Featured Stories

Richard Denning.

How Explorer Helped Launch a Six-Decade Career at JPL

By Taylor Hill

On June 19, 1961, at age 19, Richard Denning began his first day at JPL with dreams much like those of new employees today: He wanted to work on spacecraft.

And back then, just as now, those dreams can quickly become a reality. Sometimes in one day.

“I felt like I was riding on the crest of a wave,” Denning said. “That first day, I was handling instruments from MIT and Iowa State University that were slated to go on the Mariner A spacecraft, and I was pretty happy about that.”

Sixty years and countless instruments later, the once electronics technician, now senior engineer, called it a career, retiring from JPL on Sept. 10.

Starting on an Accelerated Path

As a high school student in Monterey Park, Denning had hopes of working at JPL. The now-famous image of William Pickering, James van Allen, and Wernher von Braun hoisting an Explorer 1 model in the air taken just the year before Denning graduated in 1959 piqued his interest. Thanks to the times, he was able to fast-track the schooling needed to get his hands on spacecraft parts.

Denning (left) talking with the instrument manager on the Russian Geophysical aircraft that flew a Microwave Temperature Profiler for the Solve II ozone measurement campaign.

"After Sputnik, there was a revamping of the education system, with a focus on getting technically educated workers out in a hurry," Denning said. "Pasadena Community College had a program in conjunction with Cal Poly Pomona, where they would give you four years credit [in two years] on electronics without all of the other bells and whistles."

Equipped with his AA in Electrical Engineering, Denning descended on JPL as a Technician II—the lowest level he'd heard of—as most new hires were Level III technicians or engineers.

"But I've never felt sorry for myself about it," Denning said. "I was getting paid $2.10 an hour—a big raise from the $1.75 I was making at my previous job. And at that time, a lack of degree wasn't too much of a problem. It was whether or not you could do stuff—and a range of stuff."

Denning in 1974 working during an expedition to Steamboat Hot Springs near Reno, Nevada on geothermal exploration.

Phase 1: Planetary

Denning sees his time at JPL bifurcated into two phases: The first being the "planetary" phase, where he worked for about 12 years on missions including Mariner A, Mariners 1 and 2 (Venus), 3 and 4 (Mars), Pioneer 10 and 11, Apollo 12 and 15 Lunar Surface Experiments Package (ALSEP) SWS. He recalls working on Mariner 4—a flyby mission to Mars—from inception through planetary encounter in 1965.

"I was still pretty junior, so I was scheduled for the graveyard shift in the Spaceflight Operations Facility during the cruise phase," Denning said. During his shifts, data would come in on teletypes, and he would take the printouts, decode the gibberish, and look for tell-tale flags that indicated an "event" had occurred. There was a computer upstairs that would put various instrument parameters on an xy plotter, showing the magnetic field, micrometeorite hits, and the health of the scientific instruments on board.

"My job was to jot down some numbers and alert people if something had happened with the instruments," Denning said. "A couple of times, the micrometeor sensor went off or the magnetic field reversed, and we were making calls, alerting the experimenters."

Phase 2: Ground and Air-based Science Abroad

By 1973, following the Apollo Moon missions, NASA's budget was cut and layoffs were imminent. Denning was a week away from his scheduled last day when he got a call from Jim Johnston, then-manager in the microwave radiometer group, to do ground- and air-based science with leftover instrument parts.

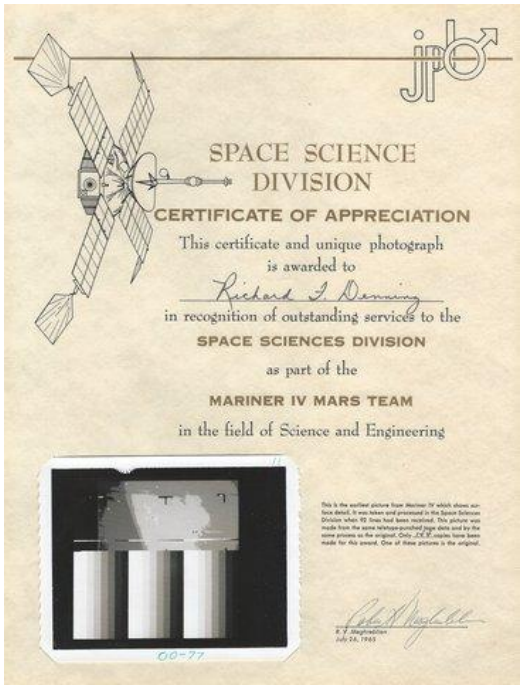
"I answer the phone and Jim says, 'I hear you're looking for a job,' and from that moment on, I transformed from a planetary guy into mostly ground-based and air-based Earth Science microwave radiometers," Denning said.

Principal Engineer and RF Microwave Engineer Alan Tanner, who has worked with Denning since 1989, said the team is truly hands-on—mostly out of necessity. Their tasks involved installing microwave radiometers and other instruments into ground-based operations systems or instruments aboard NASA airplanes in order to gather data in real time from below, which would then be used to confirm the data satellites in Earth orbit were capturing.

“For any new Earth remote-sensing satellite that goes into space, typically there’s something underneath flying to confirm that you’re getting the data that you think you’re getting.” Tanner said. “Dick was instrumental in figuring out how to make the microwave temperature profiler work on whatever aircraft they were flying, and in whatever area they were flying.”

Denning at JPL with a DC-8 Microwave Temperature Profiler used on the CAMEX-4 program in 2001.

Over the years, Denning traveled to remote airstrips around the world to shepherd instruments with JPL radiometers on board, heading to Wolf Island on Lake Ontario, Canada, in 1974 to study ice growth in support of Skylab. From 1987 to 1989, he traveled to Darwin, Australia, then Punta Arenas, Chile, and then Stavanger, Norway to examine ozone depletion levels above Antarctica and the Arctic. By 2001, Denning had racked up a paragraph’s-worth of instrument acronyms he’d worked on, and he was busy in Jacksonville, Florida operating the High Altitude MMIC Sounding Radiometer (HAMSR) to measure moisture and temperature readings in a hurricane field. HAMSR is still in operation today, providing observations similar to those obtained on NASA, NOAA, and ESA spacecraft, continuing to provide valuable comparative analyses.



