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- Activism through imagery; and more

Reflecting on *Spectrum Petals*

Seven circular acrylic sculptures have brought a playful, captivating presence to Bechtel Mall. They are *Spectrum Petals*, a new art installation by artist Shana Mabari for Caltech's *Crossing Over: Art and Science at Caltech, 1920–2020* exhibition, part of Getty's PST ART initiative. On display through December 15, 2024, *Spectrum Petals* evokes wonder through its dynamic interaction with light and space. The work is sponsored by art organization The Island.

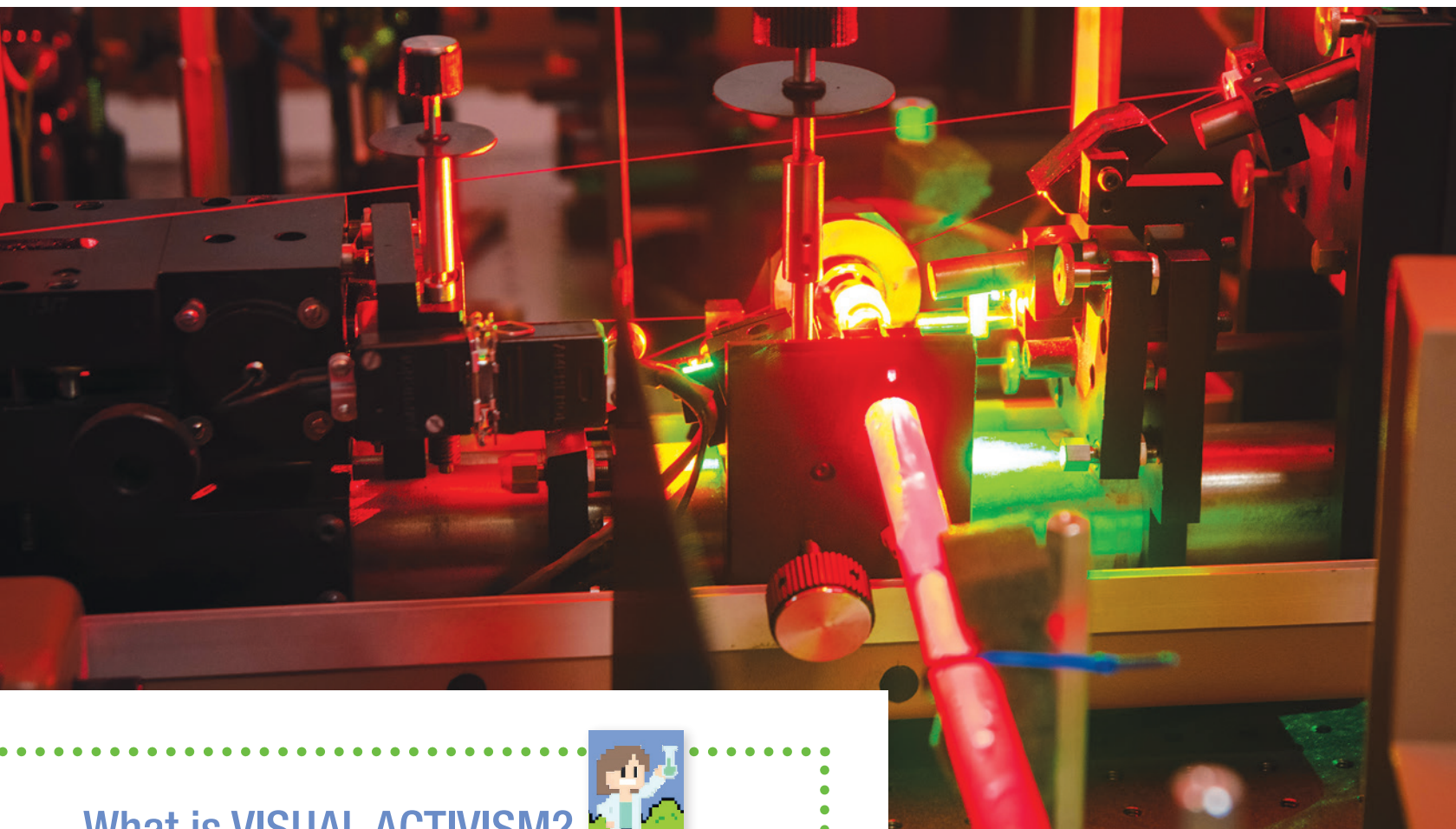
Each sculpture measures 3–4 feet in diameter and has a mirrored surface in a different color of the electromagnetic spectrum. "Color isn't just about aesthetics; it shapes our emotions, perceptions, and even decisions," Mabari says. "The ability to perceive colors from electromagnetic waves in the visible spectrum is a remarkable gift, allowing us to experience the world in rich and nuanced ways."

