

THE BENT

OF TAU BETA PI

The Engineering Honor Society

Spring 2014



Keeping Computers Cool
Leaders: Follow That Dream
Annual Giving

Rise Above the Ordinary

A career at NSA is no ordinary job. It's a profession dedicated to identifying and defending against threats to our nation. It's a dynamic career filled with challenging and highly rewarding work that you can't do anywhere else but NSA.

You, too, can rise above the ordinary. Whether it's producing valuable foreign intelligence or preventing foreign adversaries from accessing sensitive or classified national security information, you can help protect the nation by putting your intelligence to work.

NSA offers a variety of career fields, paid internships, co-op and scholarship opportunities.

Learn more about NSA and how your career can make a difference for us all.



KNOWING MATTERS

Excellent Career Opportunities in the Following Fields:

- Computer/Electrical Engineering
- Computer Science
- Cybersecurity
- Information Assurance
- Mathematics
- Foreign Language
- Intelligence Analysis
- Cryptanalysis
- Signals Analysis
- Business Management
- Finance & Accounting
- Paid Internships, Scholarships and Co-op
- >> **Plus** other opportunities



NSA

www.NSA.gov/Careers

APPLY TODAY



Search NSA to Download

WHERE INTELLIGENCE GOES TO WORK®

U.S. citizenship is required. NSA is an Equal Opportunity Employer. All applicants for employment are considered without regard to race, color, religion, sex, national origin, age, marital status, disability, sexual orientation, or status as a parent.

the Bent of

Spring 2014
Vol. CV / No. 2

*f*ounded 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 Office. Member, American Society for Engineering Education and (co-founder) Association of College Honor Societies. Affiliate, American Association for the Advancement of Science.

Features

Keeping Data Centers Cool12

by Alan S. Brown

Leadership: Hector Ruiz26

by Trudy E. Bell

ON THE COVER:
Server cluster in the high performance computing data center at NREL's Energy Systems Integration Facility in Golden, CO. Alan S. Brown looks at the issues involved in cooling supercomputer systems.



Cover artist: Dali Polivka

Reports

5 Executive Council Meetings

17 Contributors to 2013 Alumni Giving Program

30 The University of Texas-Pan American

Departments

2 Council's Corner 37 Authors

4 Editorial 38 Chapter Eternal

6 Who's Who 42 Families

8 Letters 45 Book Review

10 Association Briefs 46 Alumni Notes

32 In the Colleges 48 Insignia

34 Brain Ticklers

Tau Beta Pi:
THE BENT



Editor: Curtis D. Gomulinski, MI E '01 Editorial Assistant: David S. Roberts
Editorial Board: Lyle D. Feisel, Ph.D., P.E., IA A '61; Samuel C. Florman, P.E., NY A '44; and John W. Prados, Ph.D., P.E., TN A '54

The Bent of Tau Beta Pi® (ISSN 0005-884X) is published quarterly for \$10 per year by The Tau Beta Pi Association, Inc., Room 508, Dougherty Hall, The University of Tennessee, Knoxville, Tennessee 37996-2215; www.tbp.org; FAX 865/546-4579; email: tbp@tbp.org. Life subscriptions are \$75. Printed in U.S.A. Periodicals postage paid at Knoxville, TN, and at additional mailing offices. SUBSCRIBERS and POSTMASTER: Send address change, request for online subs., & other correspondence to tbp@tbp.org or to: The Bent of Tau Beta Pi / P.O. Box 2697 / Knoxville, TN 37901-2697. Telephone: 865/546-4578

Copyright © 2014 by The Tau Beta Pi Association, Incorporated, www.tbp.org. The Bent is the official publication of The Tau Beta Pi Association, Inc., The Engineering Honor Society. Title reg. U.S. Patent and Trademark Office. All rights reserved. Ideas expressed in articles with by-lines in this magazine and in paid advertisements do not necessarily reflect the policy or opinions of the Association.

ADVERTISING REPRESENTATIVE:
UniDiversity
Telephone: 434/244-9776
Email: adv@tbp.org



The Tau Beta Pi Association was founded at Lehigh University in 1885 by Edward Higginson Williams Jr. to mark in a fitting manner those who have conferred honor upon their Alma Mater by distinguished scholarship and exemplary character as students in engineering, or by their attainments as alumni in the field of engineering, and to foster a spirit of liberal culture in engineering colleges.
—Preamble to the Constitution

Passing the Leadership Baton

This is my last opportunity of having the privilege to write a “Council’s Corner” as a member of the Executive Council. That being said, I was hoping to find the inspiration to write one that will leave a lasting impression with you, my fellow Tau Bates. So naturally this would be the one time that writer’s block would decide to set in. I don’t know if the block has been cleared by inspiration so much as the looming deadline to get it written, so here goes...

Over the past week I have been watching the world’s athletes compete at the Winter Olympics in Sochi. Athletes who are the best in the world, who have dedicated their entire lives training and preparing for the opportunity to stand on the podium and receive an Olympic medal and be recognized as the best in their sport. In addition to their great physical ability is the level of sportsmanship exhibited by the athletes even in the face of great disappointment, a testament of their true character.

There are strong parallels we can draw between the Olympics and membership in Tau Beta Pi. As the Olympics recognize excellence in athletic performance, we recognize excellence in engineering. Just as outstanding sportsmanship is expected from an Olympic athlete, strength of character is a prerequisite for a member of Tau Beta Pi. Finally, the preparation to achieve both is the same.

I go back to three principles that stuck with me growing up; the Boy Scout Motto “Be prepared,” the Cub Scout Motto “Do your best,” and the Golden Rule “Treat others as you want to be treated.”

Nothing can be achieved without preparation; practice makes perfect. Success is earned, not given. Hours, days, weeks, months, and years of hard work are required for you to excel in any endeavor. When you achieve your goal, you appreciate it much more because of the hard work and dedication involved.

Even with all the preparation in the world, you can only do what you are capable of doing and nothing more. Focus on that, giving your all in everything you do; don’t worry if it is good enough. In the end, there can only be one winner, but how you compete is how you are remembered. In many cases, no one remembers who won the gold medal but they do remember the person who fell and got back up just to finish the competition knowing they couldn’t win.

Finally, it is not just the results you achieve but how you achieve them. Your competitors share the same

hopes, dreams, and desires as you. Their dedication is no less than yours; their joy when they succeed no more than yours; their pain when they fail no less than yours. Realizing that and showing compassion for others even in the heat of competition is the testament of a true champion.

It is a common thread for success in athletics, for success in academics, and for success in life. That’s probably what appeals to me most about being a member in Tau Beta Pi. Membership is a result of following those three simple principles in which I strongly believe. That is why it has been such a privilege and honor to serve as a member of the Executive Council for this great organization over the past eight years.

As a Council, we prepared, we did our best, and we treated others as we wished to be treated. Thank you for giving us the opportunity to lead Tau Beta Pi. I would like to personally wish the incoming Elevate Council the best of luck in the future and know they will take Tau Beta Pi to the next level.

—Jason A. Huggins, P.E., Florida Alpha ’96, Councillor



TBPI Directory

EXECUTIVE COUNCIL

President Larry A. Simonson, Ph.D., P.E., SD A ’69, SDSM&T Fnd., 306 E. St. Joseph St., Rapid City, SD 57701 larry@tbp.org

Vice President Solange C. Dao, P.E., FL A ’95, 1110 E. Marks Street, Orlando, FL 32803 solange@tbp.org

Councillor Jonathan F.K. Earle, Ph.D., P.E., FL A ’65, 8516 SW 20th Lane, Gainesville, FL 32607 jonathan@tbp.org

Councillor Jason A. Huggins, P.E., FL A ’96, 4701 Hickory Shores Blvd., Gulf Breeze, FL 32563 jason@tbp.org

Councillor Norman Pih, TN A ’82, 811 W. Cherry Ave., Flagstaff, AZ 86004 norman@tbp.org

INTERNATIONAL HEADQUARTERS

Executive Director Curtis D. Gomulinski, MI E ’01, P.O. Box 2697, Knoxville, TN 37901-2697 curt@tbp.org

Asst. Sec.-Treas. Roger E. Hawks, NY A ’75, P.O. Box 2697, Knoxville, TN 37901-2697 roger@tbp.org

Secretary-Treasurer Emeritus James D. Froula, TN A ’67, P.O. Box 2697, Knoxville, TN 37901-2697 jim@tbp.org

Telephone: 800/828-2382 tbp@tbp.org
Fax: 865/546-4579 www.tbp.org

**We do the exams.
You do the math.
Study with NCEES.**

PRACTICE EXAMS

- Developed by the same people who create the actual exams
- Include many questions used on past exams
- Simulate the format, style, and level of difficulty of the actual exam



FE Computer-Based Practice Exams **\$49.95** each
 PE Practice Exams **\$39.95** each
ncees.org/PracticeExams



NCEES
*advancing licensure for
 engineers and surveyors*

\$\$ Benefit for Members

Members may be eligible for an additional discount off their automobile insurance.



Did you know a group of wombats is called a **wisdom**? Did you know that GEICO provides a discount to Tau Beta Pi members on their auto insurance, as well as helps benefit Tau Beta Pi whenever a member gets a quote? Members could save up to an additional 8 percent on car insurance.

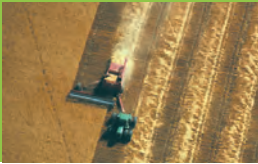
Also, GEICO can help you find great insurance rates on motorcycle, homeowners, renters, boat, and much more. Get a free quote today to see how much you could save with GEICO. It will be a very wise decision! Visit <http://www.geico.com/greek/tbp> or call 1-800-368-2734 for your free quote.

Send THE BENT to Me

(Visit www.tbp.org/store.cfm to pay by credit card, or detach and mail to: Tau Beta Pi, P.O. Box 2697, Knoxville, TN 37901-2697.)

- I enclose \$75, for which I shall expect to receive THE BENT for life. I will keep you informed of any change of address.
- I enclose \$20 as the first payment for a BENT Life Subscription. Remind me to send \$20 each year for the next three years (\$5 processing fee deducted from first payment).
- I enclose \$10, which will keep me on the mailing list of THE BENT for one year. I should appreciate an expiration notice a year from now, so that I may renew without missing any issues. (Note that you may call 800/828-2382 to pay by credit card.)

Name _____ Chapter _____ Class _____
 Address _____ Email _____
 City _____ State _____ Zip _____



EDITORIAL

Tau Beta Pi Day

by the time you read this, the inaugural *Tau Beta Pi Day* (3/14/14) will have passed. I thought I would take a moment to share why we chose this day, how it came about, and something we did with this event that the Association had never done before.

Why Pi Day?

Several people asked why we selected March 14 to celebrate Tau Beta Pi Day. Some suggested June 15 (the day TBPI was founded) would be more appropriate. For those of you who never gave it much thought or have not heard of it before, there is an annual celebration of the constant pi (3.14159...) on March 14 (3/14). There is even an official Pi Day website, www.piday.org. To be honest, I hadn't heard of Pi Day until I started working full-time and took a mathematics education course.

For many years, Tau Beta Pi has struggled to increase its visibility and name recognition. One of the more creative suggestions was to purchase a Super Bowl ad! While this would definitively increase our visibility, many of our programs would also benefit an infusion of a million dollars.. Of course, a million dollars won't even buy ten seconds of airtime during the Super Bowl.

During the Association of College Honor Societies annual meeting last year, I participated in roundtable discussions with Executive Directors from other honor societies. During one of these sessions, Kate Gaertner from Alpha Sigma Nu mentioned that their honor society had a week where chapters participated in activities to promote their society. She even mentioned that TBPI could leverage Pi Day. During an alumni event a few days later, one of our long-time volunteers, Russ Werne, MD B '64, mentioned that increasing the visibility and name recognition of TBPI was something each member could tackle from the ground up. He commented that members should display their membership certificate at work and wear their Bent and Association apparel on a regular basis. Hence, the genesis of *Tau Beta Pi Day* on March 14.

This past summer, the Executive Council and I discussed the idea in more detail and decided that this was a low cost, low risk way of increasing public awareness of TBPI and encouraging members and chapters to participate in an Association-wide initiative. We conducted a design contest for a new t-shirt, placed full-page ads in the winter issue of *The Bent* and *The Bulletin*, highlighted it at Convention, and communicated the idea to student members through email, Facebook, and LinkedIn.

Something New

Since the era of widespread email began, Tau Beta Pi had never sent an email to all of our members. Shortly after arriving at Headquarters, I learned that we had around 105,000 email addresses on file. Unfortunately, we had no

idea how many were valid, and if we were to send an email to everyone, what would we say? On top of that, while our email system was capable of sending thousands of emails, we would undoubtedly get blacklisted with some service providers and face the processing thousands of bounced emails.



Fortunately, we weren't the first group with this problem, and we identified a service that could send the emails and provide a list of invalid addresses.

Most importantly, they would NOT sell our list or contact and market to our members. On February 20, we sent the first ever email to our members about *Tau Beta Pi Day*. The response has been overwhelmingly positive! Although not our original intent, we received an additional 125 t-shirt orders in the first 24 hours. If you didn't receive the email and would like to be included in future mailings, send us an email with your chapter and class to addresschange@tbp.org.

This does not mean you will be receiving regular emails from us. We respect your privacy, and we encourage you to sign up for our Facebook or LinkedIn groups if you want regular updates on the Association. From personal experience, some professional groups email members weekly, if not daily. That is not Tau Beta Pi... perhaps you will see an "all members" email once or twice a year. When you see an email from us, we want you to know it is important. Mark your calendars for next year's *Tau Beta Pi Day*, March 14, 2015. This is a big one for the Pi Day aficionados as it will be the longest extended Pi Day of our lives occurring on 3/14/15 at 9:26:53!

Until Later,

EXECUTIVE COUNCIL MEETINGS

The Executive Council met via teleconference on July 30, 2013.

The report from the Alumnus Recognition Selection Committee to name Lt. Col. Donald W. Rhymer, Ph.D., *CO Z '94*, as the 2013 McDonald Mentor and M. Lucius Walker Jr., Ph.D., P.E., *DC A '57*, as the Distinguished Alumnus was accepted.

The Council reviewed plans for the 2013 Convention and appointed Ronald M. Hickling, *CA E '80*, as the permanent Convention Chair.

Petitions to rename the “Ann Arbor Alumni Chapter” to the “Ann Arbor Area Alumni Chapter” and the “Schenectady Alumni Chapter” to the “New York Capital District Alumni Chapter” were approved.

Executive Director Gomulinski presented the budget for 2013-14. The budget was approved as presented including allocations of \$90,000 to the Engineering Futures Fund, \$35,000 to the MindSET Program, and \$240,000 to the District Program Fund from the General Fund.

The Executive Council met in Knoxville, TN, on August 10, 2013.

S.H. Ross, *CA K '06*, was appointed to the Laureate Selection Committee to a term ending June 2015; J.W. Johnson Jr., *NC A '77*, was appointed as the 2013 Convention Parliamentarian.

Councillor Huggins reported on the work of the Director of Alumni Affairs Selection Committee. The Council accepted the recommendations and appointed Tricia E. Gomulinski, *SD A '98*, as the Director of Alumni Affairs to a term ending June 2015.

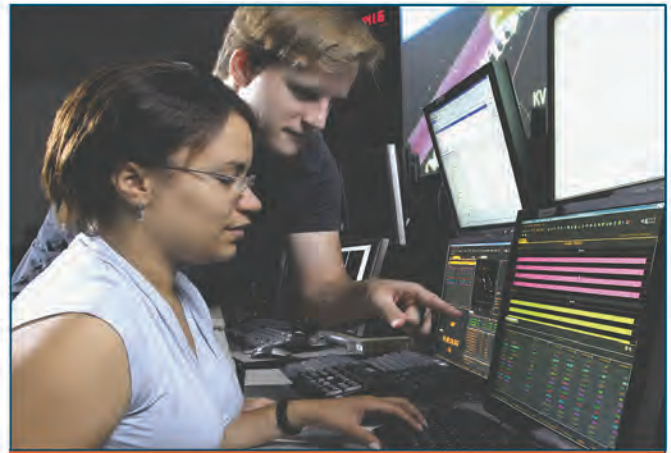
The Council accepted Executive Director Gomulinski's 4th quarter financial report and Director of Development Pat McDaniel's 2013 Alumni Giving Program report.

A proposal to increase the subscription prices of *The*
(Continued on page 25)

Chapter Project Awards

Three chapters were mistakenly omitted from the list of chapters receiving a Chapter Project Award in the Winter 2014 issue of *The Bent*. They were:

CHAPTER / INSTITUTION	NO. PROJECTS
MI E Wayne State University	33
<ul style="list-style-type: none"> Planting of trees with the Greening of Detroit. YES! Expo; teaching the K-12 community about eng'g. 	
PA B Pennsylvania State University	16
<ul style="list-style-type: none"> Carved pumpkins to decorate Fall Harvest Festival. Wrote out envelopes in support of Dance MaraTHON. 	
PR A University of Puerto Rico	32
<ul style="list-style-type: none"> Organized a “play day” at St. Judas Elderly Home. Cleaning trash and debris from Municipal Beach. 	



MIT LINCOLN LABORATORY

Discover the satisfaction of innovation and service to the nation

Since 1951, when MIT Lincoln Laboratory was established to build the nation's first air defense system, the Laboratory has been applying advanced technology to solve problems critical to national security. Decade after decade, our people have envisioned incredible technology and projects that start out as vital to national security and often become just as vital to the everyday technology of the future. More than 700 patents have been granted for technologies developed by the Laboratory's staff. In the past two years, Lincoln Laboratory has been awarded six R&D 100 Awards that recognize the year's 100 most technologically significant innovations.

If you'd like to contribute to U.S. national security in an environment of incredible innovation – then begin your career at MIT Lincoln Laboratory.

