THE BENT

OF TAU BETA PI The Engineering Honor Society Winter 2020

Nuclear Power – What's Next

Convention Recap

Collegiate Chapters (254) — 602,581

Chapter	Establishment Date	Institution
AL A	May 30, 1921	Auburn Univ.
AL B	Nov. 20, 1926	Univ. of Alabama
AL Γ	Mar. 27, 1977	Univ. of Ala. Birmingham
AL Δ	Jan. 26, 1980	Univ. of Ala. in Huntsville
AL E	Feb. 03, 1990	Univ. of South Alabama
AK A	Apr. 05, 1975	Univ. of Alaska Fairbanks
AZ A	Nov. 24, 1926	Univ. of Arizona
AZ B	Mar. 09, 1963	Arizona State Univ.
AZ Γ	Mar. 07, 1981	Northern Arizona Univ.
AZ Δ	Apr. 11, 2015	Embry-Riddle Aero. Univ.
AR A	Dec. 14, 1914	Univ. of Arkansas
CA A	Apr. 10, 1907	Univ. of Calif., Berkeley
CA B	Jun. 11, 1921	Calif. Inst. of Technology
CA Γ	Jan. 26, 1935	Stanford Univ.
CA Δ	Jan. 10, 1947	Univ. of Southern Calif.
CA E	Mar 29, 1952	Univ. of Calif., Los Angeles
CA Z	Apr. 21, 1956	Santa Clara Univ.
CA H	Mar. 14, 1964	San Jose State Univ.
CA Θ	Jan. 30, 1965	Calif. State Univ., Long
CA I	Feb. 18, 1967	Calif. State Univ., L.A.
CA K	Feb. 17, 1968	Calif. St. Univ., N. Ridge
CA Λ	May 03, 1969	Univ. of Calif., Davis
CA M	Feb. 13, 1972	Calif. Poly St. Univ., SLO
CA N	Feb. 13, 1972	Calif. Poly Univ., Pomona
CA Ξ	Mar. 04, 1973	San Diego State Univ.
CA O	Mar. 09, 1974	Loyola Marymount Univ.
CA Π	Mar. 10, 1974	Northrop Univ. (inactive)
CA P	May 09, 1974	Calif. State Univ., Fresno
CA Σ	Jan. 24, 1981	Univ. Calif. Santa Barbara
CA T	Apr. 03, 1982	Univ. of Calif., Irvine
CA Y	Feb. 18, 1984	Calif. St. Univ., SAC
CA Φ	Mar. 05, 1988	Univ. of the Pacific
CA X	Mar. 28, 1992	Calif. St. Univ., Fullerton
CA Ψ	Feb. 05, 1994	Univ. of Calif., San Diego
CA Ω	Feb. 10, 1996	Harvey Mudd College
CA AA	Mar. 02, 1996	Calif. State Univ., Chico
CA AB	Feb. 12, 2005	Univ. of Calf., Riverside
CA AΓ	Mar. 10, 2007	San Francisco State Univ.
CA AΔ	Mar. 08, 2008	Univ., of Calif., Santa Cruz
CA AE	Feb. 25, 2012	Univ. of San Diego
CO A	May 05, 1905	Colorado School of Mines
CO B	Jun. 08, 1905	Univ. of Colo. at Boulder
CO Γ	Jan. 29, 1954	Univ. of Denver
CO Δ	Apr. 20, 1974	Colorado State Univ.
CO E	Nov. 23, 1985	Univ. of Colo. at Denver
CO Z	Mar. 08, 1997	U.S. Air Force Academy
CT A	Dec. 15, 1923	Yale Univ.
CT B	Jan. 08, 1949	Univ. of Connecticut
CT Γ	Mar. 09, 1991	Univ. of Hartford
DE A	Nov. 25, 1933	Univ. of Delaware
DC A	Mar. 10, 1956	Howard Univ.
DC B	Mar. 31, 1962	Catholic Univ. of America
DC Γ	Feb. 16, 1963	George Washington Univ.
FL A	Jan. 14, 1961	Univ. of Florida
FL B	Jan. 25, 1964	Univ. of Miami
FL Γ	Feb. 16, 1974	Univ. of South Florida
FL Δ	Dec. 03, 1977	Univ. of Central Florida
FL E	Feb. 09, 1985	Florida Atlantic Univ.
FL Z	Mar. 01, 1986	Florida Inst. of Technology
FL H	Feb. 29, 1992	Florida A&M Univ. - FSU
FL Θ	Mar. 12, 1994	Florida Intl. Univ.
FL I	Mar. 12, 2011	Embry-Riddle Aero. Univ.
GA A	Feb. 06, 1925	Georgia Inst. of Tech.
GA B	Feb. 11, 1995	Mercer Univ.
ID A	May 02, 1974	Univ. of Idaho
ID B	Jan. 17, 2004	Idaho State Univ.
ID Γ	Mar. 13, 2010	Boise State Univ.
ID Δ	Mar. 04, 2017	Idaho
IL A	Jun. 02, 1897	Univ. of Ill. at Urb.-Champ.
IL B	Apr. 06, 1906	Illinois Inst. of Technology
IL Γ	Dec. 06, 1941	Northwestern Univ.
IL Δ	Jan. 18, 1964	Bradley Univ.
IL E	Apr. 03, 1976	Southern Ill. Univ. at Carb.
IL Z	Jan. 28, 1984	Univ. of Ill. at Chicago
IN A	Apr. 10, 1893	Purdue Univ.
IN B	Dec. 08, 1928	Rose-Hulman Inst. of Tech.
IN Γ	Dec. 10, 1960	Univ. of Notre Dame
IN Δ	Mar. 23, 1963	Valparaiso Univ.
IN E	Feb. 22, 1975	Trine Univ.
IN Z	Mar. 28, 2015	IN Univ.-Purdue Univ. Ind.
IA A	Dec. 20, 1907	Iowa State Univ.
IA B	Mar. 30, 1909	Univ. of Iowa
KS A	Dec. 17, 1914	Univ. of Kansas
KS B	Mar. 21, 1965	Wichita State Univ.
KS Γ	Jan. 27, 1974	Kansas State Univ.
KY A	Apr. 05, 1902	Univ. of Kentucky
KY B	Mar. 24, 1974	Univ. of Louisville
KY Γ	Feb. 27, 2010	Western Kentucky Univ.
LA A	Nov. 30, 1936	Louisiana State Univ.
LA B	Dec. 01, 1936	Tulane Univ. of Louisiana
LA Γ	Feb. 17, 1951	Louisiana Tech. Univ.
LA Δ	Mar. 05, 1960	Univ. of LA at Lafayette
LA E	Mar. 13, 1993	Univ. of New Orleans
ME A	Mar. 11, 1911	Univ. of Maine
MD A	Apr. 09, 1921	Johns Hopkins Univ.
MD B	Nov. 21, 1929	Univ. of Maryland
MD Γ	Jan. 13, 1984	U.S. Naval Academy
MD Δ	Dec. 11, 1993	Univ. of Maryland Balt. Co.
MD E	Mar. 07, 1998	Morgan State Univ.
MA A	May 14, 1910	Worcester Polytechnic Inst.
MA B	Jun 05, 1922	Massachusetts Inst. of Tech.
MA Γ	Jun 06, 1923	Harvard Univ. (inactive)
MA Δ	Dec. 16, 1927	Tufts Univ.
MA E	Dec. 13, 1941	Northeastern Univ.
MA Z	Jan. 07, 1956	Univ. of Mass. at Amherst
MA H	Apr. 19, 1975	Boston Univ.
MA Θ	Mar. 09, 1985	Univ. of Mass. Lowell
MA I	Mar. 21, 1992	Western New England Univ.
MI A	Nov. 05, 1982	Michigan State Univ.
MI B	Aug. 06, 1904	Michigan Tech. Univ.
MI Γ	Jun. 14, 1906	Univ. of Michigan
MI Δ	Jan. 20, 1941	Univ. of Detroit Mercy
MI E	Mar. 10, 1951	Wayne State Univ.
MI Z	May 08, 1971	Kettering Univ.
MI H	Feb. 11, 1978	Lawrence Tech. Univ.
MI Θ	Feb. 11, 1979	Oakland Univ.
MI I	Jan. 16, 1982	Univ. of Michigan-Dearborn
MI K	Mar. 18, 1989	Western Michigan Univ.
MI Λ	Mar. 27, 2004	Grand Valley State Univ.
MN A	Jun. 09, 1909	Univ. of MN-Twin Cities
MN B	Feb. 03, 1996	Univ. of MN, Duluth
MS A	Dec. 15, 1928	Mississippi State Univ.
MS B	Mar. 15, 1969	Univ. of Mississippi
MO A	Nov. 15, 1902	Univ. of Missouri-Columbia
MO B	Dec. 21, 1906	Missouri Univ. of S&T
MO Γ	Jun. 05, 1922	Washington Univ.
MO Δ	Jan. 26, 2002	Univ. of Missouri-KC
MO E	Mar. 23, 2013	Saint Louis Univ.
MT A	Apr. 15, 1926	Montana State Univ.
MT B	Mar. 24, 1984	Montana Tech
NE A	Jan. 26, 1974	Univ. of Nebraska-Lincoln
NV A	May 10, 1974	Univ. of Nevada, Reno
NV B	Feb. 04, 1995	Univ. of Nevada, Las Vegas
NH A	Dec. 09, 1950	Univ. of New Hampshire
NH B	Feb. 23, 2002	Dartmouth College
NJ A	Mar. 27, 1896	Stevens Inst. of Technology
NJ B	Dec. 14, 1934	Rutgers Univ.
NJ Γ	Nov. 29, 1941	New Jersey Inst. of Tech.
NJ Δ	Apr. 23, 1972	Princeton Univ.
NJ E	Jan. 28, 2006	Rowan Univ.
NJ Z	Mar. 02, 2013	The College of New Jersey
NM A	Apr. 05, 1974	New Mexico State Univ.
NM B	Apr. 06, 1974	Univ. of New Mexico
NM Γ	Mar. 02, 1985	NM Inst. of Mining & Tech.
NY A	Apr. 11, 1902	Columbia Univ.
NY B	May 16, 1906	Syracuse Univ.
NY Γ	Jun. 12, 1908	Rensselaer Polytech. Inst.
NY Δ	Jan. 17, 1910	Cornell Univ.
NY E	Dec. 04, 1931	New York Univ. (inactive)
NY Z	Dec. 05, 1931	Polyt. Institute (inactive)
NY H	Nov. 30, 1940	City College of CUNY
NY Θ	Dec. 04, 1941	Clarkson Univ.
NY I	Jan. 11, 1947	Cooper Union Sch. of Eng'g
NY K	Dec. 13, 1947	Univ. of Rochester
NY Λ	Apr. 15, 1952	Pratt Institute (inactive)
NY M	Apr. 11, 1964	Union College
NY N	Mar. 11, 1967	SUNY at Buffalo
NY Ξ	Mar. 18, 1967	Manhattan College
NY O	Apr. 26, 1970	SUNY at Stony Brook
NY Π	Jan. 23, 1971	Rochester Inst. of Tech.
NY P	May 26, 1974	Polyt. Inst. of New York
NY Σ	Feb. 02, 1991	Alfred Univ.
NY T	Mar. 16, 1991	Binghamton Univ.
NY Y	Feb. 10, 2007	U. S. Military Academy
NC A	Oct. 10, 1925	North Carolina State Univ.
NC B	Nov. 24, 1928	UNC Chapel Hill (inactive)
NC Γ	Jan. 10, 1948	Duke Univ.
NC Δ	Mar. 23, 1979	Univ. of NC at Charlotte
NC E	Feb. 18, 1986	NC A&T State Univ.
NC Z	Mar. 19, 2016	East Carolina Univ.
ND A	Jan. 14, 1950	North Dakota State Univ.
ND B	Apr. 24, 1974	Univ. of North Dakota
OH A	May 19, 1900	Case Western Reserve Univ.
OH B	Nov. 26, 1915	Univ. of Cincinnati
OH Γ	Feb. 12, 1921	Ohio State Univ.
OH Δ	Feb. 21, 1953	Ohio Univ.
OH E	Feb. 22, 1953	Cleveland State Univ.
OH Z	Feb. 20, 1954	Univ. of Toledo
OH H	Feb. 21, 1959	Air Force Inst. of Tech.
OH Θ	Mar. 11, 1961	Univ. of Dayton
OH I	Mar. 31, 1972	Ohio Northern Univ.
OH K	May 21, 1974	Univ. of Akron
OH Λ	May 22, 1974	Youngstown State Univ.
OH M	May 05, 1990	Wright State Univ.
OH N	Mar. 03, 2001	Cedarville Univ.
OH Ξ	Feb. 23, 2008	Miami Univ.
OK A	Apr. 03, 1926	Univ. of Oklahoma
OK B	Feb. 03, 1971	Univ. of Tulsa
OK Γ	Apr. 07, 1974	Oklahoma State Univ.
OR A	Mar. 29, 1924	Oregon State Univ.
OR B	Feb. 13, 1993	Portland State Univ.
OR Γ	Feb. 09, 2002	Univ. of Portland
OR Δ	Apr. 14, 2018	Oregon Inst. of Technology
PA A	Jun. 15, 1885	Lehigh Univ.
PA B	May 04, 1912	Pennsylvania State Univ.
PA Γ	Feb. 19, 1916	Carnegie Mellon Univ.
PA Δ	Apr. 11, 1921	Univ. of Pennsylvania
PA E	May 07, 1921	Lafayette College
PA Z	Nov. 24, 1930	Drexel Univ.
PA H	Dec. 11, 1947	Buckenll Univ.
PA Θ	Feb. 11, 1961	Villanova Univ.
PA I	Mar. 30, 1968	Widener Univ.
PA K	Mar. 20, 1974	Swarthmore College
PA Λ	Mar. 21, 1974	Univ. of Pittsburgh
PA M	Jan. 26, 2013	Penn State Erie, Behrend
PR A	Mar. 08. 1969	Univ. of Puerto Rico
RI A	Feb. 12, 1954	Brown Univ.
RI B	Feb. 13, 1954	Univ. of Rhode Island
SC A	Nov. 23, 1928	Clemson Univ.
SC B	Jan. 11, 1958	Univ. of South Carolina
SC Γ	Mar. 28, 1981	The Citadel
SD A	Apr. 22, 1974	South Dakota School of M&T
SD B	Apr. 23, 1974	South Dakota State Univ.
TN A	Nov. 15, 1929	Univ. of Tennessee
TN B	Dec. 07, 1946	Vanderbilt Uni.
TN Γ	Feb. 03, 1968	Tennessee Tech. Univ.
TN Δ	Mar. 30, 1974	Christian Brothers Univ.
TN E	Apr. 02, 1977	Univ. of Memphis
TN Z	Jan. 06, 1990	Univ. of TN at Chattanooga
TX A	Jun. 10, 1916	Univ. of Texas at Austin
TX B	Dec. 11, 1937	Texas Tech Univ.
TX Γ	Dec. 18, 1940	Rice Univ.
TX Δ	Oct. 11, 1948	Texas A&M Univ.
TX E	Feb. 10, 1962	Univ. of Houston
TX Z	Mar. 16, 1968	Lamar Univ.
TX H	Mar. 22, 1969	Univ. of Texas at Arlington
TX Θ	Mar. 29, 1969	Univ. of Texas at El Paso
TX I	Apr. 02, 1974	Southern Methodist Univ.
TX K	Apr. 03, 1974	Prairie View A&M Univ.
TX Λ	Apr. 04, 1974	Texas A&M Univ.-Kingsville
TX M	Mar. 03, 2002	Univ. of TX at San Antonio
TX N	Mar. 22, 2014	Univ. of TX Rio Grande Vly.
UT A	Dec. 08, 1933	Univ. of Utah
UT B	Apr. 04, 1964	Brigham Young Univ.
UT Γ	May 11, 1974	Utah State Univ.
VT A	Dec. 20, 1958	Univ. of Vermont
VT B	Mar. 13, 1965	Norwich Univ.
VA A	May 28, 1921	Univ. of Virginia
VA B	Nov. 24, 1933	VA Polyt. Inst. St. Univ.
VA Γ	Mar. 17, 1969	Old Dominion Univ.
VA Δ	Feb. 09, 1991	Virginia Military Inst.
VA E	Mar. 01, 2003	Virginia Comlth Univ.
WA A	Jun. 04, 1912	Univ. of Washington
WA B	Mar. 17, 1923	Washington State Univ.
WA Γ	Feb. 12, 1966	Seattle Univ.
WA Δ	Feb. 25, 1995	Gonzaga Univ.
WV A	Jun. 03, 1922	West Virginia Univ.
WV B	Jan. 29, 1972	WV Univ. Inst. of Tech.
WI A	May 05, 1899	Univ. of Wisconsin-Madison
WI B	Dec. 03, 1932	Marquette Univ.
WI Γ	Mar. 17, 1973	Univ. of Wisconsin-Milwaukee
WI Δ	Mar. 10, 1990	Milwaukee School of Eng'g
WI E	Feb. 01, 1992	Univ. of Wisconsin-Platteville
WY A	Apr. 19, 1974	Univ. of Wyoming

Alumni Chapters (78)

• *denotes active chapter*

District 1
- *Central Connecticut, Hartford*
- *Greater Boston Area, MA*

District 2
Buffalo, NY
- *Central Jersey, NJ*

Long Island Suburban, NY
Newark, NJ
- *New York City, NY*
- *New York Capital District, NY*
- *Rochester, NY*

Southern Tier, Binghamton, NY

District 3
Lehigh Valley, Bethlehem, PA
Philadelphia, PA
- *Pittsburgh, PA*

Wilmington, DE

District 4
Baltimore, MD
Hampton Roads, Newport News, VA
Kanawha Valley, Charleston, WV
- *Research Triangle, Durham-Chapel Hill-Raleigh, NC*

Richmond, VA
- *Washington, DC*

District 5
- *Atlanta, GA*
- *Central Florida, Orlando*

Daytona Beach, FL
Gainesville, FL
Miami, FL
Midlands, Columbia, SC
- *Palm Beach/Broward, FL*

Piedmont, Clemson, SC
Puerto Rico
- *Tampa Bay, FL*

District 6
Bluegrass, Lexington-Frankfort, KY
Central Alabama, Birmingham
- *Great Smoky Mountains, Knoxville-Oak Ridge, TN*

Greater Gulf Coast, Mobile, AL
- *Louisville, KY*

Mid-South, Memphis, TN
- *Rocket City, Huntsville, AL*

District 7
- *Ann Arbor Area, MI*

Central Michigan, Lansing
Cincinnati, OH
- *Columbus, OH*
- *Dayton, OH*

Flint, MI
- *Ohio's North Coast, Cleveland*
- *Southeastern Michigan, Detroit*
- *West Michigan, Grand Rapids*

District 8
- *Chicago Area, IL*
- *Central Illinois, Urbana-Champaign*
- *Indianapolis, IN*
- *Milwaukee Area, WI*

District 9
- *Pioneer, OK*

Rolla, MO
- *St. Louis, MO*

District 10
- *Central Texas (Austin/San Antonio)*
- *North Texas (Dallas-Fort Worth)*
- *Greater New Orleans, LA*
- *Texas Gulf Coast, Houston*

District 11
Ames, IA
- *Minnesota, Twin Cities, MN*

District 12
- *Pikes Peak, CO*
- *Front Range, CO/WY*

Salt Lake City, UT
Treasure Valley, Boise, ID

District 13
- *Albuquerque, NM*

El Paso, TX
- *Phoenix, AZ*

Sun City, AZ
- *Tucson, AZ*

District 14
Columbia River Basin, Richland, WA
- *Portland, OR*
- *Puget Sound, Seattle, WA*

District 15
- *Sacramento Valley, CA*
- *San Francisco Bay Area, CA*

San Francisco Peninsula, Palo Alto, CA

District 16
- *Los Angeles, CA*
- *Orange County, CA*
- *Greater San Diego, CA*

Southern California

The Bent of Tau Beta Pi
The Engineering Honor Society

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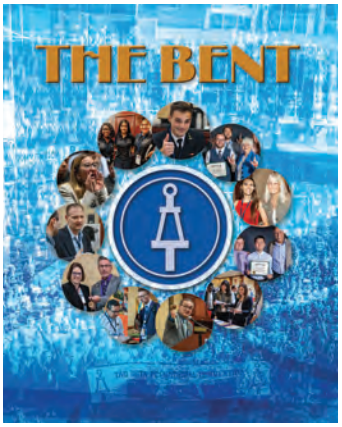

ON THE COVER: Images from the 2019 Convention surround the new (enhanced) Tau Beta Pi logo. Cover artist: Dali Polivka

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Tau Beta Pi was founded at Lehigh University, South Bethlehem, Pennsylvania, June 15, 1885, by Edward H. Williams Jr., A.B., A.C., E.M., Sc.D., LL.D. (1849-1933). Key and name registered in U.S. Patent and Trademark Office. Member, American Society for Engineering Education; co-founder Association of College Honor Societies; and Affiliate, American Association for the Advancement of Science.