Mabari cultivated a deep appreciation for the intersection of art and science during a 2004 collaboration with Shinsuke Shimojo, Caltech's Gertrude Baltimore Professor of Experimental Psychology, to develop optical illusion environments. She has also worked with neuroscientist Christof Koch and neuromorphic engineer Tobias Debruck (PhD '93), both of whom spent time at Caltech. These partnerships have inspired her exploration of how humans perceive their body position and movement as well as light and color.

"Mabari's colorful sculptures beautifully activate Bechtel Mall," says *Crossing Over* curator Claudia Bohn-Spector. "Hard-edged and luminous, they sprout like alien blossoms."

The sculptures appear to float effortlessly atop the grass, offering an opportunity for serene reflection—both literally and figuratively. "There is a sense of calm and centeredness in the work," Mabari says. "I hope it offers a meditative quality, an escape from the chaos of daily life that invites people to embrace a more thoughtful experience of joy and harmony."





◀..... Shine a Light

Sometimes, only a 50-year-old laser will do. Nick Hutzler (BS '07), an assistant professor of physics, says this Coherent 599 tunable dye laser, manufactured in 1977, is a surprisingly useful tool for an initial step in his lab's analysis of electron excitations in three species of metal-containing molecules: ytterbium, strontium, and radium hydroxide.

Because the dye laser emits light at a broad bandwidth, the team can create a large, yet low-resolution, image that

includes a wide range of the electronic excitation spectrum at once. If the team were to use a more popular low-bandwidth laser at this stage, they would have to take a series of images to cover the same range.

Broad-bandwidth lasers have fallen out of fashion, Hutzler says, because researchers often prefer to zero in on a more specific frequency range in higher resolution using lasers that emit light at a lower bandwidth. "It sounds weird, but the reason we like this laser is because it's really bad," Hutzler says.

But what happens when the 50-year-old laser breaks? "It's not a very precise instrument," Hutzler says. "We've had mirrors and mounts on them break, and we just eyeballed it and made a new part, which you couldn't do for a modern laser. If it really came down to it, we probably could just build a whole new one."

Alums



Coming



Back

"I'm really excited about championing the impact of what KISS has been able to achieve in the past and what we can do in the future. KISS is recognized for its significant impact in many different areas. Through over a hundred workshops, we've brought together thousands of people from over 300 organizations representing 27 countries, fostering interdisciplinary collaboration."

— Harriet Brettle (MS '19) on her new role as executive director of the Keck Institute for Space Studies

"My first experience working with scientists and engineers at JPL was over 40 years ago as a Caltech graduate student. From that time to the present, it has been clear to me that no other institution matches its combination of scientific breadth and engineering capability. I am thrilled to be able to play a leadership role on the science side of this remarkable institution."

— Jonathan I. Lunine (PhD '85) on his new role as chief scientist at JPL, which Caltech manages for NASA

What is VISUAL ACTIVISM?



"Why do organizers turn to visual culture to communicate demands?" "What are the potential limits of representations?" "Can art help us to understand, enact, or imagine politics otherwise?" These are some of the questions posed by Caltech's Anna Stielau, the Weisman Postdoctoral Instructor in Visual Culture, during her spring 2024 Visual Activism course.

Visual activism, Stielau explains, "goes above and beyond art. It's a big-tent term that names a range of practices that employ the visual as a political tool, from livestreaming police violence to snapping selfies that fill a void in mainstream media."