Denning received this certificate for his work on Mariner 4.

From the ozone missions to climate change and hurricane severity, Denning says the work at JPL will continue to inform.

“The ozone findings were really the first that had some controversy, as we were told back then that getting rid of freon would destroy the economy, and so on,” Denning said. “But those findings begot protocols on cutting down production of CFCs, and the ozone started healing. It’s all related. At first nobody thought that mere man could affect things on a global basis, but we know now that you do enough stuff, that it hurts. All of these things are related, and the science has to be too. When I was doing the airborne work, we were in contact with people working on Earth science satellites. It isn’t a separate area, it’s all part of one.”

A Steady Presence Through the Years

From 1961 to 2021, Denning watched and learned as the term ‘computer data’ changed from punched paper card stacks that needed to be taken to a computing center for a proper printout, to today, where researchers and engineers write their own software for specific data analysis capabilities.

“The explosion we’ve seen in computer science has allowed for the information and data explosions in just about every other field,” Denning said. “There’s no way any single person can wrap their head around all of it, but over the years, I was able to get along. In my career here, I worked on microcomputers for decades, which is pretty amazing considering I started off figuring out how transistors worked.”

For Tanner, Denning’s steady demeanor—along with his ability to continue sharpening his expertise—made him a consummate colleague.

“The beauty of our group is that we would go out into the field with the instruments we’d designed and built ourselves. We’d put them on the planes ourselves, and go and analyze the data ourselves,” Tanner said. “Dick is very much the type of engineer with broad and diverse talents—he’s been able to stay up with the latest technologies, and always remained even-keeled no matter the situation. His is a life of integrity I’d like to emulate.”

Denning in 1974 working during an expedition to Steamboat Hot Springs near Reno, Nevada on geothermal exploration.

A few years ago, Denning ran into Sue Finley, the computing legend and barrier-breaking JPLer who began her career at JPL even before he did.

“I mentioned that I was thinking of retiring, and she said: ‘Why would you do that?’”

It took a pandemic to slow Denning down. Airborne expeditions were curtailed due to Covid over the past two years, and the teleworking transition didn’t sit well with Denning and his hands-on approach. The quarantining also exacerbated the separation Denning and his wife, Lorrie, felt from their children and grandchildren. He decided it was time to stop flying to remote airfields for NASA experiments, and instead start taking more trips to see family in Northern California and Washington. So at 79, Denning set the wheels in motion for retirement.

Still, after six decades analyzing air temperatures and moisture levels, Denning wants to keep an eye on the weather. His post-JPL plans include starting a small vineyard on the property of his desert home with his wife in Littlerock, California. Denning has already set up a weather station on his property, which tells him soil moisture levels, air temperature, and more.

“I’m actually not that interested in drinking the wine,” Denning explained. “I’m more interested in figuring out the technical side of growing the grapes, and how to do it in a drought-stricken climate. It’s about figuring things out for me.”

The employee may have retired, but the engineer is still going.

Denning received his 50-year certificate of recognition from then-Director Charles Elachi in 2011.

Long-haul JPLers: Who has been on Lab the longest? According to Human Resources, the answer is a bit tricky:

- As for regular, benefit-based employees, there have been two to reach the 60-year mark: Richard Denning and Joe Savino. Savino, who started at JPL in 1956, passed in 2017 as an active employee.
- Other notable JPLers with 60 years of service are John Casani, and Carl Sauer. Casani started at JPL in 1956 and is now retired and serving in JPL's Interim Employment Program (IEP). Sauer started at JPL in 1952 and retired in 2006, serving as an IEP and surpassing the 60-year mark. Sauer passed away in 2015.
- Sue Finley started in 1958 as an affiliate and has been employed full time almost continuously.

JPL summer intern Natalie Deo.

Warp Speed

By Celeste Hoang

To hear Natalie Deo explain why she wanted to leave high school at the age of 14 and go straight into higher education is to hear it from the perspective of a precocious teenager wise beyond her years – and her peers.

“I was walking to first period in high school and I saw a couple making out and I was like, ‘I’m getting out of here. I don’t want to see that,’” Deo, now 19 and a summer intern at NASA’s Jet Propulsion Laboratory, deadpans.

Not that she hadn’t thought about fast-tracking it out of high school before that moment, of course. Deo, who grew up in Downey, California, was already familiar with the highly selective Early Entrance Program, or EEP, at Cal State University, Los Angeles that puts gifted students on an accelerated path toward college admission, and she had taken the ACT while in eighth grade. After finishing ninth grade, she was one of a handful of high-school students selected to start her undergraduate studies in electrical engineering at Cal State L.A.

“I was tired of being around people who weren’t as motivated. People were begging me to do their homework or trying to pay me to write their essays,” she says. “While that wasn’t the case with all my peers and some were even really supportive, it was cool to go to college and be around more people who are like-minded.”

Now, Deo is pursuing her master's degree in astronautical engineering at USC while interning at JPL with the team developing the Europa Clipper spacecraft. These days, one could say Deo is constantly surrounded by like-minded folks.

“USC is near home and near JPL, and JPL has been my dream since I knew I wanted to work in space,” Deo says.

Deo at her graduation from California State University, Los Angeles.

The Early Years

Deo first realized she "really, really loved space" at 13 after winning a telescope from a raffle at the Columbia Memorial Space Center in Downey, and found herself looking up at the Moon every night. Shortly after, she started volunteering at the space center every weekend, helping host field trips and robotics labs for young visiting students (something she still does to this day).

During this time, Deo was introduced to a middle-school STEM engineering class when she was in seventh grade.