Find us on Facebook — The Tau Beta Pi Association

In loving memory of my parents. Special thanks to my wife and daughter, Sue Holl, *CA L '76*, and the entire TBP HQ staff. — Dylan Lane

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Decisions, Decisions...

The remaining semester is diminishing, Convention has come and gone, and now it's time to make decisions.

I have a lifelong friend who likes to say, "Life is all about decisions, make good ones." That sounds straightforward, but the devil is in the details. Of course, that may be his point.

Students often ask me, "should I go to graduate school or go to work?" Unless you are on an academic track, I generally advise "go to work." Let your new company pay for graduate school. From a lifetime earnings standpoint, working pays better. Getting into the workforce can open doors, illuminate opportunities, and establish networks. It is a significant decision that can be remedied should the path taken turn to ashes. Few decisions in life are final. Decide, act, adjust, recommit.

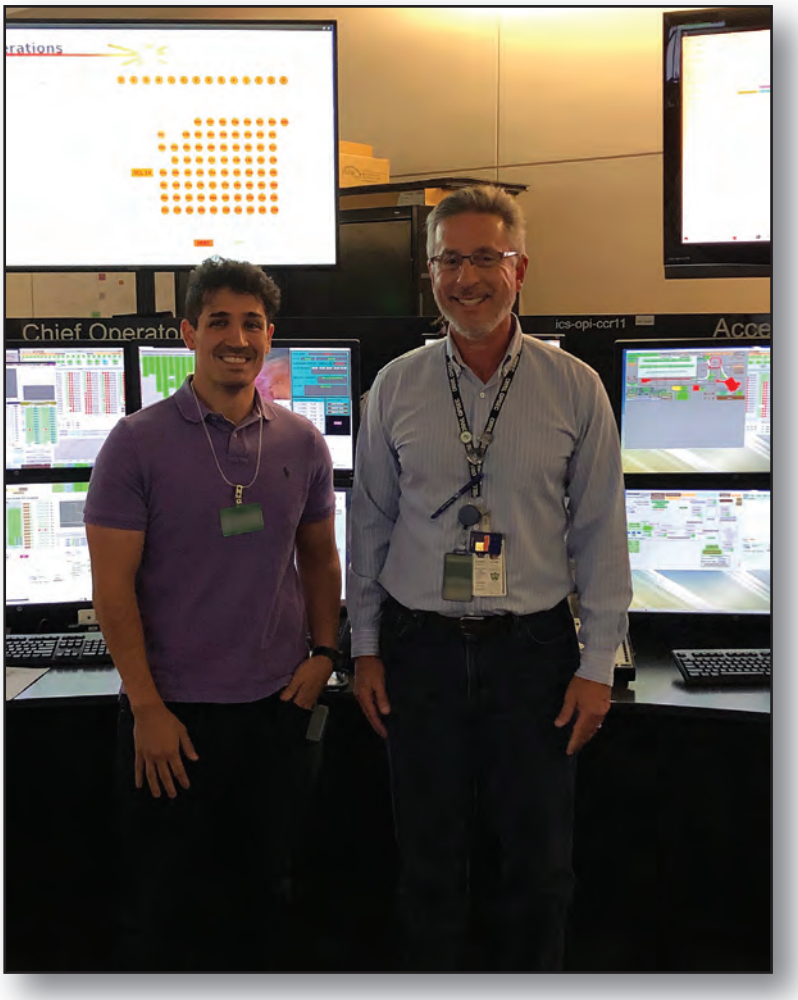
One of my favorite bands, The Clash, say it best in song, "Should I Stay, Or Should I Go?" They go on to say, "If I go, there will be trouble, and if I stay, it will be double." Yes, some decisions are certainly momentous, but many are perfunctory and are made organically, without much thought. Decisions are generally made through a mix of facts and intuition. I have generally regretted those times in my life when I reversed course on my initial decision. There are usually a lot of subconscious elements in play that are hard to perceive, until you ignore your intuition. Then they are all too apparent.

As a former flight instructor, I taught my students that deviating from altitude or course is okay, provided you recognize it and apply an immediate remedy. The atmosphere is a highly variable space; it's going to bounce you around, even on the best of days. Flying is continuous data collection accompanied by constant analysis of options and potential outcomes. "Plan your flight and fly your plan" is an old aviation saying. But, many decisions are made during the course of any flight, beginning with whether to get out of bed that day. Flying is a constant, endless decision process of "should I stay, or should I go?" Sounds like life.

I have also heard that the only bad decision is no decision. All too often, if you don't make a decision, it gets made for you. Some situations are exceedingly complex, and associated decisions are difficult. It is easy to get caught in an endless consider/reconsider loop. This is called "analysis paralysis."

Another form of decision paralysis involves a hyperactive imagination. Therapists counsel to not worry about what hasn't happened, nor about what has happened. It is a trap to endlessly imagine "if this, then that" scenarios. They are literally infinite and squander precious time and emotional energy. Of course, it is easier said than done to "be in the moment." But, considering so many options can lead to unnecessary stress and anxiety.

Networking can play a big role in decision making. Rely on your network to help navigate difficult topics. I'm not encouraging groupthink but socializing your options can often be cathartic.



(Left to Right) Daniel S. Karami, Oklahoma Alpha '19, visiting with Craig Smith, Tennessee Epsilon '80, at the Oak Ridge National Laboratory (ORNL). Craig gave Daniel a tour of the Spallation Neutron Source at ORNL and always enjoys networking with fellow Tau Bates.

Our son graduated from college recently and joined the workforce. Early in his college career, he professed that networking was unfair, even unethical. I coached him that humans are social creatures, many things happen by who you know. Some skills may be in such high demand that positions find you, but generally you must do the heavy lifting to identify them.

I have gotten exactly one job by applying for it, and that was the first one out of college. Every subsequent job came from networking. My most gratifying professional job is the one I have now. I became aware of it because a previous supervisor kept calling me and telling me about an interesting project he was working on. I had a "good job" at the time and resisted for a while. Ultimately, I relented and agreed to meet him for lunch and tour the job site. Wow! It was incredible. I took a risk and quit my "good job" to go work as a contractor and it turned into a career-capping adventure. I've been here so long now that I am one of the "old guys," both figuratively and literally.

Speaking of decisions — I work at a Department of Energy research facility, the Spallation Neutron Source, at Oak Ridge National Laboratory. In the summer, the ORNL population swells by hundreds as summer interns arrive and spend 10-12 weeks in positions across the Lab. I have hosted numerous students over the years, typically as summer interns. Many internships are available across the DOE complex and other governmental agencies, for undergraduates, graduates, and other categories. This program is administered by ORISE, the Oak Ridge Institute for Science and Education (https://orise.orau.gov/). The available positions can be viewed and searched through a system called Zintellect (https://www.zintellect.com/catalog). I encourage everyone to leverage this system to best effect.

In closing, I am unequivocal in my advice for these two questions:

- Should I take the Fundamentals of Engineering (FE) exam? **YES**
- Should I take the Principles and Practice of Engineering (PE) exam? **YES**

I took the FE exam while still in school. Piece of cake. I waited 13 years to take the PE. Not cake.

I achieved my graduate degree 20 years after graduation. I intended to go back immediately but didn't. Life often interferes the longer one waits.

Good luck as you face the coming challenges and decisions. But, you needn't do it alone.

C. Craig Smith, P.E., *Tennessee Epsilon '80*
Current ΤΒΠ Vice President,
Incoming ΤΒΠ President (2020),
Central Cooling Systems Team Leader
UT-Battelle/Oak Ridge National Laboratory

2020 District Conferences

The District Program provides a vital link between the Association and collegiate chapters. Each year the Directors gather with their students at regional conferences to provide both outgoing and incoming officers opportunities to improve chapter operations and to socialize. **Interested alumni are encouraged to attend** but should email *tbp@tbp.org* for details. All chapters are urged to elect new officers before their District Conference.

Location	District	Date
New Haven, CT	1	April 18-19
New Brunswick, NJ	2	Feb. 8-9
Philadelphia, PA	3	Feb. 14-15
Charlotte, NC	4	April 4
Atlanta, GA	5	Mar. 28-29
Oxford, MS	6	Feb. 28-29
Detroit, MI	7	April 4
Champaign, IL	8	Mar. 28-29
Lawrence, KS	9	Feb. 29
Prairie View, TX	10	April 4
Ames, IA	11	April 4
Rapid City, SD	12	Feb. 28-29
Las Cruces, NM	13	Feb. 28-29
Portland, OR	14	Feb. 22-23
San Jose, CA	15	Mar. 21
San Diego, CA	16	Feb. 29

Statement of Ownership, Management & Circulation

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Free distribution by mail (samples, complimentary)	686	688
Total distribution	73,578	73,387
Copies not distributed	324	210
Total	73,901	73,597

I certify that the statements made above are correct and complete.
—Curtis D. Gomulinski, Executive Director

"Everything Old is New Again"

As we move forward into the 20th year of the 3rd millennium, read how Tau Beta Pi is giving a nod to its rich past on which we continue to build and shape a prosperous future. In this first issue of 2020: the new TBΠ logo is revealed; a 50-year old technology gets a fresh look as a modern nuclear energy source; a Convention blends recognition for young and old alike; and the Association's 2020 President serves up advice on making life decisions.

Join us as we look to strengthen our brand by adopting a logo with historical traits. A study by The Wharton School at the University of Pennsylvania recommended using a consistent logo to create a more powerful brand. The 2018 Convention directed discontinuing use of the slanted logo and creation of a new logo reflective of the traditional Bent and Seal. The new logo was approved at the 2019 Convention.

The logo toolkit includes horizontal and vertical versions as well as options for TBΠ chapters to incorporate their name.

The simpler outline will make it easier to print on insignia (shirts, hats, etc.) and will allow for a uniform logo across all platforms.

Check out the two logos on this page and visit our website to download images for use (www.tbp.org/?graphics). Please read the full revised Insignia Replica Policy before using the logos.

The new 'horizontal' logo.

Tau Beta Pi
The Engineering Honor Society

The new 'vertical' logo.

Tau Beta Pi
The Engineering Honor Society

The 1999 slanted logo will no longer be used.

Tau Beta Pi
The Engineering Honor Society

The bottom image, taken at the 2019 Convention, shows the group of 22 pioneering women who were individually recognized as part of the celebration of the 50th anniversary of women having full TBΠ membership. Attendees were delighted to honor and meet these extraordinary engineers. See bios here. Read the three part series (Women in TBΠ) beginning with the Winter 2019 issue. These articles, and all features since 1995, can be found at www.tbp.org/?features.

And finally, see the back cover for info on a new discount partnership with Dell.

Thank you for reading and we encourage you to provide your feedback at tbp@tbp.org to help advance ***YOUR*** honor society and this magazine.

> **"Learn from yesterday,
> Live for today,
> Hope for tomorrow.
> The important thing is not to stop questioning."**
> **—Albert Einstein.**

Dylan Lane
Assistant Editor

Patricia McDaniel
Managing Editor

The 22 women honored at Convention as early members and Women's Badge recipients. Image by Kiffer Creveling, UT A '13.

(Image left to right) Front row: Maggie Irizarry, Lois Schine, Veronica Wyrwas, Linda Farrell, Elizabeth Schott, Nancy Gray, Marguerit Hrabak, Candace Woessner, Evelyn Kinzel, and Katharine Padulo. Back row: Amy Eliasoff, Linda Milholen, Margaret Domeny, Sandy Fryer, Diane Kewley-Port, Ellen Nobles-Harris, Irene Sharpe, Lynne Bergbreiter, Ruth Guydosh, Karen Spindel, Linda Wunder-Freet, and Margaret Skujins.

Scott A. Ashford, Ph.D., *Oregon Alpha '83*, has been named a 2019 Rodney D. Chipp Memorial Award recipient by the Society of Women Engineers. He was cited for work in promoting women in engineering fields as dean of the College of Engineering at Oregon State University. The number of women among the college's tenured or tenure-track faculty has more than doubled since 2014.

Jonathan F. Sauder, Ph.D., *Illinois Delta '09*, was recognized with a Presidential Early Career Award for Scientists and Engineers, the highest honor given by the U.S. government for beginning research careers. A senior mechatronics engineer at NASA JPL, Sauder was nominated for his leadership role in work on RainCube (the first radar in a CubeSat), and on the Venus Rover.

David A. Dzombak, Ph.D., P.E., *Pennsylvania Gamma '79*, was selected for inclusion in the ASCE 2019 class of Distinguished Members. He is a professor and head of the department of civil and environmental engineering at Carnegie Mellon University. Prominent in the area of water quality engineering, he also led the development of a Ph.D. fellowship program in U.S. Environmental Sustainability.

Mark T. Swihart, Ph.D., *Texas Gamma '92*, has been elected a fellow of the American Institute of Chemical Engineers (AIChE). He is a distinguished professor and chair of the department of chemical and biological engineering at the University at Buffalo. He was recognized for "modeling and experimentation to develop fundamental understanding of particle nucleation and growth."

Mark A. Hertel, P.E., *New Hampshire Alpha '72*, received the ASHRAE Distinguished Service Award for 25 years of dedication. He is executive vice president at Inter-Island Solar Supply in Hawaii. He was recognized for activities, including participating in 3 ASHRAE Handbook Cycles simplifying the sizing of solar and for participating in ISO Committees for ASHRAE Solar Standards.

Jill S. Tietjen, P.E., *Virginia Alpha '76*, was inducted into the inaugural Colorado Authors' Hall of Fame 2019 class. She was cited for "ensuring that women are reflected in the historical narrative of the U.S. as evidenced by her nine books and 200-plus articles." She is a pioneer for STEAM, a speaker, and conducted research into historical women around the world for the past 30 years.

Diane Kewley-Port, Ph.D., *Michigan Gamma '64*, is President-Elect of the Acoustical Society of America (ASA). She will begin her term as president June 2020. She is Professor Emeritus of speech and hearing sciences at Indiana University and was honored as Distinguished Woman of the ASA in 2014.

Paul R. Weckler, Ph.D., P.E., *California Mu '82*, received the 2019 Massey-Ferguson Educational Gold Medal from ASABE. The award is for dedication in teaching and student development through academic and culturally diverse learning. He is a professor of biosystems and agricultural engineering at Oklahoma State University.

A New Look at Molten Salt Reactors

By: **Louis Qualls,** Ph.D.

What if you could deliver a source of clean, abundant energy that produces little waste and could be a driver for major societal change? What if that energy source is adaptable—built on a small scale for isolated communities, on a large scale for grid-scale electrical production, or perhaps for heat production to support industry? America demonstrated that technology over 50 years ago and today molten salt reactors are getting a fresh look as a modern source of clean energy.

For most Americans, it is difficult to imagine the need for energy, clean air, or clean water. However, in many parts of the world, people have little energy available to them, and in many others, the air and water are polluted. Energy is a driving force behind modern living and the need for energy is growing. **Figure 1** shows the consumption of energy in the United States over the course of its history by resource [1]. The United States benefits from a diverse set of energy sources but remains predominantly reliant on fossil fuels for electricity and transportation, while emission-free energy sources such as nuclear and renewables provide smaller but significant amounts. The transportation sector is powered mostly by petroleum, which is the largest single source of energy consumed. The U.S., and other developed nations, are looking beyond fossil fuels. Emerging nations want to expand their energy consumption. New clean energy options are needed.

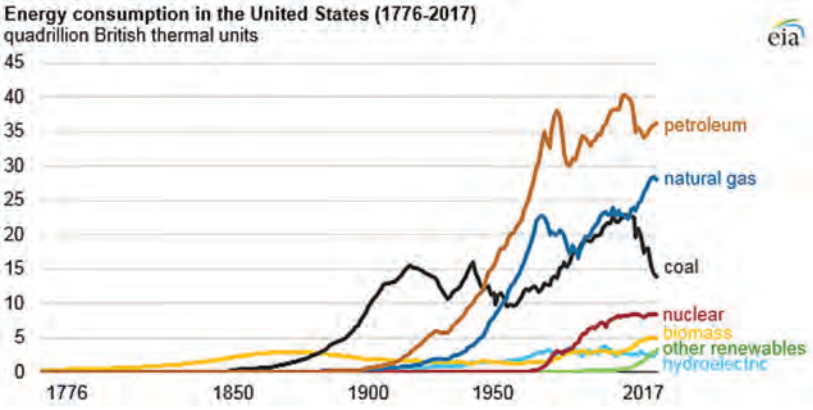

Figure 1: Energy consumed in the United States. Source: U.S. Energy Information Administration (July 2018).

When I began studying nuclear engineering in 1982, I had it in my mind that the concepts of nuclear physics and engineering were old and settled science. They were not. Einstein published his famous equation in 1905. It was a mathematical novelty of mass and energy equivalence, but at the time, no one understood that mass could actually be converted into energy for useful purposes. The atom was thought to be indestructible. The great nuclear experimentalist Ernest Rutherford, who discovered the nucleus but could not break it, is quoted as saying, "*The energy produced by the breaking down of the atom is a very poor kind of thing. Anyone who expects a source of power from transformation of these atoms is talking moonshine.*" The accuracy of that statement is disputed, but the implication was clear; based on what we knew then, nuclear disintegration would not amount to a useful energy source. That sentiment was reported in September 1933.

Enrico Fermi produced fission in laboratory experiments in 1934, but not until Lise Meitner and her nephew Otto Robert Frisch worked it out during a winter hike in 1938 did we understand that the ~1/5 of a proton mass lost during a uranium fission was the physical embodiment of Einstein's relationship [3]. The conversion of a small amount of mass results in an incredible amount of released energy. The possibility of establishing chain fission reactions was soon postulated, and the first successful demonstration of self-sustaining nuclear fission was performed at the University of Chicago in 1942. The Chicago Pile demonstrated that it was possible to get controlled, sustained energy from a properly designed reactor. From that demonstration, the first reactor designed for continuous operation was constructed at what is now the Oak Ridge National Laboratory (ORNL) in East Tennessee. The X-10 Graphite Reactor Experiment, shown in **Figure 2**, took only nine months to build and became operational in November 1943. It was a solid fuel reactor into which individual fuel pellets were loaded into ~1260 channels running horizontally through a fixed graphite matrix. The graphite held the fuel in place and provided the neutron moderation, the slowing of neutrons to increase their likelihood of producing a fission, as part of what is called a thermal neutron spectrum. Neutron moderation is needed for criticality in this design.

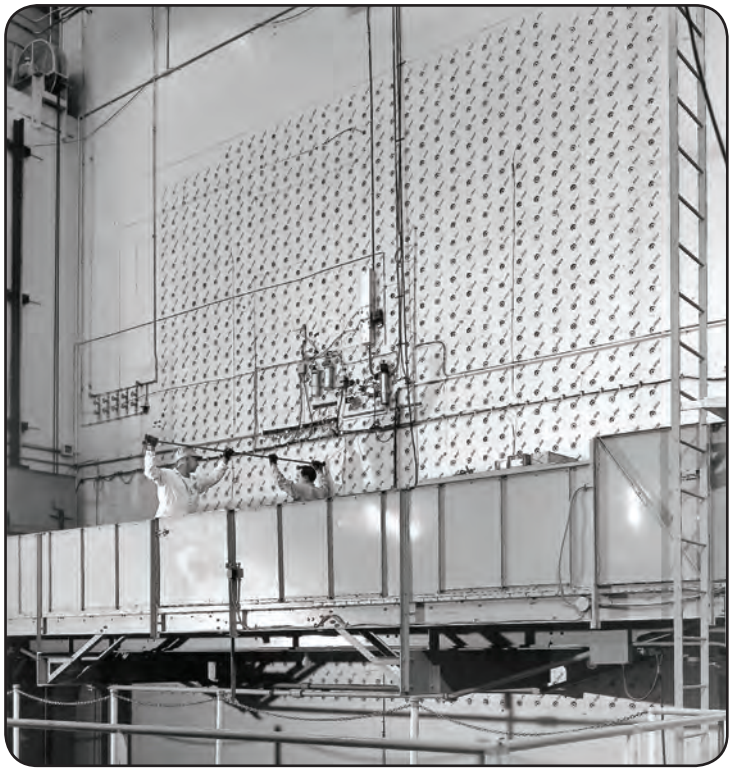

Figure 2: Workers using long rods to load fuel into the front face of the X-10 Graphite Reactor. (ORNL historical photo).