Stielau came to these questions as a photography student at the University of Cape Town in South Africa in the 2010s, a time when students there were protesting institutional racism and the legacy of apartheid in education. "Student activists were so savvy about social media and the ability of visual materials to broadcast information."

Stielau assigned her students a project in which they used writing exercises to figure out their stance on a specific issue and then come up with a way to visually express that sentiment. Some designed posters, while others took photographs and created memes. Computer science major Pranav Patil (BS '24) designed a playable computer game about the impacts of privatized health care. "If I can teach them to be sensitive to questions of audience or to think about form, they can apply these things irrespective of the messages they are trying to communicate," Stielau says.



A still image from *The Price to Live*, a computer game created by Pranav Patil (BS '24).

Read more



"It's an honor to share this lifetime with you. Thank you for dreaming, daring, and doing!"

"Farewell, Dear Friend"

On April 19, 2021, NASA's Ingenuity Mars Helicopter made history when it completed the first powered, controlled flight on another planet. Though it was expected to make no more than five test flights over 30 days, Ingenuity soared higher and faster than ever imagined by its team at JPL, which Caltech manages for NASA. The aerial scout for the Perseverance rover touched down for the final time on January 18, 2024, after its 72nd flight in just under three years. Here are some of the well wishes sent to Ingenuity and its team throughout its mission.

"Anything is possible when a group of dedicated people work together. Congratulations on a successful mission and for making history."

"You are an amazing helicopter, and I love you."

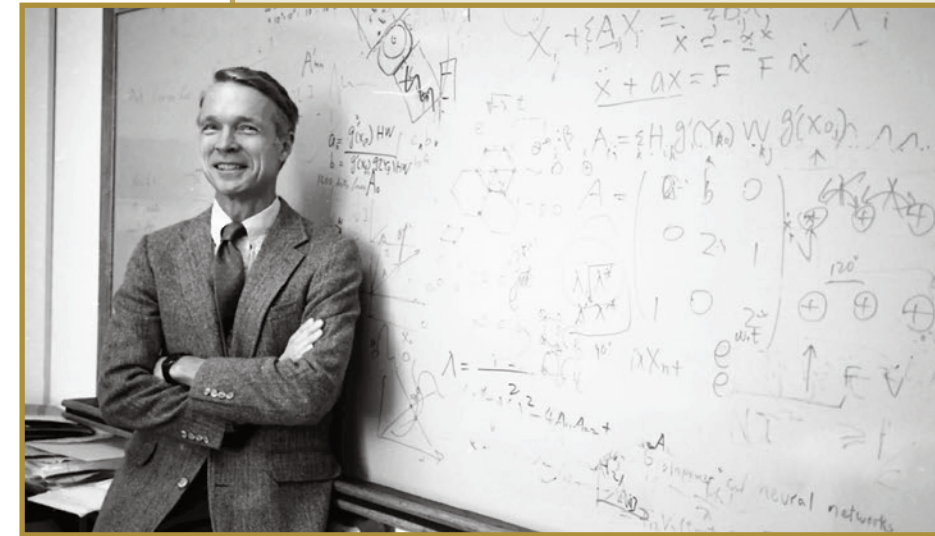
"Ingenuity, you danced in Martian skies, a testament to human brilliance. Your legacy inspires us all. Farewell, dear friend."

"I watched the first moon landing and felt privileged, and now I get to see a helicopter scanning the Mars landscape. Thank you, Ingenuity and team."

"So very proud of you and the team that built you. We must never forget that exploration is a wondrous endeavor."

"Congratulations on being the first 'flying machine' on Mars. Jules Verne would be so amazed!"

AI Pioneer John Hopfield Wins Nobel Prize



Caltech professor emeritus John Hopfield won the 2024 Nobel Prize in Physics along with Geoffrey Hinton of the University of Toronto "for foundational discoveries and inventions that enable machine learning with artificial neural networks." Hopfield, now a professor of molecular biology at Princeton University, served as a professor of chemistry and biology at Caltech from 1980 to 1996 and is currently the Roscoe G. Dickinson Professor of Chemistry and Biology, Emeritus, at Caltech. He co-founded Caltech's Department of Computation and Neural Systems (CNS) in 1986.

