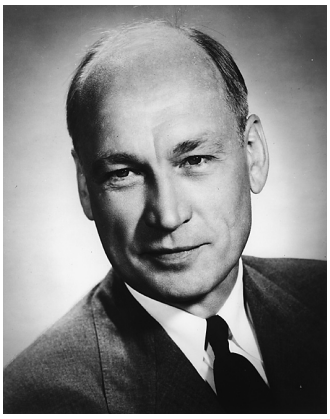
An accomplished pianist, Beckman formed his own dance band in high school. He also accompanied the silent movies at the local theater. After being discharged from the Marines in 1919, he headed west for the summer as an itinerant movie-house pianist before entering college.

Arnold O. Beckman
1900 – 2004



Beckman in an undated photo, circa 1945.

Inventor and philanthropist Arnold Orville Beckman, PhD '28, founder and president of Beckman Instruments, Inc., and chairman emeritus of Caltech's board of trustees, died in his sleep on May 18 at Scripps Hospital in La Jolla after a long illness. He was 104.

Born on April 10, 1900, in rural Illinois, Beckman's life paralleled and helped catalyze the transformation of the United States from an agrarian society to an industrial one. Running water and residential electricity did not arrive in his boyhood town of Cullom until his early teens.

A mechanically inclined son of a blacksmith, at age nine Beckman stumbled across a chemistry textbook in the attic and began doing the experiments. For his tenth birthday his father gave him the use of a backyard shed that promptly became his laboratory. His high-school dream career was to be a freelance chemist—have beakers, will travel. He would later recall, "I visualized having a trunk with apparatus—test tubes and chemicals—that I could take anywhere and analyze anything."

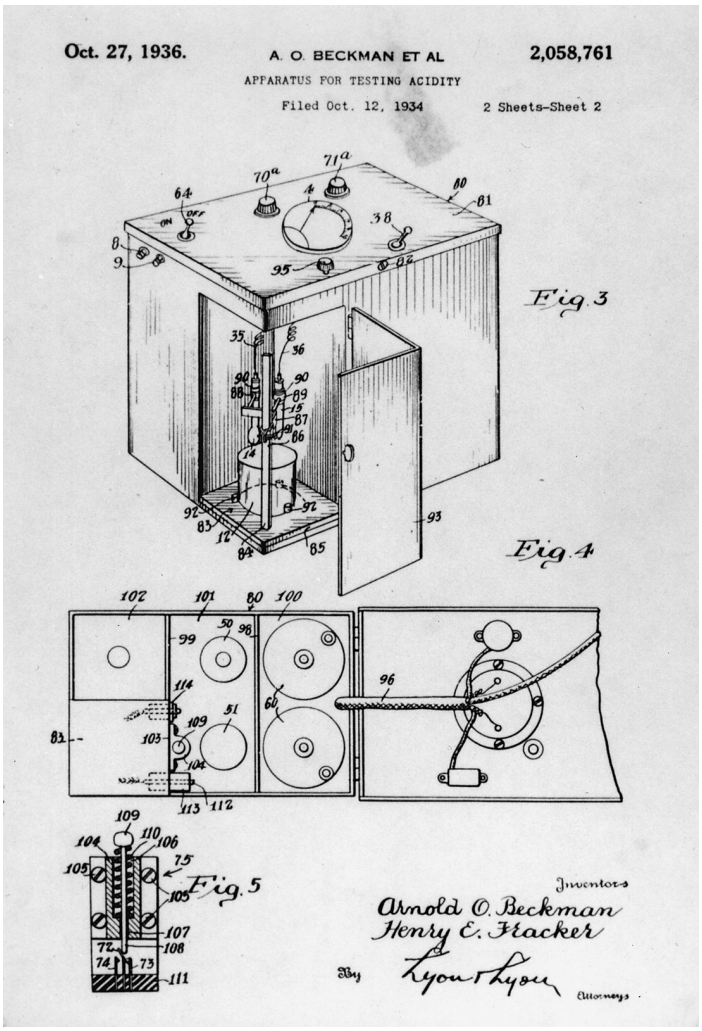
In August 1918 Beckman joined the Marines, missing being shipped off to fight Leon Trotsky's Red Army by one place in line at the Brooklyn Navy Yard. Thus he wound up eating Thanksgiving dinner at the Greenpoint YMCA, where 17-year-old Mabel Meinzer helped serve his table. It was love at first sight (they would be married nearly 64 years), but despite a voluminous correspondence, they would not get engaged until April 1923.

Instead, Beckman entered the University of Illinois, from which he earned a BS in chemical engineering in 1922 and an MS in physical chemistry in 1923. There he learned about electrochemistry and the new ionic theory that was redefining acidity, and mastered the art of glassblowing for experimental apparatus. He was accepted to the doctoral programs at the University of Chicago, MIT, and Caltech, opting for the "fabled country of California, land of milk and honey and oranges." But by now Mabel was an executive secretary at the Equitable Life Assurance Company in New York, and he left Caltech after a year to get a job near her.