The reactor operated at a maximum power level of approximately 4-MW and air was pulled into the front of the channels to cool the fuel and graphite. In over 20 years of operation, the basic principles of reactor physics were confirmed, and the first production of usable quantities of medical isotopes and transuranic materials occurred. The Graphite Reactor operated until 1963. Today, it is a National Historic Landmark you can tour if you visit ORNL.

During the X-10 Reactor's operational life, hundreds of reactor concepts of various shapes and sizes were conceived and dozens were constructed and operated. One of those concepts was the ***molten salt reactor*** (MSR) and approximately 60 variants of them were considered to one degree or another within the United States alone.

A ***salt reactor*** is any reactor that uses molten salt within the core to a significant degree as a fuel carrier or coolant. Concepts that use solid fuels are typically cooled by fluoride-based salts and are referred to as ***fluoride high-temperature reactors*** (FHRs). Concepts that include fueled liquid salts as part of the primary system fluid are generally referred to as ***molten salt reactors.*** MSRs were the subject of a great deal of concentrated research beginning in the 1940s and extending into the 1970s. The pioneers of the technology, R.C. Briant and Alvin Weinberg, described the potential for the concept in 1957 [2]. By this time, a high-temperature molten salt reactor, the Aircraft Reactor Experiment (ARE), had already been demonstrated and projections of sound economic performance were already being made. By 1960, enough was known to begin building and operating MSRs to evaluate their potential for commercial operation. The first of these reactors, the Molten Salt Reactor Experiment (MSRE), began critical operations in 1965.

The Molten Salt Reactor Experiment

ORNL began discussing the use of molten salts as a reactor fuel and coolant around 1950. The basic MSR features are shown in **Figure 3**. As the liquid fuel enters the reactor vessel, it assumes a critical configuration and the salt is heated by fission. A pump moves the salt through a heat exchanger and the heat is transferred to and removed by a second heat transfer loop to be used as a heat source or converted to electricity. In this example, the salt can be transferred to a drain tank for processing or safe storage as needed, but not all concepts utilize drain tanks. Because the boiling temperatures of salts are very high, MSRs operate at a low pressure and have a wide temperature margin to coolant boiling. This allows for the use of thinner-walled components and reduces the chances of over-pressure events.

ORNL successfully demonstrated the key features of operational stability, reliability, and flexibility in the mid to late 1960s with the MSRE, shown in **Figure 4**. The reactor vessel, pump, and heat exchanger can be seen on one level in addition to a series of salt drain tanks below. The MSRE operated at approximately 7.4-MW, but it is physically much smaller than the X-10 Reactor, as can be seen in **Figure 5**, which shows the reactor vessel prior to installation. As the fueled salt enters the vessel, it flows into and through vertical coolant channels in the internal core structure, shown in **Figure 6**. The core structure is also the graphite moderator necessary for criticality in this design. If the salt is not in the vessel, it will not be in a critical configuration. In the MSRE, the salt is passed through a single heat exchanger by a single pump and heat is removed and dissipated by a second heat transport system. Larger MSR concepts use multiple pumps and heat exchangers, but overall, MSRs are simple devices.

Currently, three predominant salt reactor technology options are under consideration for early commercial deployment:

(1) liquid-fueled fluoride-salt thermal-spectrum systems derived directly from the MSRE experience,

(2) fluoride-salt high-temperature reactor (FHR) concepts using MSRE-derived salts to cool a solid fuel form, and

(3) liquid-fueled chloride-salt fast-spectrum reactors.

Each option follows from the historic MSR program, but differ in salt and material selections, neutron energy spectrums, and business strategies. The fast spectrum reactor concepts do not use internal core structure for neutron moderation and can have very high power densities. Both thermal and fast MSRs can consume long-lived wastes that would otherwise require disposal and they can extend the available energy of nuclear fuels through breeding. An excellent review of fast spectrum molten salt reactor options is available [4].

Elevation View of Reactor and Fuel Drain Cells

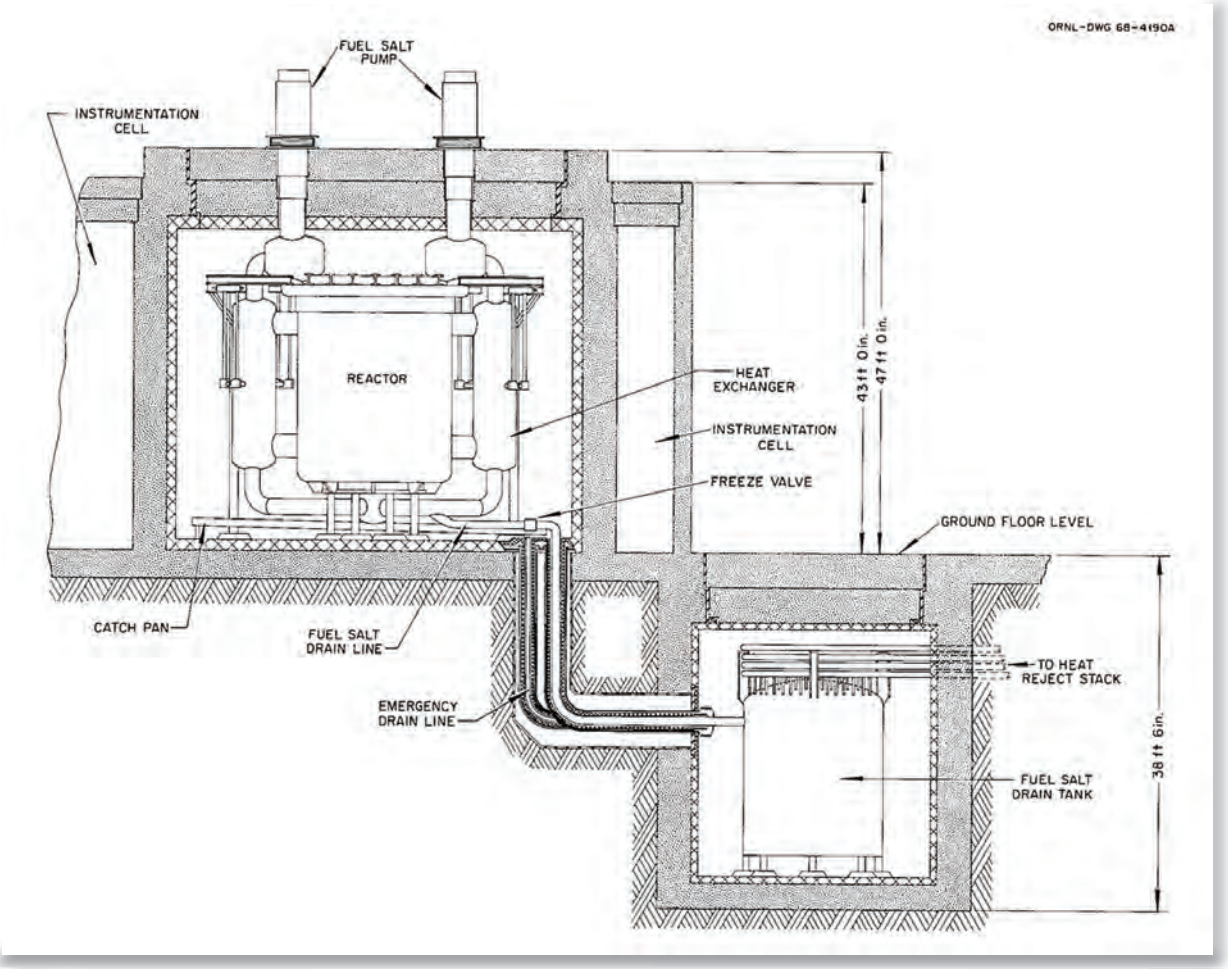

Figure 3: Simplified Molten Salt Reactor system featuring a reactor vessel, pumps, heat exchangers, and drain tank. (ORNL-DWG-68-4190a)

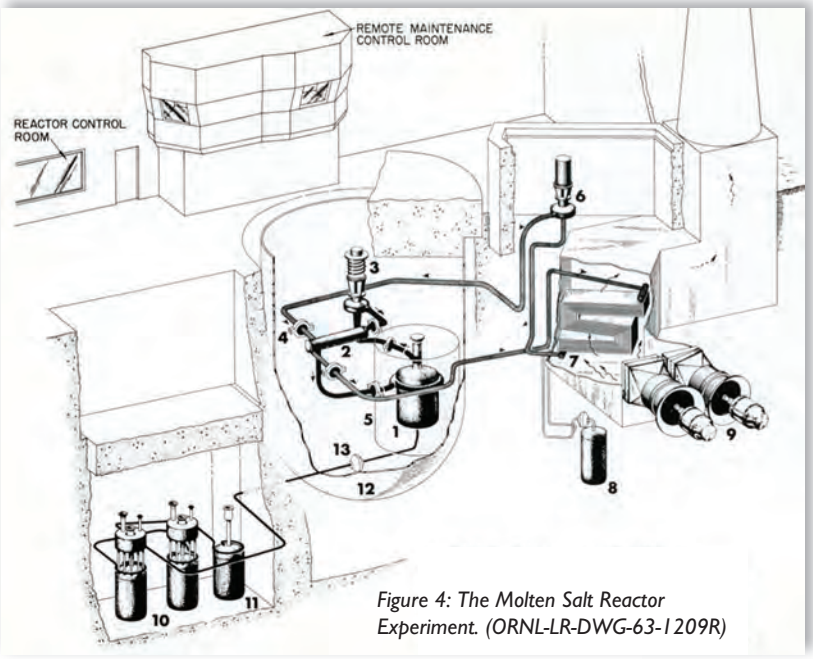

Figure 4: The Molten Salt Reactor Experiment. (ORNL-LR-DWG-63-1209R)

FIGURE 4 KEY

1. Reactor Vessel
2. Heat Exchanger
3. Fuel Pump
4. Freeze Flange
5. Thermal Shield
6. Coolant Pump
7. Radiator
8. Coolant Drain Tank
9. Fans
10. Drain Tanks
11. Flush Tank
12. Containment Vessel
13. Freeze Valve

MSRE's success was built on a substantial foundation of scientific and engineering effort pursued at scale for 15 years prior to initial operation. The extensive science and technology achievements are captured in some one-thousand technical reports. Successful reactors were built and operated in just a few years and with modest funding. Material combinations worked well enough for short-term demonstrations, and salt-handling processes proved adequate for protecting personnel, equipment, and the environment.

MSRE had over 13,000 hours of full-power reactor operation, and in one operational run it operated for six months without interruption—quite remarkable for a first-of-a-kind reactor demonstration. The MSRE was the first in a series of four reactors that were planned to achieve commercial deployment:

1. The **Molten Salt Reactor Experiment** (MSRE) was a 10-MW proof of concept reactor with limited fuel processing.
2. The **Molten Salt Demonstration Reactor** (MSDR) was to be a larger (750-MW) reactor concept to show that the operation observed in the MSRE scaled up to representative commercial reactors, but without the added complexity of significant fuel processing.
3. The **Molten Salt Breeder Experiment** (MSBE) was a 150-MW concept that was to demonstrate the full suite of fuel processing needed to operate a closed uranium–thorium fuel cycle in a molten salt reactor.
4. The **Molten Salt Breeder Reactor** (MSBR) was envisioned as a commercial prototype in which the full capability demonstrated in the MSDR and the MSBE were brought together into a single system.

Progress toward salt reactor commercialization is again occurring. Developers are maturing their designs, developing and demonstrating technology, and gathering data needed for licensing. Because of their attractive safety features and by using modern design and modeling tools, it is anticipated that new plants can be modeled with sufficient accuracy to directly support licensing and operation of commercial prototype plants, helping to significantly reduce both the time and cost to market.

Why MSRs and why now?

The direction chosen for the nuclear industry in the late 1950s led to the development of light water reactors (LWRs) for commercial deployment. The sodium fast reactor system was intended to work in concert with LWRs to close the fuel cycle and to increase utilization of what was then thought to be a much smaller supply of uranium. Over one hundred commercial LWRs were constructed and operated in the United States, and they have provided safe, reliable, clean electricity for decades. Worldwide, 400-450 commercial reactors have been operational at any one time since the mid-1980s. However, projected increases in electricity demand in the 1960s and 1970s largely did not materialize and significantly more uranium resources were discovered. Fewer LWRs were built than planned and commercial fast reactors were not extensively deployed. Commercial nuclear power is still in its early phases and its potential has yet to be fully realized.

It is challenging for existing reactors to compete in today's U.S. energy market. Natural gas prices are historically low and renewable energy options are often subsidized through clean energy production credits. The market does not currently monetize the reliability, stability, and reduced emissions of nuclear plants. Cost is certainly an important metric for a robust energy strategy, but it is not the only one. Diversity, availability, environmental impact, and the ability to achieve energy independence are also important national considerations. Nuclear energy in general can help with all of these issues and MSRs can potentially offer improved economic performance.

The higher temperatures of salt reactors allow for improved power conversion efficiencies and the lower pressures can help reduce the cost of reactor components. Emerging advanced manufacturing methods, plant standardization (for a given developer), the use of factory construction methods, and plant automation may also be important parts of successful economic performance. Salt reactors are also fueled during operation, which allows them to be online a higher percentage of the time. Online fueling also limits the amount of fuel in the system to only that needed, which reduces the number of possible accident scenarios and their potential consequences. As a simple system that operates at low pressures with a limited fuel inventory, salt reactors are attractive from both a safety and economic perspective. Salt reactors can be large, like current LWRs, or they can be small and modular. They can use a range of fuels, even within the same design, and they can be used to consume fuels discharged from other reactors. They can also operate as breeders, allowing for increased resource utilization. Salt reactors have the flexibility to adapt to many aspects of a modern energy market.

The need for more clean energy

The modern world requires electricity. As societies increase their levels of electrification (think cars, computers, automation, and communications), and as developing countries look to replace existing fossil-based systems with cleaner energy options, new energy options are needed. Approximately 450 commercial reactors produce approximately 10 percent of the world's electricity and about 1/3 of the low-carbon electricity. Coal and natural gas currently supply approximately 60 percent of the world's electricity. Renewables such as hydro, solar, biomass, and wind produce approximately 23 percent of the total electricity [5]. Solar power and other renewables

have come a long way and they continue to make excellent progress, but today, we cannot run energy-intensive economies on renewable energy alone. To maintain the current level of clean energy production, we will eventually need to replace the existing reactor fleet. To expand clean energy production to the point of replacing fossil fuels, we would have to increase generation many times over its current capacity. The key to success will be to identify and develop the best technologies and to use them together. It will be most effective to combine the foundational base of clean nuclear energy with the opportunistic clean energy of renewables, and we are working to do just that within the integrated energy programs sponsored by the U.S. Department of Energy [6]. Working together, we can get there.

The next phase of nuclear power

The MSR Program was officially terminated in 1976. There simply did not seem to be a need for another nuclear reactor technology at that time. I studied nuclear engineering at the University of Tennessee, about 30 miles from ORNL. Dr. Tom Kerlin, *South Carolina Beta '58*, was one of my professors. He worked with Syd Ball on the MSRE and they published papers about its stability and control that are still used today [7]. I learned about MSRs as a student and later as a colleague to people like Syd and Uri Gat at ORNL. New interest arose in FHRs and MSRs through the efforts of national laboratory and university programs led by new champions such as David Williams, Charles Forsberg, Per Peterson, *Nevada Alpha '82*, and David Holcomb, and by independent efforts from others, such as Kirk Sorenson, and David LeBlanc, who gave an excellent technical review of the technology in 2010 that I encourage you to read [8]. Through these initial efforts, and now with the combined efforts of hundreds of others around the world, we are working on a second opportunity to develop MSRs.

A major difference in the new MSR development effort is that industry is leading the way. Worldwide, more than ten private companies have active MSR or FHR designs under development using private investment. The first demonstration salt reactors since the MSRE are expected in the U.S. within five years, and commercial plants are planned before the 2030s, in time to help replace the clean energy lost as the existing fleet begins to age out. Another significant difference is that the pressing need for abundant clean energy is more widely recognized.

Figure 5: The MSRE pressure vessel prior to installation. (ORNL photo 71114)

Clean energy means more than just having clean air and water. It means the possibility of a stable, sustainable future for everyone. It seems unlikely that society can expand, modernize, reduce poverty, and be sustained without the clean energy that can be provided by fission and (someday) fusion energy. The nuclear industry continues to maintain its impressive safety record, address waste concerns, and be vigilant about weapons proliferation. It is also working to becoming more innovative, cost competitive, and flexible. MSRs are promising candidates to address these issues and emerge as a new clean energy option.

MSRs are demonstrated technology, they are flexible in design and purpose, they can be used to help close the nuclear fuel cycle, and they allow for effective utilization of the vast uranium and thorium resources. They may also significantly improve nuclear energy economics. Yes, they are a little different; but it's time to try something new (even if it's old).

Louis Qualls, Ph.D., is the national technical director for molten salt reactors for the U.S. Department of Energy's Office of Nuclear Energy and also serves as the reactor technology integration lead for the Oak Ridge National Laboratory Reactor and Nuclear Systems Division. In these roles, he works with the DOE to support industry efforts to develop and deploy commercial molten salt reactors. Lou has been a researcher at ORNL since 1988, working on a wide range of nuclear projects, including fusion energy, nuclear space power systems, and advanced fission reactor concepts. He holds a Ph.D. in nuclear engineering from the University of Tennessee, Knoxville.

Figure 6: The MSRE core internal structure, assembled from individual extruded graphite components to form coolant channels on the perimeter of each piece. (ORNL Photo 70797)

From the Editors: Tau Beta Pi does not advocate the use of one energy source over another. Information in the article is attributed to the author and the references provided below.

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President Paugh Reports to Convention

State of the Association

WE ARE GATHERED HERE in Columbus, Ohio, for Tau Beta Pi's 114th Convention — and nearly 135 years since our founding. We are proud to have sustained the organization for so long. But, we are still growing. I am confident our tomorrows will be even brighter than our yesterdays.

I want to take the opportunity to thank our District 7 hosts: Ohio Gamma, Ohio Delta, and Ohio Iota. Hosting a Convention is a great opportunity — but it comes with a lot of work and responsibility. So, thank you!

Although this is my first time in Columbus, it is not my first time in the great state of Ohio. When I served in the United States Patent and Trademark Office, each year I attended the National Inventors Hall of Fame gala in Akron to induct new members.

Which got me thinking—back in 2003, I traveled to Kitty Hawk, North Carolina, to mark the Centennial celebration of Orville and Wilbur Wright's first flight and Hall of Fame inventors themselves. It's been over 115 years since that world-shaking Kitty Hawk success. North Carolina — known for years as 'First in Flight.'

Ohio has always been the birthplace of aviation. The Wright Brothers were born in Dayton, Ohio. Columbus has the John Glenn airport — the first American to orbit the Earth. And, this year we mark 50 years since we traveled to the moon. Neil Armstrong was born in Wapakoneta, Ohio, about 60 miles north of Dayton.

Think about it. From 1903 to 1969, just over six and a half decades from first flight to lunar landing. It still boggles the mind. In one life, an American could have started with a horse and carriage and ended as a witness to a moon walk.

A 1969 article in *The Bent* featured 14 Tau Bates who worked on the historic Apollo 11 mission. These were the brilliant engineers who Neil Armstrong often marveled at when contemplating their contributions. I knew Neil Armstrong. He spent a lifetime deflecting what he thought was underserved praise and attempting to credit the work of others. These were the engineers who made it possible to make history — and to return safely to Earth. These were your colleagues.

Since our founding at Lehigh University in 1885, we have come a long way. Over 602,000 members; 248 active collegiate chapters; 45 active alumni chapters; nearly 20 members having served in the U.S. Congress; over 20 Nobel Prize recipients; and over 60 members in the National Inventors Hall of Fame. It's why I remain proud to have had the opportunity to serve this Association.

As president, my role has been to relentlessly pursue our mission, engage in strategic planning, bolster financial resources, strengthen our programs and services, help recruit members to serve the organization, enhance our public image, and empower and motivate the Executive Council to set goals and pursue them. With nine talented and dedicated members on the Council, each has taken a leadership role through our committee structure. For 362 days each year, we are the governing board. We also serve as community ambassadors for Tau Beta Pi.

For me, in some ways it is hard to comprehend a lawyer leading the most prestigious engineering honor society on the face of the planet. But, my engineering roots remained in the forefront of my mind throughout my service on the Executive Council. That being said, I did find sometimes that being a lawyer helped to conduct business on the Council!

Business of the Association

Let me touch on a few things that occurred during the course of the year and help fulfill my obligations under the Bylaws.

