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Message from Archives Chairman Don Nielson

Don Nielson

Well, it's spring and a time for growing. Back when we first potted this issue, we didn't expect it to reach this size. But here it is, and I hope you will engage yourself in how it addresses SRI's figurative roots and its new research sprouts.

Perhaps overdoing this analogy, the grafting of PARC onto the Institute a year or so ago was examined recently in an article by John Markoff of the NYT. Check inside for that pointer and for the return of PARC's notable forum.

New fields of research with open futures have always been a good operating point for SRI. As you read on, you will find a few SRI endeavors that by any measure are forward looking and timely. Just gear yourself for some acronyms as you learn about them. One of the most needed, and hopefully scalable to the demand, is the sequestering of CO_2. Though we are trying somewhat to address the curtailment of such gases, any help in capturing our ongoing spillage is most welcome. Next, you'll find another step in dealing with the disinformation haunting us all, followed by how AI might lend itself to the broad utility of augmented reality.

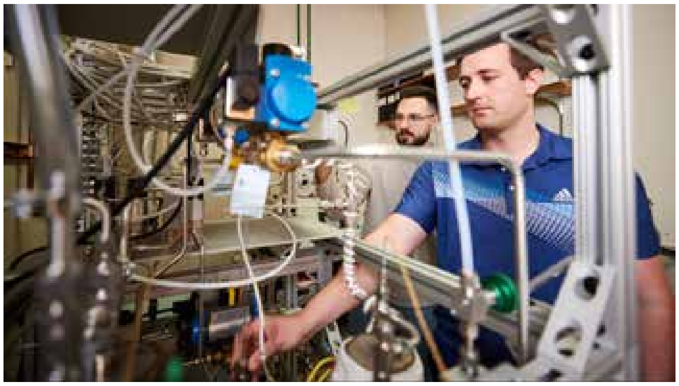
By way of reflection, we'll perhaps satisfy your curiosity about a South Bay icon. Those of you who have resided in this area are unquestionably aware of SRI's radio telescope that sits atop a Stanford ridge. Everyone calls it simply the Dish. In the first of a two-part series, you may be surprised at its origins. In the next issue, we'll explain how it has remained viable for over 60 years.

You'll also learn how SRI gets honored locally through the recognition of CEO David Parekh. You'll meet a few new SRI leaders and say farewell to some of your colleagues, one of whom, Steven Smith, has blessed our Association with a substantial gift. We have lost a few other alums we'll cover in the next issue: Gary Greenfield, Lambert Dolphin, and Dan Lynch. Dan made the Internet Hall of Fame.

Finally, with spring comes our Fling. Please check it out and, lest you forget, reply to us now that you'll join us. And join our leadership group if you're in the area. We'd love to see you and it is rewarding.

Don

SRI's Aerogels: CO_2 Meets Its Match



Jonathan Bachman (right), principal investigator and technical lead for CO_2 sorbents, and Alex Rousina-Webb (left), commercialization lead, operating the CO_2 capture system at SRI.

Excess carbon dioxide (CO_2) in the air produced from the burning of fossil fuels is a major societal problem. Forward-thinking scientists hope to both prevent CO_2 emissions and reclaim CO_2 currently in the atmosphere. Such reclamation is known as carbon capture, a concept that has gained traction in recent years in part because of new materials such as one under development at SRI. "We've developed a material—a lightweight aerogel—that acts like a sponge to remove CO_2 from ambient air," said Jonathan Bachman, an SRI research scientist and chemical engineer who has worked for a decade on carbon capture technology.

A Material Difference

While technically "solid," aerogels are a class of super-lightweight porous polymers that hold great promise in carbon capture applications. SRI's approach is based on amine chemistry and the principles of Lewis acid-base reactivity. Amines are Lewis bases; CO_2 is a Lewis acid. Opposites attract. Combine a lightweight, cost-effective, supremely porous material with acid-base chemistry and what emerges is a sponge-like material—a filter—that absorbs CO_2 from the air.

"We have a very high amine loading per mass of aerogel polymer, allowing us to get very high CO_2 adsorption," Bachman said.

A key metric in product development is the overall cost of capture—dollars per ton of CO_2 removed. With SRI's highly productive sorbent aerogel, less sorbent is needed, reducing the scale of carbon removal equipment, the amount of energy needed to remove CO_2, and the manufacturing and operating costs.

"The capital costs come down," Bachman said, to a point where it becomes economically feasible to consider carbon capture as a serious solution to our CO_2 problem. Bachman estimates cost can be reduced to less than \$100 per metric ton of CO_2.

Promising Applications

Bachman and others envision three potential applications for the technology:

1. Point-source capture, in which aerogel filters are integrated into large CO_2-producing facilities to capture the CO_2 before it enters the atmosphere.

2. Direct air capture, in which giant aerogel-based filter systems remove the billions of tons of CO_2 from ambient air. The absorbed CO_2 could then be liquefied and injected into cavities underground for permanent storage and gradual transformation into a solid mineral form.

3. Closed-environment CO_2 capture, in which aerogel filters are used in airplanes, spacecraft, and medical/life-support settings to cleanse CO_2 from enclosed spaces.

Next Steps

Bachman and his team are now exploring ways to mass-produce their aerogel to remove billions of tons of CO_2 from the atmosphere, a prospect that will require thousands of tons of aerogel. While the supply chains for such large-scale production do not currently exist, now is the time to do the necessary research. "We're at a pretty pivotal stage right now, and we're trying to position ourselves so that the material can be adopted into these large projects or put into the pipeline," according to Bachman.

Source:

SRI news, November 27, 2023. https://www.sri.com/press/story/an-sri-aerogel-aims-to-sponge-up-co2-from-air-and-exhaust/

Psych Out Cyber Attackers

The Intelligence Advanced Research Projects Activity (IARPA) selected SRI to deliver advanced technology for its recently announced Reimagining Security with Cyberpsychology-Informed Network Defenses (ReSCIND) program.

The objective of the ReSCIND program is to design and build resilient cybersecurity systems that integrate human psychology and behavior with advanced computing, thereby augmenting already proven security systems to improve outcomes. The program focuses on the psychology of cyber attackers by understanding human limitations, such as innate decision-making biases and cognitive vulnerabilities, as an innovative approach for enhancing cyber defenses.

"Aiming to use cyber attackers' cognitive vulnerabilities against them to reduce their efficiency and effectiveness is a novel concept," said Rukman Senanayake, principal computer scientist at SRI and lead investigator on the project. "This approach for cybersecurity is revolutionary, especially since we are attempting to leverage known cognitive vulnerabilities and biases against attackers. Our approach involves identifying biases a cyber attacker may have, measuring them, techniques to induce these biases, and adapting in a near-real-time fashion to observed attacker behavior."

SRI's ASCEND (Adaptive Security through Cognitive Exploitation for Defense) program will revolutionize cyber defense by effectively and efficiently measuring, understanding, and exploiting cognitive vulnerabilities to prevent cyber attackers from achieving their goals.

"In the end, everything rises and falls with humans, and that applies to cybersecurity, too," said Grit Denker, SRI program director and co-principal investigator on ASCEND. "Until now, we have relied on advanced technologies and skilled cyber defenders. This approach adds a new dimension that allows us to stay ahead of the game—understanding the cyberpsychology of attackers and using it to defend ourselves."

SRI is working with experts across fields of psychology, cognition, artificial intelligence, and cybersecurity at George Mason University, Florida Institute for Human & Machine Cognition, Margin Research, Research & Assessment Design (RAD): Science Solution, Two Six Technologies, University of Florida, and Virtual Reality Medical Center. The teams will work together to investigate the relevance of five chosen biases of cyber attackers; identify techniques to measure, predict, and influence attackers' cognitive vulnerabilities and behavior; and develop bias sensors and triggers to establish their validity and reliability.

ASCEND team member Richard D. Roberts, cofounder of RAD, explained that "heuristics are shortcuts humans use when making decisions." Quoting colleague and well-known cognitive psychologist scholar Larry L. Jacoby, who had a knack for aphorisms, Roberts said, "Cognitive biases are heuristics in a bad neighborhood; we can use this notion to our advantage in this research."

Source:

SRI news, March 11, 2024. https://www.sri.com/press/story/sri-chosen-to-deliver-cyber-psychology-informed-network-defense-technology-for-iarpa/

AI-Assisted Guidance From the Kitchen to the Battlefield

Headsets help human-machine collaboration efforts in the physical world.

