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EXTRATERRESTRIAL LIFE

SETI Pioneer Frank Drake Leaves a Legacy of Searching for Voices in the Void

Remembering Frank Drake, who led science in listening for an extraterrestrial "whisper we can't quite hear"

By Lee Billings on September 6, 2022

Frank Drake, founder of the search for extraterrestrial intelligence (SETI), poses for a portrait at his home in Aptos, Calif., on February 27, 2015. Credit: Ramin Rahimian for the *Washington Post* via Getty Images

Frank Drake, the eminent radio astronomer who performed the first search for extraterrestrial intelligence (SETI) around other stars in 1960, died on Friday at his home near Santa Cruz, Calif. He was 92 years old. His daughter, science journalist Nadia Drake, shared the news on her website. "A titan in life," she wrote, "Dad leaves a titanic absence."

“Frank founded an entire field,” says astrophysicist Andrew Siemion, director of the Berkeley SETI Research Center (BSRC) at the University of California, Berkeley. “He played a crucial role in creating the framework through which we can apply the tools of astronomy and physics to understanding and answering existential questions. But he never lost his humility and generosity. When our descendants look back centuries from now, I think they’ll rank Frank among the greatest scientists who ever lived.”

Paul Horowitz, a physicist and Harvard University professor emeritus, whom Drake guided into the field in the 1970s, recalls him as “a wonderful, gentle giant in SETI.... Often scientists are competitive, backbiting and extremely protective of their turf. Frank was the exact opposite of all of that—just totally exemplary in the selfless way he practiced science.”

Born in Chicago on May 28, 1930, Drake grew up in the city’s South Shore neighborhood. His father, a chemical engineer, and his mother, a homemaker, were not devout, but they raised Drake and his two younger siblings in strict accordance with Baptist fundamentalism. He later said this gave him a greater appreciation for different ways of life and being—and a lifelong aversion to organized religion. Neither of his parents “seemed to have any idea of how to have fun—at least in my opinion,” he recalled in a 1992 memoir he co-authored with science writer Dava Sobel. Drake’s interest in extraterrestrial life began at age eight, sparked by his imaginings of alien Earths scattered across the universe after his father told him ours was not the only world in space. He nurtured that spark with occasional visits to the Museum of Science and Industry, just blocks from his family’s church.

Drake graduated from Cornell University in 1952 with an engineering physics degree. Under the Navy’s ROTC program, he then served three years as an electronics officer onboard a heavy cruiser, the U.S.S. *Albany*. As a graduate student and Ph.D. candidate at Harvard University from 1955 to 1958, he studied radio astronomy under the tutelage of Cecilia Payne-Gaposchkin, a trailblazing astrophysicist renowned for correctly proposing that stars were mostly made of hydrogen and helium. After obtaining his Ph.D., Drake took a staff astronomer position at the National Radio Astronomy Observatory (NRAO) in Green Bank, W.V., where his scientific career truly began.

Drake’s hunt for electromagnetic transmissions from cosmic civilizations catapulted him to global fame, but it was far from being his only significant work. He also made the first radio map of the Milky Way’s center and co-discovered regions of seething radiation around Jupiter that are analogous to Earth’s Van Allen belts. Drake was among the first to measure the temperature and density of Venus’s broiling atmosphere. His numerous official appointments included serving as director of the Puerto Rico–based Arecibo Observatory,

which was the world's largest radio telescope for decades. And throughout his working life, he taught and mentored generations of younger researchers. Outside of science, his interests included wine making, lapidary work and orchid cultivation.

Drake's three most remarkable research achievements stem from a period of SETI-related productivity from the early 1960s to the mid-1970s.

The first came in 1960, when he used the NRAO's 85-foot-wide dish in Green Bank to seek radio signals from any talkative aliens in the vicinity of Tau Ceti and Epsilon Eridani, two of our nearest and most sunlike neighboring stars. Drake called the two-month effort Project Ozma, after *The Wizard of Oz* series of children's books, because both concerned fantastical faraway lands inhabited by exotic beings. Although decades earlier inventor Nikola Tesla and physicist Guglielmo Marconi had both independently tried to tune in to alien radio broadcasts, those comparatively crude observations concerned putative Martians—not denizens of distant planetary systems—making Ozma the first-ever "modern" SETI campaign. It produced no evidence of extraterrestrials, though a signal from a high-altitude aircraft did once set off a false alarm, the first of many for the then nascent field.