There were no new collegiate chapters installed during the year; however, the 113th Convention in Denver, Colorado, reactivated Colorado Gamma at the University of Denver. This is a short drive from where I live in District 12. I have had the opportunity to stay in touch with Professor Matthew Gordon and offer my assistance — and perhaps serve as a guest speaker for an upcoming initiation. Tau Beta Pi is flourishing again on campus!

One alumni chapter was reactivated: right here in Columbus, in plenty of time for the Convention.

Additionally, the Executive Council visited the University of Texas at Dallas and the University of Arkansas at Little Rock. Petitions for each school will be considered by the 2019 Convention.

Also, one petition for a new chapter was received and an inspection team will visit the local engineering society at the Georgia Southern University.

Overall, chapters initiated 8,613 new members in last fiscal year, which included 39 alumni and 36 eminent engineers. Of note, this number was down nearly 8 percent from last year so there is work to do.

Despite the decrease, I am pleased to report that we remain the largest engineering honor society in the world. As of July 31, 2019, the Association has initiated 602,043 members.

During the year, three members resigned from the Association. No one was expelled and no member was disciplined. Colorado Beta did contact the Council, however, to raise an issue regarding expulsion of a member. Over the last year, the Executive Council has been working on re-writing our Association discipline policy and procedure. This policy was formally adopted in June 2019.

Consistent with the Eligibility Code adopted by the 1926 Convention, "[d]istinguished scholarship, while the primary requisite for admission, must not be considered the sole criterion." To be sure, "[a]fter the scholastic requirements have been fulfilled, the selection shall be based on integrity, breadth of interest both inside and outside of engineering, adaptability and unselfish activity." Included under integrity are high standards of truth and justice and personal character beyond reproach. The formalized policy remains true to these directives while also adhering to fundamental fairness and due process requirements.

During the calendar year, the Executive Council met in person three times in an effort to balance costs with doing the good work of the Association. We also brought back monthly meetings this year. Overall, the Executive Council met each month of the year, by WebEx or in person, to ensure we were able to tackle the business of the Association in a timely manner.

Programs and Celebrations

Turning to programs and celebrations, the 50th Anniversary of the lunar landing is not the only 50-year mark worthy of mention. Also, this is the 50th Anniversary for initiating women into Tau Beta Pi. Back in 1969, we initiated 155 women into our Association. And, we are thrilled that over 20 of them have joined us for the 2019 Convention!

A number of chapters are recognizing 50 years as well.

- Puerto Rico Alpha – University of Puerto Rico
- Mississippi Beta – University of Mississippi
- Texas Eta – University of Texas at Arlington
- Texas Theta – University of Texas at El Paso
- California Lambda – University of California, Davis

Another important milestone this year is the 30th Anniversary of the Engineering Futures Program. In recent years, this program has achieved more impact in the engineering community, expanded its subject matter, and greatly increased its cost effectiveness. We are reaching more students with less expense to the Association. Engineering Futures remains the crown jewel of our professional development efforts.

Specifically, a total of 149 training sessions reached nearly 3,500 individuals. A total of 37 Engineering Futures Facilitators presented these sessions to help improve the leadership skills of students and prepare them for their careers.

In the renowned MindSet Program, there were almost 30 chapters that hosted hands-on activity sessions at local schools. We have reached nearly 10,000 K through 12 students.

Scholarships. 289 scholarships were awarded, an increase over last year. In fact, this is our high mark in the history of Tau Beta Pi. Over the last decade, we are generally trending up each year. There was also an increase in the number of chapters receiving scholarships for the first time. Now, we have Tau Bates who have received scholarships in all but three of our chapters. On a personal note, 4 of the top 6 chapters receiving scholarships reside within my home district — District 12. Coincidence?

Fellowships. The 86th Fellowship group included a whopping 36 students and each award totaled $10,000.

113th Convention. A follow up from last year's Convention. The Council has addressed all the directives, including some items that have carried over to 2019. To name a few, an *ad hoc* Website Committee has been chartered for this Convention. Follow up changes and proposals were pursued with our Trust Advisory Committee. Also, the Council worked hard on developing a new logo and seal for the Association.

Strategic Plan

When I served on Capitol Hill almost 20 years ago, starting as a Congressional Science and Engineering Fellow, I used to spend time in the House Science Committee hearing room. There are two prominent quotes on the wall of the hearing room. One was from the Proverbs, Chapter 29, Verse 18: "Where there is no vision, the People Perish!"

I often paused and pondered the messages when I entered the spacious room. I have also pondered this statement in my service to Tau Beta Pi. If we cannot articulate a vision paired with a plan of action to inspire and achieve, then our organization cannot maximize its potential as an organization. This is the foundation for our Strategic Plan, which continues to feature five broad goals.

- Optimize the organizational structure and develop operational processes
- Enhance the image, visibility, and branding of TBΠ
- Improve chapter support and operations
- Provide leadership and professional development training to members
- Strengthen the finances and fundraising of TBΠ

The Strategic Plan has remained the road map the Council has used to prioritize our time and funds in achieving the goals of the Association. We are simultaneously serving as stewards of the Association and as entrepreneurs, constantly seeking new ways to achieve more.

In that vein, the Council also recognizes the Strategic Plan is just that: a plan. As heavyweight champion boxer Mike Tyson observed, "Everyone has a plan until they get hit in the face." So, we have remained flexible and adaptable to emerging issues.

While we have made progress on all the overarching goals, I want to take this opportunity to highlight a few items to the Convention. You will also have the chance to hear reports from the Executive Director and other officers.

President's report continues on page 35.

Newly Elected Executive Councillors

From a field of six candidates, the 2019 Convention delegates elected one new member to the Executive Council and re-elected two retiring members to fill the vacancies of three members whose terms expire on December 31, 2019. They will serve the 2020-22 term and join six members elected in 2016 or 2017 who are serving terms that end in 2020, 2021, or 2022. The Executive Council comprises nine Tau Beta Pi alumni who serve staggered terms of three years.

The members of the Council are Scott E. Fable, *California Tau '96*; Stephan L. King-Monroe, *Michigan Epsilon '08*; George J. Morales, Ph.D., *Florida Epsilon '06*; Michael L. Peterson, *Iowa Alpha '89*, **who was elected**; C. Craig Smith, P.E., *Tennessee Epsilon '80*, George Youssef, *New Jersey Gamma '01*, **who was re-elected**; and Mennatoallah M. Youssef, Ph.D., *Virginia Gamma '04*, **who was re-elected**.

The candidates who were not elected are Justin M. Glasgow, MD, Ph.D., *Iowa Beta '05;* Matthew T. Pittard, *Utah Beta '01;* and Joan M. Sciacca, *California Mu '87.*

The new Executive Council have met and elected officers for the upcoming year from among the Council members and will serve for a period of one year. After serving as vice president for one year, the vice president automatically becomes the president the following year. The officers for 2020 include: President Craig Smith, Vice President George Morales, Secretary Rachel Alexander, and Treasurer Scott Fable. Executive Director Curtis Gomulinski serves as a non-voting member of the Council.

(Left to right) George Youssef, Michael Peterson, and Mennatoallah Youssef.

Michael L. Peterson, *IA A '89*, was nominated by the Michigan Gamma Chapter. Mike earned a degree in electrical engineering from Iowa State University, where he was chapter president, overseeing the 1988 ΤΒΠ Convention and founding of the Iowa State PrISUm solar car team; his chapter also earned the R.C. Matthews Outstanding Chapter award in 1989. Mike served ΤΒΠ as a District 7 Director for 2 years and as an Engineering Futures Facilitator for 24 years. His career at General Motors included a variety of manufacturing engineering and corporate strategy/planning positions, as both a technical expert and manager until his retirement at the end of 2018. Early in his career, he took a break to earn a master's degree in mechanical engineering and management from MIT. Mike plans to support the refinement of the Council's Strategic Plan. He has a particular interest in strengthening Association programs for professional development of its members and ensuring the organization has a strong financial base to support its programs and success for years to come. Mike has been married for 25 years to his wife Michelle and is part of a 3-generation ΤΒΠ family. His father was a Sigma Tau member and his two sons, both recent graduates of the University of Michigan, are members of ΤΒΠ. His daughter recently graduated high school and is looking forward to pursuing engineering in college.

George Youssef, *NJ Γ '01*, was nominated by the Tampa Bay Alumni Chapter and first became an Executive Councillor in January 2017. He is a graduate of the New Jersey Institute of Technology (NJIT) where he earned a B.S. degree in electrical engineering, cum laude. George joined the General Electric company field engineer program in 2002 working on gas turbines around the globe. He has served in a number of positions including field engineer, training manager, and senior customer service leader in areas ranging from New Jersey and Georgia, to Dubai in the United Arab Emirates. While at NJIT, he served as ΤΒΠ chapter president. George was a District 2 Director from 2009-16 covering the six chapters in New Jersey.

Mennatoallah M. Youssef, Ph.D., *VA Γ '04*, was nominated by the Washington, DC, Alumni Chapter and first became an Executive Councillor in January 2017. She is a graduate of Old Dominion University, where she earned a bachelor of science *magna cum laude* and an M.S., both in electrical engineering. She then attended the University of Dayton, completing her Ph.D. in 2011 focusing her research on computer vision applications. She interned for NATO working on passive radar scenario testing. In 2014, she joined the U.S. Patent and Trademark Office as a patent examiner in the image analysis workgroup. She served as a ΤΒΠ chapter president and as an advisor to VA Gamma.

Columbus Hosts 114th Convention

The 114th Convention of Tau Beta Pi was held in Columbus, OH, October 10-12, 2019. There were 462 members representing 222 collegiate chapters and 27 alumni chapters on behalf of the entire organization. Of the total, 304 were students, 158 were alumni, including 22 chapter advisors. An additional 132 non-member guests, recruiters, volunteers, and consultants participated in Convention activities.

The Ohio Gamma, Delta, and Iota Chapters hosted the Society's annual meeting in Ohio. **Samuel T. Croarkin**, *OH Γ'19*, served as Arrangements Chair and led the host committees in such duties as corporate outreach, initiation, and volunteers with support from Ohio Gamma Chapter Advisor **Mark A. Ruegsegger**, Ph.D., *OH A '95*.

Headquarters for this Convention was the Columbus Airport Marriott. Committee meetings and Professional Development Sessions started on Thursday morning prior to the official opening of Convention. Five business meetings were held, four at the hotel, and the Saturday Business Meeting and Model Initiation were conducted on The Ohio State campus.

Nanjeeba Chowdhury, IL B' 20, and Margaret J. Domeny, IL B' 70, during the 50 Years of Women in TBP celebration.

The President's Report for the Executive Council was presented on Thursday [**See page 13**]. The evening's banquet honored the four ΤΒΠ Laureates, including a keynote from **Alison L. Hu**, *CA Γ'96*, director of the talent activation and growth at Service Now and a 1996 ΤΒΠ Laureate for arts. Friday's banquet featured the presentation of the McDonald Mentor and Outstanding Advisor awards as well as keynote speaker, **Martha A. Polston,** P.E., *TN A '79*, past ΤΒΠ president and co-founder of the Association's Engineering Futures Program. The Alumni and Chapter Awards Banquet on Saturday, sponsored by GEICO, brought Convention business to a close with recognition of the Distinguished Alumni and chapter award winners. **Diane Kewley-Port,** Ph.D., *MI Γ'64*, a ΤΒΠ Women's Badge recipient and President-Elect of the Acoustical Society of America, presented a motivational speech.

The Saturday evening banquet also included a special event, "Honoring Women — 50 years in ΤΒΠ." Convention attendees learned about the careers and achievements of the 22 women in attendance who were recipients of the Women's Badge or were initiated during the inaugural year of 1969.

Almost all business at ΤΒΠ Conventions is handled by committees. Seven standing committees are called for in the Constitution, four *ad hoc* committees were appointed, and all collegiate and alumni chapter voting delegates served on a committee.

Full details of the business meetings are recorded in the official Minutes posted on the Convention website, *www.tbp.org/conv/2019/conv.cfm*. Major actions of the Convention are reported in this article.

The Recruiting Fair on Friday comprised 57 booths and were hosted by recruiters from graduate engineering programs and corporations. It was the **largest** Recruiting Fair in ΤΒΠ Convention history! Exodyne, Inc., sponsored the delegate's lunch during the Recruiting Fair.

Two New Chapters Granted

In response to petitions, two new collegiate chapters of Tau Beta Pi were granted by the Convention. This will raise the number of active collegiate chapters to 250. The society from the University of Arkansas at Little Rock will be installed March 7, 2020, as the Arkansas Beta Chapter and the society from the University of Texas at Dallas, will be installed February 15, 2020, as the Texas Xi Chapter. Both were represented by a faculty advisor and member of the Association as well as a student officer from the local society.

Constitution & Bylaws

The Constitution and Bylaws Committee diligently worked through four charges which included two proposals to modify the Constitution. On the recommendation of the committee, the Convention adopted, by the required three-fourths vote, two amendments to the Constitution. In addition, proposals to modify the Constitution from the Convention Site Committee and the *ad hoc* Image and Marketing Committee were approved by the Convention. These changes are subject to ratification by the collegiate and alumni chapters and include:

1. Update the Association's seal.
2. Adjust the Trustee requirements to allow management by a registered investment advisor.
3. Update allowable trust investments to include Exchange Traded Funds and Real Estate Investment Funds.
4. Allow the Convention to select a future Convention site more than three years in advance.

Financial Affairs
Understanding the complexity of Tau Beta Pi's financial status presents a challenge for students each year, but the Chapter and Association Financial Affairs Committee democratically reviewed all financial matters and concluded that the Association's financial health is in order.

The committee recommended, and the Convention adopted, to maintain allowable expenses at the 2020 Convention at the same level as set for the 2019 Convention except increasing the allowances for en-route meals to $37 each way and $12 for breakfast, $13 for lunch, and $21 for dinner, when applicable, at Convention. The group worked effectively with chapters to resolve debts and reviewed the 2018-19 auditor's report and Executive Director's report.

Initiation
The Rituals Committee organized a Model Initiation ceremony for three students and one eminent engineer from Ohio Gamma, one student from Arkansas Beta, and one student from Texas Xi. The Convention made no changes to the Ritual.

Awards
The Awards Committee worked long hours in reviewing the 2018-19 records of the chapters and in selecting recipients of the R.C. Matthews Outstanding Chapter Award, the R.H. Nagel Most Improved Chapter Award, and the J.D. Froula Most Improved Membership Award. Announcement of these awards and the 14 honorees of the Chapter Performance Scholarship Program are reported in detail on pages [**See pages 18-20**]. The committee reviewed progress on the pilot of the new electronic project reporting system and made several suggestions. This new system which includes personalized reports, access levels, and progress reports will be available for use starting in January 2020.

Future Convention
The Convention reviewed information from four cities to host the 2022 Convention. The proposal to host the 2022 Convention in Rapid City, SD, was accepted.

2019 Tau Beta Pi Laureates
Attendees met Laureates **Casey Main,** *IN Δ '19*, **Kendra K. Noneman,** *ID Γ '20*, **Rose C. Ridder,** *PA K '20*, and **Kelli L. Swenson,** *WI Γ '19*. Councillor George J. Morales presented a commemorative plaque and $2,500 check to each recipient and spoke of their achievements.

Tau Beta Pi-McDonald Mentor
The 2019 McDonald Mentor is **Martha C. Mitchell,** Ph.D., *WI A '89*, professor in the department of chemical and materials engineering at New Mexico State University. Vice President C. Craig Smith, P.E., presented Dr. Mitchell with an engraved commemorative medallion, lapel pin, $1,000 check, and another $1,000 will be credited to the school of her choice.

Outstanding Advisor
The 2019 Outstanding Advisor Award was presented to **Kurt P. Rouser, USAF (ret.)** Ph.D., *OH H '11*, by Councillor Menna M. Youssef, Ph.D. Dr. Rouser is an assistant professor at Oklahoma State University (OSU). He received a $1,000 check, a commemorative plaque, and a $1,000 grant will be presented to the OSU College of Engineering, Architecture, and Technology's discretionary fund.

Distinguished Alumnus
Councillor Rachel K. Alexander cited the career accomplishments of the 2019 Tau Beta Pi Distinguished Alumnus Award recipients: **Wayne T. Davis,** *TN A '73*, retired dean of engineering and interim Chancellor; **David L. Ford Jr.,** Ph.D., *IA A '67*, emeritus professor and professional development association founder; **William E. Jennings,** *GA A '85*, engineer and inventor of cellular technology; and **Abdallah H. Yabroudi,** *NY B '78*, CEO and managing director of Dubai Contracting Company. Councillor Alexander presented commemorative plaques, and a ΤΒΠ scholarship of $2,000 was given in honor of each recipient to a student this summer.

Chapter & Professional Development
The Chapter Development Program included Interactive Chapter Exchanges (ICE) and district meetings. This year, ICE Special Topic Sessions included: Chapter Projects, Financial Best Practices, New Member Recruitment, On Campus Image, and Utilizing Your Leadership Team. The popular Professional Development Sessions were conducted in parallel to committee meetings on Thursday evening, alongside the Recruiting Fair, and on

Friday evening. Attendees could select from 16 different sessions ranging from "How to Find a Job with Meaning" to "Jet Engine Crash Course."

2020-22 Executive Councillors Elected

Six candidates ran for the opportunity to serve on the Executive Council and were introduced in the Summer 2019 issue of *The Bent*. The Convention elected three members to serve the 2020-22 term and the results are reported on **page 14**.

Other Business

The *ad hoc* Alumni Chapter Committee recommended action on a provisional alumni chapter policy; reviewed changes to the operations and activities of alumni chapters; and prepared a list of potential joint collegiate/alumni activities and possible roles for alumni chapters at the regional and national levels.

The *ad hoc* Image and Marketing Committee reviewed the finalized version of the logo and found it to be in line with the design approved by the 2018 Convention. The committee also recommended, and the Convention approved, a new insignia use policy, proposed changes to insignia and marketing materials, and recommended changes to the Association's official seal.

The *ad hoc* Program Review Committee recommended a process for appeals by chapters whose programs are no longer eligible after the Constitution changes approved by the 2018 Convention. The Convention approved five program appeals by four chapters: computer science bioinformatics at California Psi; computer science at Florida Epsilon; climate and meteorology at Michigan Gamma; data science at Michigan Gamma; and computer science at New York Omicron.

The *ad hoc* Website Review Committee reviewed and provided feedback on the new recruitment website and the general member website. The committee provided a list of recommended changes to be made to the recruitment website as soon as possible.

The Resolutions Committee was responsible for thanking the host chapter members, officials, generous alumni, sponsors, award winners, Headquarters staff, volunteers, and others for all the good things that happened to Tau Beta Pi during the year. The Chair of the Resolutions Committee concluded his remarks to Convention with inspirational messages for chapter leaders to take back to their chapters.

Thanks to . . .

Tau Beta Pi gratefully acknowledges the following Convention recruiters and sponsors:

Diamond Level

GEICO
Exodyne, Inc.

Platinum Level

Bredesen Center
CESO, Inc.
Kettering University
PPI - Kaplan Professionals
Univ. of Pittsburgh Swanson SOE
The Whiting-Turner Contracting Co.

Gold Level

American Electric Power
Caterpillar Inc.
George Washington University SEAS
Keck Graduate Institute
McNally Tunneling Corp.
MIT Leaders for Global Operations
NC State Univ. Engineering
Northeastern Univ. COE
Ohio Univ. Russ College
Penn State SEDTAPP
Sandia National Laboratories
Stevens Inst. of Technology
The Ohio State Univ. COE
Torch Technologies
Tufts Univ. SOE
Univ. of Virginia Engineering

Bronze Level

The PhD Project

Silver Level

Air Force Research Labs STO
BAE Systems, Inc.
Case Western Reserve Univ.
Columbia University SEAS
DeNOVO Solutions
Elford
Epic
FedEx Ground
Gannett Fleming Inc.
Iowa State University COE
Lehigh University COEAS
The Lincoln Electric Co.
Michigan State Univ. COE
Michigan Technological Univ.
Missouri Univ. of S&T
New Jersey Inst. of Tech.
New York Univ. Tandon School of Engineering
Northwestern Univ. SEAS
NuVasive Inc.
Oak Ridge Inst. for Science and Education
Penn State Smeal College of Business
Pole/Zero
Power Costs, Inc.
Purdue University COE
Rensselaer Polytechnic Inst.
Rogue Fitness
Rovisys
Texas Instruments
University of Dayton SOE
University of Kentucky COE
University of Michigan COE
Univ. of Southern California Viterbi SOE
Univ. of Wisconsin-Milwaukee
West Virginia Univ. COE & Mineral Resources
Worcester Polytechnic Inst.

