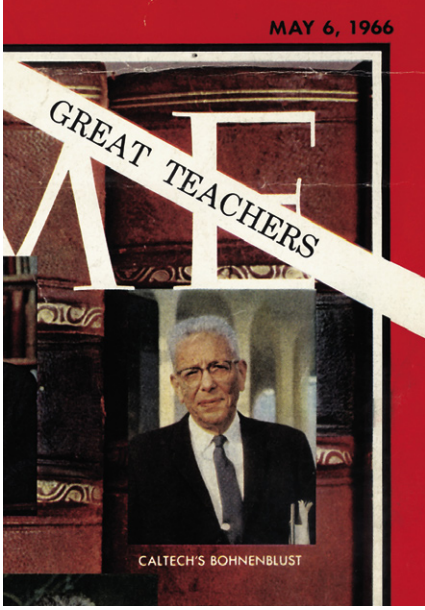
Between last November and March, three former faculty members died who had been members of the Caltech community for a very long time. Vito Vanoni, who first came to Caltech as a freshman in 1922, and Victor Neher, who arrived for grad school in 1926, were both 95. "Boni" Bohnenblust was only 94; he joined the Caltech faculty comparatively late—in 1946.



Featured, with nine others, on a 1966 cover of *Time* magazine, Bohnenblust was described in the cover article as someone "perennially ecstatic about teaching basic mathematics to undergraduates."

H. Frederic Bohnenblust
1906 – 2000

H. Frederic Bohnenblust, professor of mathematics, emeritus, died March 30, 2000, in Santa Barbara.

A native of Neuchâtel, Switzerland, Bohnenblust received his bachelor's degree from the Federal Institute of Technology in Zurich in 1928 before coming to the United States as an exchange student. He earned his PhD from Princeton University in 1931 with a thesis that dealt with the application of abstract methods to Dirichlet series.

He remained on the Princeton faculty until 1945, but during World War II also did work for the National Defense Research Council in Washington, D.C.; studied the effects of bombing in England; and collaborated with Caltech's Theodore von Kármán and Don Clark on metallurgical problems. After a year on the faculty of Indiana University, he returned to Pasadena in 1946 as a full professor of mathematics at Caltech. He retired with emeritus status in 1974. Bohnenblust served as dean of graduate studies from 1956 to 1970 and was executive officer for mathematics from 1964 to 1966.

A strong advocate of mathematics education, Bohnenblust was featured in a 1966 cover article in *Time* magazine as one of the 10 outstanding university professors in the country. The article described him as remaining "perennially ecstatic about teaching basic mathematics to undergraduates. He handles a class of 100 students in almost Socratic fashion, keeping up a gentle, good-humored patter with students in the front rows and offering a soft 'Thank you' when they chuckle at his phrasing."

The *Time* article quoted Bohnenblust on his own style: "'Once you've understood that math is just straight thinking, just plain common sense,' he says, 'then anyone can do it.' He makes it even easier with his slow-paced, nontechnical language, constantly links math's logic to life. . . . 'I chose mathematics as my profession, not teaching,' he adds, 'but I love math and want to communicate its ideas—especially to the younger generation.'"

Professor of Mathematics Gary Lorden, BS '62, knew Bohnenblust both as an undergrad and as a colleague. "As a sophomore, I took a wonderful one-quarter course from him on game theory," said Lorden, "and I loved his elegant ways of explaining how mathematical theory is developed and applied. Better than anyone else, he showed us that mathematics is beautiful.