The Defense Advanced Research Projects Agency (DARPA) is concerned that military personnel are being expected to perform an increasing number of tasks and more complex tasks than ever before. Mechanics, for example, must repair more types of increasingly sophisticated machines and platforms, and medics must perform more procedures over an extended time. DARPA's Perceptually-enabled Task Guidance program aims to develop artificial intelligence (AI) technologies to help users perform complex physical tasks while enhancing their versatility by expanding their skillset and their proficiency by reducing their errors.

Under DARPA support, SRI has developed AMIGOS (Autonomous Multimodal Ingestion for Goal-Oriented Support), which learns standard operating procedures, parts, and manual maneuvers for a range of tasks by poring over technical manuals, checklists, illustrations, training videos, and other sources of information. AMIGOS devices (headsets) have wearable cameras that allow the AI to see and hear what the wearer is seeing and hearing and microphones that permit the device to provide verbal feedback through voice, words, and graphics projected on a lens before the wearer's eyes, leaving the hands free to perform tasks.

Few people know what a pinwheel tortilla is, much less how to make one (think of ham and cheese pinwheels made with tortilla rounds). However, in a proof-of-concept demonstration AMIGOS can walk anyone—even a neophyte—through the process, ingredient by ingredient, step by step.

"You can think of AMIGOS as an assistant that looks over your shoulder while you are doing a task and helps you do things right and, when necessary, spots mistakes and corrects them," said Charles Ortiz, associate director of collaborative and conversational systems at SRI and principal investigator on the AMIGOS program. "A physical task assistant must be able to watch, understand, and track what a user is doing and also provide useful instruction on precisely how to do it and what to do next."

In the demonstration, AMIGO can see and recognize the various ingredients arrayed before it. It knows what utensils, measuring cups, and spoons are at hand. It distinguishes bowls and plates from a frying pan. It can even see the cook's hands and "read" various gestures and motions, from grasping and pouring to stirring and spreading.

The chef wearing the headset is privy to additional written and graphical information displayed on the inside of the lens. Most notable, however, is that the user can ask questions along the way, such as, "I've stirred the batter. Now what?" AMIGOS responds appropriately: "Spread a thin layer with a knife."

While training AMIGOS in the subtle nuances of a pinwheel tortilla is challenging, Ortiz and Bob Price, SRI research engineer in robotics, perception, assistance applications, and machine learning, are shifting the attention of AMIGOS to the maintenance and repair of physical devices such as gas engines that depend on very specialized knowledge rather than everyday cooking skills. "We are all very sick of making pinwheel tortillas," said Price, "The goal is to move to military uses for vehicle maintenance, field medicine, and even helicopter copiloting."

"AMIGOS is a promising prototype, but it will only get better and more sophisticated over time," said Ortiz. "The wearers will become more versatile, more proficient, and grow their skillsets even when working in new, high-stress, or changing environments. AMIGOS is a very unique AI technology."

This work is supported by the Defense Advanced Research Projects Agency (DARPA) under Contract No. HR001122C0009.

Sources:

SRI news, March 14, 2024. https://www.sri.com/press/story/sri-builds-an-ai-enabled-system-that-guides-users-through-complex-physical-tasks/

Marge, M. Perceptually-enabled Task Guidance (PTG). https://www.darpa.mil/program/perceptually-enabled-task-guidance

Quantum Leaps in Ultrasensitive Sensing Technology

SRI develops state-of-the-art portable atom sensors and systems.

Sensors are ubiquitous in modern life. From devices that measure a car's speed and direction to accelerometers that flip phone screen orientations, we rely heavily on electronic sensors to detect and respond to physical inputs for safety as well as convenience.

But a vast untapped potential exists in a new kind of sensing technology based on the laws of quantum mechanics: quantum sensors, which could be thousands of times more sensitive than current sensors.

"SRI specializes in quantum sensing right now," said Jesse Wodin, director of SRI's Applied Physics Laboratory. "We and our collaborators in government and industry recognize the tremendous potential offered by quantum sensing, and we're excited to continue moving the field forward."

Sensors That Measure Behavioral Variance

Conventional, classical sensing generally extracts information from large collections of atoms in a sensor (such as a diode or resistor) interacting with signals (such as radio waves or acceleration). In contrast, quantum sensing operates on the scale of individual atoms. The laws of quantum mechanics describe how subatomic particles such as photons and electrons interact with atoms.

With these interactions knowable to such a fine degree, SRI researchers are developing sensors that measure any behavioral variance introduced to an atomic system by forces of gravity, acceleration, or motion, as well as light and electric or magnetic fields.

"Once you shrink down to the atomic scale, you have to use all the laws of quantum mechanics to understand what's going on," said Wodin. "And those laws tell us just what to expect as change is introduced to an atom."

In physical form, quantum sensors often appear as tiny glass cells or metallic chips containing single atoms or clouds of atoms manipulated by lasers. To prepare them in a stable state for subsequent variation measurements for sensing purposes, the atoms are first kept in a vacuum to avoid disruptions from random matter. Lasers further stabilize the atoms, trapping and sometimes cooling them while also serving as the means of "reading out" any changes in the atoms induced, for instance, by exposure to electromagnetic fields or acceleration.

Quantum Sensors That Fit in a Suitcase

Building on these concepts and architectures, Wodin and his SRI colleagues are working on several projects, with the goal of bringing laboratory-proven technologies into real-life operational environments.

"We're building hypersensitive magnetic field sensors, radiofrequency sensors, and a quantum gyroscope," said Wodin. "In each case, the physics of detection is governed by quantum mechanics, which allows for incredible sensitivity and in theory can be orders of magnitude more sensitive than anything you can build conventionally."

Advanced quantum sensors give us the ability to detect biological magnetic fields, which can make a difference when trying to detect a person trapped in building rubble, for example. SRI's goal is to develop quantum sensors on par with or better than the highest performing magnetic field sensors of today, which must be shielded from Earth's magnetic field and can function only in expensive special-purpose labs that cannot be deployed to disaster sites.

A recent advancement is the Atomic Magnetometer for Biological Imaging in Earth's Native Terrain (AMBIIENT).* The technology, created with Twinleaf LLC and Princeton University, can perform live magnetocardiography, or the measurement of heart signals. Demonstrated live at Defense Advanced Research Projects Agency FORWARD, faint magnetic signals outside an expensive shielded room were observed.

"The idea is to build a quantum sensor the size of a phone that can go anywhere," said Wodin. "This kind of device could have additional applications and be used as a mobile brain scanning system, for example."

Quantum Antennas and Gyroscopes for Added Precision

SRI's quantum antenna project centers on exquisite sensitivity to radio waves across a gigantic frequency range, from megahertz to terahertz, all in one single device. Capturing this kind of range from satellites currently requires a bulky, expensive array of antennas, limiting how many platforms can be built, launched, and operated.

Quantum antennas would also prove useful aboard Earth observation satellites for forecasting weather and understanding longer term climate change. At a fraction of today's cost, these antennas could conduct signal mapping of atmospheric gases across many bands, improving data collection and analysis.

Still other quantum work at SRI involves powerful new quantum gyroscopes, which would enable vehicles to navigate accurately for long periods independently of Global Positioning System (GPS) signals. The atoms in such sensors would be prepared to be highly sensitive to acceleration, and reading out the atoms' quantum states would inform navigational systems of precise position compared to a known starting point.

"You would want these gyroscopes on everything that has to navigate, whether it's aircraft, helicopters, or drones, down to cars and other road vehicles, and on into the water on submarines," said Wodin.

The breakthrough sensor technologies SRI is developing for the military and other strategic partners should find their way into everyday civilian use—much in the same way that the Internet and GPS began in the military sector before becoming household names and products.

Source:

SRI news, December 13, 2023. https://www.sri.com/atsd/quantum/sri-is-developing-breakthrough-quantum-technologies-for-ultrasensitive-sensing/

*Also see article in *SRI Alumni Association Newsletter*, August 2023, page 6.

SRI CEO David Parekh Named to 2024 "Power 100" List

David Parekh, SRI's Chief Executive Officer, has been named by the *Silicon Valley Business Journal* as one of the Power 100, an annual list highlighting the top 100 business leaders in the Bay Area.