Below: Nevada Beta Vice President David A. Santiago '20 at Convention.

Chapter Awards

(Left to right) Steven D. Boatwright '21, Chief Advisor Sally J. Steadman, Ph.D., WY A '69; Steven P. Klepac '21; Luke D. Beech '21; and chapter president Nicholas B. Naylor '20.

Outstanding Chapter
Alabama Epsilon

The Alabama Epsilon Chapter at the University of South Alabama was selected as the recipient of the 2018-19 R.C. Matthews Outstanding Chapter Award.

The Convention Awards Committee cited the chapter for its extensive outreach and volunteer efforts, including an Engineering Open House for 200+ middle school students during Engineers Week and two Tau Bates receiving top volunteer awards from the Jubilee Best organization. The chapter also boasted a new record retention rate, thanks to tutoring services and other leadership opportunities.

AL Epsilon Chapter leaders for 2018-19 were:

- President - Tanner J. Hickman
- Vice President - Marissa A. Horstman
- Vice President - Derek L. Kelly
- Treasurer - Brandon Shurden
- Recording Secretary - Amanda S. Brown
- Corresponding Secretary - Logan J. Gonzalez

Chapter Advisors:

- Sally J. Steadman, Ph.D., *WY A '69* (Chief)
- Christy W. West, Ph.D., *AL B '96*
- Joseph D. Richardson, Ph.D., *MS B '88*
- Eric J. Steward, Ph.D., *AL E '03*

Honorable Mentions for the Outstanding Chapter Award went to Iowa Alpha (Iowa State University) and Tennessee Alpha (University of Tennessee).

Excellence Marked

Executive Director Curtis Gomulinski presented certificates to these chapters to mark excellence in their organization and administration—100% or more with distinction in bold face:

Chapter Excellence Awards

Alabama Delta
Alabama Epsilon
Arizona Alpha
California Xi
California Upsilon
California Psi
Florida Delta
Indiana Delta
Illinois Alpha
Iowa Alpha
Michigan Gamma
Michigan Epsilon
Michigan Iota
Nevada Beta
New Mexico Beta
New Mexico Gamma
New York Xi
North Carolina Delta
Ohio Epsilon
Ohio Iota
Ohio Kappa
Ohio Mu
Ohio Nu
Pennsylvania Zeta
Tennessee Alpha
Texas Beta
Texas Theta
Vermont Beta

Check out more images from the 2019 Tau Beta Pi Convention:

www.tbp.org?2019Conv

2019 Convention

Texas Theta Chapter president Amanda C. Haynes '18 with the Nagel Award.

Indiana Delta Chapter president Sarah C. Griffin '20 and District 8 Director Tom Schaub, NY N '93.

Most Improved Texas Theta

The Texas Theta Chapter at the University of Texas at El Paso was selected as the recipient of the 2018-19 R.H. Nagel Most Improved Chapter Award.

The Convention Awards Committee cited the chapter for a strong project lineup, including a scholarship workshop and Pi Day fundraising. The chapter also achieved a Chapter Excellence Award, thanks to administration and membership work.

TX Theta Chapter leaders for 2018-19 were:

- President - Luis E. Valerio Frias
- Vice President - Gerardo J. Ramirez Marquez Jr.
- Treasurer - Melissa Perez
- Recording Secretary - Guillermo N. Gutierrez Serrano
- Corresponding Secretary - Ahmad Abu-issa

Chapter Advisors:

- Deidra R. Hodges, Ph.D., *TX Θ '83* (Chief)
- Stephen W. Stafford, Ph.D., *TX Θ '70*
- David A. Roberson, Ph.D., *TX Θ '99*
- Jacqueline A. Reyes, *TX Θ '17*

Honorable Mentions for the Outstanding Chapter Award went to Michigan Iota (University of Michigan-Dearborn) and Ohio Xi (Miami University).

Improved Membership Indiana Delta

Established in 2011, the J.D. Froula Most Improved Membership Award was given to the Indiana Delta Chapter at Valparaiso University.

The award honors Executive Director Emeritus James D. Froula, *TN Alpha '67*, and recognizes the chapter which has increased the number of electees initiated in each of the previous three years. Other considerations included the percentage increase and the number of total initiates.

IN Delta Chapter leaders for 2018-19 were:

- President - Rachel L. Silcox
- Vice President - Jacqueline M. Kitten
- Treasurer - Connor S. Hickey
- Recording Secretary - Aileen A. Dobersztyn
- Corresponding Secretary - Casey L. Richardson

Chapter Advisors:

- Scott Duncan, Ph.D., *IN Δ '90* (Chief)
- Jeffrey D. Will, Ph.D., *IL A '95*
- Zuhdi Y. Al Jobeh, Ph.D., P.E., *OH Z '86*
- Daniel A. Blood, *IN Δ '10*

Honorable Mentions for the Most Improved Membership Award went to California Kappa (California State University, Northridge) and New York Sigma (Alfred University).

29 Chapter Project Awards

At the 2019 Convention in Columbus, Chapter Project Awards for outstanding performance during 2018-19 were presented to:

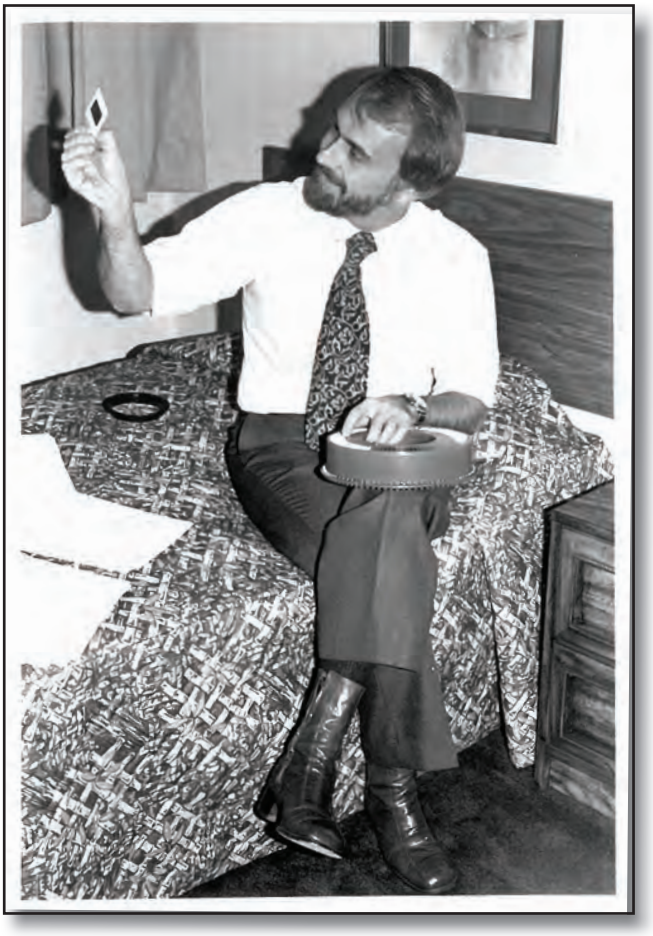
Chapter	Institution	# of Projects
AL Γ	University of Alabama at Birmingham • Helped with clothing donation & canned food drives	10
AL E	University of South Alabama • Professor & sophomore of the year recognition	47
AZ Δ	Embry-Riddle Aeronautical Univ. (Prescott) • Professional eng'g & sophomore outreach sessions	27
AR A	University of Arkansas • Cleaned up Lake Fayetteville & Earth Day trail	42
CA A	University of California, Berkeley • Hosted Nvidia Tech Talk & Exploratorium Cleanup	92
CA E	University of California, Los Angeles • Hosted K-12 outreach and undergrad prep sessions	103
CA Ψ	University of California, San Diego • Visited an orphanage in Tijuana, Mexico	81
CA AΓ	San Francisco State University • Hosted soldering workshop	36
CT A	Yale University • Prepared wax-sealed invitations to eligible members	14
FL A	University of Florida • Hosted a Pi Day 5k and rabbit rescue event	82
FL Γ	University of South Florida • Joint host pool/grill event with Tampa Bay AC	31
FL Δ	University of Central Florida • Developed a chapter promotional video	86
IA A	Iowa State University • Hosted K-12 Roller Coaster competition	128
MD B	University of Maryland • Assisted local food bank	81
MI B	Michigan Tech. University • Volunteered as dog walkers for Humane Society	43
MI Γ	University of Michigan • Hosted nearly 40 professional company events	200+
MI E	Wayne State University • Planted seeds in a Detroit greenhouse	49
MI Θ	Oakland University • Hosted a laser tag social event	20
MI I	University of Michigan-Dearborn • Participated in Science Olympiad competition	18
NM B	University of New Mexico • Helped fundraise at the Abq. Balloon Fiesta	42
NM Γ	New Mexico Inst. of Mining and Technology • Prepared Thanksgiving baskets for those in need	24
NY K	University of Rochester • Hosted alumni panel for students and members	61
NY T	Binghamton University • Hosted the annual honor society mixer	17
OH I	Ohio Northern University • Assisted with a High School Quiz Bowl	27
OH K	University of Akron • Painted campus 'spirit rock' with TBΠ designs	52
PA Z	Drexel University • Hosted breakfast at the Bent & Pi Day activities	20
PR A	University of Puerto Rico • Hosted an event to learn about budgeting/ credit	25
TN A	University of Tennessee • Hosted 'Tau Bagel Pi' monthly events	81
TX A	University of Texas at Austin • Assisted with clothing drive for homeless	127

$7,500 in Scholarships

Fourteen chapters, each of which received Chapter Project Awards for three consecutive years, were given $500 scholarships.

CHAPTER	INSTITUTION	DELEGATE
Alabama Epsilon	University of South Alabama	Nicholas Naylor
California Alpha	University of Calif., Berkeley	Jarrod Hsu
California Epsilon	University of California, L.A.	Bharat Pradeep
California Psi	University of Calif., San Diego	Edward Chen
Florida Alpha	University of Florida	Alexander Schafer
Florida Gamma	University of South Florida	Bryant Howard
Iowa Alpha	Iowa State University	Jaclyn Stiller
Maryland Beta	University of Maryland	John Hoerauf
Michigan Gamma	University of Michigan	Adam Ley
Michigan Epsilon	Wayne State University	Michael Kmiec
New Mexico Gamma	NM Inst. of Mining & Tech	Aubrey Hands
Ohio Iota	Ohio Northern University	Sara Florian
Tennessee Alpha	Univ. of Tennessee, Knoxville	Ryan Durkee
Texas Alpha	University of Texas at Austin	None

CAPTION CONTEST



TELL US THE TALE... WIN A T-SHIRT!

Send us your best caption(s) for this photo from *The Bent* archives. If the judges vote yours as one of the top three, and you *have not* been a previous winner, we'll send you a ΤΒΠ t-shirt of your choice.

The photo, right, which first appeared in the Winter 1980 issue of *The Bent*, shows then District 9 Director Ralph E. Warmack, Ph.D., *MO A '67*, preparing a slide show for his district meeting at the 1979 Convention in Lincoln, Nebraska.

Submit your entries to pat@tbp.org or mail them to HQ by Monday, February 3, 2020.

The fall caption contest picture below is from the Winter 1989 issue. During the 1988 Convention at Iowa State University, District 14 Director Marcia R. Chadly, *IA A '85*, left, and President Martha A. Martin, P.E., (now Polston), *TN A '79*, realized they each were given half of the same geode.

Our judges considered 26 entries from 16 members. The authors of the top captions are previous winners, so no t-shirts this time!

The top ranked caption submitted by Robert McMillan Jr., *MA D '69*, is **"If you hold them to your ears you can hear rock music."**

There was a tie for second place between James C. Hedtke, *MN A '69*, and Dennis A. Negron Rivera, *PR A '13*. Their respective entries are: **"Hmm. That's interesting. I got my geode from my geologist boyfriend also!"** and **"'Find Your Ideal Match' EF Session in its trial stage. It was rejected at Convention."**

David M. Dummeyer, *AZ A '84*, penned the third place caption: **"While comparing their twin geodes, Marcia Chadly and Martha Martin discover that they are also twin sisters separated at birth!"**

All 26 entertaining entries, including captions and results from recent contests, can be viewed online at *www.tbp.org/pubs/captionContest.cfm*.

Many thanks to all of you who have participated in the contest and for providing proof that engineers have a great sense of humor!

2019 Alumni Giving Program August-October Contributors

The names of 662 Tau Beta Pi alumni and others who made donations to the Association in the 2019 Alumni Giving Program appear in two separate sections on the following pages. Their gifts totaling $353,997 arrived between August 1 and October 31, 2019. Names preceded by SPEC denote gifts from non-members. **Gifts received after October 31 do not appear here but will be published in the Spring 2020 issue of *The Bent*.**

The generous support of each member is deeply appreciated by the Executive Council and other Association Officials. The financial resources have permitted strengthening our programs in several areas that emphasize the importance of Tau Beta Pi's basic objectives and that help all collegiate chapters and student members.

Recognition Club Donors are listed alphabetically within their chapters and appear in the first section below. Pre-club Member-contributors appear in the subsequent section. Names marked with a † symbol are of deceased members in whose memory donations were made either by relatives and friends or through bequests. In addition to gifts acknowledged here, several were made anonymously and are also deeply appreciated.

Donor Recognition Clubs

The names of 560 Tau Bates and others appear in this first section. They made donations to the Alumni Giving Program between August 1 and October 31, 2019, AND they have also made CUMULATIVE contributions (in some cases including matching gifts) and bequests to Tau Beta Pi through the years totaling from $250 to more than $1,000,000.

The Donor Recognition Clubs are part of our effort to recognize a donor's total lifetime cumulative giving to Tau Beta Pi. Such continuous support significantly contributes to the overall strength of the Association and allows us, with confidence in our financial resources, to plan for growth in our services to the engineering profession. These clubs were chartered by the Executive Council in 1986 and have been set at the following levels:

Matthews Club	500,000	Alpha Club	25,000	Chi Club	1,000
Nagel Club	250,000	Beta Club	10,000	Second Century Club	500
Williams Club	100,000	Delta Club	5,000	Founders Club	250
Heikes Club	50,000	Zeta Club	2,500		

NAGEL CLUB

CA Δ Hennis, Lee Alan '65

WILLIAMS CLUB

OH Γ Rockow, Ralph Arthur '58
OR A Brandt, Larry Don '67
VA B Anonymous '49

ALPHA CLUB

IA A Kilzer, David Darrell '96
OH Δ Robe, Richard '55
SD A Gomulinski, Tricia E. '88
TX A †Schulte, Francis L. '49
WY A Schoenborn, Renee M. '85

BETA CLUB

CA A Masatani, Peter James '04
CA Z Grigsby, David A. '84
CA T Fable, Scott Edward '96
IL A Ditman, Jason Blair '91
IA A Slater, John B. '43
LA E Champagne Jr., Pierre '76
MI A Colbry, Dirk J. '06
Colbry, Katy Luchini '99
MI E Gomulinski, Curt D. '01
NY Δ Jacobs, Irwin Mark '56
NY K Knox, Keith Thomas '70
TN A Cook, James Michael '72
TX A Mickelson, Kent B. '77
TX H Trich, John Albert '70
VA B Hogan, James C. '70

DELTA CLUB

AL A Bowers, Charles J. '69
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Why do we call it a ... Joule

By: **Lyle D. Feisel, Ph.D., P.E. (Ret.),** *Iowa Alpha '61*

This is the sixth in a series of articles that explore the history of science and engineering. One way in which this history has been preserved is in the names of the scientific units that we commonly use. Those units will serve as starting points for these articles as we explore "Why do we call it a...?"

There is an old, old parable about several blind men describing an elephant based on what they felt when they touched it. One felt the elephant's leg and said that an elephant is like a tree. Another felt the elephant's ear and said that an elephant is like a fan. Yet, another felt the elephant's tusk and said that an elephant is like a stone. Each was correct within his limited perspective, but the elephant was really much more complex and varied than they realized. Such was the situation with the concept of energy back in the 19th century.

Individual scientists who were trying to understand energy were doing so from the standpoint of their own fields of endeavor. Someone working in the field of mechanics saw energy as a force exerted through a distance and measured that energy in foot-pounds. Another scientist who was interested in thermal energy measured it in terms of the heat required to raise the temperature of a certain amount of water. Electricity really had not yet been developed, but if it had been, there would have been yet another measure in use. Why? Because it was not yet understood that energy is energy, whether it be mechanical or thermal, kinetic or potential, electrical or chemical.

The first inkling of the fact that energy is not created or destroyed but merely changed in form came to an American-born physicist, Benjamin Thompson, later known as Count Rumford (1753-1814). Thompson was born in the colony of Massachusetts but served on the British side during the U.S. War for Independence. After the war, he was not particularly welcome in the newly created U.S.A., so he decamped for Britain. He conducted a number of scientific investigations and was particularly intrigued by the observation that cannons got very, very hot when they were being bored (i.e., drilled, not uninterested). His conclusion was that mechanical energy was being converted to thermal energy and that, in essence, they were the same thing. He published this result in 1798. What he did *not* do was conclude how much mechanical energy it took to produce how much heat energy. That task was left to the hero of this story, James Prescott Joule (1818-1889). His namesake unit, the joule, is the fundamental unit of work or energy in the international system of units and is defined as the energy required to exert a force of one newton through a distance of one meter. Now, how many BTUs is that? Determining that number was Joule's primary contribution.

Portrait of James Prescott Joule.

But, back to the beginning — at least the beginning of James Prescott Joule. He was born on the day before Christmas in 1818 in Salford, England, a suburb of Manchester, which was and is a major manufacturing center. His father, Benjamin, was a brewer engaged with other family members in operating a major brewing company. The Joule's brewery — after several acquisitions and divestitures — still exists today in a nearby town.

In the 19th century, children of wealthy families were generally schooled at home, sometimes by the parents but often by tutors. Such was the case with Joule. Apparently, he did not attend university, but did manage to spend some time and effort learning from experienced scientists.

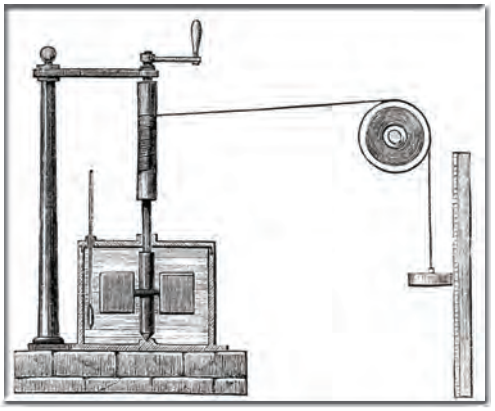
At age fifteen, Joule started working in the family brewery and went on to manage the enterprise for some twenty years. It was in connection with his brewery work

that he first became interested in physics and its application to real world problems. In the mid-1800s, motive power in British industry was largely provided by steam engines if water power was not available. In the 1830s, several inventors were developing rudimentary electric motors and Joule wondered if he could substitute these motors for the steam engines then used in the brewery. To compare the two, he had to have an understanding of the concept of energy and this led him to embark on a study of energy and of electricity.

In thinking about using electric motors in the early 19th century, it is important to remember that you couldn't simply plug these motors into a wall outlet. There were no wall outlets because there were no central generating stations. Indeed, there were no generators. The dynamo — what we now call a generator — was not invented until the 1840s and a really practical generator didn't come along until 1866.

So, where did this electricity come from in 1830? From batteries. Humongous batteries. There were several designs but, in general, a cell consisted of two electrodes made of different metals immersed in a liquid electrolyte. Any number of cells could be connected in series and parallel to produce higher currents and voltages. As a battery was used, the electrodes were consumed and the electrolyte was degraded until the battery simply didn't work anymore. Then, you salvaged what you could and bought a new battery. Pretty much what we do today with the gazillions of dry cells that power our toys and tools.

Illustration of Joule apparatus in which the mechanical energy is equal to the weight times the distance it fell.



While Joule was primarily interested in making a comparison of the mechanical energy delivered by steam engines and electric motors, he was also intrigued by the observation that electric circuits generated heat. So, how much heat? Was it quantifiable? Was the amount of heat — thermal energy — determined by the properties of the electrical system? To answer these questions, he devised a simple but very clever experiment. He submerged a coil of wire in a container of water and then observed the increase in temperature of the water as he passed a current through the wire. He was able to measure the current using a galvanometer which had been invented some 20 years earlier and which he had improved. Changes in temperature could be measured quite accurately using a mercury thermometer, which had been around for over 100 years. Through his experiments, he was able to determine that the energy delivered was directly proportional to the resistance of the wire, the square of the current, and the time the current flowed. This relationship, familiar to every engineer, is known today as Joule's Law.