Aerospace or Mechanical Engineering
Algorithm Development
Applied Math
Circuit Design and Laser Development
Computer Engineering
Computer Science and SW Engineering
Cyber Security
Digital Signal Processing
Electrical Engineering
Machine Learning and Computer Vision
Modeling and Systems Architecture
Physics

All positions are located in Lexington, MA.

For information on our current opportunities, please visit www.ll.mit.edu/employment

For information about our schedule of on-campus information sessions and interview dates, please visit www.ll.mit.edu/college

As an Equal Opportunity Employer, we are committed to realizing our vision of diversity and inclusion in every aspect of our enterprise. Due to the unique nature of our work, we require U.S. citizenship.

 **LINCOLN LABORATORY**
MASSACHUSETTS INSTITUTE OF TECHNOLOGY



WHO'S WHO

Mary T. Barra, *Michigan Zeta '85*, has become chief executive officer of General Motors. She was previously executive vice president for global product development, purchasing and supply chain.



Daughter of a GM die maker, Barra began her career with GM in 1980 as a General Motors Institute (Kettering University) co-op student at the Pontiac Motor Division. She graduated with a B.S. in electrical engineering. In 1990, Barra received an M.B.A. from the Stanford Graduate School of Business. She met consultant husband Tony while at Kettering, and they have two children.

The National Academy of Engineering has announced the award of the 2014 Bernard M. Gordon Prize for innovation in engineering and technology education to four Dartmouth College engineering faculty members, three of them Tau Bates. The



four are, from left, John P. Collier, D.E.; **Charles E. Hutchinson**, Ph.D., *MA Z '57*; **Joseph J. Helble**, Ph.D., *PA A '82*; and **Robert J. Graves**, Ph.D., *NY B '67*. They are receiving the award for the design and implementation of Dartmouth's engineering entrepreneurship program, an educational paradigm that

integrates entrepreneurship into all levels of the curriculum—from the undergraduate through the doctoral level.

Thomas A. Kennedy, Ph.D., *Ohio Eta '79*, pictured, has been named as CEO of defense and aerospace company Raytheon, effective March 31. The 35 years-plus Raytheon veteran has been executive vice president and



chief operating officer of Raytheon since April 2013 and led the recent consolidation of the company's six businesses to four. Kennedy succeeds **William H. Swanson**, *California Mu '72*, who has been CEO for 10 years.

Tau Bates were on the list when the White House announced 102 recipients of this year's Presidential Early Career Awards for Scientists and Engineers. This is "the highest honor bestowed by the United States Government on science and engineering professionals in the early stages of their independent research careers." The winners, who will receive their awards at a Washington, DC, ceremony, included:

Lucy E. Cohan, Ph.D., *NY A '05*, CIA/Intelligence Community; **Jennifer A. Dionne**, Ph.D., *MO G '03*, Stanford University/Department of Defense; **Mohamed Y. El-Naggar**, Ph.D., *PA A '01*, USC/Department of Defense; **Derek A. Paley**, Ph.D., *CT A '97*, University of Maryland/Department of Defense; and **Jennifer L. Reed**, Ph.D., *CA Psi '00*, University of Wisconsin-Madison/Department of Energy.

Ernest B. Gardow, Ph.D., P.E., *Connecticut Alpha, '56*, has been posthumously awarded the NCEES Examination Service Award for ser-

vice to development and improvement of licensing exams. Gardow, who passed away June 30, 2013, was a leader and contributor to engineering licensure exam development for almost 40 years, first for the state of Connecticut and then NCEES. He became professor of mechanical engineering at the University of Hartford in 1968, and, for a number of years, was chair of the mechanical engineering department.

Susan M. Lord, Ph.D., *New York Delta '87*, has been awarded the



Nikola-Tesla Chain, which is conferred by the International Society of Engineering Education for outstanding achievements in education and pedagogy.

It was presented at a ceremony in Kazan, Russia. She is currently professor and coordinator of electrical engineering at the University of San Diego. Lord is an IEEE senior member and the current president of the IEEE Education Society. (See Authors on page 37)

Timothy W. Simpson, Ph.D., *New York Delta '94*, professor of industrial engineering and mechanical engineering at Pennsylvania State University, has been awarded ASME's 2014 Ben C. Sparks Medal for services to



engineering education. Simpson was honored for his contributions while director of the Bernard M. Gordon Learning Factory from 2007-2012. The factory combines the real-world and the classroom by giving students experience of industry-sponsored, client-based projects.

National Academy of Engineering

The National Academy of Engineering has elected 67 new members and 11 foreign associates, announced NAE President C.D. (Dan) Mote Jr., CA A '59, in early February. Election to the academy is among the highest professional distinctions accorded to an engineer. It honors those who have made outstanding contributions to "engineering research, practice, or education, including, where appropriate, significant contributions to the engineering literature," and to the "pioneering of new and developing fields of technology, making major advancements in traditional fields of engineering, or developing/implementing innovative approaches to engineering education." New Tau Beta Pi/NAE members are listed below.

Daniel E. Atkins III, Ph.D., PA H '65, W.K. Kellogg Professor in Community Information; professor of electrical engineering and computer science, University of Michigan, Ann Arbor. For leadership in development of radix algorithms and cybertechnical collaborative systems.

W. Terry Boston, TN Γ '72, president and chief executive officer, PJM Interconnection, Norristown, PA. For leadership in development and operation of large electric grids and markets for wholesale electricity.

Paul F. Boulos, Ph.D., KY A '85, president, chief operating officer, and chief technical officer, Innovyze, of Broomfield, CO. For contributions to theory and practice of computational hydraulics simulation technology for water infrastructure.

Ruben G. Carbonell, Ph.D., NY E '69, Frank Hawkins Kenan Distinguished Professor of Chemical Engineering, North Carolina State University, Raleigh. For research and innovation in multiphase reactor design, high-pressure thin-film coating, and novel bioseparation processes.

Carlos F. Daganzo, Ph.D., MI Γ '72, Chancellor Professor of the Graduate School and retired Robert Horonjeff Chair in Civil and Environmental Engineering, University of California, Berkeley. For engineering contributions to traffic, transportation, and logistics systems and operations.

J. Gary Eden, Ph.D., MD B '72, Gilmore Family Endowed Professorship of Electrical and Computer Engineering, University of Illinois, Urbana-Champaign. For development and commercialization of micro-plasma technologies and excimer lasers.

Thomas F. Edgar, Ph.D., KS A '67, George T. and Gladys H. Abell Endowed Chair in Engineering, department of chemical engineering, University of Texas, Austin. For contributions to mathematical modeling, optimization, and automatic control of chemical and microelectronics processes, and for professional leadership.

Iraj Ershaghi, Ph.D., CA Δ '65, Omar B. Milligan Chair in Petroleum Engineering, and director, Petroleum Engineering Program, University of Southern California, Los Angeles. For contributions to characterization of complex fractured reservoirs, and for leadership in university-industry collaboration.

Gregory L. Fenves, Ph.D., NY Δ '79, executive vice president and provost, University of Texas, Austin. For contributions to computational modeling, creation of open source software for earthquake engineering analysis, and academic leadership.

Katherine W. Ferrara, Ph.D., CA Y '83, distinguished professor and founding chair, department of biomedical engineering, University of California, Davis. For contributions to theory and applications of biomedical ultrasonics.

J. Karl Hedrick, Ph.D., MI Γ '66, James Marshall Wells Academic Chair and professor of mechanical engineering, University of California, Berkeley. For analysis and control methods for nonlinear systems with application to practical problems.

Norman P. Jouppi, Ph.D., IL Γ '79, distinguished hardware engineer, Google Inc., Mountain View, CA. For contributions to the design of computer memory hierarchies.

Roger B. Krieger, Ph.D., WI A '64, retired group manager, General Motors Research and Development, Birmingham, MI. For contributions to engine research, advanced engine technologies in passenger vehicles, and leadership in engineering education.

Charles A. Mistretta, Ph.D., IL A '62, John R. Cameron Professor of Medical Physics and Radiology, University of Wisconsin, Madison. For contributions to development and application of angiographic methods in X-ray and magnetic resonance imaging.

Yale N. Patt, Ph.D., MA E '62, professor of electrical and computer engineering, Ernest Cockrell Jr. Centennial Chair in Engineering, and university distin-

guished teaching professor, University of Texas, Austin. For contributions to high-performance microprocessor architecture.

George M. Pharr IV, Ph.D., TX Γ '75, Chancellor's Professor and McKamey Professor of Engineering, University of Tennessee, Knoxville. For development of methods for determining mechanical properties of materials by nanoindentation.

Jennifer L. Rexford, Ph.D., NJ Δ '91, Gordon Y.S. Wu Professor in Engineering, Princeton University, Princeton, NJ. For contributions to the operational stability of large computer networks.

Bob E. Schutz, Ph.D., TX A '63, Joe J. King Chair in Engineering and FSX Professorship in Space Applications and Exploration, University of Texas, Austin. For contribution to the use of Satellite Laser Ranging and Global Positioning System tracking to study earth system dynamics.

David B. Spencer, Sc.D., PA E '67, founder, chairman, and chief technology officer, wTe Corp., Bedford, MA. For invention and entrepreneurship in materials manufacturing and recycling.

Jery R. Stedinger, Ph.D., CA A '72, professor, school of civil and environmental engineering, Cornell University, Ithaca, NY. For statistical methods for flood risk assessment and optimizational methods for hydropower system management.

Ian A. Waitz, Ph.D., PA B '86, dean of engineering and Jerome C. Hunsaker Professor of Aeronautics and Astronautics, Massachusetts Institute of Technology, Cambridge. For analysis of environmental effects of aviation enabling practical environmental regulations.

Alan N. Willson Jr., Ph.D., GA A '61, distinguished professor and Charles P. Reames Chair in Electrical Engineering, University of California, Los Angeles. For contributions to the theory and applications of digital signal processing.



LETTERS

Honor That Pride!

• Though a loyal member of New Hampshire Alpha, I do have some comments about the lack of recognition of Tau Beta Pi organization. I attended my wife's reunion at the University of Massachusetts, Lowell where she received her teacher's degree. On the side of one of the science buildings there is affixed a very large Bent indicating that the university has members.

I wore my Bent proudly. Certainly a university reunion would be a proper place to acknowledge the proud organization. However, there was not a single person who had any idea what Tau Beta Pi represented, or didn't even remember seeing the large Bent on the wall.

Certainly every engineering student should not only be aware of the honor, but should strive to be a member. I was unaware of the Association until I was nominated in my junior year. My interest at the time was good grades, a good job after college, and a good background in the sciences. My dedication to good grades was probably based more on the fact that I was married, on the GI bill, than any attempt at honors.

When new engineering students go through their freshman indoctrination, they should be made aware of the existence of Tau Beta Pi and what is required of them for inclusion. It is a proud limited honor and should be explained as such.

Thank you for letting me use the soapbox.

Earl D. Russell, NH A '57

Debt-Free Graduation

• Thank you for awarding me a Tau Beta Pi Scholarship for the Fall 2013 semester. The Record No. 798 scholarship allowed me to pay for my final semester of school and achieve my goal of completing college debt free. I recently graduated from the University of Toledo summa cum laude with a degree in chemical engineering. I have secured a full time job and will begin working in

January. I plan to attend graduate school in the near future. Thank you for your financial support which has helped me achieve my goals.

Joanne K. Beckwith, OH Z '13

NSA

• I suggest that Mr. Davis and Mr. Utter follow up on their threats to withdraw their memberships because *The Bent* accepts ads from the NSA. [Letters to the Editor, Winter 2014]

While it is good to see similar opinions from members of very different generations, their common suggestion regarding refusal of ads by some agencies and not others is totally impractical. *The Bent* has and continues to accept ads from General Dynamics, General Motors, and General Electric, the three "evil generals" of the Vietnam era. Ads from Apple, HP, Google, etc. are also accepted, even though those hardware and service providers also spy on any of us who have a cell phone, connection to the Internet, or credit card.

I also cherish the freedoms that define America. I also understand that freedom isn't free and that bad guys of all ilk are looking to take any and all freedoms, and our way of life completely away. I'll tolerate collection of data on EVERYBODY's phone records, etc., so that nearly all acts of terrorism are stifled or perpetrators can be apprehended very quickly (think Boston Marathon bombers, 2013).

George J. Licina, IL A '72

• Please add my name to those who are encouraging you to accept no more ads in *The Bent* from NSA.

To me, the most important reason is the inconsistency between Tau Beta Pi's commitment to "exemplary character" and the admission of the NSA Director that he lied to Congress. What Tau Bate would wish to work for such an organization?

All that is required for the tri-

umph of evil is for good men to do nothing.

*Roch J. Shipley, Ph.D., P.E.,
IL B '76*

Reconnecting with TBPI

• Your recent alumni gifts campaign letter has prompted me to do something that I should have done much earlier—re-establish contact with the Association. I was the first Assistant Secretary-Treasurer of Tau Beta Pi.

Bob Nagel visited Texas Alpha in 1961 when I was secretary of the chapter. The next year I was president of the chapter and got to know Bob better at the Convention. He told me that he needed help in the central office and asked if I was interested in a position as his assistant. We discussed it during the year, and my wife and I visited Knoxville in April of 1963. Bob and the Executive Council made me an offer to become Bob's assistant, and after careful consideration, I accepted. We moved to Knoxville in the summer of 1963, after I completed my graduate work at The University of Texas.

As I remember it, after I was in the office about a year, the Executive Council proposed an amendment to the Constitution creating the position of Assistant Secretary-Treasurer, the Convention approved the amendment, and I was appointed to the position. All told, we spent six happy years in Knoxville. Our son and daughter both were born there, and we thoroughly enjoyed our time in Tennessee and with Tau Beta Pi.

Leaving was probably the hardest decision I ever had to make. There were a number of factors involved, but the decision ultimately became a matter of necessity. Both my parents and my wife's in Texas were elderly and had severe health problems, and we simply could not take care of their needs from 1,100 miles away.

So, I contacted a UT classmate who several times had tried to get

NAVAL RESEARCH LABORATORY

ACCEPT THE CHALLENGE

Are you a seasoned professional or a recent college graduate seeking challenging and rewarding employment? Would you like to become a member of an elite research and development community involved in basic and applied scientific research and advanced technological development for tomorrow's Navy? Technical excellence and achievement through exchange of new ideas, opportunities for continuing education, and publication of research results is strongly encouraged. NRL offers a wide variety of challenging research positions.

The main office of NRL is located in Washington, DC with remote sites located at Stennis Space Center (MS) and Monterey, CA. NRL is always looking for new achievers with backgrounds and/or graduate-level education in Aerospace, Ceramics, Computers, Electronics, Material and Mechanical Engineering, Computer Science, Chemistry, Materials Science, Metallurgy, Physics, Geology, Geophysics, Meteorology, and Oceanography.

APPLY TODAY

Applications accepted for specific vacancies only. Employment opportunity information for all NRL sites is available on our Human Resources website <http://hroffice.nrl.navy.mil>. If you do not have access to the internet/require more information, please call our Human Resources Job Information Center **(202) 767-3030**.



NRL • 4555 Overlook Avenue, SW, Washington, DC 20375

www.nrl.navy.mil

NRL is an Equal Opportunity Employer

me to join him at Southwest Research Institute Institute in San Antonio. The Institute made me an offer, I accepted a position in the materials engineering department, and we left Knoxville late in May 1969. I spent the next 28 years doing challenging and enjoyable work all over the world in the fields of failure analysis and corrosion engineering, retiring in 1997. We have thoroughly enjoyed our retirement, particularly traveling and watching six grandchildren grow and mature.

My years with Tau Beta Pi were rewarding, both professionally and personally. One unique pleasure of the job was meeting and getting to know Red Matthews a bit. Working with Bob Nagel in effect was a second graduate degree. Bob was truly a "liberally educated" man and both my mentor and good friend. I saw him several times after we left, but I never had the chance to visit him in Knoxville before he died.

Enough ancient history. I am pleased to see from the website that the Association has grown and advanced greatly in the past 40+ years. I am particularly pleased to see how what we called "the fellowship program" has grown and flourished. This is wonderful! Thank you and best wishes.

Fred F. Lyle Jr., TX A '62

In Memory of John Luchini

• I was shocked to read about the passing of John Luchini in this past issue of *The Bent*. He was such a kind person and great asset to TBPI. I worked with him on a few EF sessions in Akron.

Stephen J. McCarthy, OH K '07

Trudy Bell

• A few days ago I was thinking of Trudy Bell and was so thankful to Jim and now to you for publishing her articles in *The Bent*, and was wondering how many had been published so far. I was pleased to see that you recorded this number, namely twenty, at the close of her latest article, in the current issue. The current article, like all the others, is very well written and timely.

Forrest W. Schultz, PA Z '62

Lyle's Laws

• Enclosed is a check, which represents the Tau Beta Pi portion of orders [of Lyle's Laws] received to the end of 2013, and orders continue to trickle in. Most people include a little note about what their career and what Tau Beta Pi has meant to them. It is really a pleasure to receive their letters.

We have sold just over 500 cop-

ies of the book with 260 being sold through the Tau Beta Pi promotion. From what I have been told about what most authors sell, I am quite pleased with these results. And of course, we continue to sell a few.

