- Lending before banks
- Meet Instagram innovator Alex Phillips
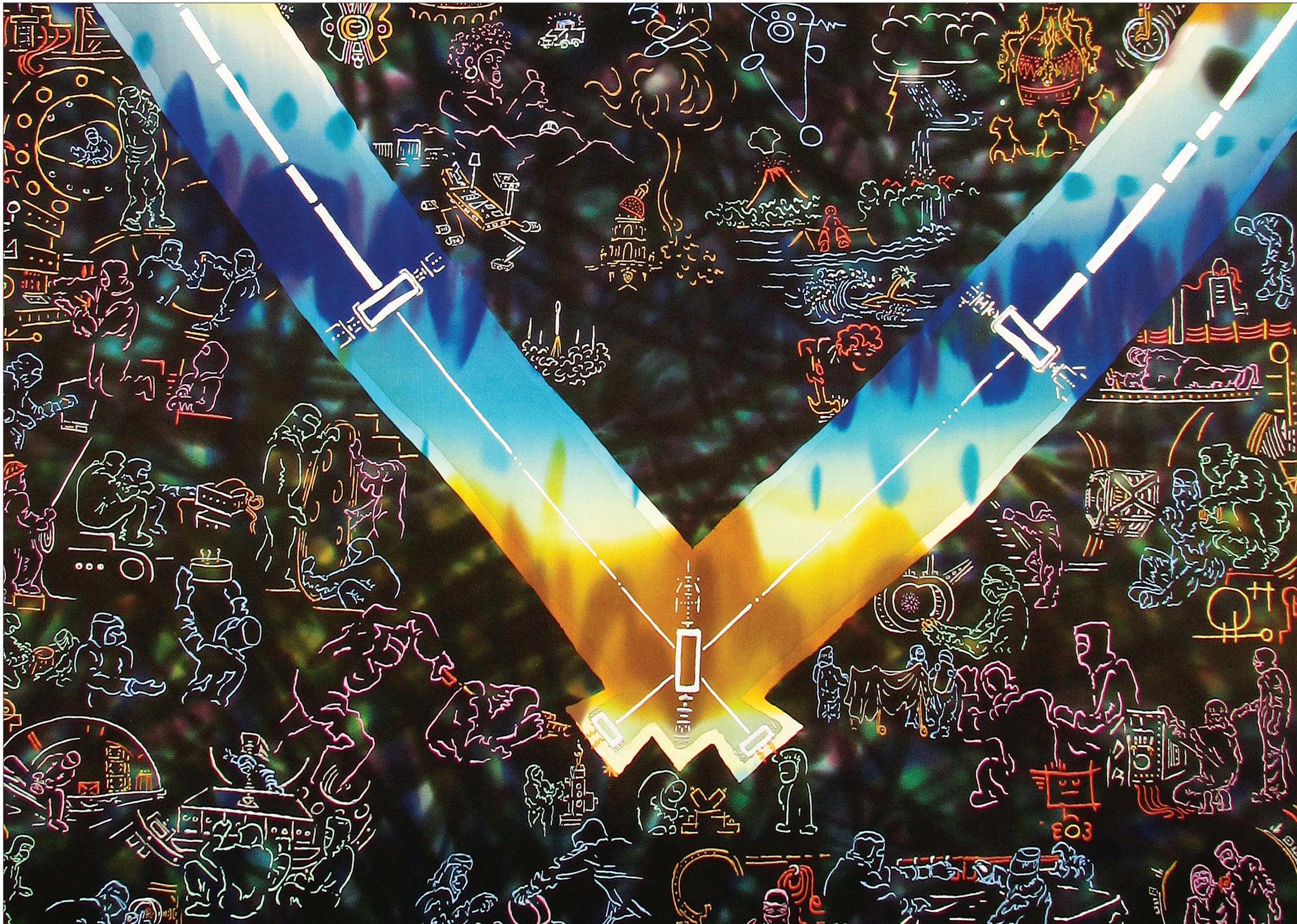- Coding for kids
- A podcast for polymaths

Making Art out of Science

"The nice thing about teaching art here is that I've had the chance to get to know many creative research scientists and engineers," says Jim Barry, Caltech's drawing, painting, and silkscreen art director. "People will invite me to visit their labs and learn more about the science of everything from gravitational waves in space to the geology of rivers."