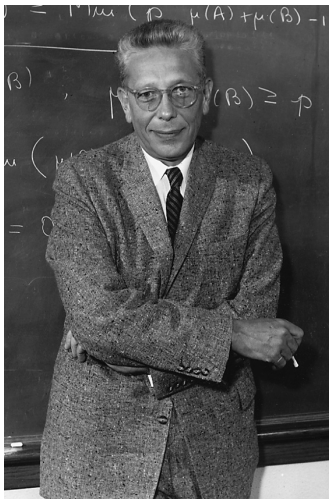
"At some point I had to turn in my own proof of some theorem—about a page long, the first one I ever wrote—and one day in his office he handed the paper back to me, giving me his big, twinkly smile and saying simply, 'I can read it!' That felt like the greatest compliment I'd ever received, and afterwards I began to seriously imagine becoming a mathematician."

In his "real" profession, Bohnenblust's specialty was functional analysis. When Bohnenblust retired in 1974, the late Robert Dilworth, then professor of mathematics and chairman of the faculty, described the subject as "just blossoming into a full-fledged research field when he began his mathematical career. Because of his enthusiasm and clear insight, his ideas had broad impact on the development of the field. . . . Appropriately, one of the basic results in the subject is the Bohnenblust-Sobczyk Theorem, which is still quoted frequently by workers

in the field. (It would probably be quoted even more frequently except for a certain understandable pronunciation problem.)"

Bohnenblust also did work with game theory and was an early advocate of the use of computers in teaching and research. "Boni realized that here were tools that could overcome many of the deficiencies of blackboard and chalk," said Dilworth.

Bohnenblust was head of the mathematics department when Tom Apostol, now professor of mathematics, emeritus, arrived as an assistant professor in 1950. "He was personally responsible for transforming it from what was considered a 'service department' into a first-class research group," says Apostol.



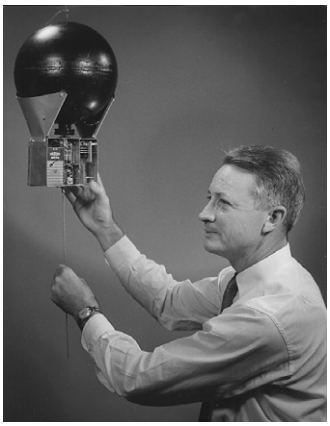
Apostol's initial experience teaching calculus convinced him that no textbook existed that was good enough for Caltech students. A committee organized by Bohnenblust considered for a year "what it is we want to teach our students" and how calculus should be taught. This led to Apostol's *Calculus*, published in 1961, which became the standard for courses all over the country. In the preface to the first edition, Apostol gave special thanks to Bohnenblust, "who first convinced me of the value of introducing integration via step functions and who supported the spirit and approach used throughout the book."

Apostol's "contact with Boni actually began years before I came to Caltech. As a graduate student in Berkeley, I studied the famous Bohnenblust Princeton Notes on Real Variables, which I still have in my library. I learned a lot from those notes."

Bohnenblust was also renowned for the Christmas punch he prepared every year for the mathematics party. It was "liberally spiced" with brandy and wine, and the dry ice that he ordered from chemistry made it into a spectacular show.

Friends and colleagues established the Bohnenblust Travel Grant to honor him when he retired. It still funds first-year graduate students whose mathematics projects require a journey abroad.

H. Victor Neher 1904 – 1999



H. Victor Neher, professor of physics, emeritus, died November 11, 1999, at the age of 95.

From graduate school onward, Neher's scientific career was spent at Caltech. Raised in California's San Joaquin Valley, where his father was a grain farmer, Neher attended grade school in a one-room schoolhouse. He enrolled in Pomona College, intending to study electrical engineering, but a physics professor invited him along to Caltech's Friday evening lecture demonstrations, where he first heard Robert A. Millikan speak (on magnetism, he remembered later) in the fall of 1922. After receiving his bachelor's degree from Pomona in 1926, Neher headed for graduate school in Pasadena.