Lyle D. Feisel, Ph.D., P.E., IA A '61

• As a past avid reader of the quarterly publications of Lyle's Law in

(continued on page 36)



ASSOCIATION BRIEFS

ALUMNI CHAPTERS AND MEETINGS



Tom Yamachika, CT A '80; Barbara Low; **Bruce Liebert, CA H '70;** **Claire Fukuoka, OR Γ '11;** **Todd Reed, MN A '77;** **Josh Lau, CO A '08;** Nancy Reed; Kristi Young; **Mark Locatelli, CA A '92;** **Marcia Leung, CA Z '12;** Jonathon Loo; Brennan Yamamoto; **Kai Gemba, CA Θ '08;** **Brandon Low, IN Γ '14;** Sandrinha Brunke; **James Low, CA Δ '83;** **Timothy Lum Yee, GA A '13;** **Tom Marzec, MD Γ '87;** and

During their vacation in January, Executive Director Curtis D. Gomulinski and Director of Alumni Affairs Tricia E. Gomulinski met with alumni in Honolulu at the Coconut Waikiki Hotel and had dinner with more alumni on Maui. If you live on Oahu or Maui and are interested in future activities, please let the Director of Alumni Affairs know via tricia@tbp.org. In Honolulu, top, were, from left, Curt Gomulinski; **Lee Mitsumori, WA A '88;** **Queenie Komori, MA H '87;** **David Smith, NJ Γ '74;**

Geraldine Lum. Gathering on Maui were (seated from left) **Rob Riebling, NY N '60;** Shelley Womack; Tricia Gomulinski; Dale Stewart; **Keith Knox, NY K '70;** (standing from left) Sara Jacobi; **Jesse Brinkman, CA Φ '13;** Karen Nelson; **Tom Nelson, CA Λ '67;** Curt Gomulinski; **Ellen Styles, AL Δ '85;** **Robert Styles, AL Δ '76;** **Robyn Walters, MA B '68;** **Pam English, CO B '84;** and **T.S. Kelso, OH H '88.**

Washington, DC, Alumni Chapter's expanded executive committee was installed late last year. They are (clockwise from the front row right) **Kaitlyn H. Krukar, VA B '10,** President; **Robert L. Hershey, MA Δ '63,** Director of Programs; **Bryan S. Wade, OK A '94,** Director; **Keith K. Benson, VT B '96,** Director; **Leonard Sadauskas, UT A '66,** Immediate Past President; **Jennifer L. Modugno, PA A '08,** Secretary; **Christopher Schanze, FL A '82,** Vice President; and **Stephanie J. Bechtold, PA Λ '05,** Treasurer.
 —Jennifer L. Modugno, jmodugno@hntb.com



Take on the P.E.
Then take on the world.



This is the time to stand out. And nothing says outstanding like professional engineer.

BECOMING A P.E.

- Increases your earning capacity
- Enhances your professional prestige
- Allows for greater career freedom and more opportunities

Earn the credential that's recognized wherever engineering takes place.

Where will your P.E. take you?

Find out what it takes.
ncees.org/licensure
800.250.3196



NCEES
advancing licensure for
engineers and surveyors

VOLUNTEERS WANTED

The Association is interested in identifying members who might wish to serve as Convention Chair or Parliamentarian in the future. Individuals must be familiar with Robert's Rules and should have experience in conducting meetings with that philosophy.

These two volunteers must be able to attend Convention in Spokane, WA, from October 2-4, 2014. Interested candidates should express their interest to the Executive Director no later than May 15.

We are also looking for District Directors in the Cincinnati, OH; Houston, TX; Oklahoma City, OK; and Washington, DC, areas.

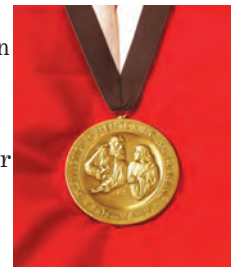
District Directors are asked to visit their local chapters (typically 4-6 per director) once per year and attend and assist with the annual District Conference, the three-day annual Convention in the fall, and the Association Officials meeting in June. Directors serve as a resource for local chapters, collaborate with one to three other directors in the district, and assist in general administrative work.

- For any of these positions, please send your resume to tbp@tbp.org and indicate the volunteer position for which you wish to apply.

MCDONALD MENTOR NOMINATIONS

Marion and Capers W. (*North Carolina Gamma '74*) McDonald and the Association established an award for excellence in mentoring and advising among Tau Beta Pi members.

Recipients of the Tau Beta Pi-McDonald Mentor Award are chosen by a committee and presented with an engraved medallion, and a \$2,000 cash award (\$1,000 to the honoree and \$1,000 to the nominating chapter or to the honoree's chapter if nominated by a member).



Any chapter or member may nominate one (or more) alumnus member(s). Email the following brief material in digital format to Headquarters by April 1.

- 1) A one-page summary of achievements and/or contributions of the nominee exemplifying the objective of the award.

- 2) Two letters of reference from persons other than the nominating party or sponsoring chapter president who are familiar with the nominee's contributions and achievements, such as a dean or supervising personnel.

GET INVOLVED WITH TAU BETA PI

Check out the list of active alumni chapters at www.tbp.org/Memb/alumniContacts.cfm and connect with alumni in your area. There may be a chapter near you! If not, contact Director of Alumni Affairs, Tricia Gomulinski, at tricia@tbp.org for other possibilities.

Keep it Cool! Inside the World's Most Efficient Data Center

Warm water is part of the system that keeps supercomputers in business and the sidewalks snow free in renewable energy research

By **Alan S. Brown**

WARMING SIDEWALKS to melt snow seems an extravagant waste of energy. Yet that is just what the National Renewable Energy Laboratory, the nation's top alternate energy lab, does on the plaza fronting the new wing at its Golden, CO, headquarters. More surprisingly, those ice-free sidewalks actually showcase the incredible efficiency of NREL's new high performance computing center.

The center houses Peregrine, a supercomputer made of thousands of interconnected servers and capable of 1.2 quadrillion floating-point operations per second. Peregrine is used for large and complex simulations as NREL researchers look for ways to integrate renewable energy systems into the electrical grid.

Behind its tall glass walls, the computing center is a radical departure from previous data centers. It crams a lot of computing power into a very small space. Peregrine takes up less than one-third of the center's 10,000 square-foot area, much smaller than comparable supercomputers. The room has none of the large floor vents that conventional data centers use to direct cold air at servers. Nor are there any chillers, the giant air conditioners used to cool com-

puter room air. Instead, warm water circulates through the servers, drawing away heat that NREL uses to warm the rest of the new 182,500 square-foot facility—and keep the entrance free of snow and ice.

"We designed it from chips to bricks to be the world's most efficient data center," its director, Steve Hammond, said.

Data center energy use is usually ranked by power utilization efficiency, or PUE. It equals the amount of energy used by a data center divided by the energy needed to run just the computers. A perfectly efficient data center that used all its energy for servers would have a PUE of 1.0. The Uptime Institute, a professional organization for data center operators, found the average PUE of members' largest (and presumably best run) data center was 1.8-1.9, while other estimates have pegged the national average at 2.5.

More Energy

Hammond designed his data center to reach 1.06. In other words, it will use only 6% more energy than it takes to run its computers to run the center's infrastructure. Yet that does not fully capture the center's true efficiency, since PUE does not count the credit the data center should receive for

warming offices and sidewalks.

Switching from energy to money puts things in perspective. Hammond expects to save \$800,000 annually when compared to a more typical data center with a 1.8 PUE. He also expects NREL to save another \$200,000 on its heating bill. And, by eliminating expensive chillers and other cooling infrastructure, the new center costs less to build than conventional installations.

NREL's new high performance



The NREL complex at Golden, CO. Photo: Dennis Schroeder/NREL

computing center is certainly on track to be one of the world's most efficient data centers. But it has competition, especially from such Internet giants as Amazon, eBay, Facebook, and Google.

Until recently, most of these companies closely guarded their data center designs and operational procedures. After all, for Internet companies, data center operations are as much a competitive advantage as a new process or procedure in a manufacturing plant.

Their silence made them an easy target for criticism, especially because data centers consume so much electricity. Consider, for example, Facebook. Every day, its users upload 350 million photos, send more than 10 billion messages, and click "like" 5 billion times. That takes a lot of computing power. Its Prineville, OR, data center, one of several, covers nearly six football fields. Together, Facebook's server farms draw enough electricity to power a city of 155,000 people. Google, the world's largest data farm operator, could power a city of 750,000, more than the populations of Boston, Seattle, or Denver.

Data centers are also increasing electricity use at a dizzying rate. Facebook's consumption rose 33% in 2012, and Google's jumped 47% between 2010 and 2012. Stanford University's Jonathan Koomey estimates that servers now use 1.7-2.2% of all electricity in the United States. Globally, the world's data centers use roughly as much electricity as New Zealand or Singapore.

Inefficient Infrastructure

Greenpeace and other environmental groups complained that they were incredibly wasteful. That argument gained some traction. So did Congressional hearings on data center waste. Then, in the fall of 2012, *The New York Times* published a series of articles that claimed only 6% to 12% of data center electricity went into actual computing. The rest was wasted on woefully inefficient infrastructure and wasteful backup computers that did no real work.

At that point, the industry began to respond. While some data centers were indeed grossly inefficient, others used outstanding engineering to drive electrical consumption—and costs—way down. Facebook's most efficient data centers have PUEs of 1.09, while Google's best checked in at 1.06 (and that was two years ago).

In fact, as measured by PUE, the best commercial data centers used 9 to 15 times less power to run their infrastructure than the 1.8-1.9 average identified by the Uptime Institute. That is an enormous gap. How did it happen? And how can NREL drive its PUE down so low but still heat its sidewalks?



ABOVE: Steve Hammond, director of the computational science center at the NREL, stands in front of computer racks in the high performance computing data center. BELOW: Pipes circulate water beneath the high performance computing data center. Photos: Dennis Schroeder/NREL .





Cooling fans at the Facebook data center at Lulea in northern Sweden. Photo: Facebook

To understand how things got so out of hand, forget about high performance computing centers like NREL's and consider commercial data centers. Since the birth of the Internet, they have had to run to stand still, and they are still trying to catch up with demand. First, they expanded so everybody could get online. They added more capacity to stream music, sporting events, games, and high-definition movies. More recently, they bulked up to serve smartphone and tablet apps.

To survive, data centers had to be fast. Websites that couldn't handle a sudden surge in traffic or that spent too long queuing up a movie or game lost viewers and revenue. They also needed to be reliable, since outages meant lost revenue. Last year, for example, Amazon sold \$2,361 worth of goods every second. If its computers were only 99% reliable, it would lose roughly \$745 million annually. Raise that to 99.9% and the loss drops to \$75 million. At 99.99%, it falls to \$7.5 million.

The same economics apply to all Internet companies, which is why data center managers spend nearly all their time paying attention to uptime. "They want their facilities running 99.995% of the time. That's where they get their bonus at the end of the year," said **Dennis P. Symanski**, *Massachusetts Epsilon '74*, a senior project manager at the Electric Power Research Institute (EPRI), a power utility think tank.

To keep up with demand and prevent failure, data centers added rack after rack of increasingly powerful servers to meet day-to-day requirements and also peak demand. "They never unplug an old server; they use it as a backup," Symanski said. They also run the same applications on many different servers, so if one goes down, the others are ready to step in. Even so, front line servers spend most of their time waiting for the next search request or customer order. Yet, the data center world does not see this duplication as waste, but as reliability.

Such duplication comes at a cost, especially in terms of power consumption. Data centers must power all their servers, and also the infrastructure that keeps it running. That

includes everything from air conditioning and fans to power transformers and constantly charging backup batteries.

In the past, energy was always a distant second to uptime. But as the Internet giants revealed how they combined reliability with economy, other companies began to ask why they could not do the same. According to the Uptime survey, 57% of data center managers say energy savings is very important, and another 39% say it is somewhat important.

Discussions about wasted energy always begin with cooling. Servers, like any electrical device, emit heat. Cram thousands of them into a room and temperatures rise while servers begin to fail. Preventing that consumes most of the non-IT electricity used in data centers.

This starts with multimillion dollar chillers, the giant air conditioners that circulate cold air through the building. Chillers are one of the few mechanical systems in the data center. They run 24/7 and are prone to breakdown.

Pedal to the Metal

They are also energy sinks. The most efficient way to run chillers is pedal to the metal, yet most data centers rarely run them above 50% of capacity. Why? Because reliability always comes first. Running two chillers at half capacity ensures that if one fails, the other can ramp up to 100% and take its place, explained Steven Carlini, senior director of global data center solutions for Schneider Electric.

The chillers push cold air through floor vents, where it comes out in aisles flanked by front-facing racks of servers. Fans pull the cold air through the racks, where it cools the servers and exits as hot air in the rear.

In a poorly organized data center, not all the racks in an aisle face in the same direction, so some might blow hot air directly into the cooling stream. Some racks may run hotter than others and create hot spots that never cool properly. Even when aisles are properly aligned, they release hot exhaust into the building, raising its temperature and forcing chillers to work harder to cool the room.

There are many simple ways to solve these problems. Managers can reshuffle servers between racks to prevent hot spots and align racks so they form hot and cold aisles. Most data centers either contain cold air in aisles or pipe hot exhaust out of the data center so it cannot mix with room air. Data centers are also growing warmer. Anyone who walked into a data center 10 or 15 years ago quickly noticed the chill. Technicians often wore sweaters or fleecies to stay warm. Since then, temperatures have been inching upwards. While 43% of data centers still run at temperatures below

70°F, some 48% now operate in the 71°F to 75°F zone. Some of them get a lot hotter than that.

This is due to the giant strides taken by chip and equipment makers. According to Jay Kyathsandra, Intel's manager of data center efficiency solutions, most facilities could run the latest Intel chips at 77°F to 81°F simply by doing things they should be doing anyway, like aligning hot and cold aisles, containing hot or cold air, and eliminating hot spots.

They could go even higher, to 86°F to 95°F, by using economizers. This is the data center equivalent of opening the windows. The key, Kyathsandra said, is to locate somewhere relatively cool and move large amounts of outside air through the facility. This is exactly what Facebook does at Prineville. It is located in Oregon's cool high desert, where fans drive outside air through the facility. When temperatures rise too high—about 6% of the time—Prineville diverts warm air through water-drenched media, which cools the air the way misters cool crowds standing in line in amusement parks. According to Facebook, Prineville has a PUE of 1.09.

Facebook, Google, Amazon and many others have also tackled the problem of duplicate servers with a technique called virtualization.

In the past, when servers were less powerful, applications such as catalog databases and streaming video, each needed to run on its own server, Symanski explained. Today, servers can easily host several applications at a time. Sophisticated software divides each of these physical servers into "virtual" servers that act as if they are operating independently of one another.

As demand for servers ebbs and flows, these virtual servers expand and contract. "These apps can spread across multiple servers. In fact, Google's crawler, which indexes the contents of web pages, is running on thousands of servers at once," Symanski said. The same type of software can also adjust the size of hard drives to create virtual storage systems on the fly. Because data centers can adjust their computing resources so rapidly to meet demand, they can finally unplug slow and under-utilized servers without sacrificing reliability.

When Hammond began planning NREL's data center in 2006, he did not have to worry about virtualization. Supercomputing time

is a scarce commodity, and researchers generally book time weeks and even months in advance. Supercomputers always run near capacity.

But he did have to tackle cooling. Supercomputers use the most powerful servers and they tend to generate lots of heat. Hammond quickly realized that he could not achieve new levels of efficiency with air cooling.

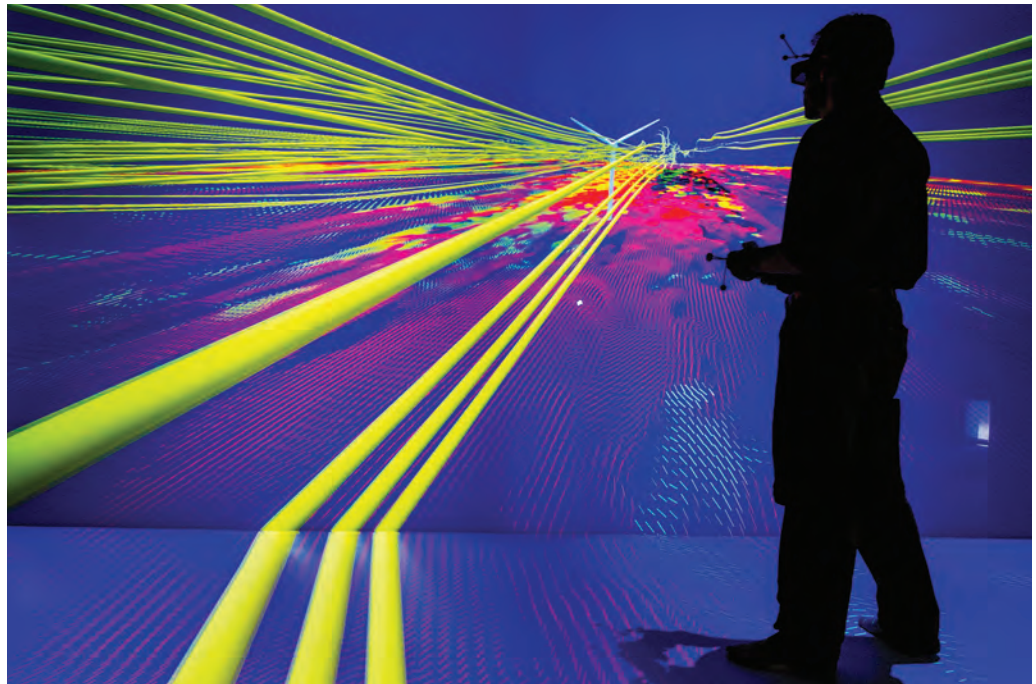
A New Type of Data Center

"From a data center perspective, it's not very efficient," he explained. "It's like putting your beverage on your kitchen table and then turning up the air conditioner to get your drink cold."

Instead, NREL decided to cool its servers with water. In terms of physics, this makes sense. Compared with air, water has greater heat capacity, thermal conductivity, and density. It removes heat 1,000 times better than air. "It is the difference between sitting in front of an air conditioner or jumping in a pool. But from an energy efficiency standpoint, that's where you have to go," Hammond said. He also noted that a juice glass of water has as much cooling capacity as a room full of air.