Learn about the world of JPL internships, the skills that will help you stand out, and how to get on the right trajectory even before college.

"My teacher reached out to me and said, 'You might enjoy it,' and I thought, 'Well, it's either this or band,'" she says.

Deo tried the class, which introduced basic engineering concepts the first year revolving around design, modeling, and the engineering process. The second year focused on automation and robotics, and put students' skills to the test in regional competitions.

"Before I realized it, I was spending every day after school working in robotics," she says.

By the time she entered high school, nothing fascinated her more.

"High school was pretty easy for me and what we were learning didn't intrigue me as much as engineering," Deo says.

Once Deo decided to formally enter EEP, she had to participate in a rigorous summer academy where students are evaluated by college admissions staff on whether they're performing at a college level. In Cal

State L.A.'s program, approximately 500 to 1,000 students apply each year and only about 20 to 30 students are admitted.

Deo was on a road trip with her mother and grandmother when she got the acceptance call.

"I was screaming, and my mom had to pull over because she was screaming," Deo says. "My brother and dad were at home, and I called them and they were screaming on the phone. There was a lot of screaming."

Deo posing in front of USC, where she's pursuing her master's degree in astronautical engineering.

Looking back on her time in the summer academy, Deo marvels at the odds she overcame to gain admission.

"I didn't realize it during that summer, but I was not like most students there whose parents had PhDs and were established in their fields," she says. "I had parents who immigrated from Fiji. My mom came [to the U.S.] at 8 and my dad came at 22 without a college education. I grew up in a poor area compared to a lot of these students, and I didn't have the resources to prepare for college that a lot of other students did. I also have Type 1 diabetes. It was special to me [to be accepted into the program] because here was this girl facing adversities of every kind – and she made it."

While the decision to leave high school was an easy one, arriving at college left Deo grappling with imposter syndrome.

"The first year, I just took general education classes with my cohort [of EEPs] who help you transition, and I was just having fun with them," Deo says. "Then it kicked in. I had no idea how college worked – my

brother was still a senior in high school at the time. I was seeing all these people who were so smart and who came from very affluent backgrounds and who were into literature and stuff like that. I was never really into that. People just knew things I didn't know and I thought, 'Should I know that? Do I belong here?'"

Deo credits therapy, talking to friends, and turning to family as ways she coped with getting through those challenging early months. She also still stayed in touch with her childhood friends and took in the high-school experience while in college.

"I still went to prom, football games, and hung out with my friends all the time," she says. "I was able to have the best of both worlds."

JPL Internship, Mentorship, and Beyond

At JPL, whispers of a 19-year-old summer intern getting her master's haven't fazed Deo in the slightest.

"I hosted an intern party the other week, and everyone coming in was like, 'Are you the one who's 19 and in grad school?' And I'm like, 'Yeah, that's me, but I'm also Natalie and I have a Lego collection,' she says with a laugh.

Deo's intern responsibilities go beyond her years, of course. So far this summer, she's spent it working on validating and verifying commands being sent to Europa Clipper's computer system, ensuring the spacecraft's instruments respond correctly to commands.

While she admits she still struggles with imposter syndrome in the workplace, she's becoming more and more comfortable as the months go by and she grows closer to her fellow interns.

"The ratio of women to men is much greater here than in my previous internships," she says. "I see more of myself in the people around me, and that helps me be able to interact with other interns and have them as a support group. I'm hanging out with them every weekend, and I've made lifelong friends already."

Deo is also part of JPL's Employee Resource Group, or ERG, mentorship program, which paired her up with a secondary mentor – one who supports a mentee outside of the mentorship their manager provides – through JPL's Advisory Council for Women, or ACW.

"This type of mentorship is based on career and academic advice, and to help interns develop their soft skills," explains Alona Dontsova, who spearheads the program for Human Resources at JPL. "If the manager is concentrating on developing technical skills and how to manage projects, the ERG mentors are helping with networking, looking at their resume, listening to their pitches, or giving them more professional development advice. The ERG mentor is also more focused on teaching interns about the JPL culture."

Deo's secondary mentor, Lynn Boyden, is "very glad that the planets aligned that way" for the two of them to be paired up, and is a firm believer that mentoring is a two-way street.

"Learning goes in both directions … and one of the ways we do that is by sharing knowledge across these divides," she says. "Sometimes there are situations that are beyond an intern's ability to navigate the institutional practices, and this is where having a mentor with deeper experience in the world of business can be helpful. Also, one of the primary functions of an internship is to help an intern build a professional network, and having another designated person at JPL can only help them extend that network."

For Deo's part, she's thrilled to have someone she can be candid with.

"I can have conversations about JPL that might be intimidating to ask my group supervisor," she says. "Like, 'How do I say please hire me without saying please hire me?'"

Deo isn't shy about her next set of goals, which include being hired through JPL's academic part-time program while she completes her master's. And while the virtual internship experience has been a challenge for her, "I really enjoy hands-on work," she says. Deo has felt the rewards of her internship and mentorship every day.

"Honestly, everything has been rewarding: the people, the experiences, and everything I've learned," she says. "I'm motivated by passion and doing what I love, and I'm doing what I love."

Round 5 in the hangar at White Sands to be weighed. Left to right are Paul J. Meeks, Frank Malina, and R. C. Terbeck. Image Credit: JPL/Caltech

The First Sounding Rocket: JPL's WAC Corporal

By Erik Conway

In my last column, I recounted the story of JPL's first two missiles, the solid-fueled Private A and its winged sibling, the Private F. Only a few months after the Private F tests in White Sands, New Mexico, JPL Acting Director Frank Malina and a band of JPLers would launch the young Laboratory's first high-altitude scientific rocket, achieving what Malina and his collaborators Jack Parsons, Edward Forman, Apollo Smith and Qian Xuesen had set out to do nine years earlier. But only Malina would be present when JPL's WAC Corporal punctured all previous altitude records.