Today's machine learning, or artificial intelligence (AI), tools—such as ChatGPT and other programs that can assemble information and seemingly converse with humans—have roots

in Hopfield's pioneering work on artificial neural networks. In the early 1980s, Hopfield merged his background in physics with neurobiology to create a simple computer model that behaved less like the computers of that time and more like the human brain.

Referred to as the Hopfield network, his computer model mimics the architecture of the human brain to store information. The Hopfield network consists of nodes that are connected to each other like neurons in the human brain; the connections between nodes can be made stronger or weaker, such that the strong connections form memories.

Shortly after joining the Caltech faculty, Hopfield teamed up with the late physicist Richard Feynman and with Carver Mead (BS '56, PhD '60), the Gordon and Betty Moore Professor of Engineering and Applied Science, Emeritus, to co-teach a yearlong course called The Physics of Computation. The course was intended to unite their respective fields to explore the relationship between nanoscale physics, computation, and brain function. Three years later, the class evolved into CNS, a new interdivisional program at Caltech that is now a vibrant community of scholars that includes dozens of faculty and has produced more than 100 PhDs.

"We never even thought about it being a department," Mead recalls. "We had lunch at the Athenaeum together. I was in engineering, John was in chemistry, and Dick [Feynman] was in physics, and we had such good arguments that we thought we should have this discussion with the students. It was the best of all worlds, and that happens at Caltech."

Hopfield's Nobel Prize is the 48th awarded to Caltech faculty, alumni, and postdoctoral scholars.

Intergalactic Verse

Emily Silich, a Caltech graduate student in astronomy, wrote a poem inspired by her studies of collisions between two massive clusters of galaxies in which vast clouds of dark matter have decoupled from so-called normal matter. Here is an excerpt:



t = zero:
particles initialized,
gas defined as air.

Opposing dipoles
traversing as livid breath
sans its collisions.

Magma-colored,
decoupling from itself in
tumultuous twists

from tessellations.
An issue of memory
nonessential for

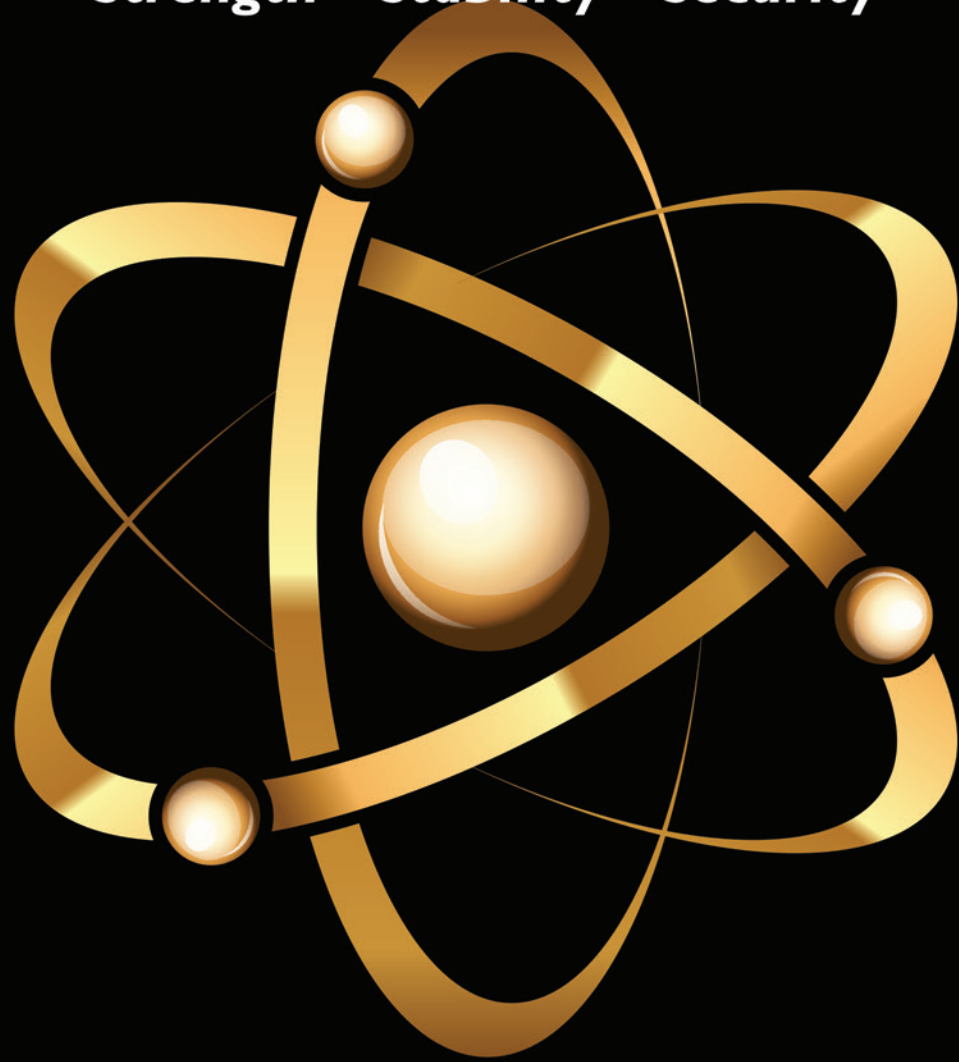
epochs defined by
some time within another;
Parallel elapse.