While the physics made sense, electrical engineers recoil at the idea of running water through hot electronics. It is right up there with crossing the beams in *Ghostbusters*. They may acknowledge water's superior cooling power, but its potential for leaks, short circuits, and corrosion threatens operating reliability.

It took NREL and partners Intel and Hewlett Packard a couple of years to develop and test a safe and reliable liquid cooling technology. HP plans to unveil this new generation



Peregrine runs complex simulations. Here, senior scientist Kenny Gruchalla examines the velocity field from a wind turbine simulation using a 3D model. Photo: Dennis Schroeder/NREL



Inside the hot aisle containment racks in the high performance computing data center at NREL's Energy Systems Integration Facility. Photo: Dennis Schroeder/NREL

of water-cooled servers this year, but has not yet discussed the technology in any depth.

Water cooling has been used to cool supercomputers going back to Cray's vector processors 30 years ago. More recently, IBM used it in several supercomputers, including Blue Gene/Q. What makes NREL's system different is that it uses warm rather than chilled water, it deliberately packs its racks with servers to heat them up, and it fully integrates the hot water into the building design.

Warm Water Cooling

Why warm water? First, as Intel's Kyathsandra noted, today's processors can withstand much higher operating temperatures. Warm water is all NREL needs to keep them running at full speed. Second, to truly drive down energy costs, NREL had to eliminate mechanical chillers, which are used to cool water as well as air.

Instead of chillers, NREL uses a series of heat exchangers and segregated cooling loops. This starts with an evaporative cooler, which chills water the same way perspiration lowers the temperature of our bodies on a hot day. As some water in the system evaporates, the process removes heat and lowers the temperature of the rest of the liquid. (On cold days, running the water through the roof-mounted heat exchanger is enough to reach the desired temperature.)

NREL uses tap water for the evaporative loop, since it releases water into the atmosphere. Its other cooling loops are closed because the water contains rust inhibitors and antibiological agents to prevent the formation of scale and biofilms that can clog cooling systems.

Water from the evaporation system chills the water in a series of 50-gallon containers distributed throughout the facility. This water is cooled to 75°F, filtered, and then sent to the computer.

Since Hammond wants to reuse the computer water to heat his building, he needs to get it hot. To do this, he jams lots of servers into his racks. A typical data center rack holds servers drawing 20kW; NREL's racks draw 80kW. That is hot enough to rapidly heat the cooling water to 95°F or higher.

The hot water heats a 3,000 gallon closed loop system that keeps the rest of the facility warm. It uses beam heaters, which resemble old fashioned steam radiators. Hot water circulates through the heater, which acts as a heat exchanger to warm the air in the rooms.

According to Hammond, the system provides all the heat needed for the new wing. "We use the heat exchanger all year round," Hammond said. "We're always bringing in air from

the outside because we suck air out through the lab. Even in the summer, we have cold nights, and we pre-heat the air so we don't bring in cold air," he explained.

The result is not just a data center that sets new PUE milestones, but one that is fully integrated with its environment. Equally important, it is highly stable and reliable.

"It provides a thermally stable environment that improves system stability. Instead of throttling back clock server speeds due to overheating, we can operate at the highest possible speeds," Hammond said.

It is a marvel of innovation, a self-contained system that not only provides all the uptime its users demand but one that slashes operating costs to the barest minimum.

Yet, it is just one of many innovative designs that have begun to attract attention. Facebook's Norwegian data center, for example, is located inside a naturally cool cave and takes advantage of glacial waters for cooling. Google's Belgian data center, which uses fresh air and water for cooling, lets temperatures rise as high as 95°F.

Yet, so many other data centers have been left behind. Even among large companies, 22% of Uptime respondents do not use hot/cold aisle containment. That rises to 38% among small companies. They have a long way to go in terms of raising operating temperatures or using outside air.

That is likely to change. NREL and the Internet leaders show that data centers can run more efficiently and save money. They are setting a standard, and increasingly, data center managers are noticing.

Alan S. Brown has been an editor and freelance writer for more than 30 years and lives in Dayton, NJ (insight01@verizon.net). A member of the National Association of Science Writers and former co-chair of the Science Writers in New York, he graduated magna cum laude from New College at Hofstra University in 1974. He is an associate editor of *Mechanical Engineering* and contributes to a wide range of engineering and scientific publications.

2013 Alumni Giving Program November-January Contributors

The names of an additional 3,211 Tau Beta Pi alumni who made donations to the Association in the 2013 Alumni Giving Program appear in two separate sections on the following pages. Their gifts totaling \$297,280 arrived between November 1, 2013, and January 31, 2014. **Gifts received after January 31st do not appear here but will be published in the Summer 2014 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. Member-contributors appear in the last 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 through the Combined Federal Campaign and Network for Good and are also deeply appreciated.

Donor Recognition Clubs

The names of 2,299 Tau Bates appear in this first section. They made donations to the 2013 Alumni Giving Program between November 1, 2013, and January 31, 2014, 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 our Society, with confidence in our financial resources, to plan for modest 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	Founder's Club	250
Heikes Club	50,000	Zeta Club	2,500		

HEIKES CLUB

NYE Lynnworth, Lawrence C. '58
RI A Anonymous '72

ALPHA CLUB

CT A Soderberg, Peter Holton '68

BETA CLUB

AZ B Myers, Gerald E. '70
CA B Schlinger, Warren G. '44
CA A Mleczko, Eugene Leon '47
CA E Pappone, Daniel Charles '77
CO B Anonymous '78
FL B Crews, Renard Calvin '70
IN A Ford, Steven R. '80
Griffin, Abbie J. '74
Sarkisian, Nancy Louise '77
IA A Faidley, LeVern William '67
Meyer, James H. '51
LA G Kitchens, Philip Hudgins '67
MAB† Bose, Amar Gopal '52
NJ A Bezos, Jeffrey P. '86
NYK Knox, Keith Thomas '70
NCA Johnson Jr., James William '77
SD A Gomulinski, George E. '98
TX A Schulte, Francis L. '49
Yates Jr., Saint Clair P. '65
TX H Trich, John Albert '70
WAA Beall, P.E., Richard L. '77
WI A Smith, Rodger F. '64
WI G Cronce, Richard Gordon '77

DELTA CLUB

CAB Sartelle, John E. '79
CA† Levin, Robert E. '53
CA E Tozaki, Ronald Yuji '74
CA Z Grigsby, David A. '84
CA I Pickett, Albert E. '75
CAN Caddock Jr., Richard E. '72
CA E Hickey, Jessica Ruth '88
Hickey, Robert William '88
CA O Turhollow, Charles B. '81
CO A Laughlin II, George T. '75
FL A Bolton, Charles H. '62
Kalter, Howard L. '66
GA A Brown III, Emil W. '82
IL A† Hanz, P.E., Daniel Frank '41
Spitzer, Robert Edward '61
IN A Grimm, Robert A. '50
Sedlacek, Warren Richard '45
IN G Rice, Donald B. '61
KS A Kleist, Robert A. '51
MDB Stahle, Carl Michael '81

MAA Fenton, Harvey Albert '58
MI G Fay, John Edward '56
Simmons, Charles David '50
MI E Frye, James H. '51
MI Z Haun, Ross M. '54
Thebert, Alan '57
Volpe, David Randall '74
MOB McHenry, Steven Dale '81
NHA Sherman, John L. '54
NJ B Mudie, Samuel Hunter '62
NJ A Mendelsohn, Andrew J. '77
NY† Gorin, Ralph Edgar '70
NY† Judd, Robert Paul '78
NYK Rudin, Murray E. '83
NC† Buehler, Martin George '61
OH A Tupa, Robert Charles '45
OH B Throckmorton, Dean W. '82
OH† Ross, Elliot Bennett '69
OK A Hall, Ralph Roy '64
Morris, Jay Kevin '81
SC B Daley, Leslie N. '71
SC† Davis, Emmett Irwin '50
Good, Mary Lowe '50
TN A Pih, Norman '82
TX A Lyon, Robert Yerdon '50
Rushing, Jay A. '76
UT A Morrison, Michael George '88
VA A Pitzer, William G. '75
WAA Okita, Richard Y. '56
Pierce, Russell W. '70
WVA Landes II, Junior H. '64

ZETA CLUB

AL B Acree, Elaine S. '76
AL A Koebel, Terry G. '84
Styles, Ellen Sanders '85
Styles, Robert Charles '76
AZ A Carrillo, Danny J. '95
Milan, John M. '67
AZ B Stout, P.E., Roger Paul '77
AR A Biggadike, Robert Holden '58
CA A Meyer, Jack A. '54
CA B Lippie, Gerald Zee '55
Shombert, Lee A. '79
CA† Marks, Stuart W. '84
Trane, Frank Hood '53
CA A Sekimura, Gerald Takashi '73
CA E Gliksmann, Jerome A. '62
CA Z Going Jr., E. Jackson '49
CA E Koblitz, Gordon Frank '66
Smith, Gregory W. '75
CA A Domning, Edward E. '84
CA M Fewell, Thomas J. '72

Heitkamp, Ross S. '85
CA O Treinen, James Patrick '85
Davidson, Jeffrey D. '79
CO A Knight, William James '79
Harris, William Robert '68
Harris, Karen L.W. '74
CT B Chatfield, Larry A. '71
Morrow Jr., John L. '73
DE A Levie, Stefan Gerhard '91
Levie, John L. '73
DC B Youssel Mir, Paul '78
FL A Vice, William E. '70
FL B Tilles, Arno William '84
IL A Fue, Harold '57
Pfefer, Bernard L. '47
IL† Dompke, Richard Kenneth '56
IL Z Woyna, Mark A. '87
IN A Barker, Kenneth Dale '64
Taylor, Harold L. '51
IN B Taylor, Jerry D. '62
IN† Buran Jr., Joseph E. '75
Jones, Walter T. '64
IN A Stechholz, Jonathan M. '72
IA A Ask, P.E., Andrew C. '64
IA B Carson, David Nethermark '54
KY A Dunning, William E. '61
LA A Comeaux, Ph.D., Keith A. '89
Williams, Colleen D. '82
ME A Brigham, Ernest B. '53
MDB Burdick, Martin M. '56
Crane, Thomas C. '62
Loger, Jaan A. '63
Trimble, Alan R. '71
MAA Duris, Robert A. '74
MAB Goldstein, Andrew C. '69
MAA Birger, Jordan '43
Carter Jr., Arthur A. '51
Coutts, Robert Bruce '72
Kulpinski, Richard J. '59
MAE Sladec, P.E., John R. '77
Stevens, Janet M. '72
MAZ Cetti, Richard P. '70
MI A Colbry, Dirk Joel '06
Colbry, Kathleen Luchini '99
Spindler, Jeffrey David '79
MI B Funk Jr., Clarence G. '63
Jeneke, Samson A. '77
MI† Battel, Steven James '79
Padzieski, Robert J. '70
Seidel, David Allen '81
MI E Gomulinski, Curtis Dennis '01
Thompson, George W. '55
MI I Allen, Christine Baros '85
Allen, Michael Peter '85

MS A Faries Jr., Charles E. '57
Goldsmith, William Alee '64
MO† Gibbs, Kenneth P. '76
Rossetti, David J. '74
MT A Collins, Douglas M. '71
NJ A Forslund, Donald Charles '60
Post, Edwin Lewis '62
NMB Sevier Jr., James M. '96
NY A Kofman, Boris '86
NY B D'Avignon, Edward Joseph '88
NY† Luckett, Larry W. '83
NY A Gibson, Michael Addison '66
Hart, Marjorie Leigh '51
Kemp, Thomas Ward '59
NYZ Present, Henry '67
NYH Varon, Michael '73
NY† Dujmich, Louis C. '78
NY A Abrardo, Joseph M. '72
NY Z Runowich, Carl Joseph '84
NY† Demmel, Ph.D., Johann G. '83
Stalzer, Jeffrey '74
NC A Walker, Gary K. '70
NC† Anapol, Edward '76
Linker, Edward M. '47
OH† Albery, James O. '59
Howland, Smith Eugene '69
OH Z Zelms, Charles M. '73
OH H Senyk, Joseph M. '67
OH I Anonymous '87
OH A Ryan, P.E., Daniel John '90
OH M Bowers, Keith Allen '91
OK A Edwards, Paul A. '87
Markland, Ralph John '88
OR A Eden, James D. '79
Lynch, Stanley C. '73
Milton, Stuart W. '84
PA A Wagner, Theodore W. '71
PA B Stockburger, Richard '73
PA E Scott, Walter Alfred '59
PA Z Forbes, Blair C. '58
PA H Thompson, Robert Alan '60
PA A Honath, Mark F. '80
SC A Doss, Thomas G. '71
Harman, J. Patrick '65
SD A Adel, Greg T. '78
TN A Baker, Jon P. '74
Froula, P.E., Ret, James D. '67
Massimini, Michael I. '76
Peishel, Frank Louis '61
TN B Layne, Margaret E. '80
Marianelli, Walter D. '75
Parrish Jr., Thomas F. '75
TX A Klump, D. Craig '77

TX B Tran, P.E., Tan Dai '87
Glenn, Stephen W. '66
Tye III, John M. '67
TX Z Wint, Stephen P. '83
TX H Schmidt, Robert W. '84
TX† Barrett, Gerald G. '70
UT A Eide, Eric Norman '89
VA A Hardy Jr., Edward I. '69
VA B Fetter, Robert Barclay '47
Harras, Edgar D. '67
Jones, John H. '73
WAA Gunter, Robert A. '62
WAB Cass, Robert D. '83
Zwolinski, John Anthony '68
WI A Deluce, Gregory James '59

CHI CLUB

AL A Hill, Gregory J. '74
Roberts, Yvonne Renee '95
Talbot, Thomas F. '52
Ulltagraff, Dewitt '72
Vottgatter, Walter K. '73
Wear, A. Wesley '92
AL B Bell III, Willis '78
Bess, William E. '46
De Lorenzo, Joseph D. '57
Harwell, P.E., Kenneth E. '59
Bradell, James M. '76
Herbst, Jane N. '80
AK A Braun, David R. '74
Cline, John Robert '81
Robinson, Wayne M. '80
Usibelli Jr., Joseph E. '81
AZ A Bailey, Harold E. '71
Berg, Jeffrey R. '93
Da Silva, Eduardo G. '58
Erickson, Kenneth L. '68
Womack, Donald E. '50
AZ B Latta, David Raymond '89
Wilcox, Milton E. '69
AR A Hunt, Gary W. '84
Kimmel, Dennis E. '88
Smith, Byron D. '85
CA A Weaver, Mark E. '74
Figueira, Michael Robert '73
Kirschman, Randall Keenan '66
May, Howard R. '51
McCune Jr., Ph.D., Earl W. '79
Ravenscroft, Dewey S. '63
Richman, Mitchell I. '77
CA B Creutz, Michael J. '66
Jessen, Howard E. '46

CHI CLUB, CONTINUED

Kulawik, Alan Eugene '93
 Lee, Roland R. '75
 Young, Lawrence R. '71
 CA Γ Cotton, Thomas A. '65
 Hardison, R. Logan '57
 Hess, Kenneth L. '74
 Inouye, Lance M. '68
 McClendon, Scott '60
 Parker, Henry Whipple '45
 Rodriguez, David A. '58
 Sansbury, James D. '66
 Tirado, Leo A. '73
 Ullman, Marc A. '83
 CAA Bruce, Steven Ray '78
 Fong, Franklin M. '69
 CA E Curry Jr., Winfield S. '57
 Gaunt, Arnold J. '80
 Gritton, Eugene B. '63
 Karagozian, Ann R. '78
 Masumura, Robert A. '62
 Spencer, Gordon F. '74
 Tucker, Leonard L. '76
 Woo, Raymond '72
 CA Z Downey, James B. '62
 Javete, Donald F. '51
 CA H Broadston, Robert D. '94
 Burrows, Stanford '63
 Cirigliano, Richard L. J. '81
 Trebaol, George O. '75
 CA Θ Bach, David P. '69
 Brewsaugh, Gregory S. '78
 Kawahara, Lester M. '80
 CA K Ramirez, Marvin J. '82
 CAA Horn, Jeffrey Ben '79
 Pickles, William R. '80
 Snyder Jr., Roland C. '74
 Stanley, Richard L. '79
 Yamamoto, Ko '84
 CAM Keiser, Randy Jay '73
 Mitsuoka, Jeffrey Minoru '79
 Rodgers, Patrick J. '80
 CAN Emery, Linda R. '82
 Lamoureux, Mark S. '81
 Ruid, John E. '73
 CAO Caballero, Ross C. '72
 Fitzsimons, Michael J. '79
 Mulvihill, Michael E. '60
 So, Wilson Francis '68
 CA II Beevers, Timothy R. '78
 Steinberg, Demetris P. '72
 CAT Shen, P.E., Eric Chi-Chun '93
 CA Y Gruspe, Nancy T. '58
 CO A Krantzler, Irvin '54
 Van Dinter, Jennifer Ann '97
 CO B Aerstin, Franklyn G. P. '64
 Aronson, Haskell Harold '52
 Bartlett, Paul E. '51
 Colonell, P.E., Joseph M. '58
 Eason, Ernest D. '71
 Kayse, Kevin S. '78
 Knapp, Barry G. '81
 Shapiro, Robert J. '47
 Turner, P.E., Edward W. '50
 Wilson, Paul L. '69
 Wood, John E. '71
 CO Γ Hough, H. Vernon '52
 Linek Jr., Frederick J. '52
 CO Δ Fisher, James E. '78
 Mehring, Richard W. '72
 CO E Hepworth, James C. '63
 CT A Fischer, Edward Michael '89
 Flint Jr., Robert B. '62
 Hawley, Chester G. '47
 McLeod, Christopher K. '77
 CT B Klopffenstein, Rex C. '59
 Layman, Timothy P. '79
 Rinaldi, Biaggio '68
 Taylor, Kenneth D. '71
 DE A Kimpel III, Paul H. '70
 DC A Belcher, Wade D. '70
 Gathungu, Peter Ger Maina '93
 Lee, Walt H. '73
 DC B Maggio, John J. '81
 FL A Gordon, Horace Cadwell '64
 Hayden, James G. '69
 Layman, Robert W. '68
 Osteen, John A. '67
 Ruth, Byron E. '55
 FL B Ault, Richard H. '64
 Elnaggar, Suzanne '93
 Jennings IV, Tipton D. '54
 FL Γ Caramalis, Nicholas '75
 Collins Jr., William Louis '75
 Garcia, Gerardo P. '83
 Lanco, Barbara J. '79
 Shimura, Mitsuo '74
 FL Δ Palm, William H. '55
 FL E Skemp, Susan H. '81
 Stierlen, Lorelei Beth '97
 GA A Backhaus, George P. '83
 Barber, Brian R. '81
 Coons, Louis W. '81
 Cooper Jr., Basil P. '65
 Gilliland, Clinton R. '59
 Hilton, Joanne Louise '80
 Kaduck Jr., William W. '76
 Malone, Thomas J. '63
 Monk, Robert F. '63
 Jones, Douglas Warren '80
 Kasper, Frank Stanley '52
 Krupka, John F. '52
 Mast, Robert Frederick '57
 Ostrodka, David L. '70
 Schoenberg, Kurt F. '72
 Tataru, Richard M. '78
 Temnery, Victor J. '54
 Zieliński, Edward Lee '74
 IL B Gurney Jr., P.E., Donald P. '59
 Kinast, John A. '79
 Lewis, Burton A. '48
 Uherek, Frank C. '82
 IL Γ Aagaard, James Stuart '53
 Armstrong, Donald R. '62
 Bockstahler, Alan J. '54
 Cunningham, Richard G. '43
 Guest, Howard Brandon '81
 Timmerman, Nancy S. '72
 IL A Hachtel, Dale A. '68
 IN A Brodie, Bruce R. '65
 Bullions III, Robert J. '64
 Carlson, Richard A. '70
 Egilsrud, Richard L. '81
 Ehlers, Steven M. '77