The WAC Corporal was Malina's own idea. During the month of November 1944, he'd toured some of the V-2 launch facilities in France, and on the way back to the U.S., he "suddenly realized that the first objective our rocket research group had set for itself in 1936 was within reach—a sounding rocket." He made use of a stopover in Washington to advocate for a sounding rocket to do high-altitude meteorological research, and gained verbal approval from Army Ordnance to put together a proposal. Over a weekend, he and Homer Joe Stewart from Caltech's Guggenheim Aeronautical Laboratory (GALCIT) drew up the proposal. It was submitted in mid-January of 1945.

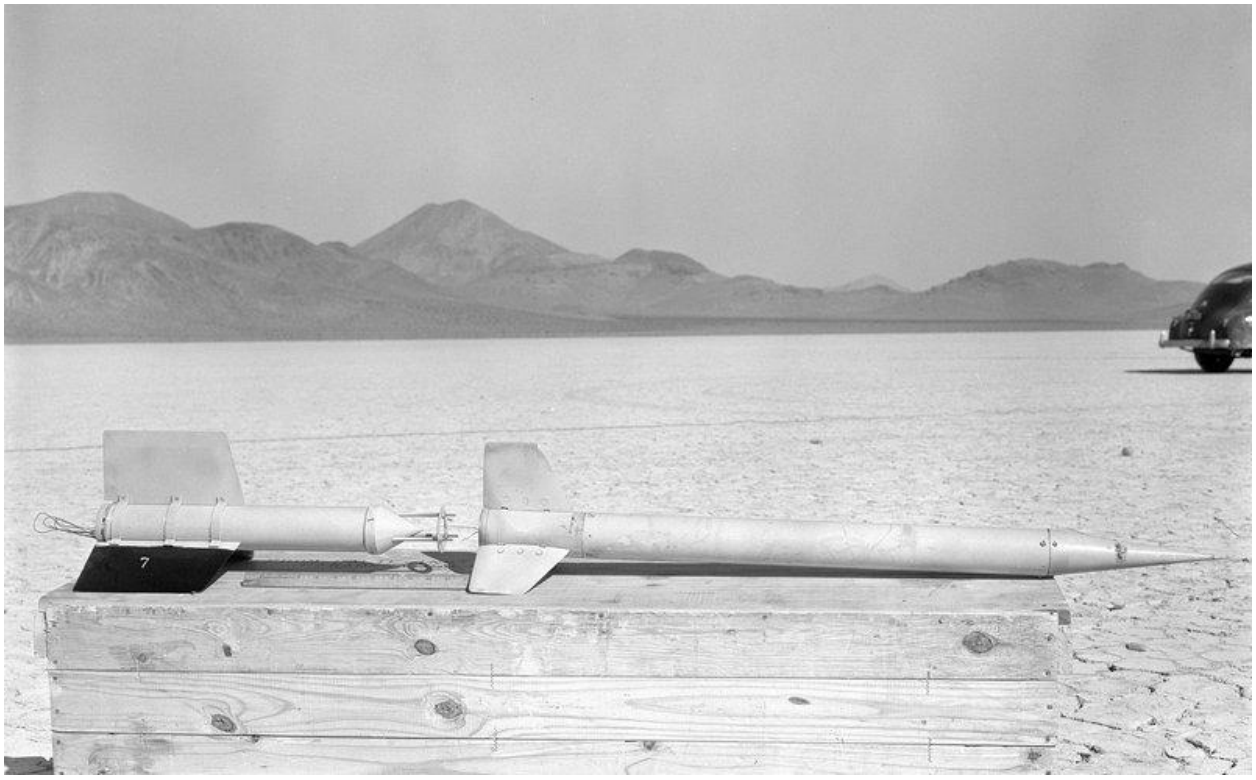
The Roots of the WAC Corporal

The basis for the WAC Corporal was the nitric acid/aniline motor they'd developed under the Jet-Assisted Take-Off effort. It produced about 1,500 pounds (6.7 kN) of thrust, and they developed a missile weighing about 700 pounds (318 kg) around it. High-pressure air forced the missile's propellant and oxidizer into the combustion chamber, avoiding the difficulty of developing high-speed pumps to do that job. And like the Private, it would have no guidance system. This made the missile relatively simple so it could be built quickly. In the proposal, Malina called the missile a scaled-down version of the Corporal. "For this reason," he wrote, "the designation 'WAC Corporal' has been chosen."

During World War II, WAC referred to the Women's Army Corps, so Malina was implying that the WAC Corporal was Corporal's little sister. Later in the proposal, Malina and Stewart also explained the missile's lack of active guidance, leading to a different interpretation of WAC—Without Attitude Control.

Without a guidance system, though, making the WAC Corporal stable meant the use of a booster to reach high speeds before leaving its launcher, just as the Private had needed. Fortunately, Caltech's other rocket project organized by the Physics Department had developed a large air-launched anti-armor missile, known as Tiny Tim, which could be adapted to that job.

One potential source of instability in an unguided missile is the movement of the missile's center of gravity towards the missile's tail as it burns off fuel. They decided to examine this issue through the testing of an even smaller version of the WAC Corporal, the Baby WAC. The Baby WAC was a 1/5th scale missile, 2.4 inches (6.1 cm) in diameter and about 5 feet (1.5 m) long, with a very low-thrust solid propellant, and a booster stage. The idea was to replicate the WAC Corporal's center-of-gravity shift in the Baby WAC in a much smaller, cheaper package via the simple expedient of changing the amount of nose weight in each flight.



A Baby WAC on its shipping crate at Goldstone Dry Lake, July 4, 1945. Image Credit: JPL/Caltech

Malina assigned this task to GALCIT graduate student Allen Puckett, their solid fuel specialist Charles Bartley, and Stewart. They built 10 of the booster/Baby WAC combination and tested them at the Caltech Physics Department's launch site on Goldstone Dry Lake on July 4 and 5, 1945. They discovered no

stability issues. The Baby WACs with the most rearward center of gravity tended to develop flat spins after reaching their peak altitudes, but that wasn't a problem. The full-sized WAC Corporal was supposed to deploy a 10-foot (3 m) parachute at apogee, making the issue irrelevant.