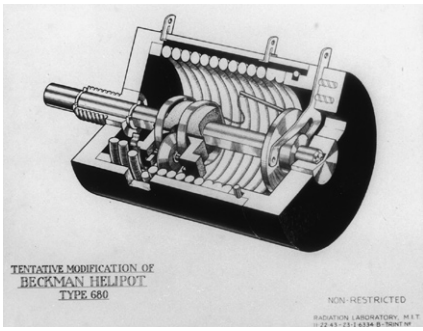
This proved to be at Western Electric's Engineering Department, which was in the process of transforming itself into Bell Laboratories, the premiere corporate research entity in the world in its day. There Beckman helped develop quality-assurance procedures for the manufacture of Audion vacuum tubes, which were used to amplify weak electrical impulses for transcontinental telephone calls, and learned about circuit design. "If I'd never gone to Bell Labs, I might not have developed any interest in electronics," he said.

Arnold married Mabel on June 10, 1925, and in 1926 the newlyweds returned to Pasadena after a six-week cross-country journey by Model T, which he had modified for better hill climbing. In the days before fuel pumps, the gasoline couldn't make it uphill from the tank to the engine on steep slopes. Most motorists dealt with this by driving up such grades in reverse, but Beckman fitted his gas cap with a bicycle-tire valve, allowing him to pressurize the tank with a hand pump when needed.

Now reenrolled at Caltech, Beckman did his PhD work on ultraviolet photolysis, applying the newfangled quantum theory to chemical reactions; he was asked to stay on as an instructor. The following year he and his thesis advisor, Roscoe


Oct. 27, 1936. A. O. BECKMAN ET AL 2,058,761
APPARATUS FOR TESTING ACIDITY
Filed Oct. 12, 1934 2 Sheets-Sheet 2
Fig. 3
Fig. 4
Fig. 5
Inventors
Arnold O. Beckman
Henry E. Fracker
By Lyon & Lyon
Attorneys

A drawing (left) from the patent application for the pH meter. Beckman held 14 patents, including the shockproof potentiometer (right).



Dickinson (PhD '20), built an instrument to determine the energy of ultraviolet light by shining it on a thermocouple, which turns heat into electricity, connected to a galvanometer. By the early '30s Beckman, now an assistant professor, had become the go-to guy when the department's instrument builder, Fred Henson, was overbooked. At least partially in self-defense, he began teaching a course in laboratory glassblowing. He fielded off-campus requests as well, leading him to set up a side business (with the blessing of Robert Millikan, Caltech's president, who had directed most of the inquirers to him in the first place) as a "scientific consultant."

One client, National Postal Meter, needed a nonclogging ink. Beckman found a workable formulation, but it was based on butyric acid—the active ingredient in stinky feet—and no ink company would touch it. So he decided to make it himself, in the back of a garage on an alley behind Colorado Boulevard that he rented from Henson. Hiring two Techers, Robert Barton (PhD '33) and Henry Fracker (BS '30), and incorporating as National Inking Appliance Company, the firm also test-marketed his invention to reink typewriter ribbons. This was not a success, as "the last things that secretaries wanted to do was get their fingers dirty with ink to save the boss a 75-cent ribbon."

Meanwhile, Sunkist, which handled more than three-quarters of California's citrus crop, had a problem of its own. Lemons that weren't top grade were juiced to make pectin (for jellies), citric acid, or other things, with the juice's acidity determining how it was processed. But the sulfur-dioxide preservative added to the juice bleached the litmus paper whose color change was usually used to measure acidity, and poisoned the hydrogen electrodes used in the favored high-precision electrochemical method of the day. An alternative, the so-called glass electrode, was immune to SO_2 but was big, with thin, fragile walls. To make matters worse, it gave a very weak signal, meaning you needed an ultrasensitive galvanometer that was itself vulnerable to the slightest jarring. And with either electrode, the whole temperamental setup, including rheostat, rectifier, and reference cell, sprawled across several square feet of benchtop.

So chemist Glen Joseph took a day trip from the lemon lab in Ontario, some 30 miles east of Pasadena, to pick the brains of his old classmate from the University of Illinois. Beckman realized that an amplifier would allow a small, stout glass electrode, which would give out an extremely tiny signal, to be hooked to a rugged but insensitive ammeter, and that the vacuum tubes he had worked with at Bell Labs were just the ticket. He built a gadget the size of a flour canister that used a second vacuum tube to crank up the output from the first one to give a REALLY BIG signal, just to be sure. It worked so well that Joseph never got to use it, as everyone else in the lab kept borrowing it.

The acidimeter, or pH meter, was the first instrument to package the chemist in the box. No more assembling complex apparatus and then spending months trying to figure out its idiosyncrasies. Now you just opened a door, stuck in your sample, and read off the result.

