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Weilai Yu (PhD '21) took this photo from the roof of the Beckman Institute in 2018.

Letters

Trailblazer

The Spring 2023 issue warmed my heart and prompted me to write. Here's why: I was awarded a Caltech MS in environmental engineering science in 1972. I was one of the first students in this breakthrough program. Now I'm 74, living in Sequim, Washington, and retired from a 38-year career as a California attorney. Why the switch to law? Because Caltech and I were trailblazers and too early for start-ups, a much less mature job market. So, I switched to law school at USC.

But because of my Caltech degree, I had the opportunity to work on the professional staff of the National Materials Policy Commission and as a script advisor to Dirk Summers, the producer of a film financed by the United Nations titled *Survival of Spaceship Earth*, which is still viewable on YouTube. So, I was amazed to see and read the "Sea Change" and "Out of Thin Air" articles! Way to go, Caltech!

Nelson (Nick) Brestoff (MS '72)
SEQUIM, WA

Water Log

The article by Ker Than in the spring issue of *Caltech* magazine about Professor Bethany Ehlmann's Lunar Trailblazer experiment to characterize water in lunar polar regions prompts me to tell a story regarding an early failed attempt by my JPL-Caltech lunar sample investigation group to detect, through nuclear magnetic resonance spectroscopy, water greater than the 0.0001 percent weight level in the Apollo samples. This failure led some of us to carry out detailed analyses of the very strong lunar ferromagnetic electron spin resonance (ESR) signals in all our lunar samples. Upon working out the theory for this ferromagnetism, we found we could measure the lunar sample Fe and Ni contents. Additionally, we could detect and

measure the paramagnetic $MN(H_2O)_6^{2+}$, which was suggestive of water contents of 20–140 parts per million in all our lunar samples.

The significance of our ESR results caused the Lunar Receiving Lab folks to immediately acquire ESR instruments and look for ESR-trained staff. The goal became to record the ESR profile of every lunar sample. My two collaborators in the ESR work were JPL–Caltech NASA research fellow Fun-Dow Tsay and Caltech professor Sunney Chan [George Grant Hoag Professor of Biophysical Chemistry, Emeritus]. I can only hope that Professor Ehlmann and Lunar Trailblazer are successful.

Stanley Manatt (BS '55, PhD '59)
LA CAÑADA FLINTRIDGE, CA

On the "Origins"

Your story on the LGP-30 brought back memories. Besides the one found in Germany, I bet there is one in a basement somewhere at Caltech. At least one was there, already obsolete, when I was an undergrad, and anyone with permission from Carver Mead [BS '56, MS '57, PhD '60, Gordon and Betty Moore Professor of Engineering and Applied Science, Emeritus] could use it. My physics lab partner Alan Hindmarsh [BS '64] and I wrote machine language code (no Fortran yet!) to run on it to calculate results from a physics lab experiment. If I remember right, we ended up doing the calculations the regular way, with our slide rules, because getting data in and out of the teletype was too clumsy.

I learned a lot about designing efficient code that was useful throughout my career when I wrote code for protein crystallography and then neuronal network simulations. Every instruction in the LGP-30 had a memory address field that specified where on the memory drum to read the next instruction. So, if you knew how long different operations took and the rotational speed of the drum, you could place your instructions, and sometimes your data, where they would come around on the drum to the read head just when needed. Maybe a little like planning where data will end up on memory cache lines in today's machines.

George Reeke (BS '64)
NEW YORK, NY

Your story on the LGP-30 brought back fond memories. In the fall of 1959, as a junior majoring in math, I took EE 180, Digital Computer Design. As part of the course, we studied the complete logical structure of that computer, showing the details of how each instruction was executed. We even put the system into tiny infinite programming loops, each executing just a single instruction, so we could view the electrical activity on an oscilloscope to monitor the execution. My project was to write a Monte Carlo method to integrate a function that could be submitted as a subroutine. That was pretty heady stuff back in those days! But it was good enough to get me a summer job in 1961 on the CPU design team at JPL for the first general purpose computer to be taken on a spacecraft: the Mars Mariner B, later the Mariner 3 and 4.

Dick Norman (BS '61)
GREENBRAE, CA

I enjoyed the article "Origins" about the LGP-30. We learned about it in a computer course and got to work with it a little. The developer, Stanley Frankel, went on to develop the electronic calculator at a company called Electrosolids.

Bruce Wilkinson (BS '58)
ESCONDIDO, CA

Members of Ali Hajimiri's lab prepare to detect a signal from the Microwave Array for Power-transfer Low-orbit Experiment (MAPLE) on the roof of the Gordon and Betty Moore Laboratory of Engineering. See story on **page 14**.