Barry, who joined Caltech more than 30 years ago, was more recently inspired to base a larger portion of his own art projects on Caltech work. "That's when I went to see some old friends from LIGO [the Laser Interferometer Gravitational-wave Observatory] and got an idea of what was going on there," he recalls. "I created a large silk painting [a portion of the work is shown at left] of the LIGO detectors and all sorts of related scenes, including ancient observatories, noise from earthquakes, and the ghost of a leftover charge from a specialized mirror cleaner."

Next up, says Barry, is a deep dive into the ideas of quantum computing and an exploration into ways of depicting the subatomic world through art.

See the whole painting as well as a legend explaining the various scenes at **magazine.caltech.edu/post/making-art**

Four Questions for :
Jean-Laurent Rosenthal and Philip T. Hoffman

In their new book, *Dark Matter Credit: The Development of Peer-to-Peer Lending and Banking in France,* Caltech's Jean-Laurent Rosenthal (at right, in photo) and Philip T. Hoffman (at left), along with their co-author Gilles Postel-Vinay, a professor emeritus at the Paris School of Economics, make the case that money borrowing and lending thrived in 18th- and 19th-century France without the help of banks. By sifting through archival data on 250,000 French loans, the researchers were able to uncover a shadow system of peer-to-peer lending. The system let nearly a third of French families borrow money in 1740; by 1840, it funded as much mortgage debt relative to gross domestic product as U.S. banks did in the 1950s.

"We can abstract away all of the astrophysics of the problem and really just think of it as a purely computational imaging problem. We have these sparse, noisy data, and our challenge is to find the image that actually caused it."

—**Katie Bouman,** *who will join Caltech's faculty as an assistant professor of computing and mathematical sciences in the Division of Engineering and Applied Science in June. Bouman is a member of the Event Horizon Telescope (EHT) team and worked on the computational imaging that recently helped capture the first-ever image of a black hole.*

1. What is the main message people should take away from your book?

JLR: Credit markets in Europe were really big before banks became important players in financial markets.

PTH: And the findings were a surprise because all this lending was going on without anything like our modern credit scores or even a way to tell if property had been mortgaged. It shows how ingenious people can be under the right conditions.

2. Do the lessons from this book have any practical applications for today's credit markets?

JLR: At first blush, this book is about a system of peer-to-peer lending that goes back centuries but didn't disappear until just before World War II. In that way, it is really history. But history is full of useful lessons, and the most important one for credit markets is that they will only thrive when reliable information can flow from borrowers to lenders. Building banks when the information system is deficient will lead to little lending or worse yet, financial crises.

PTH: The book's lessons apply to modern peer-to-peer-lending, which is cropping up around the world thanks to the Internet. In China, it has attracted over 50 million investors, but because the firms arranging the loans misled investors, the whole market collapsed in 2018. A bit of government regulation would have helped, as in other financial markets.

3. What were your favorite and least favorite parts of researching and writing this book?

JLR: The best part was working with Phil and Gilles. When we disagreed, everyone sat down and articulated how data would discriminate between our different arguments. And then we would go and collect what was needed, which was just educational and fun. My least favorite part was putting together a final database from data collected beginning in the 1990s. It took me a long time to be sure I had the best version of the data for each of the 160 localities we included.

PTH: Each of us brings something different to our research, and that is why it is a real delight to work together and figure out how to tease the data we need out of the surviving historical records. My least favorite part was going through the manuscript to check that the numbers in every table, graph, and sentence matched that final database.

4. Do you have any other books planned?

JLR: I have started to work on a book about wealth inequality in Paris from 1807 to the present.