In 1935, Beckman's rechristened National Technical Laboratories (NTL) began selling the acidimeter through scientific-supply catalogs for $195—roughly a month's salary for a junior professor—in competition with 10-cent vials of litmus paper. But the unassembled components for a build-it-yourself electrochemical setup cost about $500, so the acidimeter was really half the price and none of the headaches.

Beckman clowns with the commemorative plastic brain given to him at a construction-site ceremony for the Beckman Behavioral Biology building on May 8, 1972. He has an appreciative audience in Mabel Beckman, lower right, and Caltech president Harold Brown, center. The fence hides the two-story-deep foundation excavation; Beckman Auditorium is in the background.

Like IBM's prediction in the early '50s that the world market for mainframe computers would never exceed six, "the most optimistic estimate I got was . . . 600 over a 10-year period [would] saturate the market," Beckman would say. But in the first three months, NTL sold 87. A move to bigger quarters—a former dry-cleaning shop three blocks away owned by chemistry professor Ernest Swift (MS '20, PhD '24) that actually fronted on Colorado Boulevard—quickly followed.

In 1939, Beckman left Caltech to run NTL full-time, and in 1940 the company moved into a brand-new 12,000-square-foot plant in South Pasadena.

That same year, work began on an ultraviolet/visible spectrophotometer inspired by a Coleman Instruments (now PerkinElmer) model that itself used a slightly modified version of NTL's pH meter for data readout. Beckman, his chief design engineer, Howard Cary (BS '30), and the NTL team redesigned the instrument from scratch. They used a quartz prism for wavelength selection rather than the usual glass one after discovering that glass doesn't transmit ultraviolet light well. (This is why you can't get a suntan behind a picture window.) They blew their own ultraviolet lamps and photocells, and put the readout dial on the faceplate rather than leaving the user to wire the spectrophotometer up to a separate pH meter. Again, all the expertise was in the box, and with the twist of a knob you could read out the entire chemical fingerprint of a sample, identifying its components—a set of measurements that might have previously taken hours or even days. Or, by parking on a single characteristic wavelength, you could continuously measure the amount of the substance absorbing it. More than 21,000 Model DU spectrophotometers would be sold from April 1942 until the machine was discontinued in 1964, and a few of them are still in use today.

During World War II, DUs and infrared spectrophotometers, which NTL built in secret for the government's synthetic-rubber project, played vital roles in the production of war materiel ranging from penicillin and Vitamin A (essential to night vision) to aviation gasoline and TNT.

While at a secret meeting in Detroit with members of the Office of Rubber Reserve, Beckman got a phone call from a man named Rosenberg who refused to identify himself further but wanted Beckman to fly to Cambridge, Massachusetts, right away. Paul Rosenberg proved to be a professor of physics at MIT's highly secret Radiation Laboratory, where a British invention called radar was being perfected. (The Lab was headed by physicist Lee DuBridge, who would later become Caltech's president.) Many components in a radar set need to be precisely tuned, and Rosenberg had discovered that the potentiometers used for the fine calibration of Beckman's pH meters were a factor of 10 better than anything else available. A potentiometer is a variable resistor—as you turn the knob, an electrical contact slides along a C-shaped resistive element, and the farther along the C it travels, the higher the resistance.

The NTL design got its extraordinary sensitivity by using a helical resistive element. "Thus a 10-turn coil would provide 3,600 degrees of rotation, whereas a single-turn potentiometer provided less than 360 degrees." Rosenberg wanted to know if the Helipot, as it was called, could be made to military specs. Beckman said sure, only to soon discover a fatal flaw—any sudden jolt would knock the spring-loaded contact off the coil, causing the radar to lose lock and need retuning. Especially in a rumbling propeller-driven airplane, it was "absolutely worthless. . . . I began getting calls from the military, particularly from the Navy: "Where are the Helipots? We have ships ready to go. . . . One sleepless night I conceived of a design using a solid rotor in a groove; the contact would slide up and down in the groove so it couldn't get displaced." Tens of millions of these Helipots have been sold since, with no end in sight.

Beckman wound up providing a second secret device for the Navy as well—oxygen monitors for use on submarines, built to a design by chemistry professor Linus Pauling (PhD '25). These became standard equipment in hospitals in 1955, when doctors at Johns Hopkins discovered that an outbreak of blindness in premature babies was being caused by excessive oxygen—over 40 percent, versus air's 21 percent—in their incubators.

Air-quality issues of another sort began surfacing as the Los Angeles basin industrialized during the war—smog. From 1948 to 1952, Beckman served as the scientific consultant to the newly formed Los Angeles County Air Pollution Control District. It was widely assumed that sulfur dioxide from coal-fired power plants, oil refineries, and factories was to blame. But Beckman, who knew SO_2 when he smelled it, was not persuaded. And Arie Haagen-Smit, another Caltech chemistry professor, had been doing studies that implicated ozone. So Beckman designed a program to collect air samples

basinwide, from which Haagen-Smit extracted a few drops of "smelly brown stuff." After identifying the material as a mix of toxic, highly reactive organic peroxides, Haagen-Smit was able to trace them back to their source: a complex web of reactions between auto exhaust, sunlight, nitrogen oxides, and ozone. Beckman then helped develop the county's pollution-control regulations and smog-alert procedures. (And, incidentally, started a new line of business, up to and including mobile air-quality labs.)