As a grad student Neher worked under Earnest Watson on the scattering of high-energy electrons, earning his PhD in 1931. He stayed on as a research fellow to expand his thesis problem, but in 1932 Millikan asked him if he would like to work on cosmic rays. Neher ended up working on cosmic rays with Millikan, who had given them their name, for 20 years and continued this work for most of the rest of his academic career. He was named assistant professor in 1937, associate professor in 1940, and full professor of physics in 1944. Other members of Millikan's original cosmic-ray group included Bill Pickering (BS '32, PhD '36), later director of the Jet Propulsion Laboratory for 22 years and currently professor of electrical engineering, emeritus; and the late Carl Anderson (PhD '30), who discovered the positron, for which he won the Nobel Prize, while following the tracks of cosmic rays in his cloud chamber.

To investigate cosmic rays Neher invented electroscopes for ionization chambers, in which the rays ionize the gas inside, producing a charge that could be measured. Cosmic rays are very-high-energy charged particles—atomic nuclei, mostly hydrogen and helium, stripped of their electrons. They zip in from space (but also from the sun) and bombard Earth from all directions. Neher described them in a 1957 *E&S* article as "celestial bullets traveling at speeds very close to the speed of light."

Neher lugged his instruments to mountaintops, flew them in airplanes, launched them into space (on the Ranger and Mariner missions), and suspended them from balloons lofted to 135,000

feet above the Earth's surface. He estimated on his retirement in 1970 that he had launched about 400 balloons and had traveled the Earth from pole to pole (where cosmic rays are most intense) and in between. By studying cosmic particles, Neher and Millikan confirmed that Earth's magnetic center is 250 miles from its geological center. From his decades of data, Neher was able to plot a pattern of the density of cosmic-ray bombardment of Earth, a publication that remains a benchmark in cosmic-ray research.

Neher's ionization chambers and Pickering's Gieger counters often worked in tandem on the balloon flights. Pickering (who, as an undergrad in 1929, was taught physics by TA Neher) remembers a trip to India in 1939, during which they were to pick up the Millikans, who were already in Australia, en route. Hitler invaded Poland and World War II broke out before they set sail, but when they contacted Millikan about what to do, he told them, "Come on. Never mind the war." So they went. With most of the rest of their trip canceled, they made it to Calcutta on a series of ships via Singapore and Rangoon, launched several successful balloon experiments, and, deciding wisely to avoid their original route home through the Mediterranean, sailed back across the Pacific in 1940. It was "an interesting trip," says Pickering.

The bombing of Pearl Harbor found Neher, Pickering, and Millikan launching balloons in Mexico, where again, says Pickering, Millikan decided to ignore the war until they finished their work.

Eventually World War II did catch up with him, and Neher spent five years at MIT's Radiation Laboratory, under future Caltech president Lee DuBridge, designing and making microwave vacuum tubes. One of these, a K-band klystron, was known as the Neher tube. Last year Roy Gould (BS '49, PhD '56), the Ramo Professor of Engineering, Emeritus, traced its subsequent history and determined that the Neher tube was used in the first experimental maser, the predecessor of the laser. And Bill Bridges, the Braun Professor of Engineering, turned out to own a model of an early Neher tube, which he has donated to the Caltech Archives.

Returning to Caltech after the war, Neher was aware that high-energy physics was becoming the rage, but he had no interest in becoming involved in "big science." He preferred his independence. Caltech's involvement in cosmic-ray research consequently went down a different road after the 1962 arrival of Robbie Vogt, now Avery Distinguished Service Professor and professor of physics, with more advanced instrumentation from the University of Chicago. They were different generations in terms of technology. "Neher was heavily involved in my coming here," says Vogt. "He picked me up at the airport and was the first person I met from Caltech." But Neher made no attempt to draft him into Neher's own research group, instead allowing Vogt and his first postdoc, Ed Stone (see page 8), to go their own way. "He didn't make me miserable," says Vogt. "That was his generosity. He was a very, very generous, kind, and sensitive man, a man of immense integrity."