The full poem was published as part of a collection in the *Altadena Poetry Review Anthology*.



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Adoniya Paul (first-year undergraduate student)

#SoCaltech is an occasional series celebrating the diverse individuals who give Caltech its spirit of excellence, ambition, and ingenuity. Know someone we should profile? Send nominations to magazine@caltech.edu.

Adoniya Paul, a first-year undergraduate from Long Beach, is passionate about engineering, rocketry, and art. She came to Caltech through the QuestBridge National College Match program, which connects high-achieving students from low-income backgrounds to top colleges. Through an early-decision process, students rank their college choices among 50 partner institutions and receive a full scholarship. Paul is a member of Caltech's undergrad class of 2028, which is the first incoming class comprised of 50 percent women since the Institute began admitting female undergraduates in 1970.

"I pretty much put all my eggs in one basket. With QuestBridge, you can rank up to 15 schools, and every school is binding except MIT. I only ranked two—my top choice was Caltech, and the second was MIT. The only reason I ranked MIT was because it wasn't binding, so I thought if I do get into MIT, at least I still have another chance to get into Caltech.

I feel proud and inspired to be part of this historic incoming class. The 50 percent represents a lot more than having an equal number of men and women. It represents the fact that women are now confident to go into the areas they are interested in and don't feel limited by their surroundings or a lack of support."



In the Community

Making a Chemistry Connection

Growing up in West Virginia, Scott Cushing knew little about scientific laboratories or careers, but he loved to tinker with mechanical things, and he repaired cars for money and for fun.

Lasers first captivated him as an undergraduate at West Virginia University, inspiring his career trajectory and ultimately leading him to Caltech. As an assistant professor of chemistry, Cushing builds laser-based scientific instruments. He has also started a mentoring program called Caltech Connection to give students from community colleges and other schools without broad research programs an opportunity to discover if there is something in science that sparks their interest. “I wanted to create a program for LA-area people who have that scientific knack but have no way or no confidence to make their first step into the scientific realm,” Cushing says.

Now in its fourth year, Caltech Connection pairs graduate students and postdocs at the Institute with undergraduates from Pasadena City College (PCC), Compton College, Santa Monica College, East LA College, Cal State Los Angeles, Cal State Dominguez Hills, and Charles Drew University, the latter a historically Black graduate institution in South Los Angeles. More than 60 percent of the program’s mentees come from low-income households and some 70 percent work at least part-time to pay for their education.

During the 2023–24 academic year, the program’s 50 students performed research using state-of-the-art scientific equipment and with mentors who engage in that work daily. Most mentor–mentee pairs meet once a week or once every other week. In the first half of the program, mentors



“I wanted to create a program for LA-area people who have that scientific knack but have no way or no confidence to make their first step into the scientific realm.”

often try to teach soft skills such as time management and how to read a scientific paper. In the second half, many mentors identify a specific research project for their mentees to dig into—maybe completing a calculation, coding a problem, or learning how to operate an instrument. “By the end, we hope the mentees are making independent or joint contributions to their mentor’s project,” Cushing says.