As scientists returned to civilian work, the pace of research and development quickened, and Beckman Instruments (NTL changed its name when it went public in 1950) became a fixture in every lab. The company began acquiring other firms with compatible products, such as centrifuges and biomedical instruments, and continued to develop its own wares at a breakneck pace. In some years in the early '60s, Beckman Instruments launched an average of one new product a week.

Beckman retained close ties to Caltech, being elected to the Board of Trustees in 1953, and becoming its chair in 1964—the first alumnus to hold that position, which he did until 1974, when he was voted a Life Trustee.

He stepped down as president of Beckman Instruments at 65, "the age of statutory senility," staying on as chairman of the board while he and Mabel embarked on an ambitious campaign to give away their entire fortune to causes they believed in—in particular, basic scientific research. By the time of Mabel's death in 1989, they had donated $200 million; to date, the Beckmans and their foundation have distributed some $400 million. Major gifts to Caltech include the Beckman Auditorium, the Mabel and Arnold Beckman Laboratories of Behavioral Biology, the Arnold and Mabel Beckman Laboratory of Chemical Synthesis, and the Beckman Institute. In recognition of these and numerous other contributions, in 1981 Caltech's trustees and other donors established the Arnold O. Beckman Professorship in Chemistry, held by longtime friend and founding director of the Beckman Institute Harry Gray.

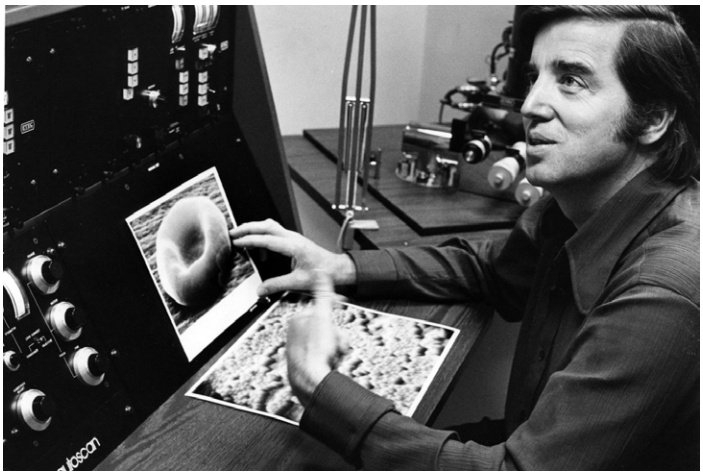
Other notable gifts include $40 million to fund an interdisciplinary research institute at the University of Illinois; $20 million to create a conference center in Irvine, California, for the National Academy of Sciences; and $14.5 million to improve K-6 science education in Orange County, California, where the Beckmans had lived since the early '60s.

Besides honors and awards too numerous to mention, Beckman was named to the National Inventors Hall of Fame in 1987. He received the National Medal of Technology in 1988 and the National Medal of Science in 1989.

He is survived by his children, G. Patricia Beckman of Corona del Mar, and Arnold S. Beckman of Asotin, Washington. □—*DS*

Beckman's quotes published here are drawn from past E&S *articles and from* Arnold O. Beckman: One Hundred Years of Excellence *by Arnold Thackray and Minor Myers, jr., Chemical Heritage Foundation, 2000.*

William Dreyer
1928 – 2004



Bill Dreyer, in 1973, analyzes two scanning electron micrographs: of a normal blood cell and of polymeric spheres coated with antibodies that will react only with specific substances on the blood cell's surface. Dreyer was trying to develop molecules that would attack certain types of cancer cells, work that grew out of his research on normal cells' surface recognition codes.

Dr. William J. Dreyer, professor of biology since 1963, died April 23 after a long illness. He was 75.

A native of Kalamazoo, Michigan, Dreyer earned his bachelor's degree at Reed College and his doctorate in biochemistry at the University of Washington in 1956. After his graduation he worked for six years as a research biochemist at the National Heart Institute and National Institute of Arthritis and Metabolic Disease before joining the faculty at Caltech, where he remained the rest of his life.

Dreyer was perhaps best known for his suggestion in the 1960s that genes could be "reshuffled" to provide additional information for the

formation of proteins. At first a controversial idea, the theory later came into prominence after it was experimentally demonstrated by others, including Leroy Hood, who at one time was Dreyer's student.