Ralph Miles, BS '55, PhD '63, was one of Neher's last graduate students and the last to do balloon flights, four of them with Neher in Greenland (where, in his late fifties, he was still hiking up glaciers). Neher had admired Millikan and wanted to finish his research, which he did. Thereafter, says Miles, Neher became more interested in teaching tools, constructing ingenious models to illustrate physical concepts. He conveyed his enthusiasm and skill at hands-on experimental physics to subsequent generations of students by building up the student labs —one of his great contributions to Caltech. He had a genuine affection for students, which was sensed and returned. As an adviser, says Miles, he was hands-off. "He didn't hover. He expected you to do independent research and didn't give you more advice than you asked for."

According to colleagues, Neher was among the last of the real experimental physicists who did their own work in the lab. He built his apparatus with his own hands. He was the "consummate experimentalist," says Vogt. "Vic had an intuitive understanding of making things work—a magic touch."

When he retired in 1970, he announced that he was not stepping down but starting the second phase of his life.

Left: Neher in 1957 with one of his ionization chambers. Balloons carried these instruments to high altitudes to measure the intensity of cosmic rays.

At the Indian Institute of Science physics department on February 2, 1940, Neher sits fourth from left next to Greta and Robert Millikan. Bill Pickering is fourth from right.

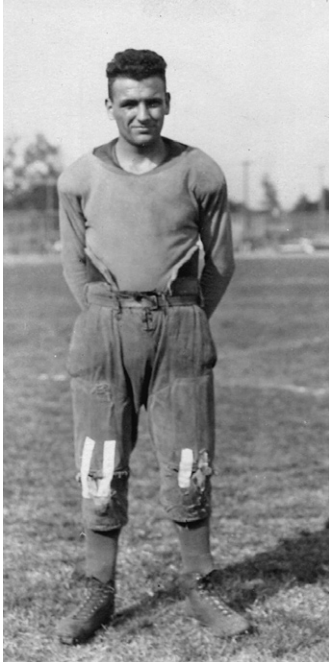
He and his wife, Sara, moved to redwood country near Watsonville, California, where they built their retirement home—with their own hands, of course—a house that survived just fine the 7.1 earthquake in 1989, whose epicenter was nearby. Neher also continued to do research, although not on cosmic rays. His last paper, published in 1993, was on "Effects of pressures inside Monterey pine trees." (He had also practiced close-to-home research in his Pasadena backyard, where, a friend remembers, he discovered through a few experiments in catching skunks, that if you dangle them by their tails, their own weight will keep them from squirting you.)

Neher never forgot his first Caltech experience—Millikan's 1922 demonstration lecture. He loved to explain to people how things worked and enjoyed putting on a spectacular show. In 1984, to celebrate the 20th anniversary of Beckman Auditorium, Neher returned to reprise Watson's famous liquid-air lecture, which had kicked off what is now known as the Earnest C. Watson Lecture Series, the descendant of those Friday evenings in Bridge Laboratory.

A SURF (Summer Undergraduate Research Fellowship) endowment has been established in Neher's name by an anonymous donor. His daughter (Neher is also survived by another daughter and three sons), Topsy Smalley, expressed her gratitude for so fitting a memorial: "The endowment is the perfect way of extending to others so much of what was central to Dad's own being. Dad fervently believed in the powers of education, in the worlds of possibilities that one-on-one faculty-student interactions could engender, and—most certainly—in the joys of finding things out."

On his Watsonville acres, Neher raised vegetables, chickens, rabbits, and goats. This photo was taken in 1977.

Vito A. Vanoni
1904 – 1999



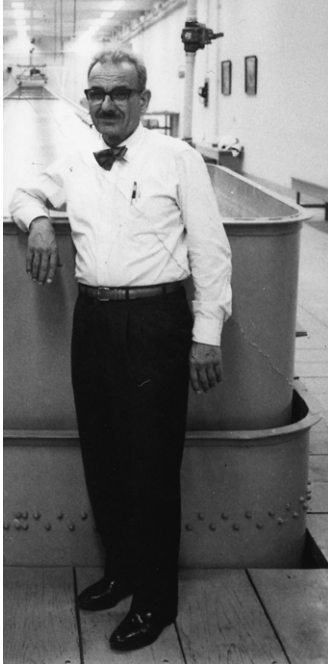
Vito A. Vanoni, professor of hydraulics, emeritus, died December 27, 1999, of congestive heart failure.