Source:

https://www.sri.com/press/story/sri-ceo-david-parekh-named-to-2024-power-100-list/

James Fritz Joins SRI as New Senior Vice President, Federal and Strategic Program Development

As senior vice president, Federal and Strategic Program Development, James Fritz will lead strategy and business development for SRI's federal programs, with an emphasis on identifying and bringing together initiatives across SRI that can lead to significant growth opportunities and have large-scale impact for new and existing customers.

Most recently a senior advisor to the Chief Commercialization Officer of the US Department of Energy, Fritz led strategy development and execution for technology-based growth opportunities at Collins Aerospace and United Technologies Corporation. Before that, he led global operations for the United Technologies Research Center.

As a partner in the Clean Energy Venture Group and member of the Angel Investor Forum, Fritz served on the Ventures and Incubator Advisory Board for the University of Connecticut. He was founding chairman of the International Energy Research Centre in Cork, Ireland.

Fritz is an Associate Fellow of the American Institute for Aeronautics and Astronautics and has been awarded nine US patents. He holds a BS in mechanical engineering and an MBA from the University of Connecticut, as well as an MS in mechanical engineering from Rensselaer Polytechnic Institute.

Source:

https://www.sri.com/press/story/james-fritz-to-join-sri-as-its-new-senior-vice-president-federal-and-strategic-program-development/

SRI Announces a New Board Chair and a New Board Member

David Motley has been named the new chair of the SRI Board of Directors. Steven H. Walker, Lockheed Martin chief technology officer and former DARPA director, has joined the board.

Motley is cofounder and managing partner of BTN Ventures, a venture fund investing nationally in industry-creating or -disrupting technologies in the areas of fin-tech, health-tech, clean-tech, and ed-tech. BTN Ventures has a particular focus on providing access to venture capital for Black and diverse founders at the helm of companies positioned to deliver outsized returns to investors.

A Distinguished Alumnus awardee of the University of Pittsburgh's Swanson School of Engineering and an MBA alumnus of the Harvard Business School, Motley cofounded the African American Directors Forum (AADF), which seeks to increase representation for African Americans in the board rooms, C-suites, and supplier bases of publicly traded US companies. Motley also led the multiyear offering for the Navy War College directed at three-star admirals entitled, "World Class Performance: The Role of Leadership, Process, and Talent."

At DARPA, Walker was responsible for developing breakthrough technologies and capabilities for national security. At Lockheed Martin, he is responsible for mission concept development and integrated operations analysis, the corporation's technology strategy, internal research and development investments, and corporate as well as international laboratories. As the primary liaison to the US and international science and technology community, Walker manages strategic partnerships with government, industry, and academia to ensure the maturation and deployment of cutting-edge technologies.

Walker is a Fellow of the American Institute of Aeronautics and Astronautics; he received the AIAA Hap Arnold Award for Excellence in Aeronautical Management in 2014 and the AIAA Hypersonics Systems and Technology Award in 2021. He has also been awarded the Presidential Rank Award, the Air Force Meritorious Civilian Service medal, and the DoD Exceptional, Meritorious, and Distinguished Civilian Service medals. In February 2020, Walker was elected as a Member of the National Academy of Engineering. He holds a PhD and BS in aerospace engineering from the University of Notre Dame and an MS in mechanical engineering from the University of Dayton.

Source:

https://www.sri.com/press/story/sri-announces-a-new-board-chair-and-a-new-member/

NYT Examines SRI-PARC's Joining of Forces

On March 26, the *New York Times* published an article looking at the viability of two legendary Silicon Valley institutions as they join forces: SRI and PARC. It is an interesting overview of how these two places had such a profound influence on the information technology that has grown to dominate our world. The question it poses is whether SRI can find anew the resources for more "open-ended research projects." In contract research places like SRI, these projects form the opportunities to create foundational or visionary changes in the way things are done. They take clients with patience as DARPA has been known to be or SRI's steady commitment of its own discretionary resources. In today's impatient world, both may be difficult.

Source:

https://www.nytimes.com/interactive/2024/03/26/business/silicon-valley-tech-xerox-parc-sri.html

SRI Relaunches PARC Forum

SRI has relaunched the Palo Alto Research Center (PARC) Forum, a free event and program series that brings together some of the world's leading thinkers for thought-provoking conversations at the intersection of technology, business, and society.

SRI's PARC campus – where the PARC forum resumed in April 2024.

The relaunch marked the first anniversary of SRI's acquisition of PARC through a donation from Xerox. "To celebrate our first anniversary, SRI is proud to offer a renewed PARC Forum, a nearly 50-year-old Silicon Valley institution," said David Parekh, SRI's chief executive officer.

At SRI's first PARC Forum, held on April 4, Parekh sat down with Pulitzer Prize-winning *New York Times* editor and writer David Leonhardt to discuss Leonhardt's new book, *Ours Was the Shining Future: The Story of the American Dream*, and how innovation, ingenuity, and investment have fueled America's technological and economic growth.

Source:

https://www.sri.com/future-concepts-division/sri-relaunches-the-parc-forum/

The SRI "Stanford Dish"

Part 1 The Genesis

By Don Nielson

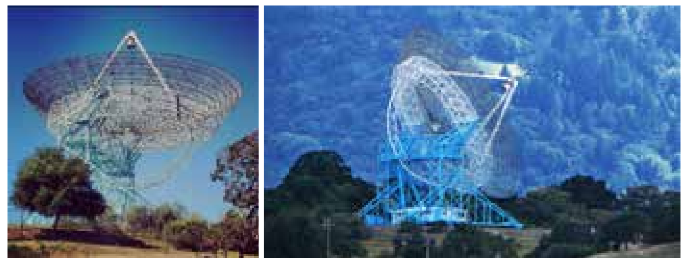
On January 21 of this year, the *San Jose Mercury News* included with its Sunday edition an interesting pamphlet on "Space."[1] It inventoried the many facilities and people dealing with that subject across the Bay Area. Included, of course, were the Mt. Hamilton Lick Observatory, NASA Ames, and a number of cosmology professors and former astronauts living here. Toward the end, under the category of relevant Bay Area hikes related to such facilities, appeared "THE DISH, STANFORD."

Two upfront observations. Since it is almost universally called the "Stanford Dish," the antenna is naturally understood to belong to Stanford University. We'll address that misconception later. The second observation, even as portrayed in the above pamphlet, is that whatever fame it has locally comes not from being a notable space-related facility, but as the destination of countless ascending hikers who love trudging up the "four-lane" paved walkway, probably not quite incidentally, to be near it. To both accommodate and control this bounty of exercisers, the university installed very long walkways, built a guard shack at the base of it, and provided scads of special parking nearby. For confirmation that Stanford acknowledges its popularity, simply go to https://dish.stanford.edu/. The image below clearly shows this "use" of the Dish.

The Dish and its hikers.

But in an almost unprecedented departure, the *Mercury* "Space" pamphlet actually gets the Dish's ownership correct, stating that it was built and operated by SRI International and simply located on land leased from the university! The article goes on with an interview with SRI's Jeff Casper and Stephen Muther, who currently manage and operate the Dish.[2]

Suffice it to say that the Dish, perched atop a ridge for all to see, has become a South Bay icon. News columns at both Stanford and SRI are entitled "The Dish." Here are two images of it. On the left it is in "birdbath mode," safer from high wind loading, and on the right is an unusual and beautiful picture taken from the top of Hoover Tower by a visiting relative of mine.



The Dish in its "birdbath" configuration and as seen from Hoover Tower.

So from whence did this iconic Dish arise? Drawing only a bit from the *Mercury* article but mostly from other sources, here is why the Dish was born, how it has found utility for over 60 years, and, surprisingly, how every day it still fulfills important roles, some that impact your individual lives. Not unlike the nearby Stanford linear accelerator, this large 70-ton, 150-foot Dish, having been erected long ago for a few not very well known purposes, has had to adapt to new uses as the original ones evaporated. We'll try to trace that history as best we can, starting in 1958.

The Origins

Principal Dish designer Neil Stafford.

While the Dish and the funds to build it came through the exclusive efforts of SRI, there was at the time a relevant segment of Stanford's Engineering Department called the Center for Radar Astronomy. Since the Dish was to be located on Stanford land, this collaborative effort enabled the necessary university buy-in. Bringing the Dish into existence, however, was the work of SRI's Radio Physics Lab and in particular its leader, Ray Leadabrand.[3] SRI's lead designer was Neil Stafford, and the engineer responsible for its servo controls, erection, and bringing it into operation was George Durfey.[4] Many other SRI people were involved in not only the construction itself, but also in the design and implementation of how the

Dish would be controlled.[5] Taylor Howard was an early research user of the Dish from Stanford, which also provided its first transmitter.