At a Society for Biomolecular Screening conference held in 2003, Hood credited Dreyer for mentoring his early career, teaching him the art of conceptual thinking, and providing him with "a wonderful introduction to the exhilaration of rapidly paced molecular immunology." Hood added that Dreyer always emphasized two principles: "Always practice biology at the leading edge," and "If you really want to change biology, develop a new technology for pushing back the frontiers of biological knowledge."

Dreyer also investigated fundamental questions related to how embryos develop, and he made significant contributions to the field of biological instrumentation.

He was the author of numerous journal articles and also held a number of patents —including one for an immunological reagant and radioimmunoassay, and two for polyacrylate beads that he developed with two colleagues.

Dreyer had been an avid pilot since 1960 and often flew to Baja California, various archaeological sites in the western United States, and to remote regions in British Columbia. He once said that his taste for flying his Cessna P210 at altitudes of 15,000 feet—high for a small privately owned prop plane but low for commercial aircraft—was "an allegory for my tastes in scientific research. I like to work where research isn't too competitive and crowded—to move beyond the current mob scene, even if the place where I end up is lonely."

Dreyer is remembered by his many former students as having taught them to look at data with a fresh eye, rather than through the filter of current scientific dogma, and for having infected them with his love of science.

He is survived by his wife and colleague, Dr. Janet Roman, and three daughters. □

Quarterback and captain-elect Sharp catches a pass for the 1933 *Big T*.

Robert Phillip Sharp
1911 – 2004

Robert P. Sharp, the Robert P. Sharp Professor of Geology, Emeritus, died peacefully at his home in Santa Barbara on May 25. He was 92.

The eldest son of Oxnard fruit growers Julian and Alice Sharp, he came to Caltech in 1930 with vague thoughts of becoming a civil engineer, but changed his mind when he took the core geology course in his sophomore year. "I had hardly ever heard the word geology before that time," he later recalled, "but this course hit me just right. Bingo! So I elected to give geology a try." He wasn't sure, though, that he would be able to make a living from it.

Sharp played quarterback for the Caltech football team for three years, thrilled to be able to compete against teams like UCLA at the Coliseum (Caltech didn't win, but gave UCLA a good run for their money) and to have the Rose Bowl as home field. When a 1958 issue of *Sports Illustrated* named him one of 25 "Men of Achievement" who had been undergraduate football stars, he told the reporter, "I think most young scientists need what you get from football—the news that you have got to be determined as hell and that there is a certain poise and aggressiveness that is desirable." He remained physically active all his life, jogging, hiking (preferably to a mountain stream for some trout fishing), and skiing (which he took up at 55).

After a BS in 1934 and an MS in 1935, he moved to Harvard for a doctorate in geology (1938), and found the going easier than the other grad students after "being worked like a dog" at Caltech. While there, he met and married another geologist, Radcliffe graduate student Jean Todd, and they were together for 62 years until Jean's death in 2000. After five years in the geology department of the University of Illinois, he was called to wartime service with the U.S. Army Air Forces from '43 to '45, working in the Arctic, Desert, and Tropic Information Center and rising to the rank of captain. After two years on the faculty of the University of Minnesota, he came back to Caltech in 1947 as a professor of geomorphology and was appointed division chair in 1952, after the untimely death of Professor of Paleontology Chester Stock. He was chair of the Division of Geological Sciences, as it was then called, until 1968, during which time he introduced several new, and groundbreaking, academic programs. (He can

also be credited with putting the P into GPS, though the official name change to the Division of Geological and Planetary Sciences didn't happen until 1971.)

"The most important thing he did was to hire real talent in the new areas of geochemistry, planetary sciences, and geophysics," said Lee Silver (PhD '55), Keck Foundation Professor for Resource Geology, Emeritus. "He knew that bringing in chemists and physicists and blending them into the division would make a very rich and productive assembly of faculty, and it quickly became a multidisciplinary division."

"All three of these areas were very mathematical," added Bruce Murray, professor of planetary science and geology, emeritus. "Sharp was not a quantitative man, yet his foresight and ability to push this through were extraordinary."

Unable to find a vertebrate paleontologist to succeed Stock, Sharp decided to give this area of research a lower priority. "Bob sold all the division's vertebrate fossils to the L. A. County Museum of Natural History," recalled Silver, "and used the $100,000 raised to build geochemistry labs. It was the first geology department in the world to go in that direction."