Although he "retired" with emeritus status in 1974, he continued to come to work into his nineties and was still a regular at the retirees' round table in the Athenaeum on Wednesdays. He had lunch there just 12 days before he died, according to Norman Brooks (PhD '54), the James Irvine Professor of Environmental and Civil Engineering, Emeritus, who planned the memorial service on February 5 for a most appropriate place. It was the first memorial luncheon at the Athenaeum that anyone could remember. "He would be pleased that we're having this luncheon party to celebrate his long, rich life," said Brooks.

Vanoni spent most of that long, rich life at Caltech. He graduated in 1926 with a BS in civil engineering. After five years of professional experience in structural steel design, he returned to Caltech for his MS in 1932 and PhD in 1940, also in civil engineering, and never really left. He was appointed assistant professor of hydraulics in 1942, associate professor in 1949, and professor in 1955, becoming a world authority on the mechanics of sediment transport by streams and rivers. He wrote a definitive and now classic manual, *Sedimentation Engineering*, published in 1975. Vanoni was elected to the National Academy of Engineering in 1977, was an honorary member of the American Society of Civil Engineers, and won two distinguished ASCE awards: the Hunter Rouse Hydraulic Engineering Lectureship and the Hans Albert Einstein Award.

Vanoni was born in 1904 near Somis in Ventura County, where his father, an Italian immigrant who worked on building Pasadena's Colorado Street Bridge to earn the money to bring over the rest of the family, had bought a hundred-acre farm. Vanoni Sr. was considered a "modern" California farmer, according to Vito's grand nephew, Andrew Vanoni, one who introduced such novelties as motor vehicles, flood control, and soil conservation and believed in what engineering could accomplish. He also knew the value of a good education and sent his son to the best engineering school around.

Andrew Vanoni recounted the story of one of his great uncle's early influences. At about the age of six, Vito had watched as "his father was



Far left: Vito Vanoni on Caltech's football field in the 1920s. Left: at his flume in the basement of Keck Lab in 1965.

building the first phase of what I always called a ditch —a big, long cement ditch. It took my great-grandfather years to build it, eventually around the entire farm perimeter. And it's still there today, doing what it's supposed to do—sitting there in dry weather and becoming a landsaver when it rains." Andrew had only recently discovered, after his great uncle died, that this was not a ditch but actually an "open channel flume."

Vito Vanoni grew up to design open channel flumes in which he carried out his meticulous experimental research. "Vito was the ultimate experimenter," said Brooks. "For his PhD research, he did the first and most definitive and careful experiments on sediment carried in suspension in rivers. " It's still regarded as one of the classic contributions to the field. Vanoni designed and built a 60-foot-long, 3-foot-wide flume for Caltech's Sedimentation Laboratory, which was operated in cooperation with the U.S. Soil Conservation Service, and which he supervised from 1935 to 1947. The temporary building stood just west of the present Chandler Dining Hall. This research moved into the W. M. Keck Laboratories in 1960.

Fredric Raichlen, professor of civil engineering and mechanical engineering, who arrived at Caltech as an assistant professor in 1962, described Vanoni's early work in coastal engineering. During the war years Vanoni did defense-related research, primarily in the investigation and control of wave action in harbors, using hydraulic models (of Long Beach Harbor, among others) on campus and later in a large off-campus wave basin in Azusa. His work in coastal engineering and hydraulic structures continued in the '60s and '70s, when Raichlen worked with him on a number of projects. "He demonstrated to me the importance of observations in an experiment, rather than just going and conducting the experiment. I remember him sprinkling fine coal in the model to trace currents and then pointing out to me the effect of intersecting waves in the lee of the island on these currents."