George Durfey in whimsical pose atop one of the Dish's trunnions.

As it turns out, SRI built not only the Dish, but also four similar ones to serve a variety of government interests arising out of the Cold War. They emerged within a few years of each other, with designs beginning as early as 1958 and extending to perhaps 1965 when all five were operational. Three of the five dishes and a few of their individual uses are mentioned here and, in at least in one instance, how two acted in collaboration is described. The sidebar indicates where the other dishes were located, with images.

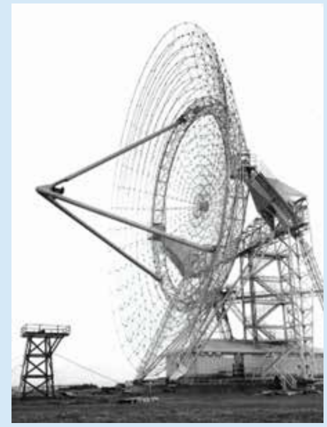
First Uses

While the first uses of the Dish by both Stanford and SRI undoubtedly involved exploratory testing, such as for meteor trails and moon reflections, soon came those original needs of the government that paid for this complement of radars. Here we mention just three of these needs and how they unfolded.

The first involved ionospheric physics and, in particular, auroral clutter; that is, would the dynamics of the auroral zone hamper the emerging large early warning radars that necessarily looked northward for Soviet threats? While other radars operated by SRI in Alaska could gather that information in this hemisphere where the auroral zone extended geographically southward, would that same auroral encounter arise for an early warning radar, such as BMEWS (a ballistic missile early warning system), operating in the European sector where it faced a more northerly displaced auroral zone? Learning this became the mission of the first SRI dish, which was placed near Fraserburgh, Scotland. It was commissioned in 1959, and from its use came a slew of articles by SRI scientists in the technical journals of the day on the nature of the aurora. At this writing, it is not clear whether this radar was ever used for anything other than those auroral studies. At some point, it was given to a West German ionospheric research group.

A second use for these antennas was to examine the atmospheric and ionospheric effects of Soviet nuclear

It is safe to say that SRI constructed five very large parabolic dishes of roughly the same design in the period from approximately 1958 to 1965. The first one appeared sometime in late 1958 or early 1959. That dish, 142 feet in diameter, was located just outside Fraserburgh, Scotland. This high-latitude location was chosen to give direct access to the auroral zone, and the data collected there helped answer whether auroral clutter would hamper the performance of US early warning radars based in Europe. Doing so, it also contributed insight into the physics of the aurora itself. And this was evidenced by papers in professional publications like the *Journal of Geophysical Research,* the *Physical Society of Japan, Radio Science*, and others.[1]



Fraserburgh, Scotland radar. Photo credit: Mike Cousins

Air Force's Sagamore Hill radar, now at MIT's Millstone Hill Facility. Image from MIT's Haystach Obervatory website.

The next antenna was contracted for and built concurrently with the Dish and most likely became operational at about the same time, 1963. It was constructed at the Air Force's Space Physics site on Sagamore Hill Observatory near Hamilton, Massachusetts, primarily for radio aeronomy work. By 1967, the Air Force was gaining its own interest in space weather and at the same time supporting NASA and its ATS satellite series. It was also used for ionospheric research using transmissions from geostationary satellites. In 1978, it was transferred to MIT's Millstone Hill Haystack Observatory in Westford, Massachusetts. It is now called the Millstone Hill Steerable Antenna (MISA) and used as a radar for incoherent scatter experiments as well as a probe for asteroids. You can learn more about it in Wikipedia.

detonations that were occurring in 1961 and 1962 and, expectedly, in ongoing years. One series was conducted in its far northern archipelago of Novaya Zemlya (New Land), and another series was over the Semipalatinsk area of Kazakhstan. What would be the impact of large high-altitude detonations on the radar systems that needed to function for either of the Cold War adversaries? Not being able to directly interact with these events from outside the Soviet Union, the only way to reach either location was via reflections from the moon. Interestingly, the technology to do that had been proven much earlier, as will be described later.

In the unfolding atomic era, it seemed the mid- to late 1950s saw an almost constant interplay between testing of all kinds and test ban proposals. But in late October 1958, after a flurry of tests, including atmospheric, all sides agreed to a temporary moratorium.[6] That ban lasted almost three years. But the Soviets broke that agreement bigtime in September 1961 with two missile-launched detonations targeted for Novaya Zemlya, followed a month later with "Tsar Boomba," an air-dropped weapon and the largest nuclear bomb ever detonated. But as it turned out, the only very-high-altitude tests were carried out only over Kazakhstan in October 1961 and 1962. Given that foray, or perhaps in anticipation of it, in 1961 the US government began preparations to monitor such tests. In addition, prompted by the Soviet abrogation of the agreement, President Kennedy later that year gave the go-ahead for the resumption of our own atmospheric tests that commenced in the mid-Pacific in the spring of 1962.

So, through whatever set of assumptions, including the Soviet's cavalier disregard for test ban agreements and that the Novaya Zemlya and Kazakhstan tests were going to continue, the government's Defense Atomic Support Agency stepped into the picture and, through the Air Force Cambridge Research Lab, funded the Dish. According to the *Stanford Daily*, the Dish saw its first full profile emerge on 30 September 1961 as the parabolic structure was lifted onto its movable support frame.[7]

We don't know exactly when the Dish first became operational. but it was almost certainly sometime in 1963. There were buildings to erect, miles of power lines to install, and perfecting the drive mechanisms, procuring and testing of transmitting and receiving equipment, running high-capacity feed lines from the transmitters to the Dish, and perfecting the computer control system would all take many months. Given that delay, the Dish was simply not going to be ready should nuclear tests of interest follow quickly on the heels of those in 1961–62. Then an important next step occurred.

The third dish antenna was built slightly prior to the SRI Dish and for the Naval Research Lab and located at its facility in Chesapeake Beach, Maryland. Its uses, other that the moon-bounce intercept work mentioned earlier, cannot be verified. It was located near the NRL's MADRE radar used for over-the-horizon missile detection, but that may be incidental. It was a 150-foot duplicate of the Dish. It is no longer at that site, and it is doubtful it still exists.

The Naval Research Laboratory antenna near Chesapeake Bay. Image from https://www.youtube.com/watch?app=desktop&v=Ppi47e-lRpM

The fourth antenna was located, of all places, just outside Asmara, Ethiopia (now Eritria.) The selected site was first used in 1953 as an Army communications station but, over time, the Navy, other DoD communications departments, and the diplomatic services appeared, blossoming the on-site staff to several thousand. Because Asmara is located on a flat 7,600-foot plateau, it has an excellent radio horizon. So, in 1965, the National Security Agency placed a project there called STONEHOUSE.[2] Its primary mission was to intercept a variety of Soviet satellite and deep space transmissions. In the photograph, the rearmost antenna is obviously the other sibling of the SRI Dish. The time frame saw the Soviets launching a host of satellite, moon, moon-landing, and deep space planetary missions. Some of their satellites were data collecting ones, and the US wanted to learn what they were doing. But, to the extent that those data dumps would occur only over their primary space-receiving sites in the Crimea, the STONEHOUSE location was needed to intercept them, being tipped off by other US sites that knew Crimea was listening. I won't list the various Soviet satellite, moon-based, and planetary

All during these 1961–62 tests as well as earlier ones, almost continuous efforts were under way to ban anything that would create radioactive fallout. And in August 1963, the three major nuclear powers finally agreed on yet another ban on atmosphere and high-altitude tests. That agreement became permanent and thus spelled the end of the Dish's potential use for nuclear test monitoring.

The background for the third and last facet of the Dish's early use starts as far back as 1946 when engineers first realized that the moon could act as a reflector for strong signals sent from the earth, either intentionally or not.[8] One fallout from that realization, and again housed in the context of the Cold War, was an ability to intercept the large radars that the Soviet Union was building for air defense and later ballistic missile defense systems.[9] Obviously, the USA wanted to learn of their capabilities, but because those radars used line-of-sight frequencies and were located in the interior of their territory, and because satellites for that purpose were not yet in orbit, direct intercept of them was well-nigh impossible. Hence, again arose the notion of moon-bounce, this time for intercept, a receive-only mode.

