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IEEE life members newsletter

contents

IEEE

Keeping Abreast of New Technology

Charles W. Turner, Chair, IEEE Life Members Committee

The IEEE is, first and foremost, about electrotechnology and its increasingly wide range of applications, but not all members are aware of the sheer scale of the resources available. Membership in any of the IEEE's Organizational Units (OUs), such as Sections, Chapters, or Affinity Groups, offers a gateway to news of the latest advances in technology. Life Members (LMs) can continue to enjoy ready access to these resources by retaining, free of charge, their membership in these OUs.

IEEE Life Members Committee Chair Charles W. Turner

When I am asked how I manage to keep up to date on current news, I admit that I can only claim partial success, but that without the IEEE and its publications, like *IEEE Spectrum* and Society magazines, it would be much more difficult. I also point out that it helps that I belong to several IEEE Societies and keep in touch via the Internet through their webinars and the digital versions of their publications. "Staying connected" seems to be the best option for LMs to avoid losing touch.

If there is one common interest that LMs and other long-serving IEEE Members share, it is the incredible story of electronics. Some retired members, understandably, heave a sigh of relief when their workplace technical responsibilities have been discharged, but an enduring fascination with electronics keeps many others technically active as authors, reviewers, or consultants. LMs are also active in groups working on the history of technology, perhaps through IEEE Milestone projects.

Within the organizational structure of the IEEE, the Member and Geographic Activities Board is formally responsible for the administration of LM affairs, through the approximately 90 LM Affinity Groups (LMAGs). But it is the Technical Activities Board (TAB), managing more than 40 Societies and Councils, that is the natural home of most LMs. The hundreds of local Chapters of these Societies (distributed across all ten Regions) are, therefore, the logical contact point for members wishing to connect with the IEEE's technical activities. Any member of a Society is automatically a member of the Chapter in his or her Section. The Chapter provides opportunities for active participation, or for personal technical updating, through lectures and other meetings. There is also an ongoing need to recruit volunteers to serve on organizing committees at all levels: LMs have the depth of experience and the organizational skills that are often in short supply.

The IEEE Life Member Committee (LMC) welcomes initiatives by Societies to encourage retired and long-serving members to remain active. The IEEE Microwave Theory and Techniques Society recently formed an LM subcommittee (LMSC), the first Society to create a group to look after LM interests. Beginning with Region 10, it plans to start up nine other regional LMSC groups, with the goal of getting LMs involved with advances in microwave technology, such as the 5G revolution. The LMC hopes that more Societies will follow this example, recognizing that LMs have contributed so much to the advancement of their own special fields of interest over many years. A new Chapter can be formed by the submission of a petition from at least 12 members of the Society. Alternatively, collaboration with a Chapter in another Section can be fruitful for members in the smaller units.

Elderly members can find it difficult to reach meeting venues and generally prefer not to drive at night. These days, with the widespread availability of webinars and other online platforms, the problems of access and transportation to attend events at distant venues can be readily overcome. Volunteers, especially Student Branch members, can help sort out any problems with Internet services and act as mentors for those who lack information technology skills. From past experience, we know that meetings can attract larger audiences if a social component is included in conjunction with a talk. For example, the San Diego LMAG hosts monthly lunches that include a presentation by a visiting speaker.

These examples illustrate how IEEE membership provides various ways to keep in touch with the latest developments in technology and also help to maintain contact with former work colleagues and other LMs in the Section. If you haven't taken advantage of these opportunities before, a simple way to become involved is to inform the relevant Chapter or LMAG chair of your interest and willingness to volunteer. The Chapters can also help members to access the extensive library of continuing education modules.

The LMC is working to improve the quality of service provided to all older members. That is why the implementation of the new LMC Task Force recommendations by every Section is so important to achieving this goal. Ultimately, it is for the members themselves to ensure that their Section's Executive Committee carries through these reforms and provides the resources to deliver a better membership experience. The simple message is keep up to date by staying connected!

In other news, it is with profound sadness that we report that our friend and colleague John Meredith recently passed away. John made many important contributions as an IEEE volunteer, most recently as vice chair of the LMC. His wise counsel and warm friendship will be greatly missed by all who worked with him.

Does Your IEEE Group Need Money for a Project?

The IEEE Foundation invites grant applications exclusively from IEEE Organizational Units (OUs) for projects that address the predefined theme identified by the foundation for each year. The theme aligns with the foundation's mission to "enable IEEE programs that enhance technology access, literacy, and education."

The LMF provided a grant to the IEEE New York Section, which teamed up with the Intrepid Sea, Air & Space Museum in New York City and the IEEE History Center to create a multifaceted exhibition and a professional development course for teachers. The exhibition, Drones: Is the Sky the Limit?, opened on 10 May 2017 and ran through 3 December 2017.

Grants are awarded from two sources: the IEEE Foundation Fund and the IEEE Life Members Fund (LMF). The IEEE Foundation Board of Directors and the IEEE Life Members Committee form a joint committee to review the grant applications and make the funding decisions. In 2018, the IEEE Grants Program will invest approximately US$300,000 in IEEE projects. Decisions for the 2018 grants cycle will be announced in mid-December.

If your IEEE OU has an idea for a project but needs funds to implement it, the Grants Program may be able help. There is one grants cycle per year. Submissions for 2019 will be accepted from February until July 2019. Applications received after the deadline will not be accepted. Be sure to check the website (https://www.ieeefoundation.org/grants) for exact dates and the 2019 theme.

Your donations make it possible to fund innovative projects of interest to the IEEE. Each year, the IEEE Foundation receives many more requests to its Grants Program than it is able to support.

Texas to Star in 2019 Technical Tour

Texas is the home to a number of centers of technical excellence, which are of national importance as well as recipients of several key IEEE historical awards, including IEEE Milestones celebrating technological breakthroughs or turning points. These sites will form the basis for a number of technology-oriented visits throughout Texas organized by the San Antonio Life Member Affinity Group (LMAG) of the Central Texas Section and IEEE Region 5.

The tour, limited to 50 guests, is scheduled for mid-October 2019 and will consist of a ten-day bus tour of significant technical sites planned for Houston, San Antonio, Austin, Waco, and Dallas. Cultural and historical sites will also be included along with many social events with local IEEE Members.