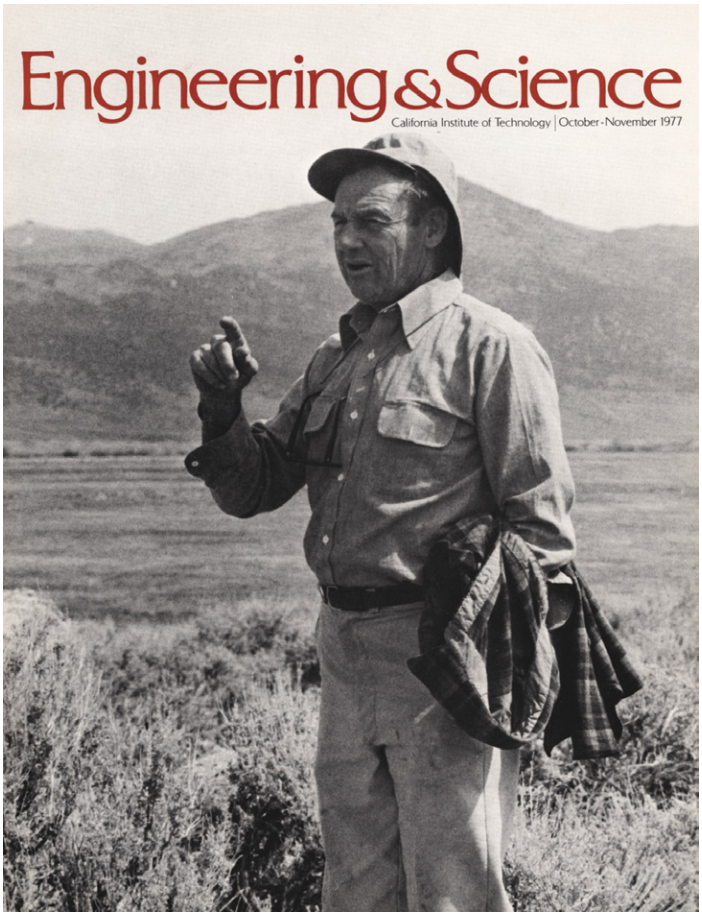
"It was a radical change," said Murray. The skepticism it generated came as a shock to Sharp, who later recalled, "I would go to national geological meetings and geologists would come up and hiss in my face, 'How's the department of geochemistry at Caltech?' I used to say, 'Just be patient and give us time.'"

Of course, he turned out to be right, said Silver. Bringing in geochemists Harrison Brown, Clair Patterson, and Sam Epstein made Caltech the wellspring for the use of isotopes in geology.

To modernize seismology, Sharp recruited geophysicist Frank Press in 1955 and raised the money to move the seismological laboratory from a cramped house in the San Rafael hills to a beautiful mansion on the other side of the road. Later, he used all his persuasive powers to bring the seismo lab downhill onto the campus.

Sharp didn't need to persuade the astronomers to let the geology division move into the field of planetary science in 1963. They were making great discoveries on the new Hale telescope at Palomar, and were quite happy to leave the planets to the geologists. Bruce Murray became Caltech's first faculty member in planetary science (he would later become director of JPL). Murray became, like so many others in the division, a close personal friend, and Sharp was best man at his wedding. Andrew Ingersoll, the Anthony Professor of Planetary Science, who arrived in 1966, still remembers Sharp's welcome: "He said to me 'My job is to give you every opportunity to be as productive as you can,' and I thought, 'Wow! What a great place to come to.' He was a great leader, and supportive of everyone in the division."

The 1965 Mariner IV flyby of Mars gave Sharp the chance to do planetary science as well. Mariner IV was the first spacecraft to carry a digital TV camera, built by physics professor Robert Leighton (BS '41, MS '44, PhD '47) and Murray. They brought in Sharp to help them interpret, "for thousands of home TV viewers" as *E&S* wrote at the time, the first-ever close-up images of the red planet beamed back to Earth. The trio also worked on Mariners



Jean joined Bob on the third Grand Canyon trip to raise money for the division's first endowed chair.

VI, VII, and IX, and "had a ball." In a 1991 *Pasadena Star-News* article, Sharp recalled how one of the Mariner technicians had told him that the latest images from Mars revealed the presence of a lake. Looking at the images, he saw that the rippling features the technician had seen were actually sand dunes. "That was the beauty of it for me," he said. "Astrophysicists, engineers, and computer guys, and they need this dumb ol', dirty fingernail geologist like me!"

As well as running the division, teaching, and fundraising, Sharp found time for "creative, original research," said Silver. "He was one of the most highly respected geologists in the world." His work included investigations of basin and range structure, continental basin deposits, mountain and continental glaciation, glacial-lake shorelines, frozen ground, erosion surfaces, desert sand dunes, oxygen and hydrogen isotopes in snow and glacier ice, surface forms and processes on Mars, and even the mysterious sliding stones of Death Valley's Racetrack Playa. He preferred "today's geology," things that could be measured, like glaciation and sand dunes. This was a smart combination, remarked Silver, because he could study glaciers in winter and sand dunes closer to home in summer.

Sharp's scientific contributions garnered many honors, including the Geological Society of America's Kirk Bryan Award in 1964 and its highest honor, the Penrose Medal, in 1979. He was elected to the National Academy of Sciences in 1973, and awarded America's highest scientific honor, the National Medal of Science, in 1989. He donated the medal to the division, and it is now on display in the Robert P. Sharp lecture theater.