Notably, the 1946 realization showed that both monostatic and bistatic (single and separate locations of transmitter and receiver) reflections from the moon were useful and reliable. While this opened the door, one might immediately think, as I did, that the use of our only natural satellite to enable pinpoint connectivity between two widely separated sites was problematical. There were three questionable factors: Would the moon be in the right place at the right time, would the target radars be active and pointing in the right direction, and would the lunar reflection destroy the coherence of an already extremely weak signal? Well, surprise! It was found that the signal could arrive with usable coherence as much as 18 to 36 hours a month depending on the azimuthal coverage of the target radars and which US-based antenna was engaged to receive. Of course, in practice the time could be markedly less due to the radars not being on the air.[9,10]

As a result, in the mid-1960s a program to monitor a specific very powerful and experimental Soviet radar was undertaken with various US agencies participating. Among the half-dozen or so large dishes employed, two were SRI-built, one for the Navy on Chesapeake Bay and the other our Dish. The target radar was first spotted in 1960, but we don't know when the employment of our US intercept dishes began. The radar was first intercepted at the Chesapeake Bay site in January 1964 and, after some sophisticated equipment was introduced, at Stanford in August 1965. When the target radar was looking west, the Navy site could see it and when it was pointing east, the Dish could see it.

systems of interest, but they were substantial. It needs saying that these were not simple tasks, for in most cases they required spacecraft trajectories sometimes relayed from other US tracking systems. Please see the referenced footnote if you want more detail.

Located outside Asmara, Ethiopia, now Eritria. Image from https://www.thespacereview.com/article/4580/1

However, by the late 1960s, the overall site was scaling down for intrinsic reasons; but, critically, the outbreak of the Ethiopian civil war in 1974 arrived at Asmara in January 1975. At that point, STONEHOUSE immediately ceased, and all the sensitive equipment was destroyed. In sum, and over almost a decade of use, the Asmara site was the only NSA site located properly to receive data from Soviet deep-space craft.

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1. https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/JZ070i017p04235
   https://articles.adsabs.harvard.edu//full/1962JPSJS..17A.218L/A000222.000.html
   https://web.archive.org/web/20180604032147/https://nvlpubs.nist.gov/nistpubs/jres/69D/jresv69Dn7p959_A1b.pdf

2. https://www.thespacereview.com/article/4580/1

Of some help, the Soviets once actually tracked the moon for an hour. Over time, these measurements successfully characterized the Soviet radar in both scanning and tracking modes and whether it had the ability to track multiple targets simultaneously. Eventually, the effort, to which SRI contributed, successfully defined the signal structure and power of that Soviet radar and perhaps others.[9]

New Life for the Dish

With the ending of the Cold War, the Dish unfortunately lost its hidden purposes and steady funding. Not finished, however, it soon began modestly benefiting from the emerging world of satellite systems along with a few other projects that carried it into the 1970s. Then began a long period of idleness and obsolescence.

While the Dish was originally intended to last perhaps a decade or so, the value of its basic design endured, and mostly at the hands of some resourceful people, it was refurbished, given new capability, and is still going after over 60 years. In the next issue of this Newsletter, you'll learn how the Dish weathered those times, how it reemerged to a useful life, and who at SRI and Stanford made it so.

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1. https://issuu.com/bayareanewsgroup_marketing/docs/01212024_space_magazine_s

2. Since at the time the Dish was built SRI was actually a subsidiary of Stanford, perhaps the distinction back then wasn't all that significant. But since 1970, the two institutions have been legally separate. And while the Dish was largely used by SRI, over time Stanford researchers have also had some hand in its use, hence some common ground. The structure itself is owned by neither Stanford nor SRI but is the property of the US government.

3. Funds for the construction of the Dish and at least one other came from the Defense Atomic Support Agency through the the Naval Research Lab and Air Force Cambridge Research Laboratory's Office of Aerospace Research. The contract began on 4 June 1959 and was for just over $1 million for the Dish and its twin for the Air Force, located in Massachusetts.

4. For the nerds among you, at 1420 MHz and 400 MHz, the Dish has, respectively, a 0.25 and 1 deg. beam width and a gain of 52 and 43 dB. Its elevation angles range from 3 to 87 degrees, its tracking speed is 1 degree per second, and its positional accuracy is 0.01 degree.

5. Some of the SRI participants were David Wray (design), John Schlobohm, Ron Presnell, Roy Long, and Murray Baron. Those at Stanford who helped bring the Dish about in the first place were Professors Allen Peterson (principally involved with a joint appointment with SRI), Von Eshleman, Robert Helliwell, Ron Bracewell, and "Mike" Villard.

6. The United States, the Soviet Union, and England were the players. France would join later.

7. https://archives.stanforddaily.com/1961/10/02?page=1. To see a 20-min film of the hoisting of the parabola, go to https://www.youtube.com/watch?v=bAvwUjN30kY.

8. This discovery in rooted in Project Diana, a 1946 Army Signal Corps effort to see if radar could penetrate the ionosphere and thus detect incoming warheads. In the absence of satellites, reflection off the moon was the approach selected. On 10 January 1946, it was successful and became the first probe of an extraterrestrial body and the birth of radar astronomy.

9. This reference can be found at either https://www.cia.gov/resources/csi/static/Moon-Bounce-Elint.pdf or https://web.archive.org/web/20201108114110/https://www.cia.gov/library/center-for-the-study-of-intelligence/kent-csi/vol11no2/html/v11i2a05p_0001.htm.
   As revealed in this now declassified article, the code name for this target radar was Hen House, and its location was in Sary Shagan, Kazakhstan, first sighted in 1960.

10. While the moon's surface is rough, it turns out that the area on its surface that results in a specular reflection is only a few miles in diameter. Thus, the resulting distortion is usable. Moreover, some of the large features on the moon's surface can, by chance, give even a stronger, more coherent return when the signal from multiple large surface features add.

WELCOME

The SRI Alumni Association welcomes new members:

Ted Bakowsky
Richard C. Smith

And welcomes back previous member:

Jerry Jones

We look forward to your participation in the Alumni Association and hope to see you at our next group event.

Donation Received from Steven Smith

The Alumni Association received a generous $5,000 donation from longtime SRI employee and Alumni Association member Steven Smith. Sadly, Steven's brother Richard Smith told us that Steven had died just a few days after we received his gift (please see his obituary in the In Memoriam section).

In gratitude, we had planned to give Steven a lifetime membership in the Alumni Association. That membership has now been extended to Richard, who was also employed at SRI, from 1958 to 1965.

Plan to Attend the Spring Fling at the San Mateo County History Museum in downtown Redwood City on Thursday, May 16, beginning at 11:30 a.m.

Join your fellow alumni on Thursday, May 16, for a visit to the San Mateo County History Museum. Housed inside the former courthouse built in 1910 for the San Mateo County Superior Court, the museum showcases the rich history of San Mateo County. A free box lunch will be served in Courtroom A starting at 11:30 a.m.

This is a free event for all alumni members and their guests. Please send in your completed reservation form, to the SRI Alumni Association by May 13. If you'd prefer, you can email the required information to steering-committee-alumni@sri.com. For questions, please contact Dave Harvey at dave.harvey620@gmail.com. We hope to see you there!

SRI International Alumni Association
Cash Flow/Income and Expense
Year ending December 31, 2023

CASH BALANCE as of 01/01/23		**$36,088.26**
INCOME		
Cash income from membership dues and fees	$5,130.00	
Dividend income from SRI Federal Credit Union account funds	$70.41	
TOTAL INCOME	$5,200.41	**$5,200.41**
EXPENSE		
Newsletter (postage, printing, etc.)	$3,784.11	
Catered Reunions (2022 & 2023)	$8,837.23	
Spring Fling @ CHM	$1,328.97	
TOTAL EXPENSE	$13,950.31	**$13.950.31**
CASH BALANCE as of 12/31/23		**$27,338.36**

Wanted: Your Submissions

We welcome articles and shorter items from all Alumni Association members to be considered for publication in the newsletter. Have you done something interesting or traveled to interesting places? Received any awards or honors? Your fellow alumni want to know! Please send items to steering-committee-alumni@sri.com.

Who Do You Believe Made an Exceptional Contribution to the Success of SRI? Nominate That Person for the SRI Alumni Hall of Fame!

The SRI Alumni Hall of Fame honors former staff members who made exceptional contributions to the success of SRI.