The tour starts with guests checking in at the Hilton Hotel on the University of Houston campus on 9 October. A reception will commence in the evening to welcome guests to Texas. The next morning, there will be a welcoming breakfast that includes speakers to explain the details of the tour and presentations by local dignitaries. Following breakfast, everyone will board the bus for NASA's Johnson Manned Spacecraft Center, where we will a tour the Space Center Houston and facilities of the Johnson Space Center that include Mission Control. Dinner that night will be at the Kemah Boardwalk, on Clear Lake, a favorite getaway for relaxation and home to fabulous restaurants, amusements, charming retail stores, festivals, and seaside shows.

While in Houston, the group will visit the University of Houston to view the High-Temperature Superconductivity Milestone Award and possibly experience a presentation by its recipient, Dr. Paul Chu, who, with his colleagues, was recognized for the work in 1987 that was able to conduct electricity without any loss due to resistance at a temperature above 77 K. The tour then moves on to Rice University's Department of Electrical and Computer Engineering, Center for Research Computing, for a tour and presentation on significant research developments.

Upon arrival in San Antonio, we will start with a visit to the Missions World Heritage Site. Information will be provided on the five missions that represent the largest concentration of Spanish colonial missions in North America. Dinner on the San Antonio River Walk will wrap up the day. The tour will visit several museums including the Alamo and the Museum of Science and Technology. We plan to make a stop at the Southwest Research Institute to hear about the IEEE Region 5 Stepping Stone Award, which was presented for work on the New Horizons Spacecraft and the research results regarding Pluto. Other highlights include discussions of autonomous vehicles, radio direction finding, robotics, and electric vehicles. This is followed by a tour of the Toyota Manufacturing Plant. In addition, one of our dinners may be served on a river barge, which would include a tour of the river.

In Austin, the tour travels to the Texas Advanced Computing Center to hear about its current work as well as its successful bid to the National Science foundation to build the nation's fastest academic supercomputer. The center designs and operates some of the world's most powerful computing resources, and its mission is to enable discoveries that advance science and society through the application of advanced computing technologies.

Experience Mission Control at the Johnson Space Center in Houston.

Tour participants will certainly remember their stop at the Alamo in San Antonio, Texas.

The Texas Ranger Hall of Fame and Museum is a symbol of Texas and the American West. (Photo courtesy of Wikimedia Commons/Pi3.124.)

Texas Instruments is the location of three IEEE Milestones. (Photo courtesy of Wikimedia Commons/Mang9.)

The Salt Lick is home to legendary barbecue. (Photo courtesy of Carol M. Highsmith.)

Barbecue will likely be on the menu during the tour, as Austin has many world-famous barbecue restaurants (a meal may include a visit to one of Austin's famous eateries, such as The Salt Lick BBQ, an all-you-can-eat restaurant in Driftwood, Texas).

On the road to Dallas, the tour stops at the Texas Ranger Hall of Fame and Museum located on the banks of the Brazos River in Waco. The museum preserves the history and inspires appreciation of the Texas Rangers, a legendary symbol of Texas and the American West. While in Dallas, we will visit Texas Instruments' facility and hear about the three IEEE Milestones located at that site: the first use of a digital signal processing integrated circuit for speech generation, the development of the first semiconductor integrated circuit, and the development of the 16-b monolithic digital-to-analog converter. After visiting sites in the Dallas area, the tour concludes after breakfast on the morning of 19 October.

Throughout the tour, there will also be activities of choice by tour participants, such as visits to galleries, museums, historic sites, and shopping. Stay alert for the announcement of the tour. The size of the group will be limited to ensure the best tour experience for all participants. A website has been established to provide more information. Registration will open in December 2018 and close on 1 July 2019. For additional details on this tour, please visit http://sites.ieee.org/ieee-tx-technical-tour.

To ensure your participation in the truly historic event, please make your reservations early to experience the true technical history of Texas.

Unprecedented Success: Dual IEEE Milestone Dedication

The IEEE Foundation continued to introduce members to the *Realize the Full Potential of IEEE* Campaign at a reception held between dual IEEE Milestone dedications in Silicon Valley on 15 August. The IEEE dedicated two important and long-awaited IEEE Milestones in Silicon Valley, California—Birthplace of Silicon Valley (Shockley Labs) and Moore's Law. In between the two dedications, the IEEE Foundation proudly hosted a reception for the members and donors who gathered to celebrate both. The day started with more than 300 guests being treated to remarks from Jim Gibbons of Stanford University and IEEE President Jim Jefferies unveiling the Birthplace of Silicon Valley Milestone on the site of Shockley Semiconductor Laboratory, which manufactured the first silicon devices. The event ended with a packed house at the Computer History Museum, in which attendees witnessed 2017 IEEE President Karen Bartleson unveiling the Moore's Law Milestone and listened as experts opined as to the future of Moore's law.

PHOTO CREDIT: DANIEL DELIBERATO

Featured guests (from left) included IEEE members and supporters Jim Omura, Thomas Kailath, Eli Yablonovitch, James Spilker Jr., Arogyaswami Paulraj, and Martin Hellman, who celebrated the establishment of both IEEE Milestones and attended the IEEE Foundation reception.

Those attending the events represented some of the foundation's and the campaign's earliest supporters, including Prof. Tom Kailath, who has been instrumental both through his personal support and by making important connections in support of the foundation's *Global Leaders Series*. Also attending were friends of the foundation, Dr. and Mrs. Jim Spilker, Prof. Argoyswami Paulraj, Dr. Jim Omura, Dr. Marcian and Mrs. Hoff, and Prof. Eli Yablonovitch and Prof. Marty Hellman. Connecting the work of the foundation to the Milestone events was foundation President and Silicon Valley resident Dr. John Treichler.

WISE Words

IEEE Washington Internships for Students of Engineering (WISE) is a wonderfully impactful program that prepares future leaders of the engineering profession to be aware of and participate in the increasingly important issues at the intersection of science, technology, and public policy. We are proud that one of the interns each year is enabled thanks to donations to the IEEE Life Members Fund of the IEEE Foundation.

WISE has connected engineers and scientists with public policy since 1980. Each year, the IEEE selects three outstanding engineering Student Members to participate in the nine-week WISE program in Washington, D.C. This year's participants included:

- Zeyi Lin, who will graduate from the Electrical and Computer Engineering, Plan II Honors, and Government programs at the University of Texas at Austin
- Alex Meier, an electrical engineering major with an emphasis in power and energy systems at the University of Nebraska-Lincoln
- Raine Sagramsingh, a senior at Florida State University, studying mechanical engineering.

IEEE-USA, IEEE Life Members, and the IEEE Technical Activities Board collectively support IEEE's participation in the annual WISE program. To learn more, visit wise-intern.org.

WISE interns (from left) Zeyi Lin, Alex Meier, and Raine Sagramsingh completed a nine-week program in Washington, D.C., during the summer of 2018.