PCC student Kevin Aday applied to the program in fall 2022. He was paired with Greg Lavrentiadis, a post-doctoral scholar research associate in mechanical and civil engineering at Caltech who studies fault displacement and ground motion models of earthquakes. By early 2023, Aday was working with Lavrentiadis to correct seismic records affected by instrument response during the magnitude 6.5 and 6.8 earthquakes in Taiwan the previous year.

Next, he worked with Lavrentiadis to create a model to characterize

ground motions in Groningen, Netherlands, an area that has experienced human-made earthquakes caused by the removal of natural gases. “Getting the opportunity to not only observe but take part in the work being done in the lab was the most valuable experience that I’ve had in college thus far,” says Aday, who recently began studying engineering as an undergraduate at UC Berkeley.

About 80–90 percent of students from PCC who participate in Caltech Connection and similar programs transfer to research-intensive universities compared to only 10–20 percent of their PCC peers. “The mentees are incredible,” says Tiffany Kimoto, executive director of the Kavli Nanoscience Institute at Caltech, who serves as an administrator for the program. “I’ve watched some folks start off as shy students ... and develop into stellar graduate researchers at top-rate institutions and leaders among their peers.”

—Kimm Fesenmaier



Caltech Connection participants and organizers during a poster session in May 2024.

Origins

A Feline Predator in Arms Lab

In an unassuming corner of the Charles Arms Laboratory of the Geological Sciences, a fanged feline snarls behind a glass cage. But this predator can no longer hurt you. The skeleton of a *Smilodon fatalis*, or saber-toothed cat, has been on display since 1997, when it was loaned to

the Division of Geological and Planetary Sciences (GPS) by the Natural History Museum of Los Angeles County (NHM).

The blackened *Smilodon* bones excavated from LA’s La Brea Tar Pits come from multiple saber-toothed cats between 12,000 and 33,000 years old; the composite skeleton was assembled in the mid-20th century. Caltech paleontologist Chester Stock measured the skull for his 1932 publication, *The Felidae of Rancho La Brea*, and, in many ways, the *Smilodon* on display in Arms tells his story.

Stock, who went on to shape GPS, NHM, and public engagement with paleontology for generations to come, became enamored with the La Brea asphalt pools after excavating there as a geology student at UC Berkeley, and he continued to study the site’s large vertebrate fossils for the rest of his career.

Stock joined the Caltech faculty in 1926, helping to found the GPS division and establish its paleontology program. In the classroom, Stock wove vivid lectures about the Pleistocene-era creatures that once roamed the region. He also took students into the field on fossil-digging expeditions across the American West and Mexico. When the Arms building opened in 1938, most of its ground floor served as a museum to display

Stock’s specimens, including a towering dinosaur skeleton.

Meanwhile, Stock also served as a curator at NHM, where he ignited imaginations with fossils and laid the groundwork for the development of the La Brea site into a museum that invited guests to descend into an excavation area. Stock did not live to see the results, passing away in 1950. But the Observation Pit, now part of NHM’s La Brea Tar Pits Museum, opened in 1952 and was dedicated in his honor.

After his death, NHM acquired Stock’s fossil collection at Caltech for \$100,000, and the museum in Arms was converted to office space. GPS used the funds to invest in a new research frontier: geochemistry (see story on page 14). “I find it interesting that the money from the collections helped to start the geochemistry program,” says Julia Tejada, an assistant professor of geobiology at Caltech and a William H. Hurt Scholar. “It’s very full circle, because my research combines both paleontology and geochemistry.”

Tejada also has an academic connection to her paleontological predecessor at the Institute. Her master’s advisor at the University of Florida and her PhD advisor at Columbia University both were advised by Stock’s student Malcolm McKenna.

Now working just a few doors down from the *Smilodon*, Tejada finds that the skeleton connects Caltech’s history with that of the region. “Having such a magnificent specimen here is incredible. It shows you how LA was only 15,000 years ago: populated by mammoths, giant ground sloths, saber-toothed cats, and camels. It just humbles you and evokes your imagination.”

—Julia Ehlert