Well, if you can do it with electricity, you can do it with mechanical energy. In another set of experiments, Joule mounted a paddle wheel in a container of water and turned the paddle wheel by means of a cord tied to a falling weight; illustration of this apparatus in the image below. The mechanical energy was equal to the weight times the distance it fell, and the thermal energy was determined by observing the increase in temperature of the water. Through successive experiments, he was able to determine that one British thermal unit is equal to 772.55 foot-pounds. Since then, that number has been determined more accurately to be 778.169, but the precision of that measurement made in 1878 is still remarkable.

It is interesting to note that Joule probably didn't refer to a "British thermal unit." According to one reference, the BTU terminology didn't come into use until about 1890. Joule probably called it a "heat unit." Whatever it was called, it was the energy required to raise the temperature of one pound of water by one degree Fahrenheit.

James Prescott Joule died in 1889 after a long and productive career as both a scientist and a brewer, a combination that few other scientists can claim. Inscribed at the top of his tombstone in Greater Manchester, England, is "772.55", the number of foot-pounds in a BTU as determined by Joule in his remarkably precise experiments. Joule was among the first to realize that energy could appear in many forms and that one form could be converted into another. During his lifetime, he probably understood energy better than anyone else. And, that's why we call a joule a joule.

Lyle D. Feisel, Ph.D., P.E. (Ret.) is dean emeritus of the school of engineering and applied science and professor emeritus of electrical engineering at Binghamton University. Following service in the U.S. Navy, he received B.S., M.S., and Ph.D. degrees in electrical engineering from Iowa State University. From 1964-83, he was a faculty member of the South Dakota School of Mines and Technology, serving as head of EE from 1975-83. Feisel was a national visiting professor at Cheng Kung University in Tainan, Taiwan, during 1969-70, and served as the founding dean of engineering at SUNY Binghamton from 1983-2001. He was named Tau Beta Pi Outstanding Alumnus in 2002. Feisel is a life fellow of the IEEE and a fellow of ASEE and NSPE.

RESULTS FROM SUMMER

Perfect

*Couillard, J. Gregory	IL	A	'89
*Gerken, Gary M.	CA	H	'11
*Griggs Jr., James L.	OH	A	'56
*Loeb, Daniel E.	CA	B	'86
*Johnson, Mark C.	IL	A	'00
Parks, Christopher J.	NY	Γ	'82
*Roche, James R.	IN	Γ	'85
Roche, Kevin M.	Son of member		
Schmidt, V. Hugo	WA	B	'51
Stafford, Michael	Son of member		
Summerfield, Steven L.	MO	Γ	'85
*Sylvester, Noah	Son of member		
*Weinstein, Stephen A.	NY	Γ	'96

Other

Alexander, Jay A.	IL	Γ	'86
*Bannister, Kenneth A.	PA	B	'82
Barthel, Gerald R.	OH	B	'67
*Bohdan, Timothy E.	IN	Γ	'85
Dechman, Don A.	TX	A	'57
*Gulian, Franklin J.	DE	A	'83
Gulian, Joseph D.	Son of member		
Handley, Vernon K.	GA	A	'86
Hasek, William R.	PA	Γ	'49
Kimsey, David B.	AL	A	'71
Lalinsky, Mark A.	MI	Γ	'77
Richards, John R.	NJ	B	'76
Riedesel, Jeremy M.	OH	B	'96
Rubin, James D.	MI	Γ	'82
Schweitzer, Robert W.	NY	Z	'52
Sigillito, Vincent G.	MD	B	'58
Skorina, Frank K.	NY	M	'83
*Slegel, Timothy J.	PA	A	'80
*Spong, Robert N.	UT	A	'58
Voellinger, Edward J.	Non-member		
Zison, Stanley W.	CA	Θ	'87

*Denotes correct bonus solution

SUMMER REVIEW

There was a little confusion with #5, the question about poker showdown. Our problem statement did not specify the hierarchy of cards. We thought ace-high was implicit and were looking for an answer of the King of Clubs. However, the judges accepted a number of different answers, including any that clearly specified the 45th ranked card from the bottom, regardless of order. Problem #3, asking the number of ways to walk a flight of stairs, was the easiest of Ticklers, drawing a correct answer on about ¾ of the entries. The other four regular Ticklers each earned a correct answer on slightly more than half the submissions.

FALL ANSWERS

1 The simultaneous cryptic additions:

```
* * * * * *   M I R R O R
M I R R O W   I M A G E *
-----------------------
I M A G E *   * E G A M I
```

have the solution:

```
4 4 7 2 6 5   2 7 4 4 3 4
2 7 4 4 3 4   7 2 1 6 9 3
-----------------------
7 2 1 6 9 9   9 9 6 1 2 7
```

2 The near anti-magic square we wanted (or its transpose) is:

1 7 2
9 3 5
6 4 8

The sums of the rows, columns, and diagonals are: 10, 11, 12, 14, 15, 16, 17, and 18. This is not a true anti-magic square, because the list of sums is not continuous (13 is missing).

3 Every **19 years**, the moon, as observed from Earth, appears in the same place in the sky on the same date. A second full moon in the same month (a Blue Moon) on the same date will occur when an integral number of solar years and an equivalent integral number of lunar months have passed since the last Blue Moon. Let Y = 365.2425 days/solar-year, M = 29.53059 days/synodic-month. Then, the expression:

$F(n) = nY - M$*[round(nY/M) to the nearest integer]

gives the relationship between the number of solar years and the corresponding number of synodic months, whose difference (in days) should be very close to 0. Trying various values shows that n=19 years gives the smallest value for $F(n)$. This is known as a Metonic cycle, which is 6,940 days (19.0010 solar years or 235.0105 lunar months).

4 The pizza shop has **11 toppings**. 1,048,576 factors to 10^{20}, so, each pizza has 10^{10} possible combinations of toppings. Use the choose function $C(m,n) = m!/((n!)(m-n)!)$, which is the number of ways of choosing m objects, n at a time. Since each pizza can have 0 to 5 toppings, use the choose function 6 times: $C(N,0)+C(N,1)+C(N,2)+C(N,3)+C(N,4)+C(N,5)$, where N is the number of toppings from which a selection can be made. Trying various values of N shows that when N=11 there are 1+11+55+165+330+462=1024 ways to order one pizza or 1024^2 = 1,048,576 ways to order 2.

5 The order of merit is (first to last) **AEBCD**. If E truth → B is 2nd → B lies → E is 1st (and lies) → B not 2nd → NO. If E lies (E is 1st or 2nd) → B not 2nd. If B is 1st (E 2nd) → B lies → E 1st → NO. If B 3..5 → B truth → E not 1st → E is 2nd. If C lies then C is last → truth → NO; so C truth (3..4). If A truth then D 3rd (truth) → B > C → have 4 truth tellers → NO. So, A lies (is 1st) → D not 3rd (4..5) and truth and C is lower than B.

Bonus. As the angle of the sector approaches zero, the ratio (area of circles/area of sector) is largest and is **π/4**. Let the sector be bounded by the x-axis and a line at angle 2Θ. Let centers of circles be on a line at angle Θ. Let the circles touch each other and the edges of the sector. For the circle that touches the unit circle, $\sin\Theta = r_1/(1-r_1)$. Solving for r_1, we get $r_1 = \sin\Theta/(1+\sin\Theta)$ which we will call k. For the next circle, $\sin\Theta = r_2/(1-r_2-2r_1) = r_2/(1-r_2-2k)$. Solving for r_2, we get $r_2 = k(1-2k)$. For the next circle, $\sin\Theta = r_3/(1-r_3-2(r_1+r_2)) = r_3/(1-r_3-2(k+k(1-2k))$. Solving for r_3, we get $r_3 = k(1-2k)^2$. In general, $r_n = k(1-2k)^{(n-1)}$. The area of all the circles is $\pi(k^2)(1 + (1-2k)^2 + (1-2k)^4 + ...) = \pi(k^2)(1/(1-(1-2k)^2))$

$= (\pi/4)(k/(1-k)) = (\pi/4)\sin\Theta$. The area of the sector is $(2\Theta/(2\pi))\pi(1^2) = \Theta$. So, the ratio is $(\pi/4)\sin\Theta/\Theta$, which has a maximum as Θ approaches zero, and that maximum is $\pi/4$ (equal to the ratio of a circle and its enclosing square).

Computer Bonus. 5,536,785,000/**369,119** = 15,000 is the third largest prime such that it divides the sum (5,536,785,000) of all the 31,463 primes smaller than itself.

NEW WINTER PROBLEMS

1 Former Brain Ticklers' judge **Don A. Dechman** (*TX A '57*) astutely pointed out that our illustrious head judge **Howard G. McIlvried III** (*PA Γ '53*) has just celebrated an amazing sixty years supporting this column. In commemoration of this event, I thought I would throw together some accolades for him. Find a unique solution to the following cryptarithm: PROPS + KUDOS = HOWARD. Not one to miss an opportunity, Howard replied, "it has been a LABOR + OF + LOVE + FOR + OVER = 60 + YEARS, and they have been prime YEARS." Solve the two cryptics individually. Standard rules apply: each different letter stands for a different digit, and each different digit is always represented by the same letter; no leading zeros are allowed.

—**J.R. Stribling**, *CA A '92* and **H.G. McIlvried III**, *PA Γ '53*

2 Adam, Brad, Chet, Doug, and Evan went abroad with their respective wives on vacation last summer to five different destinations. Three of the pairs ventured into Asia with trips to Agra, Bali, or Doha, while the other two couples traveled to Europe and visited either Cork or Elba. I knew the names of the five wives were Anne, Beth, Cate, Dawn, and Emma, but the only information I had about who was married to whom was that for each pair the names of the husband, the wife, and last year's holiday location all began with different letters.

In an attempt to discover more details, I had some conversation with three of the ladies. Beth told me she was not married to Adam and she had heard from Evan that Chet went to Doha last year. Dawn, however, firmly informed me that Chet went to Elba and Beth went to Doha. "Unlike some people I could mention," she added darkly, but rather irrelevantly, "Adam always tells the truth." Cate said when her husband was asked whether Emma was married to Chet he replied 'No.' She went on to tell me that Doug went to Bali.

Given that a reliable source divulged to me the curious fact that of each of these married couples, one member always told the truth and the other never did, deduce the name of each man's wife and where they all went for their vacations.

—*Brain Puzzler's Delight* by E.R. Emmet

3 For a spherical Earth in a circular orbit around the sun with the Earth axis tilted at an angle of 23 degrees, find an exact trigonometric expression to give the solar noon latitude as a function of time t in an Earth year of duration Y. You may assume the time of vernal equinox t_{VE} is known to use as a reference point.

—Allan Gottlieb's Puzzle Corner in *Technology Review*

4 Yesterday, I rode my bicycle to work, a straight-line distance of 10 kilometers over level ground. In the morning the trip took 30 minutes with a direct headwind; but in the afternoon the trip took only 20 minutes with the same wind (now a tailwind). Assume the only force I overcame was aerodynamic viscous drag, which is proportional to the square of my speed relative to the air. Assuming all other forces (friction, etc.) are negligible and that I generate constant power, calculate yesterday's wind speed (to the nearest 0.01 km/hr). If the wind is calm today, determine how many minutes the one-way trip will take (to the nearest 0.01 minute).

—**J.L. Griggs Jr.**, *OH A '56*

5 Consider a rectangular strip of leather, white on one side and black on the other. Cut two long slits parallel to the sides of the leather strip, but do not cut through the ends of the leather strip. The result is three leather strips joined at both ends, as shown in the following picture:

The objective is to braid the strips without cutting or altering the leather in any way except folding. Find the minimum non-zero number of strip crossings required to ensure that each side of the completed braid is a uniform color. Assume that only two strips cross at a given point and that no crossing is wide enough to hide a twist in the strip.

—Adapted from *Professor Stewart's Hoard of Mathematical Treasures* by Ian Stewart

Bonus. Find rational circumferences of two spheres that are different in diameter from two other spheres of circumferences 1 meter and 2 meters such that each pair comprises the same total volume.

—*The Canterbury Puzzles* by H.E. Dudeney

Computer Bonus. Consider sequences of exactly thirteen consecutive primes, such that the difference between any two adjacent primes is at most 8. The first such sequence is 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, and 41; there are other examples with small primes — in fact, there is even a sequence

Brain Ticklers continue on page 36.

PEOPLE

Daniel Berg, Ph.D., *New York Gamma '50*, is serving as interim dean of the University of Miami College of Engineering. He has been a distinguished research professor there for 11 years. Previously, he served as dean and then provost at Carnegie Mellon University and as provost and president at Rensselaer Polytechnic University.

Dominick J. Casadonte Jr., Ph.D., *Ohio Alpha '77*, is the recipient of the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring. The award is given to those in "mentoring roles outside traditional classroom settings and work(ing) towards the development of those who go into the STEM workforce." He is a professor of chemistry at Texas Tech University.

John D. Leonard II, Ph.D., *Georgia Alpha '83*, has been promoted to executive dean of the Virginia Commonwealth University College of Engineering and will support dean Barbara D. Boyan, Ph.D., *Virginia Epsilon '70*. He was formerly executive associate dean for finance and administration at VCU and also serves as an advisor to the VA Epsilon Chapter.

W. Samuel Easterling, Ph.D., P.E., *West Virginia Alpha '81*, has been named dean of engineering at Iowa State University. He had been a professor and head of the department of civil and environmental engineering at Virginia Tech, where he was a former president of its faculty senate. His primary research interests are in the areas of composite and cold-formed steel structures. He is an advisor to the Iowa Alpha Chapter.

Byron K. Lichtenberg, Sc.D., *Rhode Island Alpha '69*, is working with students at LeTourneau University to put a miniature CubeSat into orbit. He is a veteran of two space shuttle missions as a payload specialist, flew 138 combat missions in Vietnam, and is now a professor of mechanical engineering at LeTourneau.

Burak Eksioglu, Ph.D., *Florida Alpha '02*, has joined the department of industrial engineering at the University of Arkansas as a professor. His research program is focused on the area of optimization with applications in transportation and healthcare. He also serves as associate editor of *IISE Transactions*.

SJ Claire Hur, Ph.D., *California Epsilon '05*, is working to develop a microfluidics device that can collect and genetically modify tumor cells from the blood samples of metastatic breast cancer patients. She was awarded a grant from the Susan G. Komen Foundation to support her work as an assistant professor at Johns Hopkins University.

SPOTLIGHT

Increasing Women in STEM Fields

Two women engineers from Mississippi State University received a grant from the National Science Foundation for a project designed to identify new ways to recruit and retain women in engineering, specifically science-based computing fields, based on stories from both international and American students with regards to career choice.

Rani W. Sullivan, Ph.D., *MS A '89*, an aerospace engineering professor, is working with assistant professor M. Jean Mohammadi-Aragh, Ph.D., *MS A '02*, on this project.

"Many young women may simply see the challenges and don't realize that engineering will give them opportunities to make very impactful, meaningful, and positive differences for individuals within their communities and the world," Dr. Sullivan said.

The goal of the research is to consider the influence of culture on women's choices to pursue STEM careers. The research team will identify differences in engineering messaging within Moroccan and American cultures to determine factors that contribute to women's decisions to pursue engineering degrees at higher rates in Morocco.

PEOPLE

Ellen Yi Chen Mazumdar, Ph.D., *Massachusetts Beta '08*, is a new assistant professor of mechanical engineering at Georgia Institute of Technology. She also leads the Sensing Technologies Laboratory focused on developing new sensor systems and diagnostic techniques for robotic and other applications.

Mohamad A. Mustafa, Ph.D., *Michigan Epsilon '83*, interim dean of the College of Sciences and Technology at Savannah State University, has been named to the post permanently. He previously worked in industry as a stress engineer for Gulfstream Aerospace.

Melissa L. Morris, Ph.D., *West Virginia Alpha '06*, is an assistant professor-in-residence at the University of Nevada, Las Vegas. Previously, a teaching associate professor at West Virginia University, she now teaches a variety of mechanical engineering classes and serves as a ΤΒΠ District 16 Director.

Max L. Porter, Ph.D., *Iowa Alpha '65*, received the 2019 Alumni Merit Award from the ISU Alumni Association "for outstanding contributions to human welfare that transcend purely professional accomplishments and bring honor to the university." He is an ISU Professor Emeritus and dedicated his career to raising the structural standards for buildings worldwide.

William H. Sanders, Ph.D., *Illinois Alpha '83*, has been appointed dean of the College of Engineering at Carnegie Mellon University. Previously, he was the endowed chair in engineering at the Univ. of Illinois and interim director of the Discovery Partners Institute. He is co-founder of Network Perception Inc., and his research interests include secure and dependable computing & security.

Houssam A. Toutanji, Ph.D., *Michigan Kappa '85*, was selected as dean of the College of Engineering and Computer Science at California State University, Northridge. He had served as dean of the College of Engineering and Applied Sciences at W. Michigan University. His publications are in the area of fibre-reinforced polymer composites.

Bevlee A. Watford, Ph.D., *Virginia Beta '81*, has a new role at Virginia Tech as the College of Engineering's first associate dean of equity and engagement. An alumna of Tech, she has served as CoE associate dean for academic affairs since 1997 and received the 2017 University Rising Star Award from NACME.

John W. Weidner, Ph.D., *South Carolina Beta '86*, was appointed dean of the College of Engineering and Applied Science at the University of Cincinnati. He previously served as department chair and professor of chemical engineering at the Univ. of South Carolina and as visiting scientist at NASA's Jet Propulsion Lab. He is an advisor to the Ohio Beta Chapter.

FACILITIES

North Carolina State University plans to complete Fitts-Woolard Hall by June 2020. It will serve as home for the department of civil, construction, and environmental engineering and the department of industrial and systems engineering. The building is named for **Edgar S. Woolard Jr., Ph.D.,** *North Carolina Alpha '56*, and fellow alumnus Ed Fitts, who made a combined gift of $25 million.

University of Colorado at Boulder recently opened a new Aerospace Engineering Sciences Building. The 178,294-square foot building will house 49 faculty and nearly 1,400 students. Construction began in 2017 and the building also features bioastronautics laboratories, a 200-seat auditorium, and fabrication labs.

University of South Alabama will name the department of mechanical engineering for **William B. "Bill" Burnsed Jr.**, *Alabama Epsilon '72*, who donated $1.5 million to the College of Engineering. Burnsed worked as an engineer for South Central Bell and BellSouth for 20 years before starting Burnsed Oil Co. Inc. "I never would have gotten to where I am today if I had not received my engineering degree," said Burnsed.

University of Wyoming is home to North America's largest center to train petroleum engineers, which includes a new multimillion-dollar simulator suite. The Drilling and Completions Simulation Laboratory is part of the Engineering Education and Research Building that opened in September. The new laboratory will train students for the oil and gas industry using simulator technology and immersive training techniques such as virtual reality.

ALUMNI GATHERINGS

Yale University, the Connecticut Alpha Chapter, hosted an alumni panel discussion and tour of the engineering research facility (including the new Bent monument). The panelists were also members of the Central Connecticut Alumni Chapter.

Many connections were made between Tau Bates in Connecticut and students at Yale University and the University of Hartford. A big thank you to Greg G. Luther, Ph.D., *NY K '85*; Hubert Denis, *MO Δ '16*; Richard A. Campos, *NY A '85*; Kaleia Kramer, *AZ B '16*; and Lauren J. Swett, P.E., *ME A '04*, for serving as panelists and sharing their experiences.

Thanks to Central Connecticut AC president Ming De Lin, Ph.D., *NY Γ '01,* for submitting this collage of images and event summary.

Freshman STEM Scholarships

Every year, six incoming college freshman are awarded a Tau Beta Pi/ SAE Engineering Scholarship of $1,000 to pursue an engineering degree from an ABET accredited program. Below are some biographical details on the 2019-20 recipients.

Noah Covey (Dunwoody, GA) – electrical engineering at Harvard University

Lauren Eccles (Jefferson City, TN) – chemical engineering at University of Tennessee

Andrew McEntaggart (Marietta, GA) – electrical engineering at Georgia Institute of Technology

Mani Pabba (Clarksburg, MD) – computer engineering at University of Maryland

Aksharan Saravanan (San Ramon, CA) – computer engineering at University of San Diego

Nicole Seman (Leesburg, VA) – mechanical engineering at Massachusetts Institute of Technology

To join an alumni chapter, contact the Director of Alumni Affairs, Tricia Gomulinski, *tricia@tbp.org*. Visit *www.tbp.org/Memb/Alumni.cfm* to check on alumni events.