Brooks noted that "as a thesis adviser, he showed me that careful observations trumped theories if they disagree. He turned me from being a young, idealistic theorist into a careful observer and pragmatist. Once, when I was doing some experiments, sand dunes appeared in the flume I was using, when I thought the sand bed should stay flat. They weren't in my calculations, and I consulted with Vito as to how I could get rid of them so I could check my theories. And he said, 'Young man, that's the way it is, so that's what you should study.' So I did."

Vanoni was not an advocate of computer modeling in sediment engineering, according to Hasan Nouri, president of Rivertech, Inc., who began consulting with him in 1975. He related the tale of a colleague who came to Vanoni with his computer model, claiming that it predicted exactly what the survey showed. "Professor Vanoni looked at him and said, 'The science of sedimentation engineering is not that precise. You must have made a mistake somewhere!'"

All of the speakers mentioned the extraordinary hospitality and friendship of the Vanonis (his wife of 61 years, Edith, died in 1995). Vanoni tended a large garden (or a small farm) in what he called his "back 40"; they hosted an annual Halloween party and allowed all the children to take home as big a pumpkin as they could carry. "They were very affectionate people," said John List, PhD '65, professor of environmental engineering science, emeritus, "and they really gave genuine attention to young people, which was impressive in a senior faculty member at Caltech. Eating Vito and Edith's crop of the season in their wonderful garden and listening to Edith's sometimes bizarre stories of their travels is something that we'll carry with us forever."

Sally Daily, whose late husband, James Daily (MS '37, PhD '45), was an early colleague of Vanoni's ("I'm sure Norman asked me to say something because there aren't too many people around who knew Vito for more than 60 years") spoke of some of their travels together. "Scores of friends all over the world saw him as someone who was truly interested in people for themselves and who had a real gift for friendship," said Daily. Other speakers noted his energy, liveliness, and enthusiasm in his work as well as outside it.

Both Brooks and Li-San Hwang (PhD '65) were among Vanoni's doctoral students. Hwang appreciated Vanoni's rigorous training not only in sediment engineering but also in other skills. "He was my English professor, in a sense, correcting my English grammar," said Hwang, "and he also taught me the things I needed to succeed in business, in the real world." Hwang, who is now president and CEO of Tetratech, Inc., announced that he was establishing an undergraduate scholarship at Caltech in Vanoni's honor.

Brooks, who was closely associated with Vanoni for 49 years, noted that "I've been through several ages of man with him, you might say. First the four years as my PhD adviser, then the 20 years as a faculty colleague, and finally 25 years as an emeritus colleague, the last four of which I've also been emeritus."

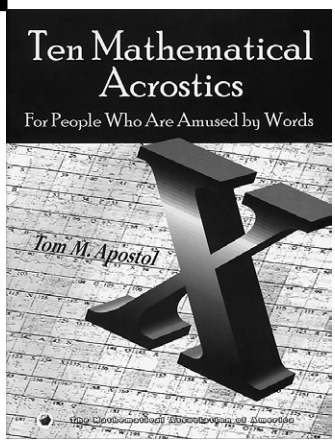
Raichlen remembered "his quandary when he had to retire. We'd sit at the round table, and he would turn to everyone who was either retired or going to retire and would ask them: 'What are you going to *do* when you retire?' And he was never happy with any answer he got." He tried it for a while, but "he would come in a little earlier, and a little earlier, until finally in his late eighties or maybe when he was 90, he would come in about 9 and leave at 3 or 4, apologizing for leaving so early."