PTH: I have a book underway on why the Industrial Revolution happened first in Europe and not somewhere else, such as China. And the three of us have another book project in mind as well about a huge financial collapse in 1740s Paris that cost powerful people a fortune. It's a great story, worthy of a movie!

Jean-Laurent Rosenthal is the Rea A. and Lela G. Axline Professor of Business Economics and the Ronald and Maxine Linde Leadership Chair, Division of the Humanities and Social Sciences. Philip T. Hoffman is the Rea A. and Lela G. Axline Professor of Business Economics and History.

UNDERGROUND OPERATION

For DARPA's latest Grand Challenge robotic competition, the SubT Challenge, teams of autonomous robots are tasked with rapidly mapping, navigating, and searching underground environments under the supervision of a single remote operator. CoSTAR, the JPL/Caltech team, led by JPL's Ali-akbar Agha-mohammadi and Caltech's Joel Burdick, has passed the qualifying rounds. This summer, CoSTAR will compete in the tunnel section of the competition at a yet-to-be-disclosed location.

August 2018
When CoSTAR found out it had won a slot in the contest

5 Number of DARPA challenges Joel Burdick has worked on

3 Number of years over which the SubT Challenge will take place

7 Number of teams selected for funding by DARPA

$1.5 million a year for 3 years
Amount DARPA is funding selected teams

≈ 8 kilometers
Length of the underground course DARPA will build

3 Number of environments robots will need to master (tunnels, urban underground, and natural caverns)

? Number of robotic vehicles the team will need to build. (Too soon to tell.)

>40 Number of CoSTAR team members

Campus 360°

A new online interactive tour lets those off campus make a virtual visit to Caltech through a series of 360-degree photographs. Shown here is the Ames Lab, where engineering professor Aaron Ames and his team tackle some of the most challenging problems in robotics, such as the design of bipedal walking robots. Students in the lab are also developing designs for robots that hop. Before assembling the robots, students tweak code, design chassis and gears, and machine the parts in the metal shop.

To see the tour, go to
tinyurl.com/Caltech360

Alex Phillips (fourth-year graduate 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.*

Alex Phillips, a fourth-year geochemistry student, is the founder and curator of the @women.doing.science Instagram account.

"Science is a lot more than women in white lab coats holding up beakers. On social media, I see a lot of headshots of scientists, but I just don't relate to headshots! Do scientists get dressed up in a suit each day and smile? That's not what science is. Science is being in the lab running a column, being out in the field collecting rocks, going on a boat, working on your computer doing models, and I think that kind of representation is missing from social media. When I looked for an Instagram account posting action photos of women doing all sorts of things in science, there wasn't a single one. So, I thought maybe I should just make one. ... so I did! When I started last June, I thought if I reach 1,000 followers, I would be proud! Now we have over 40,000, which is kind of amazing. And the cutest thing is that my dad still 'likes' every single picture. He's our biggest fan."

For more **#SoCaltech,** go to tinyurl.com/MagSoCaltech

Class Act:
Coding for Kids

On Friday afternoons, Caltech computer science students visit public schools in Pasadena to help third-, fourth-, and fifth-graders learn to code. Their work is part of a recently introduced course in which Caltech undergrads study and practice strategies for teaching programming to children.

"We start with basic concepts, and by the end, students have coded their own games in Scratch [a visual programming language developed for children]," says senior Anna Resnick, who helps lead the class as a teaching assistant. "A few have even told us they want to be programmers someday."

Stepping up

The coding initiative started about five years ago when a Pasadena Unified School District teacher requested Caltech's help with computer science instruction, says Mitch Aiken, the Institute's associate director for educational outreach. Around the same time, a group of first-year students at Caltech expressed interest in teaching coding.

A pilot program, in which student volunteers visited schools to deliver programming lessons, proved promising, Aiken recalls. But organizers determined that more students would be able to consistently commit time to the project if it were part of a formal class rather than a volunteer effort.