Sharp's take on teaching made him very popular with students: "I try to tell them something about the environment that creates interest," he told the *Claremont Courier* in 1989. "We don't teach right when we give students a mass of facts and tell them that they may need them later. What we should do is create the interest and then make them do the nasty intellectual exercises later." After just three years at Caltech, he was hailed by *Life* magazine as one of the 10 great U.S. college teachers of 1950. "Sharp's enthusiasm is contagious, and his sophomore geology course is one of the favorites on the Caltech schedule," *Life* wrote, "credited with attracting many unsuspecting students into the lifetime study of geology."

Bill Tivol (BS '62), who today manages the electron microscopy facility in the Broad Center for the Biological Sciences, recalls that when he took the Ge 1 "culture course," Sharp made a bet with the class that if there was a volcanic eruption that year, the students were to buy him a beer, and, if not, he'd buy a beer for each of them. "Not only did he win the bet—and get presented with a beer in class—but he continued to win every year since," said Tivol. "This was his very memorable way to point out that something we think of as rare is really quite a common geological event, globally."

Sharp's former students may also remember their teacher's penchant for punctuality. In a 1973 issue of *Caltech News*, one of them observed, "When he says a caravan will leave the campus for a field trip at 8 a.m., he means 8:00 and not 8:05. He's been known to drive out of the parking lot and leave stragglers standing on the steps." On one memorable occasion, he even set off without a trustee.

In 1978, he became the Robert P. Sharp Professor of Geology. The division's first endowed chair, it was funded in a very imaginative way. Delayed at an airport in Houston by engine trouble, Lee Silver and Gene Shoemaker (BS '47, MS '48) came up with the idea of taking Caltech benefactors on guided raft trips through the Grand Canyon at $50,000 a head ($75,000 for a couple) until they'd raised the necessary $1 million. The idea was enthusiastically embraced by division chair Barclay Kamb (BS '52, PhD '56, the Rawn Professor of Geology and Geophysics, Emeritus) and Sharp, and the four of them led these popular trips (with suitably luxurious campsites and meals) for the next three years. President Marvin Goldberger and his wife, Mildred, went along on the third expedition, and one evening toward the end of the trip, Goldberger announced that all the money had been raised and the new chair would be named in Sharp's honor. Dumbstruck at the time, Sharp later recalled: "It was a beautiful place for the announcement. Right on the river. Beautiful evening. In camp. And a *satellite* went over." He always felt it was one of the nicest things that ever happened to him.

Sharp loved taking people

on field trips, feeling that "you have to bring them into the fold by taking them out to have a look at nature." He felt sorry for the division's secretaries and lab technicians because they were always left behind when the faculty and students went off. So in a gesture typical of his consideration for others, he organized and led an annual staff geological excursion. Every year for seven years he took the division staff on day trips to the San Gabriels, or two-day trips to Owens Valley, and sometimes even three-day trips to Hawaii.

He also started the popular Alumni Association travel program. Arlana Silver, who currently heads the Caltech Associates and worked with Sharp on these programs for many years as associate and then deputy director of the Alumni Association, recalled that he took alumni to places such as Alaska, Hawaii, Yellowstone and Glacier National Parks, and the American Southwest until he was well into his eighties. "Other faculty members have joined in with their own trips now," she said, "but Bob was the one who set the pattern. He had a great rapport with the alumni, and the people who traveled with him once wanted to travel with him again. In fact, so many people wanted to go on each trip that they were commonly wait-listed, and the trips had to be repeated."

Project Pahoehoe, an eight-day spring break to Hawaii for the division's graduating seniors and doctoral candidates, was another of his innovations. It wasn't the traditional kind of spring break on the beach, however. Sharp wanted the students to learn about hot-spot volcanism, and he worked them hard. The project had to be funded from year to year by donations, and he put a lot of effort into raising the money. To ensure it could continue after his death, he established an endowment with his own pledge and those of others. He and his wife, Jean, also gifted a partial remainder interest in their Santa Barbara home to the Institute.

Sharp became a professor emeritus in 1979 but continued to teach a class at Caltech—staying in touch with young people was what kept him going, he said—and to lead field trips. He also wrote popular geology books, including *Geology: Field Guide to Southern California* and his humor-tinged collection of vignettes on sites of geological interest, *Geology Underfoot in Southern California* and *Geology Underfoot in Death Valley and Owens Valley* (both written with Allen Glazner). The latter two are now in their fourth printing, and have a wide and appreciative readership. He had almost finished another *Geology Underfoot* book on Idaho, which will be completed by its two coauthors.

Sharp is survived by two children, Kristin Lytle and Bruce Sharp, two grandchildren, Lenore and Mathew Lytle, and many generations of fond students and colleagues. A memorial service is planned for the fall.

Those wishing to make a contribution to Caltech in his memory should write to Robert P. Sharp Ventures in Earth Sciences Fund, GPS Division, attention Marcia Hudson, Mail Code 170-25, Pasadena, CA 91125, making checks payable to Caltech with a notation earmarking the gift for the memorial fund. □—*BE*

Edward E. Simmons Jr.
1911 – 2004

Edward E. Simmons Jr. (BS '34, MS '36) died May 18 of complications from cancer surgery. He was 93.