IEEE History Center Intern Explores Gender in the Video Game Industry

The 2018 IEEE History Center summer intern was Elizabeth Badger, a Ph.D student studying history with a minor in museum studies at the University of Minnesota Twin Cities. She is continuing her research practice in collaboration with historians on staff and exploring the culture of gender in the video game industry. Knowing that electrical engineering is intertwined with the video game industry drew Badger to the internship program and makes her partnership with IEEE History Center a perfect fit.

This internship, made possible by the IEEE Life Member Fund of the IEEE Foundation, has, for more than 20 years, provided young scholars of the history of technology with valuable research experience and an opportunity to work with the History Center staff on a variety of projects, ordinarily over the summer. Interns have assisted the History Center staff on a wide range of programs, while further developing their academic and professional skills. Since 2016, the internship has been specially supported through the generosity of 1989 IEEE President Emerson Pugh and Betsy Pugh.

Ph.D. student Elizabeth Badger served as an IEEE History Center intern during the summer of 2018.

IEEE Collabratec: The IEEE Member Advantage

IEEE Members are empowered to connect and collaborate as one community across the IEEE technical disciplines. IEEE Collabratec adds to your IEEE Member experience by offering the following:

- Verified status: IEEE Members are distinguished by their IEEE badge and affiliations.
- Member directories: exclusive access to a global network of 250,000+ IEEE and Society members.
- Mentoring program: share career guidance by participating as an IEEE mentor.
- Volunteer positions: past and present IEEE volunteer positions are automatically listed on your profile.
- Personalized certificate: one-click download of your personalized certificate of IEEE membership.
- Meaningful discussions: IEEE-sponsored communities such as Cyberethics, Smart Cities, Artificial Intelligence, Blockchain, IoT, 5G, and Entrepreneurship.

Begin the journey, today!. Sign in to IEEE Collabratec at http://ieee-collabratec.ieee.org/.

Help Realize the Full Potential of IEEE

The IEEE Foundation has evolved significantly over the last five years. It serves as the philanthropic partner of the IEEE and has adopted a more proactive approach to "Advancing Technology for Humanity." One of the hallmarks of that new approach is the first-ever major fundraising campaign undertaken by IEEE to *Realize the Full Potential of IEEE.*

Many of the world's most pressing challenges require innovations in engineering. Additionally, the need for engineers; science, technology, engineering, and mathematics professionals; and engineering students is increasing globally as important work for technologists increases.

- More than half of the world's population cannot access the Internet.
- More than one-third of the world's population do not have access to adequate sanitation.
- More than 1 billion people have no access to reliable electrical power.

These challenges are daunting and solvable, with the IEEE committed to playing a full role. The IEEE has identified a number of strategically important initiatives, including those important to Life Members, that will help meet the aforementioned pressing global challenges and more. The IEEE Foundation is leading a special campaign across IEEE's expansive network to raise awareness, forge partnerships, and generate the required financial resources, with a current goal of US$30 milliion. To date, in excess of 52% of the goal has been achieved. The objective is to meet the goal by IEEE Day 2020.

The* Realize the Full Potential of IEEE *Campaign was formally launched in February 2018 with the flick of a symbolic wireless switch by the combined efforts of (from left) IEEE Foundation Executive Director Karen Galuchie, IEEE Foundation President John Treichler, IEEE Executive Director Stephen Welby, and IEEE President Jim Jeffries. Each spoke about the importance of philanthropy and the programs that donations to the campaign support.

It is only through your support that we are able to meet these challenges and *Realize the Full Potential of IEEE*. Visit ieeefoundation.org/campaign for updates and learn how you can become involved.

IEEE History Center Seeks Apollo Program Participants

July 2019 will be the 50th anniversary of the first moon landing. The IEEE History Center is seeking IEEE Members who worked on the Apollo Program to see if they might be appropriate for an oral or first-hand history. Please contact IEEE History Center Senior Director Michael Geselowitz at m.geselowitz@ieee.org for more information.

Leaving a Legacy

People care. They care about the underprivileged. They care about providing education and advancing technology. They care about preserving history and celebrating culture. It truly is remarkable.

Every year millions of people make charitable gifts to organizations whose missions in which they believe. Most gifts are made in cash, securities, or some other liquid vehicle. Unfortunately, those in a position to give don't always consider the variety of options that are available.

Time and effort spent planning today can ensure that your wishes are followed tomorrow. They can give you confidence that your estate will be directed as appropriate and provide peace of mind to those you love.

Many donors in these situations have an asset that they don't normally consider when they think philanthropically—life insurance. In today's society, life insurance has become increasingly prevalent. As such, donors who own policies would be wise to consider life insurance as an effective way of providing support to people and causes that they hold dear.

Making a gift of a life insurance policy can often significantly reduce a prospective donor's taxable estate, which can result in substantial tax savings depending upon the donor's income and potential tax liability. Gifting a policy can provide an immediate tax deduction of the fair market value of the donor's policy. As you can imagine, this can result in quite significant deductions, depending on the circumstances.

Some important points to remember when considering a gift to a charitable organization, such the Life Members Fund (LMF) of the IEEE Foundation include the following:

- The LMF receives the entire amount of the policy upon the death of the insured.
- There is no cap on the size of the policy that may be donated to the LMF, since charitable donations have no ceiling for estate tax purposes.
- In most cases, such a gift does not alter a donor's current investment strategy.
- Such an arrangement may provide a creative way to dispose of a policy that was originally meant to cover a need that may no longer exist.

Naming the LMF of the IEEE Foundation as the beneficiary of your life insurance may be the simplest way to enact this transaction. It is a win-win for both the IEEE and the donor. The LMF receives the proceeds from the policy, and, by virtue of the gift, the donor's taxable estate is reduced by the amount of the death benefit.

While the IEEE Foundation stands ready to assist donors considering such a transaction, it is always wise to first consult your own insurance agent or estate planner.

Stan H. Retif,
Chief Development Officer,
IEEE Foundation

Support Life Member Initiatives Through an IRA Charitable Rollover

On 18 December 2015, President Barack Obama signed legislation making the IRA Charitable Rollover retroactive to 1 January 2015 and permanent going forward. As a result of this legislation, individuals may make direct charitable distributions of up to US$100,000 from their traditional, Roth, or rollover IRAs without including such distributions in their gross income, given they meet the following requirements:

- A donor must be at least 70 1/2 years of age at the time of the transaction.
- The funds must pass directly from the donor's IRA to the IEEE. This provision applies only to:
  - IRAs and Roth IRAs [SEP or Simple IRAs, 403(b)s, 401(k)s, and pension plans are not eligible]
  - outright gifts (distributions cannot be used to fund life income gifts, such as charitable gift annuities or charitable remainder trusts). The gift may satisfy a donor's IRA required minimum distribution for the year.

