God, there's likely hundreds of different amino acids in this meteorite," Glavin says. "Murchison, for 50 years, has been the gold standard. Aguas is comparable." The team is now working on a lower temperature technique to hunt for peptides: multiple amino acids bound together. If found, they would illustrate another level of prebiological space chemistry, suspected but never seen.

In a recent twist, though, ASU researchers report they've struggled to find any amino acids in their fragments. "It's strange," says Maitrayee Bose, an ASU cosmochemist. Bose suggests one explanation for the contradictory results: Each piece samples a different bit of a heterogenous rock, which may have experienced different levels of alteration by water and heat. "It's like the human body," she says. "Every part is slightly different."

Looking close at isovaline, an amino acid that occurs in space but is almost never found in earthly life, the NASA team has uncovered hints of a deeper pattern. Amino acids can occur in two mirror-image molecular forms, differing like right and left hands. Chemical reactions have no preference for either form, so left alone, nature should produce half-and-half mixtures. But organisms on Earth seem to build themselves out of only left-handed amino acids.

That bias could reflect a roll of the dice by the first life, a random choice that descendants preserved. Another theory, published in May, suggests the left-hand bias arose on Earth: After life emerged in a mix of mirror-image forms, the radiation of cosmic ray showers in the atmosphere, which has its own inherent handedness, offered an evolutionary advantage to organisms with left-handed proteins.

But Aguas Zarcas has up to 15% more left-handed than right-handed isovaline, underscoring similar findings from Murchison and other carbonaceous chondrites. The persistent pattern suggests the lefty bias may have arisen in space. Perhaps, another camp argues, the polarized light from nearby stars imparted a slight bias to meteoritic organic molecules that was incorporated by life. "I think the meteorites are telling us the story that we were destined to evolve left hand–based protein life," Glavin says.

Other labs are examining Aguas Zarcas for clues to a later stage of Earth's evolution. Models predict carbonaceous asteroids crashing down on early Earth would have produced an ancient atmosphere rich in water vapor and carbon dioxide. At the University of California, Santa Cruz, cosmochemist Myriam Telus wanted to test the idea with real data. She reached out to a dealer for samples, which she then would destroy by baking them to dust and measuring the emitted gases. "It can be very hard to convince people this is worthwhile for something that is precious," she says. But soon she had 2 grams—enough to proceed with the experiment.

For still other scientists, Aguas Zarcas landed at a fortuitous moment.

Right now, Japan's Hayabusa2 spacecraft is hurtling back toward Earth bearing dust from Ryugu, an asteroid with asphalt-black patches that resemble carbonaceous chondrites. Those samples are scheduled to parachute down to Australia on 6 December. And in 2023, NASA's OSIRIS-REx mission will deliver about 60 grams of material from the carbon-rich asteroid Bennu, also thought to be a close relative of Aguas Zarcas.

These asteroid scraps will be truly pristine, having never touched the atmosphere or sat atop rainforest soil. Aguas Zarcas—precious but not space-mission precious—is a good material for trial runs: The OSIRIS-REx team bought 60 grams of it to refine its analysis pipeline in advance of the Bennu material.

Expecting two chunks of prehistoric carbon, scientists find themselves with three. "It wasn't a million- or a billion-dollar mission to go collect it. It just fell," says Jessica Barnes, a team member at the University of Arizona. "So, thank you to the cosmos for that."

ONE DAY IN MAY, once again on the cusp of Costa Rica's rainy season, Ruddy Valerio Díaz sat enjoying the open air at his restaurant next to a freshwater tank teeming with tilapia. Butterflies fluttered through an adjacent breeding garden. COVID-19 had cleared the place of customers, leaving an empty patio, but at least he had a financial cushion. When the rocks rained down, Valerio Díaz had been skipping between temp jobs, dreaming of opening a business. No bank would give him a loan. "Our economic situation was so tough," he says. "This money literally rained from the sky."

With the money from meteorite stones he sold, Ruddy Valerio Díaz paid off his debts, built a butterfly farm, and started a restaurant.

Valerio Díaz waited 2 months to sell the 300 grams of stones he found along roads, under electrical towers, and on his own land. Farmer wouldn't pay enough. But someone else agreed to $50 per gram, enough to pay off all his debts, build his wife, Rosibel, the butterfly farm, and start the restaurant. The only problem was what to call the place. They came up with a long list of punning titles: Manna from Heaven, Cosmos Restaurant, Black Stones. Now, it's Tilapias Rancho El Meteorito—Meteorite Tilapia Ranch.

Nearby, Pérez Huertas and his family used meteorite proceeds to repaint the house, replace the roof, expand their dairy barn, and buy new furniture and a car. Once prices started to climb, Farmer—now a family friend—gave them more money to compensate for his initial lowball purchases, plus bonuses for acting as his fixers. For Argüello Arias's 50th birthday, the women of the family all took a trip to Panama.

Having sold all the putrid fragments harvested after the rains, Farmer said he's hoarding five intact kilograms, out of seven total kilograms he obtained. Some are at home, in the same Ziploc bags they went into the instant he bought them; other pieces are being stored on his behalf at ASU in sealed boxes filled with nitrogen instead of air. Right now, there's still too much available online and at rock and mineral exhibitions for him to sell his collection. "I have the majority of it in the world, and all pristine," Farmer says. "Ten, 20 years down the road, when me or my son or somebody opens that box, you've got a very important asset there."

Little of Aguas Zarcas remains in Aguas Zarcas—or in Costa Rica. UCR is now home to a few fragments, each weighing a few tenths of a gram. San José's National Museum has a little more. Madrigal says she hopes some of the pieces sold overseas might eventually be donated back to Costa Rican institutions.

Campos Muñoz is still a holdout, maybe the last. She still has the big chunk that fell through her roof, which she hopes will end up in an exhibition. She wants more for it—she won't say exactly how much—than dealers have offered.

The hole in the roof remains. She had meant to fix it, but first came the meteorite hunting frenzy, then the rainy season, and now the pandemic. Plus, she knows these bits of collateral damage are valuable to collectors, too. "This hole in the roof and the damaged tables are part of our family now," she says.

Neighbors suspect her family are all millionaires, winners of a cosmic lottery, she says. Strangers still show up from time to time and dawdle out front, looking for the "house of the meteorite." She stays in touch with the Costa Rican scientists to follow their research and reads every paper they send her way.

"I feel very proud that such an important event for history and science took place in my country," she says, "and in my house." ■

Joshua Sokol is a journalist in Raleigh, North Carolina. Andrea Solano Benavides, a journalist in San José, Costa Rica, contributed reporting.

PHOTO: ANDREA SOLANO BENAVIDES

Science

Lucky strike

Joshua Sokol

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