Jones, Douglas Warren '80
 Kasper, Frank Stanley '52
 Krupka, John F. '52
 Mast, Robert Frederick '57
 Ostrodka, David L. '70
 Schoenberg, Kurt F. '72
 Tataru, Richard M. '78
 Temnery, Victor J. '54
 Zieliński, Edward Lee '74
 IL B Gurney Jr., P.E., Donald P. '59
 Kinast, John A. '79
 Lewis, Burton A. '48
 Uherek, Frank C. '82
 IL Γ Aagaard, James Stuart '53
 Armstrong, Donald R. '62
 Bockstahler, Alan J. '54
 Cunningham, Richard G. '43
 Guest, Howard Brandon '81
 Timmerman, Nancy S. '72
 IL A Hachtel, Dale A. '68
 IN A Brodie, Bruce R. '65
 Bullions III, Robert J. '64
 Carlson, Richard A. '70
 Egilsrud, Richard L. '81
 Ehlers, Steven M. '77

LA Γ Bertsch, Paul Jeffery '79
 Bertsch, Susan H. '80
 Cox, Mickey D. '77
 Painter, Jack T. '50
 Poole, Ronald G. '69
 Sigmund, John A. '75
 LA A Vinet Jr., Percy B. '57
 MEA Atkinson III, Leland G. '78
 Blackstone, Bradford Earl '91
 Blackstone, Jill Ellen '92
 Gilman, Cynthia M. '80
 MDA Becker, William H. '65
 Eisgruber, Carl H. '77
 Scheinin, Warren M. '74
 Wiseman Jr., William J. '64
 MDB Bromley, Ralph W. '44
 Cook, Gordon D. '81
 Dinkle, Ralph E. '65
 Timmerman, Nancy S. '72
 Hardesty, Donald R. '64
 Jansen, Russell Onas '74
 Kirschbaum, Alan I. '71
 Lambrechts, James R. '73
 Rowland, Ralph Wilson '51
 Schaefer Jr., William J. '70

Trankle, Thomas L. '71
 Trojan, Paul K. '55
 Warner, Caleb '44
 Zuk, David M. '70
 MI A Conti, Mark '76
 Rutherford, Charles R. '53
 MI E Durisin, Michael J. '81
 King, James B. '65
 Zickafoose, Michael Wayne '97
 MI Z Lachele, Roger E. '75
 MI H Johncox, Robert A. '83
 MI Θ Garrity, William E. '70
 MI A Repke, Wesley Ryan '09
 MNA Ashley, Gary C. '69
 Hanson, Henry A. '66
 Lapakko, Kim A. '76
 Loughlin, James P. '85
 McLeod, Gary W. '70
 Ewing, Robert W. '45
 Severson, John A. '72
 MS A Jerome, Dennis C. '67
 MO A Crabbe, Emmanuel F. '81
 Donaldson, Albert L. '75
 Lowry, Donald C. '78
 Myles, M.D., Thomas D. '82

NY K Ablowitz, Mark J. '67
 Alcaro, Domenic John '87
 Brown, George Albert '48
 Gaul, Michael A. '76
 Hinshaw, David J. '86
 Moore, Duncan T. '69
 NY A Ball, James E. '75
 Fillo, John P. '74
 Layton, Richard L. '63
 Schmitt, Robert E. '71
 Silverman, Joel S. '74
 NY M Czub, John Stanley '78
 NY E Mathews, Joseph R. '81
 Rorke, George Leo '71
 NY O Courter, Joanne L. '75
 Farrell, Timothy M. '82
 NY II Barbee, R. Todd '87
 DeVoe, Charles G. '76
 Curran, Paul J. '83
 Rauden, Mark J. '85
 NC A Baer, Richard T. '63
 Crotts, P.E., Marcus B. '53
 Ma, Robert Ping-Chung '88
 Shelton, Monty L. '84
 NC Γ Franks, Marla Jane '79
 McConnell III, Ezra L. '83
 Scarborough, Paul R. '72
 OH A Bondor, Paul L. '63
 Gschwind, Leon Donald '55
 Heyman, Duane A. '63
 Karkalik, Fred G. '59
 Fazio, Gregory Francis '76
 Hamilton, Edward L. '73
 OH Γ Balthasar, James L. '71
 Becher, Charles David '72
 Fling, Russell Sharon '49
 Guins, Thomas S. '69
 Hagenlocker, Edward E. '62
 Hohman, Charles M. '67
 Kovach, Karl David '85
 Monter, George C. '60
 Orkins, James E. '66
 Riedel, Kimberly Sue '90
 OH A Moore, Matthew F. '62
 OH E Basta, Edward D. '82
 Balhen, Robert E. '57
 Cull, Ronald C. '70
 OH Z Frederick, Wm G. D. '58
 OH H Cole, Neil R. '75
 Fraass, Ronald G. '78
 Kohlhaas, Richard L. '62
 Nelson, James R. '65
 Reid, James H. '73
 OH Θ Doyle, James T. '65
 OH K Maki, Luke Richard '78
 Morrison, Donald Paul '89
 Stephan, Elizabeth Anne '93
 Wielopolski, Richard J. '76
 OH M Kovacs II, William '74
 OK A Lewis, Philip Earl '73
 Norris, Thomas G. '56
 OK B Royce, Robert M. '73
 Steffanelli, Loretta M. '86
 OK Γ Freese, William E. '50
 Jones, James F. '84
 OR A Beard, James L. '61
 Ewing, Robert Clark '43
 Geer, Edward Douglas '52
 Hansen, Steven W. '69
 McCormick, Gary Allen '74
 Niedermeyer, Rex '77
 Robinson, Alan H. '56
 Sato, Ben '57
 OR B Buchanan, Marlowe J. '92
 PA A Barnrd, Ronald LaMar '58
 Erickson, Richard K. '85
 Saal, Frederick A. '54
 Sherman, William J. '60
 PA B Cinea, James A. '72
 Krolek, Ronald D. '83
 Magnus, John C. '48
 Sloum, Helene Zuber '85
 Thompson, A. Frederick '63
 PA Γ Helfer Jr., Arleigh P. '67
 Licht, Robert B. '55
 Rung, Robert Donald '50
 PA A Yu, Jeffrey C. '89
 NMI Rocco, Jim R. '85
 NY A Cohen, Adam B. '85
 NY B Carr, Donald Joseph '77
 NY Γ Borkowski, Norman Peter '52
 Bruch, Charles G. '59
 Cole, Marie Sayre '84
 Lequar, James Kay '87
 Mohr, Wendell C. '53
 Pemiis, Joseph Michael '89
 Spengler, Stewart R. '52
 Stallman, Thomas F. '59
 Staudinger, James R. '77
 Thal Jr., Herbert Ludwig '53
 Walezak, Dennis J. '76
 Weinberg, Richard S. '81
 Werner, Stuart Lloyd '54
 NY A Zobel, USN Ret., William M. '55
 Anderson, Ph.D., Gordon W. '59
 MCloskey, Charles C. '71
 Randall, John Douglas '65
 Teng, William L. '74
 NY E Hellman, Martin E. '66
 Kammenzind, Henry A. '50
 McCaffrey, Ronald W. '52
 NY H Bergh, Gerald Kenneth '58
 Kopp, Eugene H. '50
 Levy, P.E., Jeffrey M. '74
 Valcourt, Jean-Mary K. '85
 NY I Calkin, Edwin T. '61
 Ronan, Gregory J. '81

COMBINED FEDERAL CAMPAIGN

Tau Beta Pi has been included as an eligible organization on the 2014 Combined Federal Campaign (CFC) national list. The CFC is the annual workplace fundraising drive conducted by federal employees and military personnel each fall, which raises millions of dollars benefiting thousands of nonprofit charities. Tau Beta Pi has participated since 2000.



Tau Beta Pi will appear in the listing of National/International Organizations which is published in each local campaign brochure. Your donation will be directed to Tau Beta Pi by using the CFC identification number 10960.

In previous years, our Association has received thousands of dollars annually from this campaign. Unfortunately, the many local agencies gathering donations for the campaign are not able to provide us with the names of all the donors. Because of this, a donation made through this campaign may not be included in a member's giving record. Please know that the contributions are used to support the Fellowship, Scholarship, Laureate, and District Programs.

Thank you to all who have contributed to Tau Beta Pi through this campaign!

English, James A. '57
 Hanover, Marilyn K. '78
 Heirman, Donald N. '62
 Hodgkin, David M. '47
 Hooks, Collis C. '64
 Jicha, Albert J. '52
 Reiter, Thomas A. '51
 Sublette, Ivan H. '49
 Warren, Scot W. '83
 Woosnam, Thomas J. '65
 Yoder, Norman E. '71
 IN B Powell, Robert L. '51
 Rose, Willis E. '44
 Ruddick, Everett L. '64
 Waterman, Robert C. '70
 IN Γ Farrow, Michelle D. '83
 Heidrich, Steven J. '82
 Kast, Steven J. '69
 Kukla, James A. '72
 Lombard, Michael G. '76
 Mason, James A. '56
 Pottmyer, James J. '62
 Schuster, Gregory M. '77
 IN A Brems, Robert R. '63
 Runge, Lambert J. '58
 Schmalz, Peter B. '69
 Spring, Bradford H. '59
 IA A Bosshart, David J. '80
 Coffey, Leo Frederick '64
 Derr, Curtis R. '85
 Drumm, Alfred W. '64
 O'Connell, Michael J. '87
 Reinhardt Jr., William H. '48
 Sellow, Roger F. '59
 IA B Bristol, Rodney E. '92
 † Seaba, Peter J. '67
 KS A Black, Arthur G. '70
 Henman, Ivan L. '56
 Knapp, Roy M. '63
 Leamon, Richard G. '67
 Massoth, William Henry '82
 Shankles, Larry E. '69
 KS B Howe, Donald Craig '78
 KS Γ Benton, Kirk '78
 Bucher, William A. '76
 KY A Bauer, Arthur R. '63
 Feather, Gary Alan '80
 Howe, P.E., Richard S. '59
 KY B Hundley, John Smith '87
 Hundley, Theresa H. '87
 LA A Compton, Ronald R. '72
 Franklin Jr., Duard D. '74
 Kleinper, Joseph A. '65
 Smith, Stewart V. '73
 LA B Buessinger, Robert Ford '78
 Mullins, Peter L. '57
 Perrin III, Shepard F. '83

Toense, Robert E. '76
 Werneth, Russell Lee '64
 MAA Bernacki, Stephen E. '70
 Berndt Jr., Edward C. '44
 Bujaucius, Gerald A. '79
 Hubelbank, Mark '68
 Snively, Fred S. '60
 Brandes, Richard D. '57
 Clauss Jr., John S. '54
 Freeman, Reed H. '61
 Grossweiler III, Philip J. '72
 McKim, Thomas F. '75
 Nobel, Sanford M. '58
 Patterson, John B. '68
 Smallwood, Richard Dale '57
 Smoot, William N. '56
 Strauss, Richard A. '38
 Wilson Jr., Albert Olof '38
 MAA Colen, Esq., Frederick H. '69
 Curtis, Jonathan G. '69
 Hart Jr., Frederick R. '61
 Osborn, Henry H. '50
 MAE Herzberg, Ernest '51
 Cain, John F. '61
 MAZ Gusciora, Kenneth H. '69
 Harrison, C. Brett '64
 Mathews, Archie '53
 Meurer, Glenn W. '86
 Smith, Richard G. '78
 MAH Penafiel, M.D., Jay Buhay '90
 Whitley, Norman L. '75
 MI A Bonner, Robert C. '60
 Griffin, Albert Walter '80
 Houthoof, Janet M. '76
 Hudson, Clarence D. '58
 Bohren, James F. '67
 Henriksen, Leslie Louis '58
 Leven, Peter Johannes '93
 Link, Barbara S. '77
 Sandretto Jr., Peter P. '64
 Saul, William E. '55
 Scott, Kenneth John '55
 Stromp, John Edward '78
 Wacker, Don H. '52
 MI Γ Albrecht, Terry E. '76
 Bigelow, Daniel Conroy '82
 Coates, Larry L. '78
 Engelhardt, Larry N. '77
 Holderness, James Henry '67
 Isackson, Robert M. '78
 Pepper, Julia L. '84
 Prescott, Thomas J. '69
 Reines, Jose '55
 Sanguinetti, John Winston '70
 Sheets, Alan '81
 Stewart, Stephen R. '66
 Toliver, Christopher M. '74

Sprouse, Loren V. '73
 Stiefemann, Michael C. '86
 MOB Ash Jr., Richard L. '70
 Davis, Jon T. '85
 Ernest, Terry L. '82
 Koehler, David E. '75
 Peat, Robert J. '79
 Saloff, Stanley Alexander '65
 Schaefer, Orville L. '58
 MOI Byrne, Clare M. '78
 Chambers, David H. '80
 Johnson, Richard M. '56
 Osgard, Dennis M. '62
 NE A Criswell, Marvin Eugene '65
 NHA Jarvis, John Edward '79
 NJ A Hoyt III, John G. '76
 Murphy, Kevin J. '78
 Tirado, Daphne Christine '82
 NJ B Bovee, Ronald B. '79
 Cohen, Robert B. '77
 Fletcher, Leroy S. '58
 Rice, Darren Christopher '91
 NJ Γ Krumins, Aivars E. '75
 Kinzy Jr., Joseph J. '73
 NJ Δ Lisle Jr., Thomas K. '69
 Prutzman, Robert A. '72
 Yu, Jeffrey C. '89
 NMI Rocco, Jim R. '85
 NY A Cohen, Adam B. '85
 NY B Carr, Donald Joseph '77
 NY Γ Borkowski, Norman Peter '52
 Bruch, Charles G. '59
 Cole, Marie Sayre '84
 Lequar, James Kay '87
 Mohr, Wendell C. '53
 Pemiis, Joseph Michael '89
 Spengler, Stewart R. '52
 Stallman, Thomas F. '59
 Staudinger, James R. '77
 Thal Jr., Herbert Ludwig '53
 Walezak, Dennis J. '76
 Weinberg, Richard S. '81
 Werner, Stuart Lloyd '54
 NY A Zobel, USN Ret., William M. '55
 Anderson, Ph.D., Gordon W. '59
 MCloskey, Charles C. '71
 Randall, John Douglas '65
 Teng, William L. '74
 NY E Hellman, Martin E. '66
 Kammenzind, Henry A. '50
 McCaffrey, Ronald W. '52
 NY H Bergh, Gerald Kenneth '58
 Kopp, Eugene H. '50
 Levy, P.E., Jeffrey M. '74
 Valcourt, Jean-Mary K. '85
 NY I Calkin, Edwin T. '61
 Ronan, Gregory J. '81