Since the amount of the direct charitable distribution can be excluded from the donor's gross income, there is no federal income tax deduction available for such gifts. The IEEE Life Members Fund of the IEEE Foundation qualifies as a 501(c)(3) (EIN # 23-7310664).

As with any considerations regarding your estate planning, we suggest you consult your own attorney and/or tax advisor to make sure this vehicle makes sense given your personal circumstances. Contact: Stan Retif (s.retif@ieee.org), IEEE Foundation, Development Office, with questions about how to make a gift from your IRA.

The Brickbat Club

In 1950, the Industrial Mobilization Division of the Signal Corps Supply Agency, Philadelphia, was tasked with developing production for military-required products that were too expensive or too complex for industry to produce on its own. During that time, the highest levels of the government were concerned about detecting the Russian bombers approaching over the North Pole. GE had been tasked to build the radars that were to be deployed. The design of the pulse modulator for the high-power magnetrons was a 20-MW, type-1754 hydrogen thyratron. Hydrogen thyratrons had been developed during World War II at the Massachusetts Institute of Technology (MIT) Radiation Laboratory. Sylvania was selling the 4C35 and the 5C22 but were plagued by short life, instability, and the inexplicable loss of hydrogen within the tubes. Herman Kuthe had worked at MIT and started a small company in New Jersey to manufacture the 1754 but was unable to produce a standardized tube with any reasonable life. Kuthe was delivering a few tubes a month, all with different characteristics and all with short life.

After serving as an officer in the U.S. Army Signal Corp in New Guinea and the Philippines, I joined the National Advisory Committee for Aeronautics at Langley Air Force Base as an aeronautical research scientist, and in late 1949, I moved to the Industrial Mobilization Division. Within weeks of my arrival, I was told about the problems of obtaining the 1754 and tasked with developing an mil spec tube with a production goal of 50,000 in two years.

The head of the Procurement branch, John Fitch, was assigned to work with me, and he was invaluable. Ted Kyne, my section head, was supportive and a fine buffer against outside interferences. After reviewing all the literature and consulting with Darryl Ricker, chief of the highly capable Thermionics Branch of the Signal Corp Engineering Labs, and Mort Zinn, the expert on thyratrons, we sent our request for proposals, winnowed them down to a select group, and proceeded.

Our list was impressive. It included all three service labs, EGG, Bell Labs, RCA and its Labs, Western Electric, GE Syracuse and Schenectady, and North Adams, Westinghouse, Sylvania, Machlett Labs, and many more fine companies. Under the Defense Production Act, I was able to waive antitrust proceeding and set up what we called the Integration Committee on Hydrogen Thyratrons. This group of technical experts from each of our contractors met monthly and exchanged the information we developed. We combined research, development, and production simultaneously. In addition to managing this program, I was proud to have personally specified the high-power test sets.

The program was so critical to national defense that it reported to President Truman every Monday morning and carried a “Brickbat” priority. *Brickbat* meant that our contracts had priority over any and all other jobs in the contracted company. Within fewer than two years, we were obtaining standardized tubes that were meeting the 500-h goal. This was the most fascinating and satisfying work of my entire career.

Bert Aaron, SM
Williamsburg, VA

The Apollo Lunar Heat Flow Experiment

The Lunar Heat Flow experiment, which was emplaced on the Moon during Apollo missions 15, 16, and 17 by NASA astronauts, measured the heat flow of the moon and resulted in scientists understanding the composition of the Moon as well as other findings. I was the project engineering manager for the experiment and reported to Dr. Mark Langseth the P.I. at Columbia University. My main task was to insure that the experiment was designed and built according to a very rigid array of requirements and specifications.

To achieve this end, there were many meetings and design reviews between the prime and subcontractors, NASA and the P.I., regarding the sensors, thermocouples, lunar drill, heaters, borehole, and electronics, among other things. At one of the reviews at an electronic subcontractor’s location in the Midwest, a question was raised if a particular very-strict sensor voltage measurement was accomplished during recent qualification tests. The subcontractor said it was, and immediately a NASA engineer offered a coffee break followed by a look at the voltmeter that was used for the test.

We all returned to the conference room after the break, but there was no voltmeter in sight. It turned out that there wasn’t any equipment that could possibly measure to the required tolerances. To resolve the concern, the specifications were ultimately adjusted to manageable levels.

The NASA engineers and astronauts were so technically talented and resourceful. The experiment performed successfully for over two years on the Moon, sending heat-flow data to Earth from Apollo 15 and Apollo 17, the last mission to the Moon. During Apollo 16, a cable connecting the experiment to the central station was dislodged, and no data were achieved.

Kevin J. McDermott, LM
Newark, NJ

A Logic Recorder Tolerant of Static Sparks

In 1982, during the development of printers at IBM, Austin Office Products, Division for the Displaywriter (a word processor using the Intel 8086), I took on the job of finding electromagnetic compatibility (EMC) modifications for the printers. Good EMC was a key advantage of IBM products. A proprietary IBM electrostatic discharge (ESD) tester shocked office products at a 60-Hz rate, simulating body static encountered in low-humidity environments, generated by nylon fabrics.

The 5215 Selectric-based printer was not passing the ESD criterion. There was a rare machine state that was susceptible, once every 2,000 sparks. Logic analysis during sparking could not be done; any test equipment would act as antennas, coupling radio-frequency impulses from the sparks right into the high-speed logic. The poor EMC engineer was blind to logic failures. The printer would hang, and there was no clue about why.

With a hope that the printer's logic was, in the main, adequately tolerant of ESD, I was determined to overcome the blindness. The digital design lab provided TTL counters and static, 4-b RAM. I made a quick design for a custom logic waveform recorder that could reside inside the printer and record 1,024 samples, triggering upon the static event and retaining addresses and 8-b data, pre- and poststatic. This might reveal the susceptible machine state if the recorder's memory could be read out to a logic analyzer, after stopping the static.

But time was critical. I had a stock of Bishop Graphics prototyping copper patterns, with adhesive to apply them to the perf board, so that I could do rapid prototyping. "Solder-through" insulated wire made hundreds of connections. In three days, I had a 13-integrated-circuit, 5-in x 6-in recorder with 28-b width (address data) and 34 pins of interconnect to the printer logic. After laboriously connecting 34 wires into the printer logic, 5V, and clock, a trial showed that the noise margins of the custom recorder were adequate to record the printer's logic during discharging. I was no longer blind!