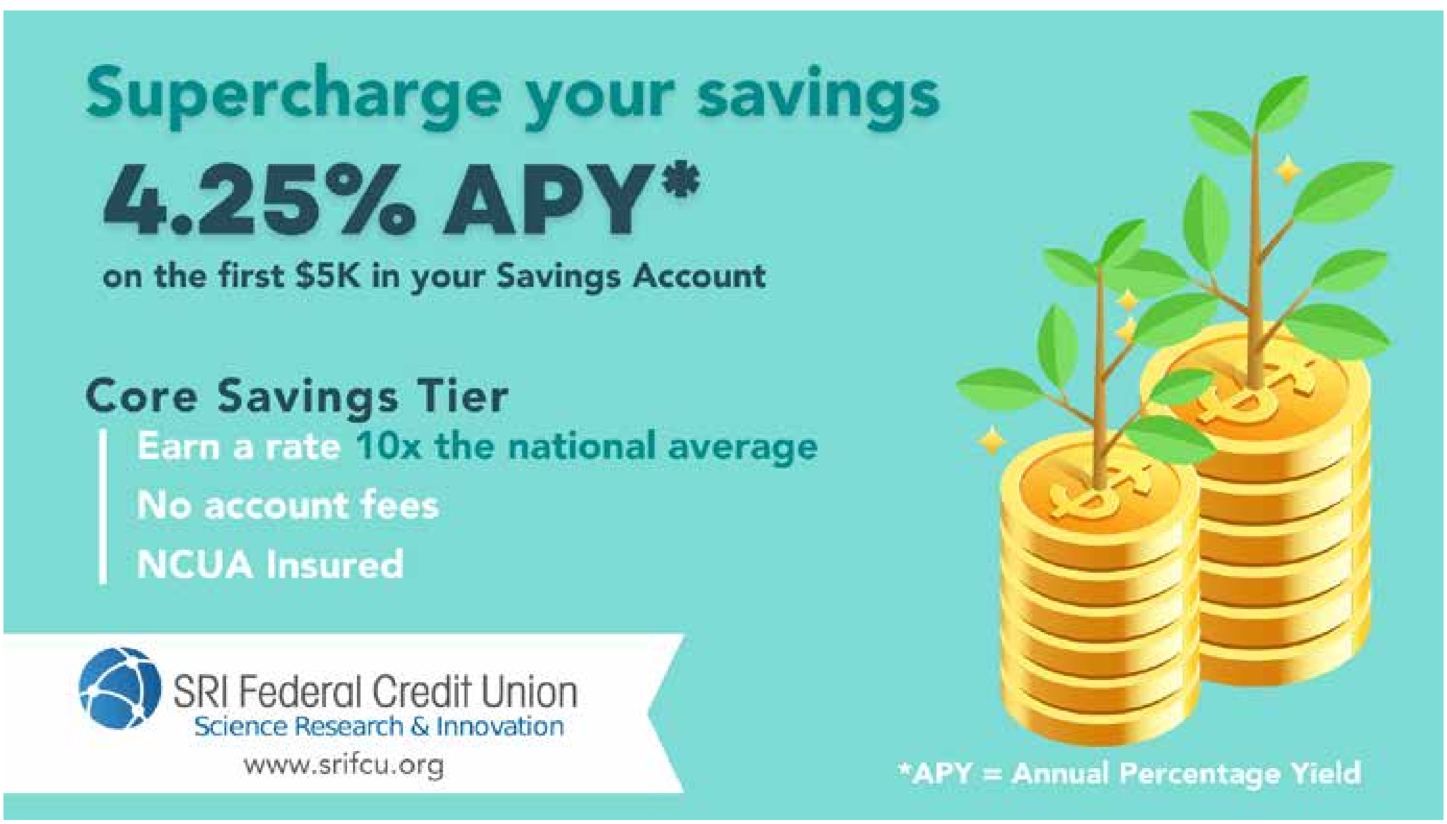
All former staff members are eligible, but nominees should meet the following criteria:

- Significant, lasting contributions to the success of SRI
- Contributions recognized by staff, management, or clients
- Contributions in any area of research, management, or service, such as
  - Establishing a new laboratory or a new field of research
  - Performing an outstanding recognized service
  - Clearly demonstrating qualities of leadership, vision, and creativity
- What did the person leave behind?
  - Enhanced reputation for SRI
  - New or enhanced research, business, or support activity or facility.

Please prepare a write-up of about 300 words indicating how your nominee meets these criteria. If you have questions about the nomination process, members of the Steering Committee will be happy to answer them. Send the write-up or questions to steering-committee-alumni@sri.com or SRI Alumni Association, 333 Ravenswood Avenue, AC-108, Menlo Park, CA 94025-3493.

The distinguished inductees are further honored by having their names engraved on brass plates permanently displayed on a wooden plaque in the I Building foyer. Current-year inductees also have their framed citations and photos mounted next to the wooden plaque (see photo below).

Credit Union News



Bronwyn Brady

Bronwyn Brady, former technical editor at SRI, died of cancer on January 20, 2024, in Phoenix, Arizona. She was 69.

Bronwyn was born in Covina, California, to Vester and Ruth Brady and lived in Southern California until she moved to Santa Cruz to attend college. She graduated with a Bachelor's degree from the University of California at Santa Cruz in 1976.

In the late 1970s, Bronwyn joined the technical publications group in SRI's Technology and Systems Development Division, where her careful editing greatly improved the readability of hundreds of SRI proposals and reports. During her nearly 20 years at SRI, Bronwyn worked in a number of divisions, finally ending as an editor in the Remote Measurements Laboratory in the upstairs "penthouse" of Building 301, above the SRI Café.

In the mid-1990s, Bronwyn left SRI to attend law school at UC Berkeley, passed the California State Bar Exam, and moved out of the Bay Area in 1999 to practice law in Fresno, California. She later moved to Phoenix to be closer to her brother Sean and sister-in-law, Beth, who helped care for her during her long illness.

Bronwyn will be remembered for her concise writing style, her sparkling and dry (like a good Champagne) wit, and her gracious manner. Bronwyn loved literature, art, music, animals (especially dogs and cats), flowers, chocolate, fashion, absurd YouTube videos, and her closest friends and family.

Based on an obituary written by Jeanie Graham.

Robert Willis Gates*

Robert (Rusty) Gates died on February 4, 2024, in Ukiah, California, at age 97 with his son Dan at his side. Rusty had a varied, fulfilling life.

Rusty was born on December 19, 1926, in Lihue, on the island of Kauai, Hawaii. His father, Cecil, who favored aloha shirts, was an engineer from New York or Pennsylvania, and his mother, Helen, was a school teacher from Okarche, Oklahoma. Rusty was the second of two children. When he was a baby, his hair was reddish, so they called him "Rusty," which he said meant that he was a man of steel.

For a time during the Great Depression, the family moved to California and then returned to Hawaii where Rusty's father was in charge of civilian housing at Pearl Harbor. Rusty and Cecil spent most of their teenage years in Honolulu and had wonderful adventures with small boats in the harbor. This idyllic life came to an end on December 7, 1941, when the Japanese bombed Pearl Harbor. Rusty, who was only 14 years old, claims to have watched the bombing from the top of a palm tree.

That event changed Rusty's life completely. His schooling was interrupted, and his brother went into the Navy. Rusty took on three jobs, working as an ambulance attendant, on a glass bottom boat, and at a distillery to produce alcohol for military use. A traveling salesman convinced his parents that Rusty could go to Stanford University and join the Chemical Corps. Rusty caught a ship to San Francisco, California, but when he arrived at Stanford, they had no idea who he was. It seems the "training program" was a con for the salesman to get money from his parents. Because Stanford was in need of students, they let him stay as a provisional 15-year-old student. Four years later, he graduated with a degree in chemistry.

Rusty worked his way through Stanford living at the firehouse, bussing tables in the cafeteria, and carrying trunks upstairs to the freshman girls' dorm. Carrying luggage is how he met Margaret Joan Hodgson, a new Westinghouse scholar and Belmont, California, native who graduated from Stanford with a degree in physics. She soon became his wife. The young couple built a house in Los Trancos Woods, and between 1952 and 1963 had six children. Joan was a high school science teacher and an artist skilled in textiles, woodworking, and stained glass. Rusty and Joan were married for 68 exciting years, until her sudden death in 2014.