NY K Ablowitz, Mark J. '67
 Alcaro, Domenic John '87
 Brown, George Albert '48
 Gaul, Michael A. '76
 Hinshaw, David J. '86
 Moore, Duncan T. '69
 NY A Ball, James E. '75
 Fillo, John P. '74
 Layton, Richard L. '63
 Schmitt, Robert E. '71
 Silverman, Joel S. '74
 NY M Czub, John Stanley '78
 NY E Mathews, Joseph R. '81
 Rorke, George Leo '71
 NY O Courter, Joanne L. '75
 Farrell, Timothy M. '82
 NY II Barbee, R. Todd '87
 DeVoe, Charles G. '76
 Curran, Paul J. '83
 Rauden, Mark J. '85
 NC A Baer, Richard T. '63
 Crotts, P.E., Marcus B. '53
 Ma, Robert Ping-Chung '88
 Shelton, Monty L. '84
 NC Γ Franks, Marla Jane '79
 McConnell III, Ezra L. '83
 Scarborough, Paul R. '72
 OH A Bondor, Paul L. '63
 Gschwind, Leon Donald '55
 Heyman, Duane A. '63
 Karkalik, Fred G. '59
 Fazio, Gregory Francis '76
 Hamilton, Edward L. '73
 OH Γ Balthasar, James L. '71
 Becher, Charles David '72
 Fling, Russell Sharon '49
 Guins, Thomas S. '69
 Hagenlocker, Edward E. '62
 Hohman, Charles M. '67
 Kovach, Karl David '85
 Monter, George C. '60
 Orkins, James E. '66
 Riedel, Kimberly Sue '90
 OH A Moore, Matthew F. '62
 OH E Basta, Edward D. '82
 Balhen, Robert E. '57
 Cull, Ronald C. '70
 OH Z Frederick, Wm G. D. '58
 OH H Cole, Neil R. '75
 Fraass, Ronald G. '78
 Kohlhaas, Richard L. '62
 Nelson, James R. '65
 Reid, James H. '73
 OH Θ Doyle, James T. '65
 OH K Maki, Luke Richard '78
 Morrison, Donald Paul '89
 Stephan, Elizabeth Anne '93
 Wielopolski, Richard J. '76
 OH M Kovacs II, William '74
 OK A Lewis, Philip Earl '73
 Norris, Thomas G. '56
 OK B Royce, Robert M. '73
 Steffanelli, Loretta M. '86
 OK Γ Freese, William E. '50
 Jones, James F. '84
 OR A Beard, James L. '61
 Ewing, Robert Clark '43
 Geer, Edward Douglas '52
 Hansen, Steven W. '69
 McCormick, Gary Allen '74
 Niedermeyer, Rex '77
 Robinson, Alan H. '56
 Sato, Ben '57
 OR B Buchanan, Marlowe J. '92
 PA A Barnrd, Ronald LaMar '58
 Erickson, Richard K. '85
 Saal, Frederick A. '54
 Sherman, William J. '60
 PA B Cinea, James A. '72
 Krolek, Ronald D. '83
 Magnus, John C. '48
 Sloum, Helene Zuber '85
 Thompson, A. Frederick '63
 PA Γ Helfer Jr., Arleigh P. '67
 Licht, Robert B. '55
 Rung, Robert Donald '50
 PA A Yu, Jeffrey C. '89
 NMI Rocco, Jim R. '85
 NY A Cohen, Adam B. '85
 NY B Carr, Donald Joseph '77
 NY Γ Borkowski, Norman Peter '52
 Bruch, Charles G. '59
 Cole, Marie Sayre '84
 Lequar, James Kay '87
 Mohr, Wendell C. '53
 Pemiis, Joseph Michael '89
 Spengler, Stewart R. '52
 Stallman, Thomas F. '59
 Staudinger, James R. '77
 Thal Jr., Herbert Ludwig '53
 Walezak, Dennis J. '76
 Weinberg, Richard S. '81
 Werner, Stuart Lloyd '54
 NY A Zobel, USN Ret., William M. '55
 Anderson, Ph.D., Gordon W. '59
 MCloskey, Charles C. '71
 Randall, John Douglas '65
 Teng, William L. '74
 NY E Hellman, Martin E. '66
 Kammenzind, Henry A. '50
 McCaffrey, Ronald W. '52
 NY H Bergh, Gerald Kenneth '58
 Kopp, Eugene H. '50
 Levy, P.E., Jeffrey M. '74
 Valcourt, Jean-Mary K. '85
 NY I Calkin, Edwin T. '61
 Ronan, Gregory J. '81

SECOND CENTURY CLUB, CONTINUED

MI ⊕	Scott, Richard T. '78		Young, Raymond J. '74		Garner, Scott J. '77	CA Δ	Kobayashi, Mark V. '79
MNA	Bakke, Mark Alan '88	NYH	Dicker, Daniel '51	OR A	Kunze, Glenn R. '77		Lerma, Malvina C. '82
	Ball, William L. '70		Filipek, Stephan J. '82		Newton, Philip L. '67	CA E	Bienstock, Bernard J. '68
	Braaten, David L. '75		Schlein, Robert G. '72		Nuccio, Robert P. '51		Hollar, Ray R. '78
	Carlson, Philip J. '68	NY ⊕	Yee, Donald Wing '72	PA A	Richards, Tameia L. '81		Lew, Marshall '71
	Chapin Jr., George Gilman '47		Berlat, Norman R. '62		Rueter, Curtis O. '86		Stone, Allan J. '58
	Olson, Daniel J. '85		Lester, John W. '52		Schwierke Jr., Perry J. '60	CA Z	Tipton, Howell J. '61
MS A	Stryk, Robert Anthony '60		Marvin, Mayne D. '80		Swink II, Marvin N. '80		Anderson, Sedic E. '56
	Anderson, Shirley Lee '90		Meyer, Bruce G. '69		Hernjak, James Gregory '96	TX E	Bauerle, Richard D. '59
	Dickson, Ronnie D. '77		Schwind, Daniel R. '76		Hjorth, Beverly E. '79		Coppellina, Frank J. '59
	George, P.E., James F. '71		Stone, Robert E. '76		Leach, Jeffrey D. '77		Masnada, Dante Angelo '75
	Grim, Mark D. '82		Taylor, William L. '64		Swartwout, John B. '73	TX H	Sabbatini, Julian '68
	Miller, Elton R. '70		Wesler, Philip '48		Tomkiel, Stanley A. '72		Bahr, Alfred J. '58
	Mills, Marvin L. '65	NYI	Jovanovic, Adrian Burton '89	PA B	Anderson, Ray E. '50	CA H	Holstead, Raymond H. '71
	Tyner, Fred M. '93		Levine, Abraham '50		Cohen, Bruce A. '72		Hughes, Norman L. '74
MSB	MacDonald, Glenn E. '78		Telesco, John Charles '69		Coombs, Bernard F. '55		Kovalick, Albert W. '72
	Miles Jr., John H. '71	NYK	Epstein, Benjamin R. '78		Ross, David Stanley '69	TX ⊕	Asahina, David T. '78
	Farrrell, Adam John '99		Isaacs, Morton S. '66		Weston, Ph.D., Matthew W. '93	TX K	Hoekstra, Gerben N. '66
MOA	Henderson, Betsy A. '84		Levy, Cynthia A. '80	PA I	Capone, Christopher D. '87		Mardah, Steven '84
	Hibner, Dale V. '74	NYA	Braun, Bernard '65		Chan, Allen H. '82	TX A	Ward, Michael L. '67
	Jorden Jr., Bruce W. '56		Di Miceli, Angelo A. '82		Kromer, Robert P. '82	UT A	Matthews, G. Morris '73
	Parmeter, Richard J. '90		Killeen, Michael J. '73		Laynor, John E. '54	UT A	Olson, Kent G. '65
	Taylor, James S. '77		Monroe, Charles W. '53		Pierce, Amy M. '80	UT I	Clyde, Eric S. '75
	Thoe, Terrence W. '92	NYM	Check, Frank T. '66		Riedel, Frederick W. '68	VT A	Egner Jr., J. David '79
	Warmack, Ph.D., Ralph E. '67		Hurewitz, David L. '64	PA A	Banks, Daniel '54	VT B	Clark, David T. '81
MOB	Bohnar, William B. '75		Meador, Lyla Rebecca '86		Lewis, William '64		Henry, Thomas A. '70
	Cavns, Albert E. '59		Sutter, Richard R. '71		Sern, Stacey D. '86	VA A	Colonna, James L. '65
	Derbak, Charles B. '84		Wilcox, Robert E. '73	PA E	Boyles, Bruce W. '76		Fox, William R. '71
	Edgington, Antony N. '51	NYN	Darroch, Michael E. '84		Dadey, Ph.D., Kathleen Ann '81		Hopson, Robert Craig '69
	Herndon, Richard S. '56		Gluszak, Timothy J. '88		Hartsel, James E. '62		Rubenstein, David N. '79
	Jenkins, Glenn Willard '59		Havas, Donald W. '67		Odenwelder, Dale G. '73		Stickle, Robert L. '54
	Kyser, Dale Anthony '83	PA Z	Kosmerl, Richard D. '72		Lee, George C. '55	VA B	Wyant III, Thomas R. '71
	Meyer, Gene R. '84		MacNeil, Randall L. '69		De Maio, Joseph Anthony '75		Dalton Jr., Eddie G. '86
	Schmidt, Thomas E. '70		Theoclitus, David T. '86		Hill Jr., Albert M. '67		Davidson Jr., Charles A. '70
	Wilreker, Victor F. '72		Weber, Thomas W. '53		Hosdon, William R. '67		Dollard, Joseph S. '51
MOI	Zimnick Jr., Harold E. '64	NYE	Haller, Marc Frederick '85		Howe, Howard J. '63		Gresham, James A. '83
	Burgi, Charles E. '51		Mercando, M.D., Anthony '76		Jastrzewski, Joseph S. '64		Roberson, C. Leslie '66
	Kilert, Albert H. '63		Rubano, Vincent F. '73	PA H	Price, Russell W. '72		Sloan, Forrest Eugene '83
	Levy, Donald J. '47		Mills, Robert A. '57		Stiger, David L. '83		Tuttle, Frederick L. '52
	Patterson, James Glen '99		Rosenkoetter, Elwood A. '49	NYO	Barron, William R. '60	VA I	Wayne, Jennifer Susan '83
	Salman, Naif D. '56	NYI	Wildermuth, Amy J. '94		Hemness III, John L. '73	WAA	Cahill, Robert S. '72
	Egeland, Monte D. '81	NYP	MacKin, R. Peter '81		Lombardi, Charles G. '65		McGuire, Jeremiah J. '77
MTA	MacKin, R. Peter '81	NCA	Bennett Jr., C. Leonard '63	PA K	McElhenry, James E. '70		Miller, Stefan John '63
	Jackson, Darron Boyd '86		Buckner, Harry Benjamin '92	PA A	Andes, John A. '83		Porte, Jeffrey A. '72
	Malsam, Allison A.H. '95		De Haas, Cynthia R. '91		Leiss, Wayne G. '76		Purdy, Catherine P. '72
	McDonnell, Kathleen G. '83	RI A	Fitch Jr., Johnny E. '76		Sanchez, Hector Luis '76		Rosen, Donald G. '58
NEA	Stransky, David Wayne '92		MacHnik, Nicholas J. '76	PR A	Campbell, Neal S. '68	CT B	Saxberg, Brov V. H. '80
NVA	Levins, Larry A. '85		Minday, Richard M. '66		Chorney, Paul '56		Searing, John E. '83
NVB	Nott, James Allen '09		Neely, Clyde C. '51		Clarke, Edward N. '45	WAB	Simpson, David P. '76
NHA	Charron, Ronald H. '64		Skinner, James O. '73		Olding, Duncan R. '55		Charles Jr., Daniel A. '83
	Daniels, Stuart F. '63	NCI	Block, Norman G. '54		Townsend, James C. '60		Sarles, Vivian B. '80
NJ A	Ehrhardt, Ph.D., William C. '68		Board Jr., John A. '82	RI B	Aubin, Timothy Francis '94		Simon, Terry W. '68
	Ghosh, Subhendu '89		Chambers, William F. '60		Brady III, William James '80	WAA	Small, James M. '52
	Sussmann, Kenneth P. '72		Flowers III, George Horace '65		Kames, Jeffrey S. '80	WVA	Trippel, Robert Carl '57
	Wolosky, Irwin S. '68		Hustvedt, Kent C. '75		Mitnick, Margaret H. '85		Yamayee, P.E., Zia Ahmad '72
NJ B	Andre, Gerald R. '75		Lowry, James R. '88		Nardone, Steven Craig '72		Bibbee, Dennis E. '75
	Bubenick, David V. '73		Moulton, Paul R. '80		Post Jr., Arthur H. '57	WVA	Pellegrin, John D. '73
	Moench Jr., Fred R. '67	NCA	Le Grone Jr., Durall T. '80	SC A	Kragas, Tor K. '79		Rowe Jr., Eldridge E. '68
	Palko, John R. '69	NDA	Mittelsteadt, Steven J. '81		Marley, Brian Lee '89	WVB	Zimmerman Jr., Albert R. '58
	Plant, Stephen Irving '65		Schmidtke, Ben E. '77		McCormac, Jack C. '48	WI A	Stevens, Ellen W. '84
NJ I	Branco, Maria dos Milagres '74	OHA	Bracy, Kevin Norman '93		Moore, Thomas C. '72		Allman, Robert L. '59
	De Waal, Johannes '70		Brichford, Thomas K. '55		Scherer, John H. '65	FL B	Diedrich, Donald L. '69
	Gagliardo, Reginald S. '70		Cassidy, Robert Blair '94	SC B	Skvoretz, Jonathan Maxwell '95	FL F	Kiesling, Dean A. '69
	Germain, Dorothy M. '73		Glick, Robert R. '68		Barton Jr., Robert Harley '62		Martinson, Lloyd William '57
	Goodrich Jr., Robert R. '70		Gupta, M.D., Punit K. '96	SC I	Burton, Kevin Lane '90	FL A	Meister, James R. '78
	Lipuma, Charles R. '53		Padgett, Richard J. '72		Cauthen Jr., Lewis Jackson '54	FL Z	Niemeyer, John Allen '68
	Padgett, Richard J. '72		Reitano Jr., Anthony J. '72		Fralix Jr., James Theodore '59	GA A	Oliver, Floyd F. '60
	Rij, Jerry J. '72		Weddell, James K. '76		Pastrick, Harold Lee '58		Priestelski, James S. '66
NJ A	Nisonger, Thomas M. '78	OH B	Zeis, John F. '62	SD A	Beacom, E. Kevin '82	WIB	Senty, James A. '60
	Wolff, Richard J. '72		Best, Robert Allan '55		Cavender, James M. '66		Siekier, Frederick A. '70
NMB	Busch, Robert D. '72		Greene, Samuel J. '75	TNA	Chambers, George P. '58	IL A	Tausche, Paul Everett '48
NMI	Perna, Trina '84		Lenz, Richard R. '66		Garber, Joel W. '61		Tennie, John C. '64
NYA	Bucknor, Norman K. '84	OH I	Au, Ralph D. '71		Jackson, Karen E. '81		Wellauer, John C. '65
	Feuerstein, Stewart F. '80		Bilhmire, David A. '72		Jenkins, Ronald Wayne '72		Bella, Robert A. '65
	Friedman, Morton B. '48		Engen, Todd C. '81		McCracken, Stephen H. '72		Graef, P.E., Luther W. '52
	Repetti, Ronald J. '57		Friedland, James Alan '75		O'Bryan, Lynda K. '62		Hughes, Philip J. '66
	Silbert, Glenn R. '75		Hall, Clarence Albert '37		Robertson, Janet P. '85		Lugthart, Cornell W. '51
	Zimmerman, Robert W. '77		Hoover, Thomas E. '56		Snyder, Kevin Lloyd '93		Niggemann, Richard E. '60
NYB	Despirito, James '83		Jester, Donald John '67		Welch, David O. '60		Oehler, Daniel A. '79
	Fedoroff, Oleg V. '61		Kirner-Prube, Susan M. '85		Williamson, James M. '79		Panning, Martin H. '49
	Gorey, Anthony G. '84		Kohls, Thomas C. '81	TN B	Brown, George A. '55		Petrie, Dennis J. '78
	Monson, John A. '58		Magee, John V. '81		Drago, Joseph A. '65		Smith, Thomas M. '60
	Smith, Kelvin C. '55		Mendelsohn, Richard H. '71		Jackson Jr., Harold Edward '55		Wentink, William Stewart '68
	Stanton, James W. '61		Merry, Carolyn J. '88		Lyle, Stephen M. '79		Wick, Paula B. '81
NYI	Blakeman II, Robert Denis '89		Milder, Nelson Louis '59		Macchio, Gregory John '84	WI I	Wilhelmi, James J. '69
	Brown, A. Windsor '66		Moellman, Gordon K. '48		Petersen, Eric Scott '84		Boehmer, Carolyn M. '82
	Buck, Frederick A. '76		Nodes, P.E., Scott E. '84		Petersen, Stephanie O. '84		Bomba, Steven J. '59
	Butler, Charles W. '50		O'Neal, Joe E. '55	TN I	Crawford Jr., Walter K. '62	WYA	Harms, John Thomas Lee '09
	Covello, Joseph '63		Zeller, Hugh J. '66		Pedigo, Donald B. '83		Galles, Daniel J. '74
	Curtis, Justin A. '60	OHA	Lamprey, Richard V. '73	TX A	Badgwell, Thomas Alan '92		Hill, Janet Lynn '95
	Hopkins, Harold B. '51		McKittrick, Ben J. '60		Bain III, P.E., Henry Cari '80		Lester, Roger N. '87
	Jordan, William E. '64	OHZ	Christen, Thomas E. '64		Curdwell, John W. '68		Rodriguez, Derriek R. '97
	Lehman, Herbert M. '43		Deblase, Michael L. '78		Eck, Leroy '43		
	Sacks, Alexei Hiram '90		Seow, Kee Chong '88		Hight III, Terry H. '70		
	Stull, Frank D. '53	OHH	Weaver, Ernest W. '43		Le Bleu, Robin B. '65		
	Wilkinson, Richard W. '51		Nygaard, George M. '67		Lyle Jr., Fred F. '62		
	Williams IV, Carter N. '66	OH ⊕	Rice Jr., John W. '75		Marshall, James L. '72	AZ A	Shaver, Frederick W. '55
NYA	Funke, Richard H. '71		Crispino, David J. '80		Meers, Steven W. '72		Tretschok, Cody D. '89
	Gordon Jr., James P. '83		Kelly, P.E., John B. '67	TX B	Gates, Robert D. '72	AZ B	Hislop, James S. '69
	Jureller, Steven F. '87		Luhan, John B. '70		Hood, David L. '73	ARA	Lawson, Catherine A. '85
	Price, Richard H. '65		Sero, Raymond J. '67		Jain, Ravinder K. '71		Bushart, Graydon J. '50
	Waring, Michael D. '65		Walter, Kenneth L. '63		Olson, Rebecca J. '75	CA A	Little, James H. '53
NYE	Wiley, David R. '82	OH I	Davis, J. Paul '76	TX I	David, Anne Wierzbicki '87		Chew, Richard S. '85
	Dobbins, Bob M. '73		Schilling Jr., Walter William '97		Horn, Kenneth Porter '61		Chiara, John P. '70
	Jaasma, Edward '59	OHK	Volosen, John '77		Lucas, Raymond D. '60		Kaprielian, Elmer F. '42
	Lombardi, Francis A. '70		Murphy, Charles J. '77		O'Dell, Stewart C. '78	CA B	Widergren, Steven E. '75
	Finnes, Edward L. '71	OHA	Montgomery Jr., William L. '86	TX A	Popplewell, Thomas R. '74		Wiemken, Albert J. '57
	Rosen, Fredrick K. '62	OHM	Gunning, Ira C. '48		Caso, Gregory S. '87		Colgrove, Robert C. '81
	Rubin, Lowell '61	OKA	Kriete, Vance R. '63		Crosser, Robert E. '50		Manatt, Stanley L. '55
	Sisto, Fernando '44		Wolf, Jerald M. '88		Deisler, Paul F. '46	CA I	Tokheim, Robert E. '58
NYZ	Chu, Lawrence J. '71	OK B	Harper, Lois Marie '86		Dokos, Nick George '57		Bateman, Terry S. '58
	Sindel, Fred H. '59				Dyson, Norman K. '60		Fisher, Benjamin P. '74
							Miller, William C. '50
							Nagel, John Frederick '91

The Heritage Society

The Heritage Society was established in 2001 to recognize and honor those who continue the tradition of outstanding support by remembering TBPI in their plans. Heritage Society members, listed below, have included a provision in their estate plans to benefit the Association and have informed TBPI of this commitment. Their support is gratefully acknowledged, and their names will appear each spring.