Putting the static tester on one-shot mode, I dialed up the voltage, toward 20 kV, until I saw the logic hang. Leaving the recorder inside the powered-on printer, I changed the 32 pins of signals over to an adapter for the logic analyzer and uploaded the recording. There it was, a tight, infinite loop that the logic had entered upon a critical shock.

It was lunch time, but I found a logic designer who could look at the loop and the logic states leading up to the critical shock. He said little but went away for 40 min. Returning with an erasable programmable read-only memory (EPROM) that had a proposed fix, probably multiple polls of a keyboard or paper-sensor signal, he changed out the EPROM. We set the tester to the 60-Hz rate and were thrilled that the printer was now functioning through thousands of discharges at the required voltage. The fix was in EPROM, not by shielding, filtering, or logic changes. There would be no added product cost.

Based on this and other EMC innovations, I received an IBM corporate-level award.

John Engelbrecht, LSM
Austin, TX

A "Gotcha" Moment

Back in 1964, I was teaching the third NASA astronaut class about their Apollo radio for use to and from the Moon. I had been chosen for the teaching job because I was former U.S. Air Force navigator and knew how to deal with military pilots. I also was one of the NASA–Houston engineers dealing with the design of that radio.

I was up at the blackboard trying to explain how their high-gain antenna worked. I wrote the equation for the effective area of the antenna, just to give them an intuitive idea of what the term *high gain* meant. Astronaut Roger Chaffee, who sat in the front row, said, "I think there is an equivalent formulation for that."

He gave it to me, and I wrote it just below the first equation. I then told him, "Yes, Roger, that is equivalent."

He cracked a slight smile and said, "And I think there is another equivalent form."

After I had written that on the board, I turned around and said, "Yes, Roger, that too is equivalent." Then, I asked him, "Roger, what did you say your M.S. degree was in?"

"Aeronautical engineering," he boomed. The entire class laughed, loudly. It was a "gotcha" moment, and I was got. That's when I started wondering if I could make it as a college professor.

John H. Painter, LSM
College Station, TX

Anti-Aircraft Missile Radar Tests

In 1952, my first engineering job at Raytheon's Missile and Radar Division was analyzing the data from tests using a missile radar (carried aboard a B-17) against a jet aircraft. But the test data was being recorded at a miserably slow pace, and I complained to the senior engineer who was running the field tests. He said, "You had better come out with us next test day." And he grinned.

The next fair-weather morning, I boarded an ancient B-17 at Bedford Airport. The missile continuous-wave radar was mounted in the nose, and we and the recording equipment were aft of the pilot's compartment. The hatches were open, and the wind and noise were overwhelming. The jouncing was worse. The Navy jet that was to serve as the test target was already in the air, but it took perhaps 40 min to align for a test run, with the two aircraft being out of sight of each other most of the time. The run took only a second or two. The jet shot by within 100 m of the B-17, a beautiful sight against the blue sky; then the whole lengthy process was repeated once before the test aircraft had to land to refuel, ending the day. I climbed out unsteadily. The senior engineer grinned at me again and said, "Now you understand what we're up against."

One morning, the secretary of the U.S. Navy arrived for a program review. I was at my lab bench when I was told to hurry to the front conference room with my test flight tapes—the director wanted to show them to the secretary. There was no need for any equipment—the conference room was fully equipped. Arriving, I loaded my tape spool onto a familiar Ampex tape deck and, surrounded by a crowd of Navy brass, stared dismayed at the front of the latest model Tektronix oscilloscope. It was easy enough to turn on, but where were the sync controls? Unlike the ancient scope at my bench, there were some three-dozen buttons and knobs. The pattern on the scope was hash, but I managed to keep my cool. One of our senior engineers was standing next to me. I said quietly, "Bill, what am I doing wrong here?" He reached over and touched a button and the radar return signals appeared on screen. I didn't have a chance to do anything more than edge out of the room as the director immediately took over. I returned to my lab bench, both shaken and self-congratulatory.

Leonard S. Taylor, LF
Silver Spring, MD

Signaling the End

In 1961, I was working at the Vandenberg Air Base Tracking Station on the computer control/monitoring system. One of the jobs of the folks at that station was to read out and control the functions of the payload in the satellite as it orbited Earth. This particular system was a photographic satellite that could take a photo from about 100 mi altitude, which was clear enough to read a license plate on a vehicle.

As the satellite orbited Earth, it was common to switch between systems, like the radio communication receivers. (The system had two for reliability.) As the vehicle passed overhead, the operator was to turn off receiver A and turn on receiver B. This was the written instruction. But as the operator turned off receiver A and then sent the message to turn on receiver B, there was no response.

After close scrutiny of the film showing the operator actions, the answer was found. As he had turned off receiver A, there was no way for the payload to receive the signal to turn on the receiver B. This was the end of the useful life for the payload.

Bob E. Smiley, LM
Bloomington, IN

Up in Smoke

In 1966, I was a Drexel co-op at Fischer and Porter Data Automation Division in Warminster, Pennsylvania, where I worked on automotive vehicle detectors (induction loop detectors) and traffic light control products. One day, I was tasked with fixing a failed power supply board from a traffic light controller. I applied power to it at my workbench and, while bent over the board, was probing with a meter when there was a loud bang and plume of smoke. A tubular aluminum electrolytic cap had blown up, and, fortunately, the two ends soldered into the board remained, and nothing hit me in the eye. There were no ubiquitous cell phones then to capture an image of me with smoke curling around my head and a long strip of aluminum foil draped around my neck. Turns out the cap was installed backwards. I learned a valuable lesson—to perform a good visual inspection of a faulty board before applying power to it.

John O'Donnell, LM
Rockledge, PA

An Expensive Lesson

At IBM in Yorktown Heights in the 1960s, we were experimenting with read-only memory (ROM) for the System 360/40 that could be quickly changed with readily available equipment. Circuit boards were copper-plated, with the image of four 12 × 80 punched cards on each side, and covered with a thin insulating layer. A supply of punched cards was printed with conducting ink for the rectangular "holes" and for covering the verso. When one of these punched cards was pressed against the circuit board, the capacitance at the intact positions was interpreted as "1" and the lack of capacitive coupling at the punched-out positions as "0." Therefore, four two-sided boards with 32 cards could hold 30,720 b, enough for the 360/40's boot code. The ROM would not be affected by turning off the computer, and it could be quickly reset with cards prepared on the ubiquitous keypunch.