After graduation, Rusty worked as a chemist at the Spreckels sugar refinery in Salinas, California, before taking the job he would hold for the next 37 years at SRI in Menlo Park, first in Poulter Laboratory and later in the Chemical Engineering Group. Rusty could be depended on to conduct more difficult experiments and was in high demand to serve on project teams. He never had a problem keeping his "sold time" high.

Rusty worked on seismic properties of permafrost in Alaska and on air pollution in Los Angeles. He studied the cancerous effects of asbestos fibers on rats, what happens when airplanes hit birds, and how sea lions echolocate. He didn't simulate these things on a computer; he was a proud *laboratory* scientist. His bird strike study involved shooting frozen turkeys at 600 miles per hour at airplane windshields. Rusty considered himself to be primarily a shock wave physicist but was not above rigging branding irons for elephant seals to study their migration habits. Many of his projects involved explosives, much to the detriment of his later hearing.

The Los Trancos Woods where Rusty and Joan lived in the early 1960s was known as a "bohemian" community, which Rusty said meant it was full of intellectuals and beatniks. Its bad roads and rural ambiance attracted Stanford professors and artists. The local marching band was legendary. Neil Young showed up, and Joan Baez had a house up the hill. Rusty made beer and kept chickens and goats, until the goats started eating the trees.

In his 30s, Rusty was a sailor. He and his buddy Peter Dawson purchased a 24-foot sloop named *The Symbiosis*. They sailed all over the San Francisco Bay and spent many happy hours dockside maintaining the boat and supporting the Pete's Harbor bar. Their kids played in the mud and sailed tiny El Toro boats around the harbor. Rusty knew every mudflat in the bay at low tide, having been stuck on most of them.

In his 40s, Rusty discovered diving, an endeavor that complemented his life-style: not too expensive, good for kids, cool equipment, adventure, and delicious abalone. For years he traveled up and down the coast, staying at state parks and diving in the coves. He joined the SRI dive club, the Tritonians, and went on more elaborate dives to places like Catalina, where they caught lobsters. When Rusty and Joan bought property in Mendocino County, the dive club had quarterly trips there to take advantage of the plentiful abalone. Much cheap beer was consumed, and many songs were sung, written, and rewritten. This was the period when Joan started her long involvement as an active member of the Mendocino Art Center.

During the Mendocino years, Rusty and Joan contributed to the Jughandle Creek Farm. Their contribution involved communal ownership of what is now the Jughandle State Park and resulted in saving that farmhouse, the beautiful little cove, and acres of old-growth redwoods. For two years, Joan camped with kids in a teepee on that property while she studied at the Mendocino Art Center. The Jughandle Farm was eventually transferred to the state. Joan and Rusty then purchased the property on Cameron Road in Elk where they built their solar house, mostly off grid. For years, Rusty commuted to Elk on weekends from Menlo Park, before retiring at 60 and moving there permanently.

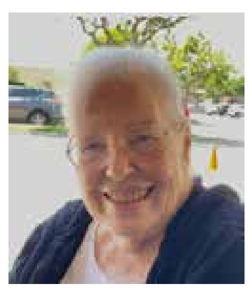
Rusty grew up in the Great Depression and came of age during World War II, a war with nuclear weapons. Only luck kept him from being in that war or the next. The lessons he taught, not by lecturing, but by example, are that we need to be nice to each other and work together to build a better community for everyone. He wasn't impressed with wealth and did not seek it out. He had enough and was happy.

Rusty's commitment to the common good included donating blood to the Red Cross (more than 20 gallons—not all at once!). He was involved in starting the Elk Community Services District to provide reliable funding for his beloved Elk Volunteer Fire Department. He served as President of the Board of Directors for 17 years, from 1990 to 2007. One of the community fire trucks still lives in his barn. Rusty was still out flagging for fire calls at 80.

Rusty was preceded in death by his wife, Joan. All six of their children survive (Keith, Ken, Jennifer, Daniel, David, and Judy), as well as seven grandchildren and four great-grandchildren.

Based on remembrances written by Daniel Gates and Jerry Jones with contributions from Don Shockey.

Lora Frances Barshell Laine*



Lora Laine died with her family at her side on December 18, 2023, at the age of 85.

Lora was born on September 26,1938, at Children's Hospital in San Francisco, California, the younger of two children to Edwin and Margaret Barshell. She and her sister, Margaret, were raised in Burlingame, California. Lora excelled in academics at Burlingame High School while finding the time to participate in numerous interscholastic activities. This passion for knowledge resulted in her application to and acceptance at the University of California at Berkeley. Her outward demeanor and personality allowed her to run in multiple social circles and afforded her the opportunity to join the Delta Zeta sorority, which influenced her later pursuits.

Lora found her soulmate and love of her life, Edward J. Laine Sr., while attending Ed's best friend's bachelor party, where stories have it that she got his attention by jumping out of the presented cake. Lora and Ed tied the knot on February 4, 1960, at Saint Stevens Church in San Francisco. They had four children and lived in San Bruno, California, for many years before moving to Redwood City, California. There, on "the ranch," Lora and Ed encouraged the kids to help with all the birds, rabbits, goats, and other animals they raised throughout their life together. Lora began as a domestic engineer, raising the four children, but her continued outward nature and interests found her landing a position at SRI, where she had a long, varied, and successful career as an executive assistant to the Vice President.

Lora, Ed, and the two youngest kids moved to Riverside, California, in 1981 for Ed senior to further his career with the California Highway Patrol. Lora's active involvement with volunteer (Panhellenic) and social (Newcomers) groups ensured that the family was surrounded by friends and myriad social activities. As outgoing and engaging as ever, Lora assumed the role of chairperson for both organizations. This allowed her to host events that awarded academic scholarships to the youth of Riverside and the surrounding communities. Lora loved the social aspect of her community, and she used every opportunity to mingle with her friends and participate in multiple community groups.

Lora was an avid quilter. She created many magnificent quilts that she gave to friends and family. Lora used all methods of piecing her quilts and leaves behind textile remembrances to those she loved.

Lora was a loving mother and a caring human who had an abundance of compassion for others. She was a kind, warmhearted person who always showed dignity and respect to the people she encountered throughout her life. Lora enjoyed all kinds of travel, from the family-friendly four-kids-and-a-dog summer vacations around the United States in an RV to the various river cruises in Europe with Lesa and their numerous friends.

Lora had a significant impact on the people who became her friends and appreciated her presence over the years. Her imaginative flair and clever jokes will leave a void.

Lora is survived by her four children (Deborah, Stephen, Elizabeth, and Edward Jr.), six grandchildren, and a great granddaughter.

Based on an obituary published by the San Francisco Chronicle *on December 22, 2023.*

Steven Lawrence Smith*

Steven Smith died on February 7, 2024, at the age of 79.

Steven was born on June 4, 1944, to Richard Coleman and Jeanne Louise Smith; he was the second of their five children.

Steven was diagnosed early with learning challenges and was in special classes through high school. He graduated from Menlo-Atherton High School in Menlo Park, California, in June 1963. Through a program in high school, Steven had done an internship with SRI and on graduation was hired by SRI as a bookbinder in the printing shop. He kept that job for 47 years, retiring to Eugene, Oregon, to be with family in 2011.

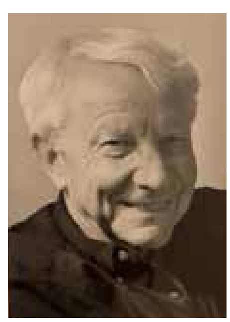
Steven had a full life. His major interests were trains (especially being part of the Niles Canyon Railway); Palo Alto First Methodist Church and Choir; travels with his longtime friend BJ of Meriden, Kansas; musical shows at local performance centers; and Stanford University sporting events, especially football.

Steven was diagnosed with progressive supranuclear palsy in 2018 and spent his last years with wonderful care from the staff at Farmington Square in Eugene. In the end, the palsy took his life quickly and without discomfort.

Steven is survived by his brothers, Richard, Russell, and David, and his sister, Deborah, and their families.

Based on an obituary provided by Richard Smith.

Charles Alvin Spindt*



Charles Alvin (Capp) Spindt, age 92, of Portola Valley, California, died on December 22, 2023.

Capp worked as a research scientist at SRI for 61 years, handing in his resignation only after his 90th birthday. Capp was the Program Director (Emeritus) of SRI's Microsystems Innovation Center in Menlo Park, California. A pioneering leader in vacuum microelectronics technology, field electron and ion emission devices, and high-performance field-emitter array cathodes, he invented and developed techniques for the fabrication of submicrometer field emission sources based on thin-film technology and advanced lithography systems.