- | | | |
|---|--|---|
| Aagaard, Ph.D., James S., <i>IL</i> '53 | Forslund, Donald C., <i>NJ</i> '60 | Regula, Ph.D., Donald W., <i>MI</i> '63 |
| † Alford, Henry M., <i>MS</i> '27 | Froula, P.E., James D., <i>TN</i> '67 | Reinhardt Jr., William H., <i>IA</i> '48 |
| † Althouse, Ernest E., <i>PA</i> '26 | Fue, Harold, <i>IL</i> '57 | Sax, Franklin S., <i>MO</i> '55 |
| † Anderson, Marshall, <i>MI</i> '32 | Gendron, Roger J., <i>IL</i> '55 | Scheffler, P.E., Paul H., <i>PA</i> '48 |
| Anonymous, <i>IL</i> '55 | Gomulinski, Curtis D., <i>MI</i> '01 | Schmoller, Ralph H., <i>OH</i> '61 |
| Anonymous, <i>MA</i> '66 | Gomulinski, Tricia E., <i>SD</i> '98 | † Scribner, A. Clayton, <i>NY</i> '29 |
| † Arm, David L., <i>PA</i> '30 | † Hanley, Edward P., <i>IL</i> '42 | † Sickafoose, Robert D., <i>IL</i> '50 |
| † Banner, Charles E., <i>OH</i> '47 | † Hart, Jack B. & Arline I. (ΣT) | Siller Jr., Ph.D., Curtis A., <i>TN</i> '66 |
| Barnes, Raymond H., <i>MI</i> '40 | Haynes, Ph.D., P.E., Charles D., <i>AL</i> '62 | Slafer, Loren I., <i>CA</i> '68 |
| Basta, Edward D., <i>OH</i> '82 | Herke Jr., Frederick P., <i>OH</i> '54 | Smith, Andrew L., <i>MS</i> '48 |
| Bateman, Terry S., <i>CA</i> '58 | † Heymann Sr., Andrew P., <i>FL</i> '39 | Smith, Richard N., <i>OR</i> '57 |
| Beans, Ph.D., E. William, <i>OH</i> '53 | Jackel Jr., Henry E., <i>IN</i> '57 | Smith, Rodger F., <i>WI</i> '64 |
| Brill, Arno W., <i>TX</i> '71 | Jackewicz Jr., Joseph I., <i>IN</i> '75 | † Stechmeyer, John P., <i>OH</i> '48 |
| Budd Jr., Col. Roger, <i>IL</i> '62 | Jennings-King, Sherry D., <i>TN</i> '93 | Stella, P.E., Damien F., <i>AK</i> '82 |
| Burg, Stoddard S., <i>PA</i> '51 | Johnsen, Roy L., <i>MI</i> '57 | † Strom Jr., George J., <i>CA</i> '56 |
| Burns, Carlisle V., <i>NY</i> '50 | Johnson Jr., James W., <i>NC</i> '77 | Swanson, P.E., Hilmer S., <i>WA</i> '76 |
| Campbell, P.E., Cleveland L., <i>IA</i> '47 | † Jones, David S., <i>KS</i> '49 | Swanson, Ph.D., John A., <i>NY</i> '62 |
| Cancilla, Charles E., <i>CA</i> '59 | Kern, Jack C., <i>CA</i> '71 | Taber, Norma J., <i>MO</i> '80 |
| Chamberlain, Ph.D., P.E., Adrian, <i>MI</i> '51 | Kitchens, Philip H., <i>LA</i> '67 | Tarwater, James P., <i>MO</i> '51 |
| Colbry, Ph.D., Dirk J., <i>MI</i> '06 | † Kolff Van Oosterwijk, H.L.J., <i>CA</i> '50 | † Taylor, Paul D., <i>KS</i> '58 |
| Colbry, Ph.D., Kathleen Luchini, <i>MI</i> '99 | † Liggett, John A., <i>MI</i> '43 | Tydeman, Frederick J., <i>CA</i> '73 |
| Cook, Norman L., <i>WY</i> '79 | Luce, John W., <i>FL</i> '50 | Tyson, Samuel E., <i>PA</i> '48 |
| † Curtis, Ph.D., Richard A., <i>OH</i> '64 | † Luchini, Ph.D., P.E., John R., <i>MI</i> '71 | Weissman, Martin J., <i>NY</i> '58 |
| D'Avignon, Edward J., <i>NY</i> '88 | † Lucken, Ernest G., <i>NY</i> '42 | White, Robert C., <i>IL</i> '56 |
| † Donoghue, Leonard W., <i>MA</i> '37 | McDonald, Capers W., <i>NC</i> '74 | Widmann, Bradley H., <i>NY</i> '69 |
| Dooley, George H., <i>NH</i> '53 | † Nelson, Thomas A., <i>CA</i> '49 | Williams, David C., <i>TX</i> '47 |
| † Duenweg, Col. Louis, <i>IN</i> '36 | Orkins, James E., <i>OH</i> '66 | † Wilson, Charles N., <i>WA</i> '70 |
| † Dulles, John W.F., <i>AZ</i> '43 | Peterson, Charles C., <i>UT</i> '68 | † Winkler, Albert H., <i>AZ</i> '75 |
| Fisher, James E., <i>CO</i> '47 | Pierce, Russell W., <i>WA</i> '70 | Wisner, Benjamin G., <i>CA</i> '49 |
| Fleming, John R., <i>IA</i> '58 | † Ray, Frederick H., <i>OH</i> '49 | † Zimmerman Jr., Marlin U., <i>MD</i> '44 |
| † Forge, Charles O., <i>CA</i> '56 | † Reed, Ph.D., Charles E., <i>OH</i> '34 | Zuurbier, George W., <i>IL</i> '53 |

Please contact Patricia McDaniel at pat@tbp.org if you wish to be included as a member of the Heritage Society.

FOUNDER'S CLUB, CONTINUED

- | | | | | | |
|-----------------------------------|-------------------------------------|------------------------------------|---------------------------------------|------|---------------------------------|
| Makarewicz, Peter J. '73 | Cascio, Horace E. '77 | Hazelton, Arthur R. '66 | Loomis, Howard B. '51 | NYB | El-Hindi, Ahmad M. '52 |
| Morrissey Jr., Thomas N. '64 | Gatts, Thomas Ficus '62 | Zarbo, Richard M. '85 | Martin, Bruce Douglas '97 | | Leight, David M. '75 |
| Naimoli, Vincent J. '59 | Heuckerth, Deborah M. '88 | MAH Magoffin, Michael A. '88 | Phelps, Andrew M. '77 | | Rubinstein, Ian Z. '69 |
| Turek, Joseph Anthony '79 | Lawrence III, Joseph P. '68 | MAO Deluca, Michael A. '84 | MSA Douglass, Thomas E. '58 | NYI | Beesley, Arthur H. '75 |
| Turek, Mary Beth D. '79 | Ornett, William S. '59 | MAI Smith, David Robert '87 | Garnett III, James M. '65 | | Foust Jr., Tiltman H. '68 |
| Walsh, John S. '80 | Rosen, Robert H. '65 | MI A Swail, P.E., Michael Paul '04 | Steele Jr., W. Glenn '68 | | Gordon, Benjamin Bruce '97 |
| IN Δ Kastman, Kenneth H. '66 | Semewald, Perry F. '53 | MI A Burdette, William A. '66 | MOA Campen, Kenneth W. '55 | | Greaves, Charles J. '60 |
| Kirschmann, Kendrick C. '71 | Van Eepoel, John Michael '00 | Fike, Jay Edward '96 | Salerno, Michael J. '84 | | Hruda, Prokop V. '80 |
| IN E Nagielski, Lawrence S. '81 | Lipscomb Jr., George A. '87 | Heimiller, Wayne R. '80 | Sandridge, Jack R. '65 | | Ives, Jon R. '61 |
| IA A Brackett, Robert C. '48 | Obsitnik, Paul E. '86 | Lipsitt, Harry A. '52 | MOB Weidinger, Robert P. '61 | | Kotzalas, Nick '60 |
| Feamster, R. Scott '67 | MDA Schroeder, P.E., Theresa R. '01 | Logan, William S. '75 | Bach Jr., Wilbert E. '50 | | Lenney, Robert V. '62 |
| Hayes, John O. '66 | MAA Griffith, Rebecca '91 | Meckler, Carrie Lynn '98 | Dalton, Thomas J. '84 | | Lyden, USN Ret., Michael J. '78 |
| Johnson, David C. '64 | Hopf, William H. '58 | Pfeil, Richard John '54 | Davis, Raymond W. '50 | | Maichak, Thomas H. '50 |
| Maifield, Christopher James '95 | Jacques, Donald A. '83 | Su, William Perry '90 | Katz, Manfred '53 | | Rickings, James H. '64 |
| Mehrad, Mojgan '82 | Petersen Jr., Donald W. '66 | Walker, John C. '54 | Knepper, Andrew E. '51 | | Schrader, Gustav '51 |
| Olney, Patrick R. '85 | Schurzyk, Kenneth G. '67 | MI B Barnhart, Kent T. '83 | Kopsky Jr., P.E., Raymond '84 | | Teixeira, Justin Savoie '05 |
| Sorensen, John A. '62 | Weeks, Frank E. '46 | Ilax, Susan B. '77 | Oberschelp, William F. '53 | | Walker, Robert W. '64 |
| Stammen, Russell D. '79 | MAB Bangser Jr., William '48 | Kranz, Paul R. '63 | Ratkey, Craig Michael '80 | | Wedgwood, Janet E. '80 |
| Van Horn, David A. '51 | Baxter, Gail D. '74 | Lindberg, John R. '52 | Riley, Kenneth G. '56 | | White, Andrew H. '71 |
| VA A Veenstra Jr., Henry R. '71 | Burtis, Evenson M. '60 | McNeil, Michael T. '86 | Steinman, Rebecca Lee '96 | NYA | Allen, Frederick G. '44 |
| Luecke, Gerald '50 | Foster, Ph.D., P.E., Edward '63 | Meiselman, Herbert J. '62 | Thomas, Crystal Yvette '04 | | Ball Jr., Robert W. '65 |
| Nicodemus, Keith L. '52 | Frassinelli, Guido J. '48 | Skaugen, Borg '63 | MOI Ladewig, Scott James '90 | | Batson, Philip E. '70 |
| Priester, Henry W. '83 | Goren, Leora Michelle '91 | Whipple, Kristina G. F. '87 | Mitxel, Kevin R. '95 | | Beaubien, Robert Patrick '90 |
| Stoughton, Roger Lewis '59 | Hoover, Lloyd N. '46 | Zollinger, Howard A. '51 | Payne, Bradley A. '87 | | Gaspard, Noah Daniel '05 |
| KS A Carvell, Lee A. '84 | Jackson, Charles Wilson '79 | MI I Badalament, Michael A. '91 | Stephens, Mary Elizabeth '88 | | Goifin, William B. '85 |
| Hinton, Robert A. '61 | Johnson, Timothy Lee '68 | Bittman, Thomas W. '70 | MTB Jones, Sharon Alane '93 | | Lampell, David M. '73 |
| Neff, Cassandra J. '82 | Longley, Lester Anderson '78 | Burnham, Lewis A. '55 | NEA Hofer, Diane J. '82 | | Lazar, Dale S. '74 |
| Obrien, Harry G. '59 | Peak, John C. '62 | Foulke, James A. '59 | NHA Kaminski, Wayne A. '79 | | Newhard, P.E., Jack Earl '52 |
| Pack, Garrett E. '60 | Robinson, Thomas C. '58 | Frantz, John A. '75 | Langford, Susan Kathleen '90 | NYE | Schumacher, Raymond H. '48 |
| Rock, Brian A. '85 | Russo, M.D., Ph.D., Gilberto '69 | Geib, Arthur J. '43 | Bean, Stanley O. '57 | | Einson, Stephen E. '59 |
| Vaughan, Charles F. '77 | Seagle, John P. '55 | Gross, Paul Henry '83 | Costa, Lisa J. '85 | | Gallo, Santo V. '72 |
| KS B Stuever, Robert A. '87 | Shepperd, Stanley W. '70 | Kalafus, Rudolph M. '60 | Davis, Paul F. '76 | | Jaffe, Herbert R. '47 |
| KS I Gudenkauf, Wayne Anthony '93 | Weston, Theresa A. '80 | Mahowald, John E. '77 | Russell, Earl D. '57 | | Maglien, Robert Z. '63 |
| KY A Lockhart Jr., Zane D. '86 | Zukowski, Charles A. '81 | Passman, Richard A. '44 | Cloyd, Joseph R. '02 | NHB | Lander, Ferris H. '72 |
| Midkiff Jr., Kenneth Clark '79 | Anderson, Thomas T. '57 | Plonka, Francis E. '74 | Price, Alexander Daniel '05 | | Levy, Cesar A. '72 |
| Wells, William L. '62 | MAA Levin, Neil '80 | Rollinger, Martin Gerard '82 | NJ A Boardman, Thaddeus J. '52 | | Pollack, Martin L. '72 |
| White, Garey L. '51 | Savage, Paul D. '77 | Thomas, David C. '56 | Kuhlberg, Joel F. '59 | NYH | Biesiadcki, Glenn J. '78 |
| KY B Gray, John H. '75 | Stanfield, Robert B. '53 | Upham, Donald Lee '58 | Rhyner, Frederick C. '75 | | Le, Phuong Dang '90 |
| LA A Bouvier Jr., Maurice J. '59 | Trimble, David C. '60 | Wille, Donald J. '58 | Swanson, Frederick J. '68 | NJ B | McCleam, Jomo L. '92 |
| Edgerton, Michael T. '66 | Weigand, Christopher D. '77 | MI A Dauerer, Walter P. '60 | Keller, Lara Alice '93 | | Rubin, David K. '59 |
| Robert, Stephen Douglas '03 | Young, Wendell S. '45 | Gallagher, James A. '68 | Lawler, Barbara E. '82 | | Steecher, Leonard S. '44 |
| LA I Sutton, Jerry K. '67 | MAE Field, Leslie A. '83 | Gies, Paul E. '51 | NJ I Barnickel, P.E., Donald John '49 | NYO | Beckeman, William J. '79 |
| Wright, P.E., Cameron H.G. '83 | Hooper, Frederick Payson '96 | Lee, Albert W. '62 | Barry, James J. '70 | | Freely, William J. '46 |
| LA A Hoffman III, William C. '84 | Keys Jr., Lloyd S. '70 | MI E Grant, Robert M. '75 | Berkowitz, Ellsworth Dean '81 | | Free, Albert P. '78 |
| ME A Baker, Elaine M. '83 | Nordstrom Jr., Carl H. '73 | MI Z Harrison, Patrick J. '69 | Budzyn, Ludomir A. '90 | | Hunt II, William E. '59 |
| Jones, Cheryl W. '78 | Raymond, Edward John '63 | Tyekoski, Paul J. '76 | Busch, Robert E. '68 | | Mayotte, P.E., Mary F. '78 |
| Otto, Fred B. '56 | Priest, Peter H. '77 | MI H Johnston, Richard '84 | Dittrick, Dennis W. '69 | | Young Jr., Lloyd William '66 |
| Priest, Peter H. '77 | Savanna, Louis M. '77 | MI I Haupt, Eric Keith '84 | Kobylarz, Thaddeus J. '58 | NYI | Ahman, Lars T. '71 |
| Catlin Jr., John C. '69 | Wetherell, Herbert G. '74 | Lyle II, Arthur Raymond '93 | Lerner, Marshall A. '62 | | Andrews, Richard F. '79 |
| Doll Jr., Martin L. '78 | MAZ Anthony III, James W. '65 | MI K Seymour Jr., Richard L. '97 | Schreiber, Otmar F. '49 | | Deluca, Richard T. '78 |
| Flynn, Paul D. '48 | Bearman, Maxim V. '86 | MI K West, Michael David '90 | Moore, James H. '84 | | Eliasoff, Amy L. '59 |
| Howard, John E. '65 | Fiejdasz, Paul A. '85 | MNA Grill, Susan M. '82 | NY A Madia, Joseph '82 | | Ispass, P.E., Alan B. '74 |
| Sniegowski, Gary H. '78 | Guros, Francis B. '75 | NY A Larson, Michael L. '59 | Moody, J. Roger '58 | | Kayton, P.E., Myron '55 |