The blockhouse at White Sands, September 13, 1945. Later known as LCC-33, this would also be the test site for V-2s brought back from Germany. Image Credit: JPL/Caltech

Or so they thought.

The JPL team also built three 3 prototype motors and a prototype WAC Corporal. Paul Meeks's motor test team subjected the first of these to 18 one-minute runs in a test pit at JPL. Then that motor went into a prototype WAC Corporal set up on a test stand at Muroc Dry Lake, now part of Edwards Air Force Base. This prototype WAC was "flown" successfully on the stand 12 more times. They took this as evidence of high reliability and motor longevity.

The WAC Corporal's flight test site was built simultaneously with the missile development. The White Sands Proving Ground was formally dedicated on Sept. 29, 1945. It was administered by Fort Bliss, and at the time consisted of an 80-mile-long (129 km) firing range. In addition to a 100-foot-long (30 m) launch tower for the missile, the Army erected a bombproof control building 465 feet (142 m) away (with 10-foot-thick reinforced concrete walls, and a 27-foot-thick roof). The range instrumentation consisted of both still and motion picture cameras, phototheodolite instruments to help measure altitude, and a radar set, with spotting aircraft to locate the missiles' impact sites.

The WAC Corporals themselves were assembled by Douglas Aircraft Company in Santa Monica, with some of its components built by JPL, and others by other contractors. They were shipped by air to White Sands, where the JPL test team put them through what we would probably call acceptance testing—they examined the workmanship quality, did leak testing, and operated all the valves.

Flight Test Challenges

The first version of the WAC Corporal, WAC 'A,' carried a radiosonde package as its payload, which was supposed to be deployed at apogee. Radiosondes were meteorology packages designed to be flown on balloons, and they would serve as a means of proving the altitude achieved. The WAC did not have a radio

beacon of its own and did not carry telemetry of any kind, either. A second version, the WAC 'B,' would be the first JPL missile to have an air-to-ground telemetry system.

The WAC Corporal flight test program took place between Sept. 26 and Oct. 25, 1945. As with the Privates, Malina's crew first launched boosters alone, then boosters with partially-fueled WACs to ensure the two rockets separated properly.

The first fully fueled WAC Corporal was Round 5, launched Oct. 11, 1945. Round 5's propulsion system worked flawlessly, but its nose cone didn't release until it hit the ground 7.5 minutes later, so neither the parachute nor the radiosonde package deployed. Their tracking methods didn't work either, so we'll never know how high the missile went. But they found it easily, less than a mile from the launch tower.

Round 5 after flight. Malina is just to the left of center in the dark hat and light sweater; Paul Meeks is on the far right. Image Credit: JPL/Caltech

This tracking problem would become the test program's theme. Malina believed, like his mentor Theodore von Kármán, that science progressed through the collection and analysis of data, and despite the apparently perfect flight, they didn't get any from Round 5. It was a problem they had to solve.

They had five more WAC Corporals to fly. They added "window," a radar reflecting material that nowadays is called 'chaff,' that would be deployed at apogee to provide a larger radar target, but it didn't help. Their radar never detected it on any flight. On Round 8 they added 8 pounds of "lamp black" to the nose cone and half a pound of black powder to disperse it, making a better optical target at apogee. Round 8's nose cone came off right after launch, so this didn't work out for them either. Due to a launch pad fire, Round 9 was launched 7 minutes earlier than planned, so they got no tracking data at all and never found the missile's wreckage, either.

To Round 10, the last of this flight test program, they added one more feature—a 100,000 candlepower flare, to be deployed (along with radar window and the radiosonde) at apogee. So that the theodolite operators could see the flare, Round 10 was launched "at 1930 hours in the dark of the Moon," on October 25. The nose cone didn't come off, so they didn't get an altitude measurement again. But the radar tracking finally worked, following the missile until it passed 90,000 feet (27 km). From the radar data, they calculated an apogee of 235,000 feet (+/- 5000 feet, or 72 km +/- 1.5 km).

They had more than doubled the altitude achieved by the best research balloons. They had also demonstrated that future progress in rocketry needed a revolution in instrumentation.

Post-war Reflections

Malina had already flown home to Pasadena before Round 10's flight, forced by the need to plot a new course for JPL, and GALCIT, after the sudden end of World War II two months earlier. His own course wasn't clear, either. In August, he'd discussed taking a one-year leave of absence from JPL with von Kármán to figure it (and himself) out. He didn't make the formal request until late November, planning to depart in June 1946. He told his parents "What I really want to do at the end of the free year I am not at all certain. The way the world looks now too many people are getting ready for World War III."

On one of his flights from White Sands in September, Malina had gotten his pilot to fly him over the test site for the first atomic bomb, "Trinity," detonated in July a few tens of miles from the WAC Corporal launch tower. He realized the combination of nuclear weapons and his own missile work portended even more destructive wars than the one just ended. He wasn't at all sure he wanted to continue to be one of the architects of the Army's missile program.

There were two potential trajectories available to JPL after the WAC Corporal's success. Malina could, and would, argue for remaking JPL as the explorer he wanted it to be, building research rockets to facilitate high altitude and eventually space research. The other was continuing down its current path of weapons development. It would be a few more months before the future of JPL, and its acting director, would be clear.

Neela Rajendra leading a session about her work with the Science of Diversity & Inclusion at the University of Chicago.

Meet JPL's New Diversity, Equity & Inclusion Manager

By Jane Platt

Sometimes good things come when you least expect it. And timing is everything. Those two old adages proved to be true for Neela Rajendra, JPL's new Diversity, Equity & Inclusion Manager.

Soon after the Perseverance rover landed on Mars in February, Rajendra received a LinkedIn notification from a recruiter about the Lab's new DEI job, which piqued her interest.