Call for Authors

The Editor of *The Bent* is frequently searching for well-written, general interest, feature articles for the magazine. Many of you have the appropriate experience, are qualified, and capable of preparing such a feature. If you have a topic that you believe would be suitable, email proposals to tbp@tbp.org. Members working on interesting research or design projects are encouraged to submit an article. Manuscripts should be 1,000-3,000 words, double-spaced, and submitted as a text or MS Word document. Publishing decisions cannot be guaranteed.

HEADQUARTERS VISITORS

Susan L.R. Holl, *CA L '76*, Carmichael, CA; November 30, 2018.
Rachel K. Alexander, *CA U '15*, Sacramento, CA; December 1, 2018.
Russ W. Pierce, *WA A '70*, Puyallup, WA; December 1, 2018.
Philip T. Bond, *TN G '19*, Kingston, TN; December 12, 2018.
Liam G. Saccucci-Bryan, *NY S '19*, Mount Tremper, NY; February 9, 2019.
Donna R.H. Riggs, *TN A '87*, Knoxville, TN; March 14, 2019.
Robert A. Edlund, *TN E '79*, Knoxville, TN; March 14, 2019.
Patrick C. Jennings, *TN G '99*, Maryville, TN; March 14, 2019.
Ryan E. Kelly, *TN A '20*, Camden, SC; March 14, 2019.
Preston Spires IV, *TN A '20*, Jonesborough, TN; March 14, 2019.
Richard T. Redano, *NC A '78*, Knoxville, TN; March 14, 2019.
Evan A. Newell, *TN A '20*, Chattanooga, TN; March 14, 2019.
Daryl R. Armentrout, *TN A '65*, Knoxville, TN; March 14, 2019.
Terry D. Olberding, *TN A '78*, Knoxville, TN; March 14, 2019.
Robert L. Olberding, *TN A '82*, Knoxville, TN; March 14, 2019.
Sicilee Macklin, *NM A '18*, Knoxville, TN; March 14, 2019.
Mariah R. Lafond, *TN A '19*, Knoxville, TN; March 14, 2019.
R. Dudley White, *VA A '76*, Sterling, VA; May 22, 2019.

Association Officials receive Resolutions of Appreciation for service at the 2019 Convention. (Left to right) Christina Harrison, *TN A '93,* Scott Fable *CA T '96,* Josuan Hilerio Sanchez, *PR A '07,* and Chris McComb, *CA P '12.*

SERVICE ANNIVERSARIES

Thank you to the following members that have served as volunteers on the ΤΒΠ Fellowship Board.

Charles W. Caldwell, *CA A '64*
6 years of service

Margaret M. Darrow, *AK A '02*
4 years of service

SOCIAL MEDIA

On Instagram:
instagram.com/tau_beta_pi/

On Facebook:
facebook.com/TauBetaPiHQ/

On Twitter:
twitter.com/TauBetaPi

WordPress Blog:
taubetapiathq.wordpress.com/

Follow us on social media and tag us, so we can see your TBP images using #taubetapi.

The condensed style of these notices of death is made necessary by the Association's large membership and space limitations in The Bent. *You may email or write the Editor for additional facts (if available) concerning the following deceased members. The assistance of all is earnestly sought in reporting the deaths of Tau Bates, with appropriate details, including date of death and full name. You may report the death of a member by sending an email to chapter.eternal@tbp.org.*

BADGE **Van Aacken, Karen Louise;** no details.
AL A '54 **Sarinopoulos, George Anest;** September 7, 2019.
'65 **White, Ronald;** September 24, 2019.
AL B '24 **Johnson, George C.K.;** no details.
'56 **Harvey, Joseph Glenn;** November 13, 2018.
'57 **Neighbors, Billy Harrell;** October 3, 2013.
AZ B '77 **Bouwer, Edward John;** October 9, 2019.
AR A '42 **Isely, Francis Dort;** no details.
'57 **Bates, Charles Edward;** August 24, 2015.
'57 **Meador, Norman Watts;** July 7, 2012.
'57 **Nutter Jr., Lysle Hugh;** November 6, 2006.
'57 **Scroggs, Robert Jackson;** May 22, 2006.
'57 **Wells, Mack Ray;** no details.
CA A '54 **Breitenstein, Richard Earl;** December 25, 2015.
'59 **Deleray, Arthur Loyd;** June 29, 2017.
CA B '58 **Stone, Charles Joel;** no details.
CA Γ '38 **Vincenti, Walter Guido;** Oct. 11, 2019. [Cent.]
'48 **Reed, Jack Ellsworth;** February 19, 2019.
'52 **Ma, Paul Chien-Yuan;** September 16, 2019.
CA Δ '48 **Cozens, Eric Trevor;** June 16, 2019.
'57 **Elder Jr., Leon Edward;** August 2, 2017.
CA E '56 **Braverman, David John;** no details.
'65 **Fray, William James;** no details.
'70 **Trask, Philip Arthur;** April 16, 2018.
'86 **Lui, Stephen;** May 29, 2012.
CA Z '63 **Hensley, Henry Paul;** March 31, 2019.
CO A '48 **Wood, Edwin Townsend;** August 24, 2019.
CO B '58 **Lamb, Robert Charles;** no details.
'59 **Mosgovoy, Walter Vadim;** July 6, 2018.
CO Γ '68 **Haydock, Frank John;** no details.
CT A '50 **Donaldson, Edward Eames;** April 19, 2011.
'50 **Stillman, Robert Donald;** August 4, 2019.
CT Γ '54 **Kalika, Peter Walter;** September 9, 2019.
DE A '65 **Herzog, Bruce Milton;** no details.
GA A '56 **Austin, Edward Marvin;** no details.
'57 **Armistead, William Spence;** no details.
IL A '49 **Vanden Boom, Robert Fischer;** August 20, 2019.
'53 **Chen, Chuan Fang;** August 17, 2019.
IL B '58 **Kearney, James Francis;** July 11, 2005.
'62 **Lis, Chester;** October 12, 2019.
IL Γ '49 **Cantwell Jr., Edward Norton;** June 16, 2019.
IL E '83 **Lutzow, David John;** April 7, 2019.
IN A '43 **Reed Jr., Harry James;** June 26, 2012.
'44 **Vickers, Robert Squire;** July 24, 2019.
'48 **Buzard, Robert Spurgin;** March 12, 2012.
'49 **Willmarth, William Walter;** no details.
'50 **Datwyler Jr., Walter Frederick;** May 14, 2016.
'51 **Maxfield, Daniel Paul;** August 18, 2019.
'54 **Truax, Philip Park;** February 1, 2019.
'55 **Gunther, Robert William;** June 28, 2017.
'58 **Crooks, Robert Wendel;** January 4, 2018.
'58 **Doak, Don William;** April 16, 2013.
'58 **Dunn, Wendell D.;** no details.
'58 **Glasbrenner, Stanley Nelson;** March 27, 2019.
'58 **Mitchell Jr., Wayne Darwin;** May 20, 2007.
IN B '49 **Coughanowr, Donald Ray;** September 20, 2009.
'51 **Morehead, Bruce Hutchins;** August 19, 2006.
'57 **Brown Jr., Harold D.;** September 6, 2019.
IA A '44 **Casey, Everett Randolph;** March 24, 2012.

IN MEMORY

Karen L. Van Aacken, was ΤΒΠ Women's Badge recipient number 510. She earned a degree in civil engineering from Marquette University and received her badge from the Wisconsin Beta Chapter.

'45 **Myers, James Lewis;** no details.
'48 **Bottum Jr., Curtis Edward;** February 14, 2005.
'58 **Luckstead, David George;** March 14, 2013.
'58 **Strunk, Richard Dean;** June 19, 2003.
IA B '49 **Nichols, Alan Dean;** no details.
'58 **Kuriger, William Louis;** June 19, 2017.
'58 **Prosser, Arnold Roy;** January 11, 2019.
KS A '46 **Irani, Keki B.;** May 2, 2018.
'53 **Wilson, Bayard Spence;** September 23, 2019.
KS Γ '57 **Bissey, Charles R.;** November 18, 2006.
KY A '58 **Gaddie, Thurman W.;** May 17, 2004.
LA A '47 **Singletary, Ernest Calhoun;** July 30, 2012.
'50 **Doucet, George Elmo;** December 11, 2017.
'58 **Higgins Sr., Charles Marion;** December 24, 2018.
LA B '52 **Beauclair Jr., Gaston;** March 15, 2019.
ME A '48 **Danforth, Donald Worth;** August 17, 2017.
MD B '47 **Beam Jr., Walter Raleigh;** January 15, 2018.
'57 **Haney Jr., William Samuel;** August 28, 2019.
MA A '41 **Parks, Russell Whidden;** May 4, 2016.
'49 **Underwood, Max Elwin;** August 20, 2016.
'51 **Grenier, Aime Joseph;** December 21, 2016.
MA B '42 **Stark, Robert Edward;** January 13, 2019.
'45 **Mumford Jr., Nicholas Van Slyck;** January 16, 2013.
'46 **Hamaker, Richard Franklin;** no details.
'46 **Wadel, Louis Burnett;** June 1, 2019.
'48 **Bangser Jr., William;** October 11, 2019.
'48 **Hill, Jacques A.F.;** February 26, 2014.
MA Δ '57 **Flannery, William Charles;** February 11, 2000.
MA E '47 **Yamartino Sr., Ernest Joseph;** October 4, 2019.
'50 **Chatfield, William O.;** no details.
MA Z '61 **Kelley, Kevin Joseph;** April 1, 2017.
MI A '47 **Mitzelfeld, Thomas Henry;** September 2, 2019.
'49 **Dedecker, Frank Joseph;** September 21, 2017.
'49 **Stepnitz, Claire Alden;** April 26, 2019.
'61 **Gilbert, Jerry Alan;** September 1, 2019.
MI B '49 **Stanaway, Sheldon James;** August 30, 2004.
'50 **Dobb, John Albert;** March 21, 2019.
'64 **Neumann, Edward Schreiber;** October 21, 2017.
MI Γ '41 **Scott, Norman Ross;** August 30, 2018.
'43 **Sleator, Frederick Bishop;** December 30, 2011.
'45 **Hess, Robert Lawrence;** May 19, 2017.
'46 **Johnson, James Louis;** April 15, 2013.
'47 **Marsh, Marvin R.;** April 29, 2005.
'47 **Smith Jr., William Bernard;** April 27, 2019.
'48 **Redfield, John Harold;** March 27, 2018.
'48 **Rosso, John McClelland;** September 17, 2008.
'49 **Frey, Stuart M.;** March 6, 2013.
'49 **Grimes, Harvey J.;** May 9, 2019.
'49 **Kelly, Eaton Vale;** December 7, 2017.

'50 **Brunner, Robert Allen;** June 9, 2017.
'50 **Vigor, Charles William;** no details.
'52 **Gilbert, Elmer Grant;** June 16, 2019.
'57 **Diamond Jr., Horace William;** February 9, 2003.
MI Δ '44 **Best, William Joseph;** April 28, 2018.
'49 **Esper, Jerome Albert;** April 4, 2010.
'57 **Rollinger, Charles Nicholas;** September 17, 2019.
MI E '41 **Moncher, Frank Leonard;** October 2, 2005.
'48 **Heffner Jr., Francis Earl;** no details.
'48 **Hodess, Joseph M.;** no details.
'48 **Shier, John Wellington;** September 3, 2009.
'50 **Burn, Franklin Abbott;** August 13, 2019.
'50 **Homier, Robert I.;** April 23, 2018.
MI Z '48 **DiPietro, Frank Anthony;** December 12, 2016.
'59 **Pratt, Victor W.;** August 31, 2019.
MI H '44 **Allmendinger, Paul F.;** December 16, 2018.
MN A '41 **Severson, Donald Everett;** April 7, 2018.
'57 **Seaburg, Paul A.;** December 29, 2014.
MS A '59 **Brabston Jr., Bryan Willis;** September 6, 2019.
'70 **Dyess, James Roy;** September 17, 2019.
'72 **Lucas, Jerry Lee;** July 29, 2019.
MO B '35 **Murphy, James Joseph;** no details.
'47 **Bennett, Paul Manarde;** September 20, 2017.
'67 **Bereisa Jr., Jonas;** no details.
'85 **Kniepkamp, Barbara Jane;** September 24, 2019.
MO Γ '49 **Kubik, Kenneth Charles;** November 10, 2012.
'54 **Whitworth Jr., Lennie Oscar;** October 14, 2019.
NV B '48 **Wyman, Richard Vaughn;** January 29, 2019.
NJ B '68 **Whetham, Donald Charles;** October 2, 2019.
NJ Γ '52 **Papazian, Jack;** September 22, 2019.
'58 **Meyninger, Rita;** October 19, 2019.
'63 **Jessop, Warren Howard;** February 23, 2019.
NY A '48 **Schnall, Marvin Joseph;** June 19, 2019.
'49 **Roming Jr., Charles;** February 26, 2007.
NY B '49 **Landau, Louis Herbert;** December 30, 2018.
'58 **Webber, Paul Jones;** April 30, 2004.
NY Γ '43 **Lehman, Herbert Martin;** May 2, 2018.
'49 **Ladd, Garth Cook;** August 23, 2013.
'49 **Rishavy, Edward Alvin;** no details.
'55 **Uber, Charles Bertram;** February 19, 2019.
NY Δ '47 **Broeker, Roger John;** September 6, 2019.
'51 **Kirchner, Norman Frederick;** Sept. 16, 2019.
'58 **Elmaghraby, Salah Eldin;** June 12, 2016.
NY E '58 **Lynnworth, Lawrence Conrad;** May 9, 2019.
'61 **Beutner, Roger Earl;** May 3, 2019.
NY Z '57 **Fallet, George;** February 17, 2017.
'67 **Present, Henry;** August 16, 2019.
NY H '57 **Smith, Irving R.;** September 1, 2019.
NY Θ '48 **Lechler, Howard Earl;** June 3, 2018.
'52 **Perfetto, Antonio;** September 18, 2019.
NY Λ '64 **Bieber, Allen Carl;** September 15, 2019.
NY N '50 **Wolf, Karl Adolph;** August 4, 2019.
'52 **Nicholson, Carlton Kendrick;** Sept. 15, 2019.
NC Γ '50 **Chesson Jr., Eugene;** January 17, 2017.
OH A '57 **Lesher, Robert Donald;** June 1, 2015.
OH Γ '48 **Setzer, Carl John;** April 21, 2007.
'58 **Dierksheide, Dale Henry;** March 26, 2014.
OH E '47 **Kopke, Thomas Lawrence;** January 6, 2018.
'54 **Kasuba, Romualdas;** October 10, 2019.
'69 **Kichak, Robert Allen;** October 8, 2017.
'73 **Ross Sr., David Edward;** July 27, 2019.
OH Z '67 **Erickson, Stephen Flanders;** March 4, 2019.
OH H '66 **Puffenbarger, Edward Samuel;** Nov. 15, 2016.
'67 **Anderson, Gerald Marshall;** August 21, 2019.
OK A '49 **Miller, Loyle Pope;** October 23, 2016.
'57 **Schlenker, Robert Henry;** October 31, 2015.
'58 **Walker, Dennie Lee;** January 19, 2000.
OR A '50 **Larsen, Ralph Irving;** July 18, 2018.
PA A '41 **Kalmbach, Charles Frederic;** January 22, 2008.
'43 **Kutosh, Stephen;** April 6, 2015.
'51 **Cummins, Frank Michael;** August 31, 2018.
'52 **Randall, Neil Coulter;** July 12, 2019.
'55 **Van Hoesen, Everett Hamilton;** Sept. 3, 2019.
PA B '49 **Harchar, Joseph John;** September 25, 2019.
PA Γ '42 **Ziga, Ernest Joseph;** October 8, 2019.
'54 **Garrecht, Clark Proctor;** September 18, 2019.
'65 **Young, Paul Jonathan;** September 9, 2019.
PA E '41 **Marchetti, Lawrence Victor;** no details.
PA Z '43 **Mercer Jr., Samuel;** June 20, 2014.
'47 **Ditaranto, Rocco A.;** September 5, 2017.
'50 **Sheaffer Jr., Isaac Martin;** July 12, 2018.
'57 **Hoffman, Robert Frank;** November 7, 2006.
PA H '59 **Wildenberger, Richard James;** October 12, 2019.
PA I '61 **Jefferis III, Raymond P.;** March 25, 2018.
PR A '68 **Arrieta, John Richard;** January 28, 2018.
RI B '48 **Deluise, Frank Joseph;** November 7, 2018.
'56 **Messere, Earle L.;** October 29, 2019.
SC Γ '58 **Lightle, Ted Lee;** September 5, 2019.
SD A '50 **Paullin, Robert Lewis;** October 24, 2017.
'50 **Wilson, Seth Ernest;** December 27, 2017.
'58 **Rozendal, David Bernard;** December 15, 2018.
'83 **Vammer, Paul David;** September 26, 2018.
'86 **Heathershaw, Todd D.;** August 4, 2019.
'98 **Asquith, Aaron Keith;** February 8, 2019.
'13 **Zacher, Jonathan Edward;** July 15, 2019.
TN A '48 **Patterson, Dwight Robert;** September 2, 2019.
'96 **Wyatt, Mark Stephen;** September 17, 2019.
TN B '50 **Tipton Jr., John Howard;** September 26, 2019.
TX A '28 **Hangartner, Max Joseph;** no details.
'49 **Almgren, Frederick Axel;** April 8, 2005.
'49 **Cawley, Aaron;** August 14, 2017.
'49 **Schulte, Francis Leander;** July 14, 2019.
'51 **Totah, Aneese;** no details.
'56 **Boatright, Mody Keefer;** December 19, 2018.
'58 **Davis, Phillip Keith;** June 23, 2015.
'71 **Guy, Gary Boyd;** September 5, 2019.
'72 **Sweat Jr., Robert Herrington;** Sept. 8, 2019.
TX B '43 **Shuler Jr., Holly Culfred;** July 11, 2004.
'48 **McGowan, Walter Edward;** December 24, 2014.
'50 **Valliant, Charles Bryan;** June 29, 2019.
'51 **Brown, Donald Byron;** September 28, 2019.
'51 **Joiner, Johny Blondel;** April 2, 2010.
'51 **Stripling, Richard C.;** October 26, 2010.
'58 **Elliott, Lynn Hamilton;** September 14, 2019.
'65 **Mangrem, George E.;** December 3, 2005.
TX Γ '48 **McKinley, Murray Don;** January 27, 2014.
TX Δ '40 **Hanover, Joe Grady;** May 22, 2017.
'48 **Darsey III, George Edward;** August 29, 2006.

IN MEMORY

Romualdas Kasuba, Ph.D., *Ohio Epsilon '54*, passed away on October 10, 2019, at the age of 88. He was the first dean of the College of Engineering and Engineering Technology at Northern Illinois University. He retired in 2003 and was given the title of dean emeritus. He was elected as a foreign member to the National Academy of Sciences of Lithuania in 1999.

TX Δ	'48	**Halbower Jr., Ralph David;** April 7, 2017.
	'48	**Perry Jr., John Vivian;** January 2, 2009.
	'48	**Wallace Jr., Barton Brinker;** January 11, 2018.
	'48	**Woolf, Jack Royce;** June 10, 2014.
	'49	**Hamilton, Hance Henry;** May 6, 2004.
	'49	**Lipscomb, Lindsey Ivey;** October 2, 2014.
	'49	**Roy, Frank Jackson;** January 2, 2010.
	'49	**Salter, Thomas Ray;** February 20, 2006.
	'49	**Spillman, Pat Yates;** January 11, 2016.
	'49	**Wearden, Paul Leonard;** July 22, 2015.
	'50	**Couch, Billy Lloyd;** July 21, 2015.
	'50	**Hutton Jr., Robert Swanson;** September 23, 2017.
	'50	**Irwin, Paul Eugene;** May 2, 2013.
	'50	**Knight, Henry Allan;** August 21, 2017.
	'50	**Powell, Arthur B.;** August 13, 2018.
	'51	**Dardaganian, Stephen Garabed;** March 27, 2017.
	'51	**Dowling Jr., Cloyd James;** August 26, 2019.
	'51	**Hartman, Kenneth Swift;** March 3, 2018.
	'51	**Martin Jr., Alfred Deloach;** December 25, 2010.
	'51	**Mathis, James Warner;** August 2, 2008.
	'53	**Stinson Jr., Ronald Calvin;** June 27, 2019.
TX H	'48	**Everard, Noel James;** September 13, 2014.
VA B	'57	**Hollandsworth, Edgar Marion;** Dec. 21, 2018.
WI A	'40	**Lowe, Myron Howell;** June 26, 2018.
	'47	**Povejsil, Donald Joseph;** July 8, 2017.
	'49	**Debbink, John Dirk;** March 20, 2019.
WI Γ	'81	**Peterson, Lora Brook;** April 28, 2019.