Capp was born on July 20, 1931, in San Jose, California, the son of Lester James and Eline Bertha (Anderson) Spindt. Capp grew up in the farming community Los Banos, California, where because of a severe manpower shortage during WWII he obtained his driver's license and worked in the fields with other children at the age of 13. He attended Los Banos High School, where he was student body president, played basketball and baseball, and was a two-way starter on their undefeated football teams during his junior and senior years.

After a year at the University of California at Berkeley, where he was a member of the Del Rey Fraternity, Capp left to serve in the US Air Force as an all-weather supersonic fighter jet pilot and squadron leader. On leaving the Air Force, Capp earned an electrical engineering degree at San Jose State University in 1960.

Capp landed his first internship—in 1959 at SRI—because his interviewer saw a resemblance between Capp and Steve Canyon, the eponymous Air Force hero of a long-running American adventure comic strip. Capp received a compliment from his boss: "His best feature was that he wasn't handicapped with a higher education." (Capp did earn a PhD in 1990!) On several occasions, his boss told him that an idea he was describing wouldn't work—before Capp could finish saying how well it had worked!

Capp and his team were originally funded by SRI internally. However, in 1973, NASA's Lewis Research Center stepped in with additional funds to take the research to the next level. Ivor Brodie, a known expert in vacuum-tube technology, joined Capp at SRI. Ivor was tasked with publicizing the advances in the field emission technology. In 1985, the Laboratory of Electronics and Information Technologies announced early results in the development of a flat-panel, field-emission display (FED) based on what came to be called the Spindt cathode.

Capp's field-emission technology was able to produce displays requiring less than 100 volts and no thermionic heating. As such, the properties of field-emission technology offered an alternative to the very-high-voltage, inefficient cathode ray tube displays of the day. Hence came the most sought-after use his technology, FEDs and ultimately television screens. These displays also had the attributes of high contrast and no viewing angle restrictions, two qualities lacking in the plasma and liquid crystal displays (LCDs) of the day. At one point, Sony invested heavily in a South Bay start-up to exploit this potential. However, two factors ultimately argued against FEDs: first, they still needed a vacuum to operate, a challenge in large flat displays, and second, LCDs kept improving in quality. In the end FEDs never hit the display or television marketplace.

However, in addition to flat-panel displays, applications have expanded to include microwave tubes, spacecraft charge management, scanning electron microscopes, mass spectrometers, and vacuum integrated circuits.

While directing the Vacuum Microelectronics Program at SRI, Capp cofounded the International Vacuum Nanoelectronics Conference in 1988 with a colleague from the Naval Research Laboratory. The conference brought attention to the technology, and articles featuring Capp's work have appeared in many publications.

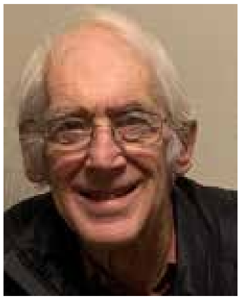
Capp went on to contribute to world understanding of vacuum microelectronics through many positions on committees and editorial boards, as well as by delivering invited lectures all over the world. In 1992, he was honored as an SRI Fellow. In 1996, the Society for Information Displays awarded Capp the Jan Rajchman Prize for inventing and developing field-emission flat-panel displays using microtip structures. In 2006, he received the Institute of Electrical and Electronics Engineers (IEEE) International Vacuum Electron Sources Conference (IVESC) award for his contributions to electron emission science and cathode science. He was inducted into the SRI Alumni Hall of Fame in 2004.

Capp is survived by his sister, Chris (Alan) Peterson; children, Kim (Bo) Corby, Christopher (Kristin) Spindt, and Susan (George) Pess; and grandchildren, Melissa, Brad, Alison, Samantha, Ben, Olivia, and Emma. Services will be planned for this summer.

In lieu of flowers, the family requests donations be made in honor of Charles "Capp" Spindt to the Belle Haven "Boys and Girls Club of the Peninsula," 401 Pierce Road, Menlo Park, CA 94025, or BGCP.org.

Based on various sources, including an obituary published in The Mercury News *March 24, 2024; the August 2015 issue of the* SRI Alumni Association Newsletter*; SRI website articles "Spindt cold cathode for displays" and "75 Years of Innovation: Spindt cathode field emission technology; SRI's 2004 Hall of Fame commendation (https://srialumni.org/halloffame-archive.html#2004); an IEEE author biography (https://ieeexplore.ieee.org/author/37272848500).*

Bernard Michael Wilber



Michael (Mike) Wilber died peacefully on December 14, 2023, at the age of 80 in Menlo Park, California, from complications of Parkinson's disease. Until he moved to Menlo Park in his later years, Mike resided in Palo Alto, California, for more than 50 years.

Mike was born in Berkeley, California, and spent almost all his life in California. His one foray to the East Coast was for his undergraduate years at Massachusetts Institute of Technology, where he began as a physics major and switched to mathematics for his BS degree, although he continued to have a lifelong interest in physics. He was later a graduate student in the second year of Stanford University's new computer science program where he received his MS degree.

Mike worked at SRI for 17 years in the Artificial Intelligence (AI) Group under Charles Rosen, starting in the mid-1960s. His greatest joy was working on the Shakey project, and he was a proud member of the team that received the Institute of Electrical and Electronics Engineers' Milestone Award in 2017 for Shakey at the Computer History Museum in Mountain View, California, where Shakey is spending his well-earned retirement.

After leaving SRI, Mike worked at Apple Computer, Inc., under Steve Jobs, designing the sound system for the first Macintosh computer. His subsequent career included working at a variety of corporations and start-ups in the fields of AI and expert systems and, before his retirement, as a private consultant.

Mike enjoyed traveling to Europe and especially to Paris. To the end of his life, he never lost his curiosity about the world and especially how things worked. Although by nature a quiet person, Mike took over a "TGIF" (Thank Goodness It's Friday) group that met monthly in good weather outside at Zott's (Rossotti's Alpine Inn in Portola Valley) and ran it for years. The gatherings attracted a good-sized crowd through word-of-mouth, and there were always lively and interesting discussions on matters technical and scientific and lots of good humor along with the beer and burgers. It was a perfect place for this TGIF group because Zott's is well known to SRI'ers as the place where the Internet was born!

Mike is survived by his partner of 28 years, Dianne Ellsworth, an SRI Alumni Association member. (Mike and Dianne were introduced by a mutual acquaintance who was also a former SRI staff member.)

Mike will be greatly missed by his family and friends.

Based on a remembrance provided by Diane Ellsworth.

Note: At press time we learned of the deaths of three other former SRI staff members—**Lambert Dolphin**, **Gary Greenfield**, and **Dan Lynch**.* Their obituaries will be published in the August 2024 newsletter, or when more complete information is is available.

*Member of the SRI Alumni Association

Please consider joining the SRI Alumni Association. The association was founded in 1996 to provide former staff members the opportunity to keep in touch with SRI and their colleagues, to support the institute in a variety of ways, and to help perpetuate SRI's traditions and values.

SRI Alumni Association members enjoy many activities and services:

- **Alumni Association Newsletter**—Published three times a year, giving news about SRI programs, Alumni Association activities, and individual members (see past issues at https://srialumni.org/newsletter.html).
- **Membership Directory**—A regularly updated resource of contact information for association members.
- **Annual Reunion Meeting**—An opportunity for:
  - Socializing with other Alumni Association members.
  - Viewing the Alumni Hall of Fame Induction ceremony.
  - Hearing a prominent SRI speaker describe an important SRI project or organizational development.
- **Spring Fling**—A picnic or visit to a Bay Area point of interest; past trips have been to the Computer History Museum, the Hiller Aviation Museum, NASA-Ames, and the California Academy of Sciences.
- **SRI Archives**—Association members maintain and catalog SRI's photographic and nonproject archives.

We encourage you to participate in the SRI Alumni Association. Your first year's membership is free. Your membership thereafter will be $25 per year. By completing and returning the application below, you will be enrolled and will receive future issues of the newsletter and invitations to all alumni events. Please indicate how you would like your information to appear in the Membership Directory. If you prefer that some or all of your contact information not be published in the directory, please indicate your preference below. Also, please indicate whether you would prefer receiving the newsletter as an electronic copy (PDF, which saves the association printing/mailing costs) or as a hard copy. If you prefer to complete an application online, please do so at https://srialumni.org/join.html.

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