"I hadn't been really actively looking. But it immediately caught my attention because I come from a family of space nerds," Rajendra says. "My family lives all over the country, and we had a Zoom party to watch the Perseverance landing all together. So my sister and her kids, my dad, my mom, my family, and my son, who just recently turned five and has declared that he wants to be a "space scientist engineer," all watched together and popped popcorn. And so this job prospect came up soon after that, and the idea of being able to work and support a mission like JPL was just too good to pass up."

Rajendra's passion for space exploration harkens back to childhood. "I thought I wanted to work in this field but realized the hard sciences weren't for me. So to be able to apply my skill sets and talents to support JPL and get access to this world is a dream come true."

Now just a month into her new job, Rajendra sat down with us (virtually) to introduce herself to the JPL community and to share her background and her hopes and plans for diversity, equity, and inclusion at JPL.

What attracted you to this line of work in general? And how did you get into it?

My background is really in social innovation, social change. I've always had a mindset to focus my career on creating a difference in the world. Being a person of color growing up in North Carolina, I have experienced being the only person of color in the room for much of my life. While diversity was something I was always aware of, I didn't really get a laser focus on this issue until I started working at Claremont

McKenna College, when I was in charge of developing social innovation programs. This was also during the time of nationwide protests on college campuses demanding greater change and greater justice for minority populations. And so I became the informal advisor to that student group on campus – again, because I was one of the few people of color who had some influence, they saw me as a person of support for their initiative. That was the first time that I took an active role in this work.

Later, I left Claremont McKenna and our family moved to Chicago when my husband, a professor of economics who does research in diversity, equity, and inclusion, was offered a visiting scholar position at the University of Chicago. He had been conducting research with a large financial firm to improve application and hiring rates for underrepresented groups. This research partnership led to a realization for us both that this research model could be scaled. We got approval to host a conference in U. of Chicago's Economics Department in 2017 to bring together behavioral science researchers and five large companies that had an appetite to take an evidence-based, research-driven approach to DEI. From that, the Science of Diversity & Inclusion Initiative (SODI) was born, and as part of that, for me personally, it was an alignment of my social entrepreneurship background and launching a startup, but also a growing passion in this issue and recognizing that a lot more needed to be done to advance opportunities for all people, regardless of identity or background.

What do you see as being included under the DEI umbrella? What areas will you be involved in, and can you provide a brief description of what you'll be doing?

I'm really excited that it's a new role, which means it can be customized and crafted to the needs of the organization. So what I'm doing right now is actually identifying what are those needs and where are areas that I can influence and support change. I see my role right now as kind of a few buckets.

One is working very much in concert with the Executive Council, the Employee Resource Groups leadership, the Inclusion Advisory Committee, and other stakeholders to determine a strategy. What is a vision we want for JPL in five years and 10 years? My goal is to develop a strategic plan with a shared vision across all stakeholders.

Bucket two is identifying some specific areas where change could be catalyzed. Some divisions and leaders are already coming to me and saying, "I'd love to do x, y, or z...can you help me with that?" So I'll be leveraging the research that I'm already aware of through my work at SODI. We would be able to specifically identify possible solutions using social science methodologies such as experimental economics, and include randomized control trials. So let's take, for example, a division interested in increasing the number of hires from underrepresented groups. From the body of research, I know a couple of things that could improve that. We would then discuss and identify which solutions might be a good fit for that context, and create a pilot program for a specific job opening to see if we could actually increase those numbers. And then ideally we'd share those results across the Lab and say, "We tested this, here are the results, anybody who's interested in trying this in their own setting, please let me know."

Then we could start to cultivate a list of action steps leaders can take to improve DEI outcomes for the organization that's embedded in the JPL culture, which I'm learning is very decentralized. So I'm not saying, "Hey, this is what you should be doing," but instead, "let's work together to find a solution that works for your setting."

You mentioned decentralized. Obviously with the pandemic, things are not as they used to be, and with an unknown time for when it will be again. How will that affect what you do in trying to reach a community of a significant number of people who are on Lab, but most who are not?

The work that I used to do was virtual already, my team was all over the world. I'm already used to working in a virtual environment, so working remotely now isn't negatively impacting my ability to connect with people all that much. And I'm relying on the networks already established among JPLers committed to DEI, to identify additional stakeholders and others I should be talking with during my two-to-three month

listening tour. That includes all the ERGs, the IAC, the EC, and I'm hearing from them, "Oh, you need to talk to this division manager because they've already been working really hard on this issue, so connect to that person." So I'm starting to find those folks who are already ready to put their foot to the pedal and go. And then it's about engaging with the folks who are neutral. These are people who maybe think,"DEI is great but it's not for me...I'm just doing my work." I'm going to start doing presentations on why this is important not only from a "DEI" perspective but from an innovation and business perspective. And using research to provide evidence for that. And so that's sort of phase 2. And hopefully we won't need to get to phase 3, hopefully phase 3 does not exist...those are the skeptics.

So you have plans to embrace the entire community, whether they're on board, not quite on board, or maybe not wanting to get on board?

Absolutely. My philosophy is that this work is not just for the people who are already on board. I'm not preaching to the choir, I am on a mission to demonstrate that DEI is for everyone and that everyone at JPL will come to see that by adopting practices that address systemic bias that is built into organizational structures, not because anybody is a bad person, but because we all have those biases and they creep into systems without us realizing it, that we're going to ensure that not only are we bringing the best talent possible, but we're keeping the best talent possible and advancing the best talent possible for the success of all missions. So to me, DEI is not only a social justice issue, it's a question of optimizing the potential of talent.

If you can briefly sum up, give us an idea of your priorities and any examples during the next time period of your choice.

First two to three months is a listening tour, which I am actively engaged in, just getting to know people and understanding the culture. I'm also listening for what's going well and where there is need. But ideally, I'd like to get some quick wins, make some changes, show that change is possible, and demonstrate momentum. And this will inform a strategic plan, so we can iterate from what we're learning and actively test some ideas.