IN MEMORY

Walter G. Vincenti, *California Gamma '38*, passed away on October 11, 2019, at the age of 102. He was a professor emeritus of aeronautics and astronautics at Stanford University. According to his obituary, he laid the engineering groundwork for flight at the speed of sound and also helped to develop more efficient swept-wing airplane design which is still in use today.

the heritage society

The Heritage Society was created to recognize those who include Tau Beta Pi in their estate plans. Becoming a member can help the Association achieve its mission. For more information, email Sherry Jennings-King at sherry.jenningsking@tbp.org or visit www.tbp.org/giving.cfm

"Tau Beta Pi has been very important to me from the time of my induction in 1960 to the present. It embodies the 4 E's that have been the focus of my professional career: Engineering, Education, Excellence, and Ethics. As such, it has provided inspiration and incentive to thousands of engineering students and alumni and funded hundreds of graduate fellowships. Recognizing that the good things done by Tau Beta Pi require money, Dorothy and I have supported the Society financially as we have been able. We also saw the opportunity to continue our support after we are gone by including Tau Beta Pi as a beneficiary in our wills. It is gratifying to know that the Society will continue its work well into the future and that our legacy will help it to do so."

Lyle's Law creator and frequent contributor to The Bent, *Lyle D. Feisel, Ph.D., P.E. (Ret.), Iowa Alpha '61, is dean emeritus of the school of engineering and applied science at SUNY at Binghamton. His new series Why Do We Call it a...? appears each Summer and Winter.*

IRA Charitable ROLLOVER

The IRA Charitable Rollover provision is an easy, tax-wise way to make a gift to TBP! Donors aged 70½ or older may move up to $100,000 annually from their IRAs directly to qualified charities without having to pay income taxes on it. The charitable gift amount will count against the donor's required minimum distribution (RMD). IRA custodians may send your gift to Tau Beta Pi Association, P.O. Box 2697, Knoxville, TN 37901-2697. Our federal tax ID number is 62-0479545. If you have any questions, visit our website at www.tbp.org/give/IRArollover.cfm or send an email to sherry.jenningsking@tbp.org.

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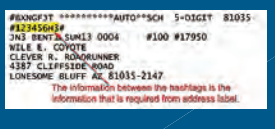


www.tbp.org/EBent

President's Report

Continued from page 13.

Finances

Overall, the financial status of Tau Beta Pi remains strong. There are, however, opportunities to strengthen our finances by staying connected and resonating with members after they have graduated.

Total alumni contributions increased by $60,000 over the fiscal year. Specifically, unrestricted alumni giving totaled $1,020,000 from 8,816 donors. Compared with last year, this is about the same dollar value but a significant decrease in the number of donors who contributed.

There remains a call to action for newer members to transition to alumni chapters for involvement. Lifelong membership does not necessarily equal involvement. But, we want to make sure it does.

Over 30 years ago, in 1987, we had over 319,000 members. Of those, 19,695 donated to Tau Beta Pi, representing nearly 6 percent of our membership at the time. In terms of giving, any school or non-profit would be grateful to achieve this contributor level.

In 2018, we had nearly 600,000 members. Of those, less than 9,000 donated to Tau Beta Pi, representing about 1.5 percent of membership — about twice the number of members but less than half the number of donors. Over the last 30 years, the decrease in number and percentage of members has been steady. If we were to apply the percentage from 1987, we should hope for over 35,000 donors.

To combat this alarming trend, we first want to achieve 100 percent giving from current officers and volunteers. The amount is not critical but the act of donating is. When the number of donors rise, the number of giving dollars is sure to see an impact and it is an important message to communicate to potential donors.

Additionally, in 1998, Tau Beta Pi had 21 percent of donations originate from members 11-20 years removed from graduation and only 13 percent from those 50 years or more from graduation. In 2017, we received over 15 percent of our donations from the 11-20 years removed category and a whopping 32 percent from those in the 50-year category.

Moreover, in 1998, over 15 percent of donations originated from members 0-10 years from graduation but in 2017, that number decreased to 5 percent.

Overall, the number of donors is steadily decreasing. Additionally, donors are getting older and we are not replenishing those donors with younger members.

In recognition of this trend, one of the Development Committee recommendations was to hire an Annual Giving Officer. The Executive Council quickly approved that recommendation. Such a hire is underway. An Annual Giving Officer will focus exclusive attention on member giving, with an emphasis on re-connecting with alumni, in particular our millennial members.

Our Major Gifts Officer, Sherry Jennings-King, has continued to raise significant funds for our Chapter Endowment Initiative (CEI). This is great news for the long-term prospects of our Association.

Image, Visibility, and Branding

Enhancing our image, visibility, and branding remains a primary goal. Although we are approaching 135 years of Tau Beta Pi, as an organization we need to do a better job of broadcasting who we are to prospective members, the engineering community, and to the general public.

In 2016-19, the number of eligible members for initiation steadily increased: 46,000, 48,000, 51,000, and 57,800, respectively. But, a steady 66 percent of those eligible did not join Tau Beta Pi based specifically on a lack of interest in the organization. Two-thirds of those we offered initiation to declined. We must improve and effective branding can help.

We are seeking more ways to earn recognition, raise our profile, and reach a wider audience. This can be done through issuing more press releases. The goal is to make our name more widely known and to attract more interest from those who have earned an invite to join our Association.

One of the areas that we are exploring are the chapters with the highest acceptance rates, which could provide an insight to developing best practices at the chapter level.

Effective branding can generate more members, which can lead to more involvement, more lifelong learning experiences through Tau Beta Pi, and ultimately more support for our honor society.

In April 2019, I traveled to Washington, DC, to participate in the National Academy of Engineering — Convocation of Professional Engineering Societies. Part of my participation was to find mutual areas of interest with other professional engineering societies and to have a chance to increase our academic and industry profile.

One discussion focus noted that despite efforts to increase STEM education, the statistics still show that less than 5 percent of incoming college freshmen choose science, technology, engineering, or math as majors.

Educators resist tying educational pursuits to job prospects; therefore, all paths of study are given equal billing. Many believe, however, that STEM careers should be highlighted so students are motivated to choose the greater challenge and invest in themselves for greater rewards. Engineering is hard, but it is worth the intellectual investment.

Convention

There is a lot of important work to be accomplished in the committees and we rely on your dedication to the tasks at hand.

Also, similar to recent years, we have an excellent line-up of Professional Development Sessions to attend.

Last year, we received feedback that Convention attendees were interested in having more corporations at the Career Fair. We listened. This year, we worked hard to recruit companies and to grow participation in the event. We have 22 companies and 56 total recruiters — our biggest Career Fair yet. Please take advantage of this impressive list.

Finally, I want to mention the photo opportunity on Friday. This was a popular activity last year and we received very favorable feedback from the Convention in Denver; again we listened.

Candidates

For most of the year, the Executive Council governs the operations of Tau Beta Pi. Having capable, professional, and dedicated Councillors is critical to pursuing our mission and managing the organization. On Saturday, the Convention will vote on three members to join the Council.

Please take the opportunity to meet with each of the candidates running for election. I cannot overemphasize the need for good people on the Council.

Closing

In closing, I want to thank Executive Director Curt Gomulinski for his dedication and tireless efforts on behalf of our Association; our Headquarters staff for all the little things that always matter most; our Association Officials and volunteers, who collectively believe in something bigger than themselves; and our donors who have generously supported Tau Beta Pi and helped to pass the torch to a new generation of engineering leaders.

I want to mention one particular Tau Bate who joined our Chapter Eternal this year. Lido 'Lee' Iacocca, *PA A '45*, at Lehigh University, passed away on July 2, 2019. Former Chairman of Chrysler, Mr. Iacocca spoke at Convention in 1985 when we celebrated 100 years of Tau Beta Pi.

Iacocca always applied the "Nine Cs" of leadership to his executive career and I thought it appropriate to share a couple of them with you as you embark on your careers. I've applied them to my own career.

A leader has to be able to communicate effectively. A leader has to have charisma to inspire others and cultivate trust. And a leader has to be a person of character to have the guts to do the right thing in the face of adversity.

WE are the ones who will continue to solve the world's most daunting challenges and change life in profound ways.

WE are the ones who will be responsible for advancing the standard of living and developing things thought impossible.

As Orville Wright stated, "If we all worked on the assumption that what is accepted as true is really true, there would be little hope of advance."

So, let's relentlessly question the status quo. After nearly 20 years as a lawyer, that's why I remain committed to my engineering roots.

It has been a privilege serving as president of Tau Beta Pi this year, but I have most enjoyed simply serving as a volunteer and helping to advance the goals of our Association.

I look forward to meeting many of you these next few days.

Neil Armstrong once said "I believe every human has a finite number of heartbeats. I don't intend to waste any of mine." Don't waste any of yours.

Thank you and have a great Convention.

Wayne B. Paugh, LL.M., JD, *Florida Gamma '93,* has served as an Executive Councillor since 2017, Vice President for 2018, and President for 2019. He has served as a ΤΒΠ Engineering Futures Facilitator for 6 years. Wayne earned a B.S. (mechanical engineering) and B.A. (communications) from the University of South Florida. He was an applications engineer until earning a graduate degree in the management of technology. He then pursued a career change by attending law school in Washington, DC, and specialized in intellectual property. He spent 13 years in DC and worked primarily in the federal government in executive and managerial roles. During this time, Wayne served on Capitol Hill and was the Chief of Staff of the U.S. Patent and Trademark Office. He was also appointed U.S. coordinator for international intellectual property enforcement by President George W. Bush. He now serves as special assistant U.S. attorney in the major crimes division.

BRAIN TICKLERS

Continued from page 27.

starting at 14,713. For larger primes up to 1 billion, find how many such sequences exist and list the first prime in each sequence.

—Adapted from *The Last Recreations* by Martin Gardner

Postal mail your answers to any or all of the Brain Ticklers to **Dylan Lane, Tau Beta Pi, P.O. Box 2697, Knoxville, TN 37901-2697** or email to *BrainTicklers@tbp.org* as plain text only. The cutoff date for entries to the Winter column is the appearance of the Spring *Bent* which typically arrives in late March (the digital distribution is several days earlier). The method of solution is not necessary. We welcome any interesting problems that might be suitable for the column. The Computer Bonus is not graded. Dylan will forward your entries to the judges who are **H.G. McIlvried III**, *PA Γ '53;* **F.J. Tydeman**, *CA Δ '73;* **J.C. Rasbold**, *OH A '83;* and the columnist for this issue.

—**J.R. Stribling**, *CA A '92*

Show Up Tau Beta Pi on Pi Day, March 14

Join us for the Seventh Annual Tau Beta *Pi Day*

Wear your Bent or TBP apparel
Participate in a TBP activity
Post on social media with #TauBetaPiDay

www.tbp.org?PiDay

Your fellow Tau Bates are interested in news about you. Send items about civic activities, honors won, weddings, promotions, changes in address, etc. to Tau Beta Pi, P.O. Box 2697, Knoxville, TN 37901-2697 or to dylan@tbp.org. Material for publication must be received by February 1 for the **Spring** issue and by May 1 for the **Summer** issue. Include name, address, chapter/class year, and email address or phone number. Thank you!

Image credit: NASA

Alabama Beta

William K. Hefner, '84, was selected for the 2019 Wall of Fame class at Boaz High School (AL). He worked for 34 years at NASA on various projects, including the Hubble Telescope and the Chandra X-ray Observatory and was selected to join the Senior Executive Service, the top federal rank for a civilian.

Arizona Alpha

Chris Stemple, '10, was honored with the 2019 Young Alumni Volunteer Award from the University of Arizona for his support and service to the college of engineering. He is a program manager and product engineer for Texas Instruments and additionally serves as a senior design team mentor and recruiter.

California Gamma

Doug B. Lee, '88, joined Dayspring Technologies as a developer with the consulting services team. He spent 20+ years working as a high school math teacher and then as a pastor, but now returns to technology and client solutions. His BS and MS degrees are in electrical engineering with a focus in computer hardware.

California Mu

Helene M. Finger, Ph.D., P.E., '88, received the 2019 Outstanding Faculty Advisor Award at the SWE conference this fall. She joined the Cal Poly Obispo faculty in 1997 and has been the SWE advisor since 2000. She has guided the chapter to more than 10 national Gold Level Outstanding Collegiate Section Awards.

Colorado Alpha

Nadya Sri R. Rushdi, '19, is a recent graduate of the Colorado School of Mines in petroleum engineering. She served as the recording secretary for the CO Alpha Chapter and has joined Schlumberger as a field engineer, where she is motivated to change the mindset of petroleum engineering as a polluting industry.

Courtesy Photo

District of Columbia Alpha

Laurence A. Burley Jr., Ph.D., P.E., '87, was an inductee for the 2019 class of Glen Burnie High School's (MD)Alumni Wall of Honor. He is a manager at LLM Engineering, PLLC; an adjunct professor at Howard University; and his specialty is forensic engineering.

Florida Epsilon

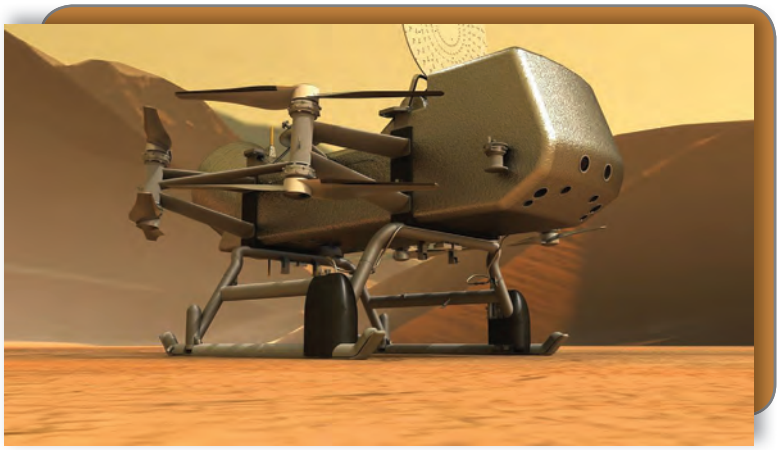
David J. Cowan Jr., P.E., '14, became president of the Palm Beach Chapter of the Florida Engineering Society (FES) at the close of the September meeting. The FES is an association of Professional Engineers with more than 3,000 members. He is a project engineer at Mock Roos & Associates Inc.

Georgia Alpha

Calvin Mackie, Ph.D., '90, received the Chair's Phoenix Award at the Congressional Black Caucus Foundation's dinner. The award recognizes the highest level of dedication, ability, and creativity. He is founder/president of STEM NOLA geared at inspiring and engaging communities in STEM, and a former professor.

New Jersey Delta

Audrey C. Cheng, '20, was awarded the George B. Wood Legacy Junior Prize for recognition of exceptional academic achievement during junior year. She is a senior at Princeton University majoring in operations research and financial engineering and was an investment banking summer analyst for Goldman Sachs.



Artwork of the dual-quadcopter Dragonfly sitting on the surface of Saturn's moon Titan. Credit: JHUAPL / Michael Carroll

Indiana Alpha

Douglas S. Adams, Ph.D., '94, is mission systems engineer for the Carrier and Relay Stage/Spacecraft for NASA's Europa Lander project.

Dragonfly, a rotocraft, is slated to launch in 2026 and land on Titan (Saturn's largest moon) eight years later.

It will survey the surface by hopping around from location to location and use optical cameras, "the same kind of thing you might take a picture with... for navigation, and also use flash LiDAR (light detection and ranging), which allows us to do hazard detection in real time," said Adams. Watch a YouTube video(youtu.be/IdYeWN9ZivE) from NASA on the Dragonfly mission flying/landing sequence animation.

New Jersey Delta

Nicholas A.G. Johnson, '20, received the Class of 1939 Princeton Scholar Award for the junior who achieved the highest academic standing. He is pursuing a degree concentrated in operations research and financial engineering, is NJ Delta Chapter president, and has worked at Google.

New York Upsilon

David T. Bindon, '19, is a 2019 Phi Kappa Phi Fellowship recipient. He is a recent graduate of the U.S. Military Academy with a degree in mechanical engineering and plans to pursue graduate studies in economics and philosophy at the London School of Economics and Political Science.

Ohio Delta

Brig. Gen. Mark C. Arnold (*ret.*), '81, was named 2019 Alumnus of the Year by Ohio University. He served in the military for 37 years, including three combat tours in Afghanistan; earned the Bronze Star Medal, the Legion of Merit, and the Distinguished Service Medal; and also served as president / CEO of GSE Environmental.

Ohio Theta

Tim J. Simon, '19, was named a semi-finalist for the National Football Foundation Campbell Trophy®. Referred to as "The Academic Heisman" and given to the student-athlete who best exemplifies academic success alongside football performance. Simon is a safety for Univ. of Dayton and mechanical eng'g major.

Rhode Island Beta

Christine C. Broadbridge, Ph.D., '89, is vice president of the Connecticut Academy of Science & Engineering. She is professor of physics, executive director of research and innovation at Southern Connecticut State Univ., and was the 2008 CT Women's HOF honoree for outstanding women of science in academia.

Washington Delta

George K. Miyata, '10, has joined DeNOVO Solutions, LLC as a systems architect and will run the R&D program. He previously spent 8 years as an engineer/project manager at Northrop Grumman. He is a ΤΒΠ District 12 Director and past president of the Washington Delta Chapter at Gonzaga University.

TRUE TALES from the TESTBENCH...

Fellow engineers: the story you are about to read is *true*. Only the *names* have been changed to protect the guilty.

Words / Art: Krishna M. Sadasivam
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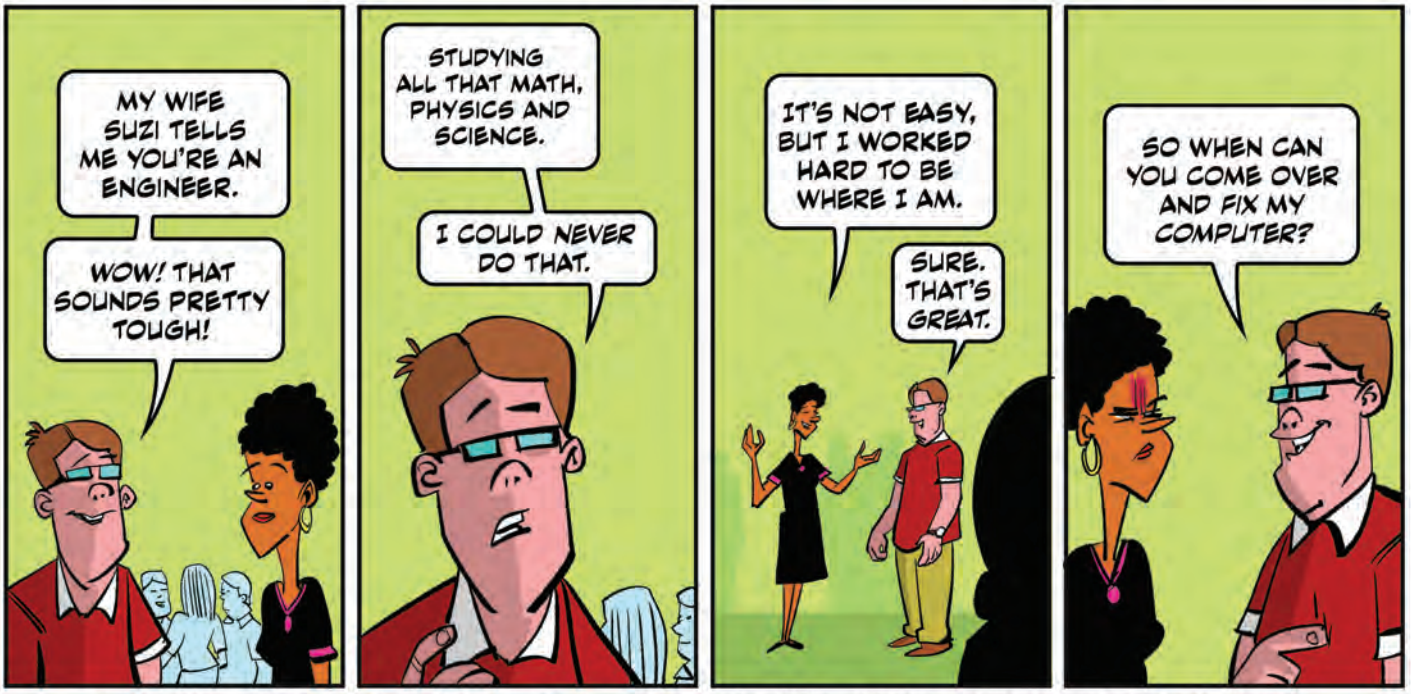

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