To ensure good capacitive coupling, the cards were pressed against the board by a custom-designed inflatable plastic bag sandwiched between the boards. The airflow would be controlled by a valve. I proposed a Teflon T-valve with copper fittings and a knob for turning a slotted cylinder that would connect either spur to the stem. The nipple on the stem would be connected by a tube to the airbag, one spur to a fish-tank air pump, and the other spur left open to allow deflating the bag to change cards.

Having worked summers in college as a draftsman, I prepared a drawing myself, with isometric, cross-section, and projection views and dimensions to three decimal places. I took my drawing to the Research Center's superb machine shop, where an old German machinist examined it carefully. He told me that it would take 9 h to machine it to the tolerances I had specified. The cost of the materials was negligible, so it would cost about US$540 dollars. My manager signed the authorization.

I tried it as soon as it was ready. It leaked, so I coated the cylinder with silicon grease. It still leaked. When I took it back to the machinist, he asked me what I was using it for, and then he showed me a US$1.75 glass air-valve that might serve. It did. I kept the Teflon valve on my desk for decades to remind me not to be shy about soliciting advice.

George Nagy, LF
Troy, NY

The Mystery of the Missing P-Junction

In the early 1970s, Kearfott, a division of the Singer Corp., was working with the U.S. Air Force and NASA, defining a time-division multiplex command and response communication network. The network connected up to 32 avionic units via a single twisted pair of wires, operating at a frequency of 1 MHz. The multiplex system eventually became Mil-Std-1553.

While the standard was being developed, our team was charged, via an internal research and development (IR&D) program, to develop semiconductor(s) that would perform the encoding and decoding of the waveform that was to be used in the forthcoming Mil-Std-1553 specification.

Prior to taking on the task, our experience was in vacuum tubes, transistors, and small-scale semiconductors, such as Flip-Flops, And, Or, etc. We knew very little about large-scale integrated (LSI) circuits. Our research and design parameters, plus analysis and bread-boarding, led us to consider integrating all circuits onto one LSI semiconductor and to possibly use a new low-power semiconductor technology named *complimentary metal oxide on silicon* (*CMOS*). In addition, we were required to convert our transistor-level design to the P and N junction level of a semiconductor. During this period, minimal computer-aided-design was available for this level of LSI circuit design.

With further research, we located a start-up foundry in Valley Forge, Pennsylvania. It would work with us and manufacture the CMOS wafer/chips. To manufacture the wafers, we were required to supply the masks necessary for the multiple layers of the semiconductor (the P-layer, the N-layer, the conductor-layer, etc). Utilizing an X-Y plotting and cutting table, the initial mask-making process required plotting and cutting the physical shape of each circuit layer out of a plastic material called *Ruby-Lit*. A parallel IR&D effort developed a software program for the X-Y plotting and cutting table. The result generated a Ruby-Lit sheet for each layer. After photographing each Ruby-Lit layer and reducing it down to the wafer/chip size, a mask for each layer was manufactured. The Ruby-Lit sheets were then rolled up and stored for possible future use. The masks were sent the Pennsylvania wafer/chip foundry, and the first wafers were produced and delivered.

We received our first wafers and, with an unsophisticated straight pin probing tool, tested the functioning of the first encoder/decoder chip. Every output, except one, was functioning as designed. Further test and analysis determined that one of the output circuits had a faulty or missing P-junction. Our investigation led us to the Ruby-Lit layers, and following some razzing from fellow engineers, we found a piece of tape covering that particular P-junction. The tape had gotten photographed into the mask. With a new mask and new wafer, the problem was solved. Other design changes followed, but the laughing and ribbing continued.

Anthony F. Sanducci, LM
Riverdale, NJ

The March and Crawl of Technology

In the summer of 1982, I took my family to visit the USS *Massachusetts*, a World War II battleship that was, by then, a museum. This ship was designed and commissioned in the late 1930s and saw service throughout the war. In 1982, the U.S. Navy was bringing the battleship USS *New Jersey*, a later design, out of mothballs to serve in the Mediterranean offshore of Lebanon. I am familiar with ships due to my engineering background and because I served my Reserve Officers' Training Corps duty at a naval shipyard. As a result, I was able to guide my family around the ship and explain things to them. In due course, we arrived at the gyrocompass room deep in the bowels of the ship. To my surprise, I saw two technicians disassembling the gun fire control computers. These were electromechanical devices that stored the complex equations on three-dimensional cams that looked like curvy-sculpted soda cans. By 1982, these computations could be done trivially by an Apple II or IBM PC, leaving aside the need for ruggedness.

"What are you doing?" I asked them.

"We're cannibalizing it for the *New Jersey*."

"You're kidding," I responded.

"No, we're not!"

When the *New Jersey* was mothballed for the third time, in 1969, the expectation was that it would be back in operation in 90 days. In fact, it took over 18 months. The delays arose because so many items that needed replacement or repair could not be found or had to be made to order at great expense and delay. This and other events led the Office of Naval Research (ONR) to launch the Parts on Demand (POD) program. The goals were to better match the spare parts inventories on board ships and in the Naval Supply System to actual operational needs and find ways to repair systems that had long outlived the people and companies that originally made them.

The Charles Stark Draper Laboratory, where I worked, received a grant in March 1983 to study this problem systematically. We worked with experts from the National Bureau of Standards (now the National Institute of Standards and Technology), which had a research program in manufacturing automation, and Science Applications Inc., a defense systems analysis contractor. Our expertise was in robotics, robot assembly, and automation. We dutifully undertook our study and submitted our findings and recommendations in December 1983. These included creating part procurement processes that exploited digital data to define the part, its specifications, and its process plans so that it could be recreated in the future.

Part of our study involved visiting naval supply depots to better understand the problem. It was truly daunting. The Navy must decide what parts might need replacement, how many to have on hand, and how to keep the supply base intact and ready to respond. The scope can be illustrated by what happened when our hosts at one facility attempted to demonstrate the ordering system. The operator put in the stock number for the glass bezel of a radar repeater but it came up as a shower curtain hook. This led me to conclude that the Navy was, in fact, a huge centrally controlled economy with perhaps 4 million inhabitants—men, women, and children. Its job was to keep those inhabitants supplied with all the necessities of professional and personal life, including radar repeater bezels and shower curtain hooks.