"If you look at today's radio SETI experiments, they're all still doing Project Ozma," says Seth Shostak, senior astronomer at the SETI Institute in Mountain View, Calif., where Drake worked for more than a quarter-century until he retired in 2010. "They're doing it with enormously better equipment and with many more targets, but the experiment itself is to look for narrowband signals coming from the sky. And that was Frank's idea."

Drake's second landmark contribution came scarcely a year after Project Ozma, amid an invitation-only gathering of elite scientists in November 1961 to discuss SETI's prospects. Opening the meeting, Drake unveiled an equation to estimate the number of detectable civilizations in the Milky Way. The equation's seven interlinked factors were an ascending scale of ever greater unknowns, ranging from well-constrained estimates of star-formation rates to educated guesses about the prevalence of habitable planets to wild speculations about the number of life-bearing worlds and the longevity of technological cultures. He had concocted it as a way of guiding the three-day meeting's agenda, hoping to enlist the attendees (who included a young postdoctoral researcher named Carl Sagan) to help hone its values. But his so-called Drake equation also became a dominant force shaping all future SETI efforts—as well as a potent reflection of our own Earth-bound biases and assumptions about the nature of life and intelligence in the wider cosmos.

"It has stood the test of time," Drake told the author of this article in a 2011 interview. "I've never had to change the factors, although I've tweaked some of their definitions. And I've gotten many suggestions for adding other factors to it—like one for politicians."

Drake's third signature feat came in 1974, after his rising star led him to a tenure-track position at Cornell University—as well as the directorship of the National Astronomy and Ionosphere Center, which managed the Arecibo Observatory. After overseeing three years of work that boosted the giant dish's sensitivity and gave it a powerful new radar system, during a November 1974 opening ceremony, Drake used the facility to transmit a radio signal toward M13—a star cluster more than 22,000 light-years away. Encoded in the transmission's 1,679 frequency pulses was Drake's "Arecibo message." This series of pictograms detailed, among other things, the double-helix structure of DNA, the dimensions of the human form and the location of Earth within the solar system. The transmission lasted less than three minutes, but at its specific wavelength, it outshone the sun by a factor of 100,000—offering a shred of hope that somehow, somewhere someone out there might detect and decipher it. The Arecibo Observatory's 1,000-foot-wide dish (big enough, Drake once calculated, to hold 350 million boxes of cornflakes) tragically collapsed in late 2020 amid allegations of underfunding and neglect. It may yet be rebuilt. But even if not, its epochal transmission will continue to ceaselessly travel through the void.

The Arecibo message was Drake's farthest-reaching attempt at interstellar signaling, but it was neither the first nor the last time he was involved in such work. Collaborating with Sagan and Sagan's then wife Linda Salzman Sagan in 1972, Drake co-designed the Pioneer plaque—a pictorial message that was bolted to NASA's interstellar-bound Pioneer 10 and 11 spacecraft and that included illustrations of a nude man and woman, as well as a cosmic map intended to trace the probes' origins back to Earth. This became the first physical message to be sent out of the solar system. In 1977, alongside Sagan and novelist Ann Druyan (who would later marry Sagan), as well as artist Jon Lomberg and science writer Timothy Ferris, Drake helped design the Voyager golden record. This interstellar "message in a bottle," packed with a curated collection of sights, sounds and greetings from Earth, was launched onboard the Voyager 1 and 2 probes.

"If it wasn't for Frank, there wouldn't have been a Voyager record," Druyan recalls. "Because it was his idea to make the message a phonographic record as opposed to some other form for holding all the information."

Similarly, if not for Drake, SETI itself could look very different today. Around the time he conducted Project Ozma, seeking radio signals was only one of several proposed strategies for finding cosmic civilizations. Astronomer and engineer Ronald Bracewell suggested that researchers should instead look for probes and other artifacts here in our solar system. Physicist Charles Townes, whose work led to the laser's invention, thought lasers would be a better basis for interstellar communication and thus the optimal focus for SETI work. Theorist Freeman Dyson devised a way to find even the quietest technological cultures, which he surmised could be detected by looking for gigantic energy-harvesting structures they might build around their home stars.

According to Jason Wright, a Pennsylvania State University astronomer and director of the Penn State Extraterrestrial Intelligence Center, the fact that radio SETI came to be the de facto standard was linked in part not only to Drake's scientific acumen but also his showmanship. "What really strikes me about Project Ozma, the Drake equation and the interstellar messages is that, in each case, Frank was so aware of the power of demonstration," Wright says. "That's why his name is revered—because it's attached to these iconic experiments that captured the public's imagination and got the attention of philanthropists, NASA, and so on."