And then we'll try to identify the priorities for the Lab that will be the inputs for the strategic plan. I'm hoping that in the next six months, we'll have a draft of a strategic plan in place that will have the buy-in of all major stakeholders at the Lab. And after that, we'll start to share it more broadly, so that anyone who wants to have input into it can, including voices I missed in the first six-month process. And by nine months in, we've got a plan in place that we can act on.

And how will you measure success, how will you define success in your new position?

One of the things I'll be doing as part of the strategic plan process is identifying some benchmarks, both from parallel organizations – other FFRDCs, as well as the substitute organizations, the organizations that JPLers would go to if they weren't at JPL. Because increasingly DEI is becoming a requirement for younger employees, I think. They're looking at what their potential employer is doing and evaluating whether or not they want to work there based on how inclusive the environment really is. There's some really great research recently that came out of Dartmouth that supports this idea.

It shows that when women are looking for a new job – well, everybody networks and everybody does what they call schmoozing, they're just trying to get information about the institution and networking with people who work there to learn more about the organization – but women actually scout: they're finding out about the culture and whether or not the culture is supportive of women or if it's aversive to women. So women are seeking out other women to find out if this is a safe environment for me to work in. And reputation really matters to get underrepresented groups to want to apply and go to your organization. And if your organization doesn't have a good reputation with underrepresented groups, it's really hard to attract new underrepresented talent.

The argument for using substitute organizations as a benchmark is that if they are meeting those DEI requirements better than JPL is, we could lose out on great talent.

We're also going to put some stakes in the ground in terms of specific numbers that we want to hit. For example, we might want to state a goal for how many women will be in senior leadership by 2030. So part of that is going to be data transparency, which I know is an ongoing conversation among everyone at JPL. And so identifying how can we be more transparent while staying within our legal confines/constraints is a major question that is a huge priority for me, and I have plans in place to determine for JPL collectively how do we go about becoming more transparent in an ethical way.

Then other metrics – we'll still be looking at entry level hiring rates and promotion rates by demographics and gender. There's also a question of how do you measure inclusion. SODI-affiliated researchers are working on a really great assessment tool, so they are essentially tackling that question, and hopefully JPL will be able to participate in that index so we can have a baseline and start to track the progress of our interventions to see if we can actually increase our equity score.

What would you say to a JPLer who feels marginalized that might help them see a difference in the future by having you here?

I would say first you're not alone. And second, your story is not unusual. And that by becoming part of a community of people who are working towards making changes, there is hope. And I would say we're going to work together to make those changes. And it's not going to be easy, and these challenges I describe as wicked problems. They're complex, they take a lot of people to make changes, and the changes are incremental. But change is possible, and there's a willingness and a commitment across the board, and so that means that not only is it possible, but it's likely, and to bear with me and be patient.

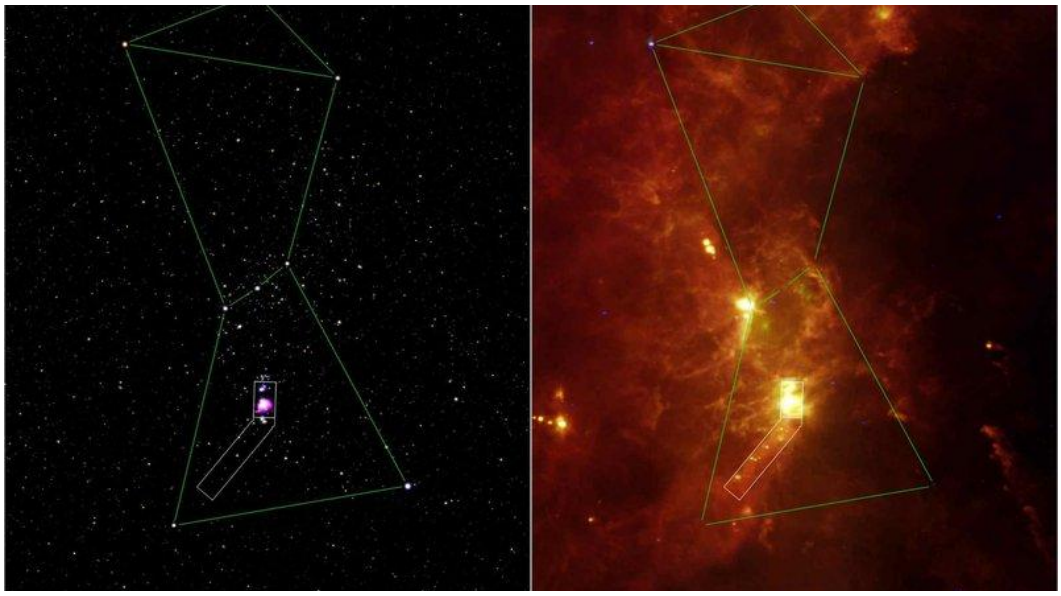
What would you like JPLers to know about you outside of JPL?

I have two children, including a newborn baby. Another fun fact that people may not know about me is that I used to be a professional violinist before I went on this journey and still am part of a band that is based in Washington, D.C., not that I've been able to get together with them since Covid. We played at the Kennedy Center eight years ago. The band is actually going on tour in October, but of course I'm not able to go.

For a JPLer who wants to reach out to you, how would you prefer that to be done?

My virtual door is open. They are free to email me, they can find me on Slack, if they want to meet up, they can email my assistant, Liz Lambdin. The welcome I've had since arriving at JPL has been overwhelmingly warm, people have been so excited that I'm here, and I walk away from every conversation jazzed.

Events



Von Karman Lecture Series: The Warm Glow of our Cool Universe

Thursday, Oct. 14
7 to 8 p.m.
YouTube link

In order to explore the mysteries of our universe, we need to look at it in different ways. Astrophysics missions like SPHEREx and Euclid will use infrared astronomy to deepen our knowledge of unseen phenomena, such as inflation and dark matter. Join us as we explore how infrared observations are changing our understanding of the cosmos and its origins.