In his quasi-medieval garb (which he had adopted as perfectly practical for Southern California), Simmons was a familiar figure around Pasadena, particularly on the Caltech campus, where for decades he attended all seminars and lectures that interested him—and just about everything did. He considered Caltech "a suitable local amusement park."

Simmons was born in Los Angeles and grew up in the Pasadena area, where both he and his brother Robert attended Caltech at the same time. Both were outdoors enthusiasts; Robert, who became known for innovations in surfboard design and construction, died in a surfing accident in the early '40s.

While constructing electrical equipment (in his own garage) for Assistant Professor of Mechanical Engineering Donald S. Clark's Impact Research Lab in 1938, Ed Simmons invented the strain gauge, an instrument consisting of a tiny wire connected to a device that measured the change in electrical resistance when strain stretched the wire. It was simple, elegant, and cheap, and quickly proved

indispensable to the wartime aircraft industry. The postage-stamp-sized strain gauge could be plastered all over a prototype airplane wing and is credited by some as the greatest contribution to the efficient structure of American aircraft during World War II. The strain gauge eventually spun off a multi-billion-dollar industry when it also found application in bridges, buildings, machinery, and any kind of structure that undergoes stress. Today it's an essential component of electronic weighing equipment, and in his last years Simmons was fond of presenting bathroom scales to baffled recipients as a reminder of his achievement.

When Caltech claimed the patent, Simmons sued; he fought his case all the way to the California Supreme Court, which finally ruled in his favor in 1949. The case inspired the board of trustees to adopt a resolution requiring of employees a written agreement assigning to Caltech all patents for "inventions made in the line of Institute duty."

In 1944 Simmons was awarded the Edward Longstreth Medal of the Franklin Institute of Philadelphia. At the awards ceremony, he sat next to Harlow Shapley, the famous Harvard astronomer. Shapley was dressed in white tie and tails; Simmons wore his tennis clothes.

At a memorial service on May 24, longtime friends fondly recalled Simmons's unique genius and eccentricity, his passion for experiment, and his love of collecting used equipment (sometimes very large used equipment). Despite his lack of social skills (he couldn't bring himself to shake hands and was unable to recognize differences in emotion in others), he was kind, gentle, and generous. He didn't just think outside the box, said the Rev. Stanley Hirtle. "He *was* outside the box."

Simmons was buried near his parents and siblings at Mountain View Cemetery. □ —*JD*

Simmons was a conspicuous presence in the audience of many, if not most, of Caltech's public lectures and seminars. Here, in Baxter Lecture Hall, he's warmly greeted by Russian poet Yevgeny Yevtushenko in March 1992.

Honors and Awards

Jacqueline Barton, the Hanisch Memorial Professor and professor of chemistry, has been awarded a grant of $50,000 for two years by the National Foundation for Cancer Research.

Seymour Benzer, the Boswell Professor of Neuroscience, Emeritus, has been awarded the inaugural 2004 Neuroscience Prize of the Peter Gruber Foundation for his innovative and pioneering contributions to neuroscience.

This year's recipients of the ASCIT Teaching Awards are **Colin Camerer,** the Axline Professor of Business Economics; **K. Mani Chandy**, the Ramo Professor and professor of computer science; **Alan Hajek**, associate professor of philosophy; **Kayoko Hirata**, lecturer in Japanese; and **Feng-Ying Ming**, lecturer in Chinese.

Sunney Chan, the Hoag Professor of Biophysical Chemistry, Emeritus, has received the William C. Rose Award of the American Society for Biochemistry and Molecular Biology/International Union of Biochemistry and Molecular Biology. The award recognizes "his outstanding contributions to biochemical and molecular biological research and his demonstrated commitment to the training of younger scientists."

Mory Gharib, the Liepmann Professor of Aeronautics and Bioengineering, has been selected by the Technion, Israel Institute of Technology, for its 2004–05 Pollak Distinguished Lecturer Award.

Three of the latest Presidential Early Career Awards for Scientists and Engineers have gone to members of the Caltech faculty: **Babak Hassibi,** associate professor of electrical engineering; **Mark Simons,** associate professor of geophysics; and **Brian Stoltz,** assistant professor of chemistry. The award recognizes outstanding young professionals at the outset of their independent research careers.

Peter Goldreich, the DuBridge Professor of Astrophysics and Planetary Physics, Emeritus, has been elected a Foreign Member of the Royal Society, which cited him and his close collaborators for "several seminal contributions to an unparalleled range of topics in planetary science and theoretical astrophysics, including spiral arms in galaxies and planetary rings and the explanation of white dwarf oscillations."

Hiroo Kanamori, the Smits Professor of Geophysics, has been selected as a recipient of the 2004 Japan