"Personally, I find nothing more tantalizing than the thought that radio messages from alien civilizations in space are passing through our offices and homes, right now, like a whisper we can't quite hear," Drake wrote with typical understated gusto in the preface to his 1992 memoir. Finding other cosmic civilizations, he mused, was a way of seeing "the history of the future" because any such civilizations that humans were likely to detect would be far older and more advanced than our own, offering a preview of our own possible fates. By then his time at Cornell was almost a decade in the rearview—he had left the misty chill of Ithaca, N.Y., in 1984 for California's sunnier climes, taking up prestigious positions at the University of California, Santa Cruz, and the newly formed SETI Institute. Both would remain his primary academic affiliations for the rest of his life.

In the same book he triumphantly noted that NASA had just dedicated some $100 million to a major, decade-long SETI effort. After years of inhabiting the fringe of legitimate science, SETI had finally gained mainstream acceptance. To Drake, SETI seemed on the cusp of its greatest victory: a legitimate detection of signals from an extraterrestrial civilization and proof that we were not alone. "This discovery, which I fully expect to witness before the year 2000, will profoundly change the world," he wrote.

Instead congressional backlash resulted in the program's cancellation less than a year later. Thus began SETI's long sojourn without one cent of U.S. federal funding devoted to hunts for alien civilizations (a situation that has only started to change in the past few years, after NASA once again began allotting minuscule fractions of its budget to SETI studies). In those difficult times, Drake and other SETI luminaries increasingly relied on funding from the rising class of superwealthy Silicon Valley technologists—many of whom had been inspired to pursue science and engineering careers by Project Ozma and other rousing exploits of the early space age.

"If it weren't for Frank I'd be filthy rich," jokes U.C. Berkeley astronomer Dan Werthimer, who, before becoming Drake's frequent collaborator, rubbed shoulders with Apple co-founders Steve Jobs and Steve Wozniak in the Homebrew Computer Club in the early 1970s. "While other Homebrewers were designing and selling the first home computers, thanks to Frank, I spent my time figuring out how to utilize the first computer chips for SETI

experiments." In 1999 those efforts led to Werthimer co-founding SETI@home, one of the first and most successful "citizen science" projects, which used distributed computing and volunteers' spare CPU cycles to look for signals in archival SETI data.

Robust support also came from the late Microsoft co-founder Paul Allen, who provided tens of millions of dollars to the SETI Institute. This culminated in the 42-dish Allen Telescope Array in Hat Creek, Calif., which began operations and various SETI-related studies in 2007. That philanthropic trend continues today with Breakthrough Listen, an ambitious SETI program funded by Russian-Israeli multibillionaire Yuri Milner and helmed by BSRC's Siemion, who was one of Drake's last protégés. Whereas Project Ozma tuned in periodically to two stars on a single channel, Breakthrough Listen targets millions, observing each on tens of billions of frequencies, with sensitivities suitable for detecting even some forms of modest, unintentional "leakage" radiation from stealthy alien societies. All this has been augmented by the explosive growth in knowledge of exoplanets, which, after the first discoveries in the early 1990s, now fill astronomers' catalogs by the thousands. The bulk of available evidence hints that Drake's great quest may not be in vain; data indicate most stars harbor a retinue of worlds. And probability laws dictate that from that innumerable starry host, some fraction simply must be habitable, Earth-like and replete with life. In keeping with Drake's equation, some smaller fraction still must then host other minds that gaze up in awe at the heavens from their isolated planetary perch, wondering if they, too, are alone.

And yet the skies remain silent. Barring a handful of candidate signals—tantalizing but suspect onetime events that never repeated and could easily have been mere astrophysical "noise"—SETI has not found its long-sought quarry. "I guess you could say it's been a giant failure so far, because we haven't found anything yet," Horowitz says. "But what a wonderful ride. And for me at least, it all comes back to Frank."

Will we ever find an answer, some sparkling sign of intelligent life from across the interstellar or even intergalactic gulfs? Drake of course thought so, as he once told the author of this article:

"This, I think, has been just the beginning. People presume we've been somehow monitoring the entire sky at all frequencies, all the time, but we haven't yet been able to do any of those things.... Even if we have been pointed in the right direction and listening at the right frequency, the probability of a message being beamed at us while we're looking is certainly not very large. We've been playing the lottery using only a few tickets."

In addition to his daughter Nadia, Drake is survived by his wife of 44 years, Amahl Shakhashiri Drake; his daughter Leila Drake Fossek; his sons from a previous marriage, Steve Drake, Richard Drake and Paul Drake; his brother Bob Drake; and a nephew, two nieces and four grandchildren. He was preceded in death by his sister Alma Quigley.

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