Speakers:
Dr. Dida Markovic, Research Scientist, NASA/JPL
Dr. Phil Korngut, Research Scientist at Caltech, SPHEREx Instrument Scientist

Host: Marc Razze, Public Services Office , NASA/JPL
Co-Host: Kaitlyn Soares, Public Outreach Specialist, NASA/JPL

JPL Family News

Retirees

The following JPL employees recently announced their retirements:

40+ Years:
Thomas A. Wynne, Section 1841, 42 years
James S. Border, Section 335D, 41 years

Passings

Some of the material in obituaries is provided by family members.

Steve Brown died on Aug. 11, 2021, at the age of 69. He worked at JPL for 31 years, most recently in Division 35.

Steve began his career in aerospace as a light aircraft mechanic and was forever proud of his A&P license. In 1982, Steve became a senior engineering technician in Propulsion Systems for Hughes Aircraft Company. He worked launch preparations at Kennedy Space Center and Cape Canaveral and was always thrilled to share about his experiences working on the Space Shuttle gantry and living in Cocoa Beach. In 1986, Steve began working for JPL as a senior engineering test assistant at Edwards AFB test stands, involved with research and development of solid and liquid rocket motors, ground support equipment, and flight systems. He loved that work and often told colorful stories about it. In 1991, he began working in the JPL Safety Operations Section as a senior safety specialist in occupational and industrial safety. He was the team leader for Fall Protection, Lifting Safety, and the Safety Inspection Program, as well as task leader of Laser Safety. Steve then progressed to Division 35, where he reached senior engineering status in charge of Facilities, Safety and Laboratory safety compliance.

Steve received NASA Achievement Awards of Excellence for SFOF Emergency Generator System Replacement Project Team and also for Safety Inspection Team. Steve was extremely fond of his colleagues at JPL and always so proud of his career.

He is lovingly survived by his wife, Lori Mooradian Brown, his daughter, Chrysta Brown, and his stepchildren Emily DeRosa and Gregory DeRosa.

Forever beloved and heartbreakingly irreplaceable.

Former JPL employee **Hildegard Pitters** died on July 13, 2021, at the age of 86. She had worked for JPL for 15 years, most recently in section 2141. Pitters did administrative work. She enjoyed and was proud of working at JPL.

Three Perseverance Team Members Receive Hispanic Heritage Awards

Three Latina engineers at JPL are 2021 recipients of STEM Awards from the Hispanic Heritage Foundation. They will be honored for their significant roles in the Mars 2020 Perseverance rover mission during the 34th Hispanic Heritage Awards broadcast on PBS Oct. 8, joined by Carlos Santana, Ivy Queen, and others.

The three JPL recipients are:

Christina Hernandez, who began her work at JPL in the Natural Space Environments group and as mission assurance manager on STABLE (Sub arcsecond Telescope and Balloon Experiment). Her Mars-related work began with impact assessment to keep Mars spacecraft safe during the Comet Siding Spring event. As a payload systems engineer for Perseverance, she has worked on three of its seven science instruments. Her work on the rover's PIXL (short for Planetary Instrument for X-Ray Lithochemistry) will help scientists hunt for signs of ancient microbial life by taking super-close images of rock and soil textures and uses its X-ray spectrometer to identify chemical elements within them.

Clara O'Farrell, originally from Argentina, moved to the U.S. on her 19th birthday to start college. She studied aerospace engineering at Princeton and completed a PhD at Caltech with research on fluid dynamics of jellyfish swimming. After joining JPL in 2013, she began her work on parachutes, aerodynamics, and trajectory simulation for Mars entry, descent, and landing. Her accomplishments as a guidance and control engineer include certifying a supersonic parachute to land Perseverance via supersonic sounding rocket tests.

Diana Trujillo, an aerospace engineer, is currently Technical Group Supervisor for Sequence Planning and Execution and a Tactical Mission Lead for Perseverance. Born and raised in Colombia, Trujillo immigrated to the U.S. at the age of 17 to pursue her dream of working for NASA. While enrolled in English-as-a-second-language courses, she also worked full time to support her studies in community college and later the University of Florida and University of Maryland. Diana has held several roles for

NASA and JPL, including Mars Curiosity Mission Lead, Deputy Project System Engineer, and Deputy Team Chief of the Engineering Operations on Curiosity. Trujillo has also been active in sharing the excitement and opportunities of STEM with the public. She created and hosted #JuntosPerseveramos, NASA's first-ever Spanish-language live broadcast of a major mission milestone (Perseverance landing on Mars), attracting millions of viewers worldwide.

Dr. Jim Green, NASA's Chief Scientist, noted the accomplishments of the three recipients. "Each of them was integral to the planning, development, and successful landing of our Mars Perseverance Rover. Our Mars Perseverance mission will advance NASA's quest to explore past habitability of the Red Planet. Because of the hard work and dedication of our team, we can now look for past microbial life through the collection of core rock and soil samples and test technologies that will pave the way for future human exploration of Mars. Thank you to the Hispanic Heritage Foundation for their consideration and for this outstanding recognition of our extremely talented, diverse, and inspirational NASA workforce."

In the Hispanic Heritage Foundation's news release, the organization's president and CEO, Jose Antonio Tijerino, said, "As leaders in the STEM space, these inspirational Latinas demonstrate the great vision and value proposition our community presents America. These engineers also represent role models for aspiring Latinx engineers in expanding human knowledge and scientific discovery."

The Hispanic Heritage Awards are produced by the Hispanic Heritage Foundation and were created by the White House in 1988 to commemorate the establishment of Hispanic Heritage Month in America. The awards are among the highest honors by Latinos for Latinos and are supported by 40 national Hispanic-serving institutions. The Foundation's programs focus on education, workforce, and social impact through the lens of leadership.

More information at: www.hispanicheritage.org.