"It reminds our students why they were first inspired by computer science," says Claire Ralph, lecturer and outreach director for Caltech's computing and mathematical sciences department. "And it's an opportunity to give back, another way to have an impact on the field."

Easy access

For participants, undergrads, and elementary schoolers alike, the experience can also make computer science seem a little more accessible, Ralph says.

"For our students, it's a good reminder of how far they've come," she says. "It can be easy to underestimate how much you've learned and how much you know. You have to really understand something well to be able to explain it to a fifth-grader."

"I've always loved teaching, helping people understand things," senior Steven Brotz says. "The kids are all familiar with computer games. We have the

chance to help them understand how those games get created."

Looking ahead

Alix Espino, a Caltech senior, hopes the time she spends with younger students encourages them to consider careers in computer science.

"I felt like it was important for me to get involved because there are not a lot of Latinos in tech, and this school [Jefferson Elementary] is predominantly Latino," Espino said. "I thought I could be a good role model."

Caltech senior Anna Resnick shares basic coding skills with Natalia Jimenez at Pasadena's Jefferson Elementary School.

"Most students are willing to work very hard and dedicate substantial time and energy to learning if they know that what they are doing is worthwhile. That is why it is so important for them to know why a certain seemingly obscure mathematical concept or a physical phenomenon matters and where it fits in the grand scheme of things."

—Ali Hajimiri

Winner of Caltech's 2019 Feynman Prize for Excellence in Teaching and Bren Professor of Electrical Engineering and Medical Engineering in the Division of Engineering and Applied Science

Back on Campus

Astrophysicist and Caltech alumna France Córdova (PhD '79) stepped onto the Beckman Mall stage on June 14 as the speaker for Caltech's 125th commencement ceremony.

Since former President Obama appointed her director of the National Science Foundation in 2014, Córdova has developed initiatives that cut across fields of scientific discovery, technological innovation, and STEM education.

Formerly president of Purdue University, Córdova also served as NASA's chief scientist in the 1990s. At the time, she was the youngest person and the first woman to hold that position.
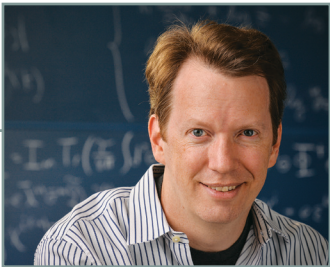
Prefrosh Visit? Solved!

The almost 300 students who visited Caltech in April for the Institute's Prefrosh Experience, a welcome event for newly admitted first-year students, were greeted by two oversized Rubik's cubes balanced on the lawn of the admissions office. Attendees at the three-day event formely known as Prefrosh Weekend got to stay overnight in student residences, meet current students, and interact with members of the Caltech community.

Squirrel added for scale

Extracurricular:

Sean Carroll Versus the "Science Silo"

While science is a powerful tool for understanding our universe, it is not the only one, insists Caltech theoretical physicist Sean Carroll. On *Mindscape,* his new podcast, Carroll hosts conversations with interesting thinkers on topics across the spectrum: from superstring theory to the fall of Rome.

Carroll first became interested in podcasting after guest appearances on podcasts hosted by others. To come up with the format, he drew on his experience interviewing diverse thinkers for his latest book, *The Big Picture.* "Really, a podcast is just my excuse to talk to a bunch of interesting people," he says.

Those "interesting people" have included scientists such as Caltech's Mike Brown and Kip Thorne, of course, but also historians, musicians, movie critics, conservationists, theologians, and activists. Featuring guests beyond the field of science is central to the premise of *Mindscape.* "There's a certain way in which people who do economics, or law, or philosophy, or anything else can spread out their thoughts a little more widely," he says. Carroll also hopes to tear down barriers. "I want to establish that science should be a part of this interconnected ecosystem," he explains, "rather than off in a separate silo."

New episodes of Mindscape *are posted weekly and can be found on Carroll's website at* **preposterousuniverse.com/podcast.**