"That is what I call young old age," said Brooks, "which lasts until your transition to old old age. Vito made young old age last for about 20 years, going to the lab almost daily, writing papers, doing consulting work. He greatly enjoyed consulting with the Corps of Engineers after the Mount St. Helens eruption in the early 1980s about what to do with all that extra sediment." In Vanoni's old old age, Brooks would take him on short excursions and continued to bring him into the lab. "He'd go with his cane but we'd also bring a chair. When we'd get to the flume, I'd sit him down because if he got too interested he might not pay attention and lose his balance."

The Vanonis had no children, but List noted that Vito had left a "legacy in his academic children and grandchildren and great-grandchildren all over the world. . . . Vito and Edith passed through life without a great deal of drama and fanfare and pomposity, and left us in much the same way," he said. "We'll do well to remember the example they set. Good memories will endure." □

Vanoni with one of the products of his legendary garden in the fall of 1999.

Books



Back in the early '70s, Double-Crostic fan Tom Apostol (also professor of mathematics, emeritus) constructed such a puzzle for his colleagues at the annual West Coast Number Theory Conference; it was unique in that all the words and all the clues, as well as the ultimate solution, related in some way to mathematics or mathematicians (sample clues.: "Euler's function"; "two of the creators of functional analysis").

Apostol's clever exercise was an instant hit, and he duly produced nine more for a decade's worth of conferences. All have now been collected in a small booklet published by the Mathematical Association of America—*Ten Mathematical Acrostics: For People Who Are Amused by Words*.

Although the cover blurb claims that "most of these puzzles can be (and have been) solved by people who know little or no mathematics but have a good vocabulary," an excellent memory of your college math courses and a handy volume on the history of mathematics will help. Even if your vocabulary can cope with "type of equation," it might have a bit of trouble with "two over the square root of pi times the integral from 0 to W of $\exp(-t^2)\,dt$" And though you might consider yourself a person "amused by words," if you don't know much about math history, you might not be chuckling to yourself as you tussle with "early Japanese form of integral calculus" or "Irish mathematician (1826–1883) who studied quadratic forms."

As a further hint, the first letters of the answers to the clues spell out the author and title of the work containing the passage that constitutes the solution. So if you're really familiar with, say, Hardy's *Integration of Functions*, it's a snap. Of course, then there's the German passage, just to make it a little bit more difficult; at least its clues are in English.

But Apostol, in his introduction, cautions the faint-hearted not to be intimidated at first glance. Because the nature of acrostics is a back-and-forth process, one answer allows you to intuit quite a few missing letters and, thus, words. The solutions, at least, do consist almost entirely of common, recognizable English words. Apostol claims, "If you can guess five or six of the words correctly, you should have enough information to complete the solution." Except maybe that German one . . .

So, for example, if you know that "facts or figures" are "DATA" and that "where QED appears" is "ENDOFTHEPROOF," then you can put the two T's where they belong in a nine-letter word in the solution. By the time you get that "a kind of product" could be "CROSS," and what "often accompanies jays" is "EYESANDKAYS," you have a C and a K for _TT_CK_ _ _, and can reasonably assume that the word is "ATTACKING." Then you can fill in those extra letters (including three vowels) back under the clues, where the two A's may help jog your memory to come up with "HADAMARD" as one of those "creators of functional analysis." Now you've got several more letters—a bunch of critical consonants—to fill in where *they* belong in the solution. And so on. Apostol says, "Once you have filled in just a few letters in the diagram, you will be amazed to see words and phrases begin to take shape." Well, make that *quite* a few letters.

Anyone up for the challenge can order Apostol's acrostics from the Caltech Bookstore for $9.95. Also available (for $39.95), for those who prefer something less than total immersion, is *Patras Diary*, by Jane Apostol, Tom's wife: an entertaining account of a semester in 1978 spent teaching mathematics in Greece—leavened with accounts of travel and delicious meals among Tom's Greek relations. Add $3 for postage and handling ($4 if you order both). □

Caltech Bookstore, 1-51, Pasadena, CA 91125; phone: 626-395-6161; or e-mail: citbook@caltech.edu