All our research was very systematic, engineering oriented, and workmanlike. But a funny thing happened along the way. At our first meeting, the program manager, Marvin Dennicoff, told us of another POD proposal he received from a well-known artificial intelligence (AI) researcher. Dennicoff funded a great deal of innovative AI research through ONR and knew the community well. But he felt that this proposal was, to say the least, fanciful, and so did we. The proposal suggested that a new part could be made from a "broken" one by scanning its geometry into a computer, building up a replica using layers of material such as powder metal, and then hardening it. Dennicoff funded us partly to create a sensible counter to this fanciful proposal. Us engineers knew that parts are much more than their shape: material properties, surface finish, chemical compatibility, and so on are needed to define a "part." Furthermore, even a not-"broken" part is an imperfect example of its ideal design and should not be used as the basis for a replacement. What a fanciful idea indeed.

Today, the term *parts on demand* is still in use, and descendants of the 1983 AI proposal are being applied daily. Layered or three-dimensional manufacturing is a growing technology. Among its first successful applications were parts that did not have to reproduce all the properties of a functioning part, such as form and fit experiments and demonstrations. Today, materials and processing methods are constantly improving, and actual production parts are being introduced.

I look back on this experience as reinforcing a conclusion I drew in the past regarding the AI researchers I knew and respected: they were the most imaginative people I ever met.

Daniel E. Whitney, LF
Redmond, WA

An Unbreakable Bond

In the 1960s, after completing my master's degree in electrical engineering with an emphasis in biomedical engineering at the University of Missouri–Columbia, one of my positions was a research engineer in the Biomedical Engineering Division of Zenith Radio Corporation in Chicago, Illinois. I worked on the first portable cardiac defibrillator, a hospital bed monitoring system, and a compound-B ultrasound scanner.

Working in Chicago was great, as everything an engineer needed was available there. One new item was cyanoacrylate instant glue (CA). One of our engineers was an older fellow from Germany. He refused to believe that CA was any good, so we asked him if we could to run an experiment with him, and he agreed. We put a drop on his left thumb and had him press the tip of his left index finger against it, encouraging him not to move. Then we had him encircle his right thumb and index finger within the loop of his left fingers and glued them together. We then left for lunch. When we came back his hands were still locked together, and he was a believer.

Blair A. Rowley, LM
Xenia, OH

The Strange Dimensions of the TO-3

My first engineering job out of school in 1963 was at Motorola Semiconductor in Phoenix, at 5200 East McDowell Road. My initial boss in Applications Engineering was Ralph Greenburg. Ralph was one of the earliest employees at the Semiconductor Division at the old 56th Street building. One of my first assignments was to design an audio power amplifier using the 2N176. Looking at the data sheet, I was perplexed about the mechanical dimensions of the TO-3 package. I thought, who in their right mind would pick 0.430 in for pin spacing? Who would choose 1.187 in for the spacing between the screw holes at the ends of this package? And who would pick a dimension of 0.665 in from the center of the screw hole to the plane of the two pins? Why would anybody ever pick numbers like these?

The TO-3 and nine-pin tube socket.

I asked Ralph these questions, and he chuckled and said, "Do you remember auto radios with tubes in them and that vibrator used to convert 12 V to 200 V or so for plate voltage?" I replied, "Yeah." Ralph said the basic reason for the 200 V or so was that it was required for a vacuum tube to make the 2-W audio output requirement for an auto radio. Ralph then went on to explain that the reason Motorola started the semiconductor division in the first place was to get rid of that auto radio vibrator (which failed on a regular basis), the power supply transformer, and the high voltage rectifier tube. The only way to do that was to design a power transistor for the audio power output stage—if you could do that, then you could use tubes with a 12-V plate for the small signal circuits in the radio and 12 V for the high-current power transistor to make the 2 W of audio power output and get rid of the vibrator and its circuitry.

So, in 1956, Ralph got the job of figuring out the package for this new power transistor device. He came up with a couple of packaging options with stud mounting, but then they needed a socket for these new packages, three leads for the emitter, base, and collector. The best quote was US$0.25 for this three-pin socket. The Motorola auto radio engineers squawked about the high price of this socket, since they were only paying a penny a pin for tube sockets. So Ralph figured the best thing to do was to design the power transistor package around a nine-pin tube socket—two pins for the tube socket and use the case as the collector terminal. That way, the auto radio guys could order the tube socket with only two pins on it. Or, if they wanted extra solder terminals for other circuitry, they had up to seven extra terminals to use. So, the TO-3 package was designed to fit into a nine-pin tube socket, and that's where the funny dimensions came from. Of course, once the socket manufacturers saw the volume with auto radios, it didn't take them long to design a specific socket for the TO-3 with only two pins on it and reduce the socket cost from the nine-pin tube socket. The TO-3 is such a good design that it is still a common package for power transistors even today, despite the strange dimensions.

Don Wollesen, LSM
La Selva Beach, CA

No Longer a Hard "Cell"

Having retired a few years ago from the cellular radio industry and doing engineering for cell towers in Iowa and Nebraska, I found it is no longer just a problem of siting a tower for the best propagation to cover a targeted area, but one of taking into account many additional factors—environmental concerns, historic preservation, avoiding areas of migratory birds—to name a few. So while "location, location, location" was the prime objective in siting cellular towers, how to achieve all of this was far beyond an electrical engineering education and a radio-frequency (RF) design problem.

I had to become familiar with archeological studies, consider the possible effect a tower may have on nearby historic properties, and work with the U.S. Fish and Wildlife Service (USFWS) to assure it that the towers would not attract birds at night or become a possible source of avian mortality. Besides surveying 20–30 native tribes to see if any had historic/cultural concerns in the area proposed for the tower, I quite often worked with the Tribal Historic Preservation officer detailing all the ramifications of building a tower and cell site at the proposed location. This included a description of the amount of earth being impacted by the tower foundation excavation to estimating how far the tower would be visible in all directions. Many times after submitting all of this information, we received a rather generic response of "We have no interest in this site."

Usual archeological studies involved hiring a professional archeologist to perform a site survey, which included taking shovel samples of topsoil sifted to find if any cultural artifacts were present. Quite often, surface samples were good enough, but then the State Historic Preservation Office (SHPO) might require samples be taken 4 ft below the surface, since sediment from a nearby creek may have covered any artifacts. Usually, the artifacts recovered consisted only of glass shards or brick fragments, which the archeologist deemed "evidence of recent development."

In the 1990s as cellular radio service grew and there was a race to provide wide-area coverage, we faced problems at hearings before city councils and county boards of supervisors. Nearby rural neighbors would complain they didn't want to see any of our ugly towers from their front doors, or in towns, we would hear the "not in my back yard" response. Responses included that a tower would destroy their property values, and we heard all sorts of problems RF radiation would cause, even though they didn't realize the RF radiation from holding a flip phone close to their brain while talking on it (especially if they were far from a cell site and their phone was cranking out maximum power) far exceeded any exposure they would get from our tower.

However, things have changed more recently. With the proliferation of smartphones and all the data being transmitted, people rely on their Ipads or tablets for far more than just conversation. And with this comes the requirements, especially for people using their phones for work and business, that they need good reception for high-speed data service. So we are sometimes welcomed by people saying, "I need good cell reception. You can put the tower in my backyard or across the street." I believe we have hearings where we would have had more objection if we announced plans to build the tower farther away from a town rather than in a central downtown location. It's completely different than it used to be.

All of this resulted in a renewed respect on my part for the many regulations that have come into existence concerning the siting of towers and protection of natural elements and historic locations. I found that working with the regulators was far more productive than trying to work against the regulations. I gained a true respect for those in the SHPOs and found them to be very dedicated people. Likewise for the people at the U.S. Federal Aviation Administration and the USFWS as they reviewed our plans and made recommendations and suggestions as we sited towers. With this mutual cooperation and respect, I believe we achieved better tower locations since we were equally responsive to their suggestions and they may have bent some to consider all our needs.

Loyal C. Park, LM
Lincoln, NE

Live and in High-Def

Around 1975, British Telecom wanted a microwave link from Birmingham, United Kingdom, toward London and vice versa. However, they wanted it to be a digital microwave link, as the BBC was going all digital for its color, high-definition television (HDTV) broadcasting.

I was in charge of the EMI Communications Division in Somerset at that time, so we bid for the contract and won. There were many challenges to get the error rate satisfactory, but we achieved a very low rate and installed the link from Birmingham to Charwelton to carry HDTV at 140 Mb/s. The link had all the necessary service functions to monitor its performance when carrying live TV signals. At the time, only Bell Labs was working in this field, but our link was the first digital link in the world to carry live TV.

Brian Jackson, LM
Wedmore, Somerset, U.K.

Words Are Important

Engineers use math, block diagrams, timing charts, and logic equations to describe what we build. But the early stages of design often employ written specifications in which words and their definitions are important.

In the early 1970s, I was working for Victor Comptometer, a well-known maker of mechanical calculating machines, which just began making electronic calculators. I led a small team writing the detailed specifications for a microprocessor-based electronic cash register—an innovation at the time. The machine would use a 4-b microprocessor, the PPS4 from Rockwell International, which was being developed as we were preparing the specifications for the machine. This was the dawn of the microprocessor age: Intel and Motorola were also developing and producing their early microprocessors.

A cash register must accumulate and preserve sales data. (Modern retail systems do much more.) In our microprocessor implementation, the sales data would be held in electronic memory, which would have to be preserved in case of power failure. At that time, the read-write memory that was available to us was volatile solid-state memory (random access memory), which could hold data with battery support, and ferrite core memory—the state-of-the-art, nonvolatile, electronic storage of the time. We designed the machine to use either option, but both memory systems required an orderly shutdown procedure. The microprocessor program would need advance warning of power failure so that it could stop reading/writing memory and then produce a signal to lock the memory from changing as the dc power failed.

Our written specifications required that a dc logic signal be supplied to the processor within two cycles of ac power failure and the power supply provide dc power to the electronics for at least 40 ms after the notice of ac failure. Prototypes of the design were shown to preserve memory as the ac power was switched off and on repeatedly.

In early 1975, the first production prototype machines were deployed to a test application in Texas. One day, we received a call that the site had a power failure in a thunderstorm, and the registers lost all their memory. The machines failed their basic job of preserving data. Woe to the designers!

We tested and retested but could not duplicate the failure in our lab. Then another message came from the Texas site—sometimes the power didn't fail but the lights dimmed for a couple of seconds. We went to the lab, hooked up a Variac (variable ac source), and slowly lowered the voltage. Lo and behold, at a particular voltage level the machine died and did not preserve memory.

My simple specification of power failure had resulted in a system that detected complete loss of ac power but did not detect a voltage drop to a level that would make the dc power output fail. We had not envisioned types of power failure beyond a lights-out loss. The power supply was quickly redesigned to sense a drop in ac voltage to the critical level and produce the power fail signal at that time. The product then performed well and was a put into full production. I learned a lesson about the precision of language in specifications.

John J. Guagliardo, LM
Elmwood Park, IL

Underground Substation

It was 1950, and I was a recent electrical engineering graduate working under a registered Professional Engineer in a consulting engineering firm. A project came along to upgrade the electrical distribution system at the Brooklyn Navy Base.

The firm's owner handed me, as part of the project, the task of designing a new underground transformer substation. I happily went to work calculating loads and determining voltages, wire sizes, transformer capacities, and fuse types and sizes. Under my boss's prompting, I laid out the equipment figuring accesses and operational spaces.

Feeling secure in my design, I presented the scaled drawings, calculations, and specifications to my boss. He took it into his office to check my work and returned the next day congratulating me on a job well done. Everything checked out.

But then, he said that the job was incomplete. I asked him what was missing. He replied, "You need to design the vault in which all of this equipment goes."

I protested. "I'm an electrical engineer. The concrete vault is the work of a structural engineer."

His rejoinder was classic in simplicity. He asked, what kind of a vault was it. I said that it was an electrical vault.

He looked straight at me and said, "It is an electrical vault. You claim to be an electrical engineer. *You* design the vault."

Well, I did. I delved into the concrete handbook and several texts on structural design selecting concrete types, rebar sizes and locations, cable supports, and the rest. Of course, my boss had my work checked by a real structural engineer who pronounced my design as competent. I was very happy.

As with most war stories, this one also has a moral. In the facilities design field, it is not enough to be knowledgeable about only one branch of engineering. A truly competent engineer knows how his or her work fits into the whole.

Arthur Belefant, LM
Melbourne Beach, FL

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We welcome articles for this newsletter. In particular, we seek articles about projects that are initiated at the Section and Region level by Life Members as well as "Tales from the Vault," which should focus on novel or interesting technical issues. The suggested length for "Tales from the Vault" submissions is 500 words.

Acronyms should be completely identified once. Reference dates (years) also should be included. Editing, including for length, may occur. If you wish to discuss a story idea, you may contact Craig Causer, managing editor, by e-mail at lm-newsletter@ieee.org. The deadline to submit an article for possible inclusion in the next issue is 1 April 2019. Please include your Life grade, town, state, country, phone number, member number, and/or an e-mail address with your piece.

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