FOUNDER'S CLUB, CONTINUED

	McCutcheon, William J. '66		Harris, William E. '58	PA I	Bissert, Fred J. '56		McCoy, Herbert E. '57		Johnson-Payton, Lori R. '97
	Nelson, Carl E. '54		Sattler, Frank J. '62		Bloom, Jeremy A. '73		Pitts, Robert E. '69		Lee, Michael Q. '84
	Orans, Robin M. '81	OH A	Essman, Joseph E. '57		Hall, Thomas J. '49		Rochat, Vernon E. '58		Nickell, Grason T. '47
	Ronan, Anne D. '73		Hild Jr., Wilbur H. '64	PA A	Berger, Bruce S. '54		Stache, Richard R. '76		Reynolds, Albert B. '53
NY K	Footo Jr., James Conklin '60		Hupp, William M. '69		Besser, Gilbert M. '49		Tang, Alice W. '86		Rodeferr, Charles C. '58
NY A	Mizzi, P.E., John V. '63		Kizlik, Lawrence James '90		Brenner, Donald '75		White, Joseph H. '71		Roth, Irwin '51
	Taylor, Alwyn '75		Oatman, Thomas Dean '56		Cavallaro, Joseph R. '81	TN B	Campbell Jr., Henry G. '59	VA B	Blanchard, Benjamin S. '51
NY N	Frame, Barbara R. '80	OH E	Andrews, William E. '57		Gross, Jeffrey B. '73		Westerman Jr., William J. '59		Blanton, John C. '76
	Le Van, David O. '77		Bennett, William R. '80	PA E	Korff, Marvin '50	TN I	Clevenger, Jerry A. '65		Ernest Jr., Charles L. '70
	Tumminello, Paul A. '85		Helmerich, Kenneth D. '83		Catudal, Joanne B. '80	TN E	Orr, Nancy L. '77		Kern, David P. '88
NY E	Green, Gary P. '71	OH Z	Larson, N. Kenneth '61		Ziegler, Mark A. '77	TX A	Bouchier, Joe T. '67		Madden, Michael Mark '91
	Miley, Kevin J. '78		Birchall, Curtis L. '73	PA Z	Boyle, Elmer H. '59		Ehlers, Clarence J. '66		Mayer, D. Stephen '49
	Stabile, Paul J. '79		Jones, Barbara J. '82		Collins, Harley L. '48		Givens, Kent B. '72		Myers, Kenneth S. '53
NY O	Fraine, David M. '76		Spicer, Alvin L. '67		Kopansky, Arkady '95		Heath, Margaret S. '90		Smith III, Clold R. '75
	Wickman, Richard A. '76		Woeller, Arthur C. '70		Pessiki, Stephen P. '84		Kumpf, David Kenneth '70	VA I	Hartelius, P.E., John T. '80
NY II	Conzola, Vincent C. '88	OH H	Curran, Edward T. '48		Snaton, George '68		Machemehl Jr., Charles A. '57		Trotter, Vanessa H. '97
	Newman, David A. '76		Manter, Joseph M. '74	PA H	Pedersen, Neil J. '74		Smith Jr., Horace F. '57	WAA	Allyn, Donald C. '59
	Shakshober, Douglas J. '85		Merkle, Laurence D. '92	PA O	Aschenbrenner, George T. '82		Wachel, Johnny C. '59		Danielson, Donald H. '54
NC A	Agreda, Victor H. '79	OH O	Begovick, John M. '74		Phillips, Lee K. '78		Wilkes, Chester P. '50		Davis, Beverly Z. '80
	Benge, G. Gregory '83		Ralston, David William '71	PA I	Henry, Martin W. '72	TX B	Harrison, Marvin E. '48		Levin, Marc E. '80
	Borden, Laura H. '82	OH I	Morrison, Robert Leroy '59		Kane, William F. '61		Jenkins, William '58		Mace, Leslie E. '75
	Keith, Alan R. '82	OH A	Danessa, Dominic A. '78	PA K	Martelli, Phil J. '85		Krauss, Kerry L. '72		Stacy, L. Eric '77
NC I	Davidson, P.E., Lindell A. '49		Valentz, Thomas M. '80	PA A	Klee, Charles S. '86		McMillen, Robert P. '78	WAB	Comstock, Lori A. '78
	Schubert, Derek Kingsley '96		Weber, Donald William '90		Heinrich, Christine D. '86		Talati, Deepak A. '84		Stephens, John Lawrence '51
	Thor, Philip W. '74	OH M	Lynch, George Arthur '74	TX I	Hutchison, William George '95		Jacobson, Marcus J. '52	WA I	Renneberg, Daniel F. '82
NC A	Nixon, Robert D. '82	OK A	Cramer, Karen F. '80		MacCarone, David John '95		Tilton, James C. '76	WVA	Britton, Barry K. '85
NC E	Craft, William J. '63		Williamson, John Wesley '55	TX A	Tjadi, William S. '79		Barnhouse, Herbert W. '58		Cain, P.E., Wendy Amrhein '94
NDA	Hoffman, James S. '55	OK B	Zink, James G. '74	PR A	Acosta, Carlos A. '88		Bearsley, Brent Scott '93		Kaick, Richard J. '84
	McCormack, Fred E. '76		Petruska, Gregory J. '80		Perez, Juan A. '78		Cox, Ralph F. '54		Mongold Jr., Guy E. '50
	McLaughlin, Jenny L. '84	OK I	Zhao, Liqiang '91	RI A	Biddle, Justin M. '56		Hopper, Bruce L. '67	WVB	Cox, William K. '62
	Rieder, William G. '56		Cease, John E. '48	RI B	Chalsen, Michael J. '81		Jackson, Mary C. '83		Howard, Michael Ray '93
	Schmidt, Wayne J. '50	OR A	Gibbs, Bruce F. '79	SC A	Hill, James C. '61		Roberts, Thomas A. '69		Johnston, Robert S. '71
	Solberg, Bruce J. '69	PA A	Albright, Carl H. '55	SC B	Segui, William T. '60		Schroeder, Scot A. '81	WIA	Ellison, Henry O. '58
OH A	Fakult, Joseph Paul '90		Branting, Katrina L. '80	SC I	Stuedel Jr., Edward M. '64		Wright, Charles E. '62		Frazier, Clive '66
	Litzler, Thomas C. '53		Danner, Joseph C. '59		Hoel, P.E., Jeffrey S. '83	TX E	Bloschock, Mark J. '77		Nesbitt, John David '82
	Lund, Jeffrey W. '69		Fehnel, Gary N. '79	SD A	Tyner, Hugh L. '59		Kennedy, Sean F. '94		Stahl, Kenneth L. '57
	Reichard Jr., George W. '60		Frey, P. Wayne '51		Berend, Mark D. '78	TX O	Hippenstiel, Ralph D. '72		Wulf, Carl E. '42
	Ricart, D. Glenn '71		Groff, Ronald Parke '62		Bier, James J. '84	TX I	Maguire, Daniel M. '81	WIB	Koester, Fred W. '59
	Roth, Robert Andrew '42		Ho, Jasper '77		Eizember, Thomas R. '76	TX A	Plaza, Ruben D. '74		Lind, Bruce A. '64
	Schuerger, Richard G. '49		Huester, Peter K. '53		Paullin, P.E., Robert Lewis '50	UT A	Soss, David A. '71		Pelt, Thomas E. '70
OH B	Ball, James M. '69		Johnson, Robert S. '80		Schafer, Richard L. '51	UT B	Hardy, Mark D. '84		Romensko, Randolph L. '81
	Kojola, Scott Alan '95	PA B	Kendrick, James F. '69		Strobel, J. Walter '67		Hart, Robert E. '73	VT A	Russell, Jeffrey Thomas '88
	Rex, Clinton Owen '92		Boyer, Lester L. '60	TN A	Blazier, Stephen Draper '74		Rowland, William C. '77		Semrad, Edward V. '49
	Wilke, Raymond J. '81		Garbacki, Richard J. '59		Holmes, Winston H. '85		Sweeney, Gregory N. '60	WI E	Holte, Jennifer E. '90
OH I	Buehrer, Huber H. '51		Kutz, Michael Ralson '88		Hudson, Harold D. '64	VT B	Lauben, Robert W. '70		Holte, Kenneth, Alan '89
	Facer, Roger G. '85		Reifsnnyder, Jeffrey W. '80		Jones, Michael J. '68	VA A	Binder, Ronald W. '74	WYA	Meacham, Scott A. '88
	Gruber, Keith G. '80		Trochio, James T. '82		Low, Robert A. '70		Byers, Duane M. '80		

In Grateful Appreciation of Member-Contributors

AL A	Baker, Thomas R. '05		Taketa, Erin Sueko '12		Richard, William Edward '54		Hutson, Robert W. '76		Philbin, Jeffrey S. '64
	Benefeld, Larry David '66	CA H	Tewari, Ashok '84		Schneider, John L. '78		Kuo, Franklin '56		Pendergast, Steven Daniel '12
	Ellison, John R. '67	CA O	Hinkle, James Michael '89		Staniunas II, Joseph W. '65		McLay, Laura Ann '00		Sverodsky, Michael James '00
	McBride, Robert E. '52		Nease, Ardell '74	CT I	DeFelice, Frank C. '09		Meyer, Charles F. '50		Tavares, Edward J. '70
	Pearson, Barry Edward '12	CA I	Gaz, Richard A. '67		Gardiner Jr., Francis Espey '62		Mueller, Donald E. '83		Yogan, Thomas J. '52
AL B	Jolley, Steven B. '96		Hernandez, Christian '12		Garibian, Andrew C. '12		Rogness, Gaylord Grant '58		Zavesky, David J. '80
	King, Timothy V. '85	DE A	Romo, Christopher Hector '12		Gorman, Harry H. '59		Seo, Seokje '11	IN A	Abraham, Edward E. '63
	Messick, Keith A. '89		Shutt, E. Lynn '86		Stein Jr., Edwin Lee '07		Stutzman, Byron William '60		Schneider, Verne R. '63
	Novak, Thomas '75		Tanaka, Kazuro R. '68		Wilkes, Lester Dale '50	IL B	Cetera, Michael William '69	IN E	Mereau, Oliver Pierre '02
	Pilleteri, Joseph '74	CA K	Clemens, Rick A. '74		Battiste-Alleyne, Heather '12		Fitzgerald, Frank R. '61		Scranege, David A. '86
	Price, Andrew Roy '11		Khachatourian, Roger R. '07	DC A	Colman, Don Michael '60	IL I	Mukai, Cheryl Kiyomi '10	IA A	Brom, Richard H. '52
	Price, Marion R. '75		Kwan, Gregory L. '88		James, Paul K. '82		Bettinger, M.D., Paul C. '85		Dotzler, Frederick J. '67
	Ray, Richard E. '52	CA A	Miller, Ph.D., Richard K. '71		Mkandawire, Jimmy B. '67		Butz, James R. '73		Engel, Loren Mark '81
	Talley, Robert Michael '12		Nelson, Thomas A. '67		Rosen, Arye '63		Dierdorff Jr., Lee H. '43		Holan, Elmer W. '50
	Vickers, William K. '88	CA M	Chang, Fu-Lien '74	DC B	Gaunaud, Guillermo C. '66		Frystak, Mark K. '76		Jochimsen, Ronald D. '72
AL I	Etheridge, Brandon Scott '03		Filomeo, Leonard G. '74		Huynh, Philip Quang '10		Nudd, Oliver R. '92		McGuire, Jack Francis '63
AL E	Oliver, Christopher Robert '08	DC I	Perry, Paul E. '05		Diehl, James M. '67		Pector, Scott W. '78		Parsons, Cecil Eugene '45
AK A	Blum, Cynthia Louise '85		Robertson, David W. '74		Kowalski, Ashley Anna '12		Rawson, Norman Elroy '58		Sindt, Andrew Donald David '11
AZ A	Berry, Robert L. '67	CA N	Amirhosseini, Michael M. '90		Tzou, David T. '85	IL A	Henricks, Gwenne A. '81		Wheelock, Thomas D. '49
	Bigelow, William A. '85		Chan, Chung-Chin Stephen '94	FL A	Bedford, James Z. '78	IL Z	Steinkoenig, Glen Lee '95	IA B	Dodge, Robert D. '76
	Brusch, Richard G. '65		Nadasdi, Kristof '00		Douglas, Gavin L. '63	IN A	Beebe, Robert L. '43		Madsen, Nels H. '88
	Draelos, M.D., Zoe Diana '79	CA E	Wong, Jacky C. K. '85		Eadens, Matthew James '99		Birkhimer, James Edwin '88		Marshall, Rhonda P. '79
	Kenimer, Farrell L. '63		Morrow, Angela Lynn '97		Grau II, Erwin F. '67		Boehnlein, Robert C. '84	KS A	Crisler, Robert M. '56
	Mooberry, David G. '68	CA O	Tabor, Chelsea Jeanne '09		James, John L. '66		Campbell, Richard D. '53		Deckert, James L. '75
	Nowatzki, Edward A. '62	CA I	Hoye, Walter W. '59		Marko, Paul D. '81		Carbaniere Jr., Wayne A. '85		Henderson, James C. '49
	Rosoff, Henry '79	CA P	Lewis, William N. '63		Moore, Richard G. '68		Christensen, Carl S. '58		Jorgenson, Wilbur E. '61
	Young, Matthew Leighton '14	CA S	Dimond, Christopher N. '74		Perez, Ricardo '76		Clark, Ronald R. '62		Phillips, Robert K. '88
AZ B	Brown Jr., Miller H. '73	CA T	Chambers, Guy W. '78		Schoppman, Gregg M. '08		Derrick, David G. '68		Ridder, Wendel C. '80
	Good, Janice Bennett '82	CA Y	Tran, Doe Van '89	FL I	Schmitzer, Ph.D., Paul '57		Feil, Joseph N. '55		Simpson, Trent Alan '89
	Rasmussen, Brenda Kay '91		Swine, Joel Daniel '04	FL E	Guevin, Jim J. '92		Hale, David C. '59		Tholstrup, Richard J. '75
ARA	Holden, William Andrew '10	CA Y	Sanchez, Harrison B. '09		Nguyen, Linh Thi '89		Halley, Thomas A. '65		Timmecke, Michael Donovan '95
	MacKee, Bruce C. '80	CA O	Leung, David Shiukee '85	FL Z	Hall, Stephanie L. '08		Hamilton, Robert J. '58	KS B	Jahde, Russell Linn '88
	Peeler, Frank C. '53	CA X	Reeve, Tammy Marie '88	FL O	Paas, Holger '10		Hendrich, William R. '62		Lemon, Kimber Ann '09
CA A	Chan, Darin Arthur '90	CA Y	Isaac, Anthony Alba '05		Rodriguez, Eliel Fresco '02		Kerber, Ronald L. '65	KS I	Doud, Galen Charles '90
	Chu, Jeffrey M. '82	CA I	Lu, Cindy '10		Valdes, Giovanni '09		Kruse, Alexander Sherman '08		Heronemus, Daryl L. '77
	Foppiano, Linda Ellen '77	CO A	Banaszak, James E. '83	FL I	Nowacki, Matthew John '12		Landsky, George L. '57	KY A	Butler, Bradley David '12
	Spinazze, Laurel '55		Banfield, Frederick '64	GA A	Allison, Patton Manuel '08		Leban, Frank A. '57		Emrath, Glenn M. '75
	Talghader, Vivien Lee '91		Bennett, Diane R. '77		Andrews, Harry W. '70		Long, Harold T. '59		Hill, Richard C. '65
	Whisler, William D. '59		Maharg, John W. '51		Cooper, Jerome Maurice '52		Meyer, Don Allan '51		Mitchell, Joseph Blane '74
CA B	Andelin Jr., John Philip '55	CO B	Marrone, Frank Joseph '81		Croft III, John James '66		Miliken, Don B. '52	LA A	Beard, Rex Lane '86
	Biswal, Ph.D., Sibani Lisa '99		Peregoy, John J. '76		Daniel, John K. '70		Minton, Frank A. '44		Blum, Joseph F. '65
	Drehman, Alvin J. '78		Rex, Vincent '52		Driggers, Herbert H. '63		Moore, Darrel D. '64		Bullard, Salem C. '63
	Helfrey, Paul F. '51		Wolfgram, Phillip J. '08		Dunderville, Walter E. '58		Petty, Paul E. '53		Harvey, John Timothy '09
	Munsil, Wesley Elwood '71		Bratschun, Thomas D. '83		Gresham, Joshua James '10		Porter, James C. '59		Kile, Winston E. '66
	Sato, Kazuhiko '51		Dadd, Susan Valentino '96		Haney, Michael Douglas '63		Ross, Clark N. '42		Lambert, Jesse D. '83
	Whitehead, John C. '82		Hadley, Mark P. '69		Hecht, Robert G. '48		Sawyer, R. Steven '81		Schaneville, Donald L. '69
CA I	Doody Jr., James M. '56		Kohnert, Laura Watry '88		Hordlt, Philip Christian '61		Schafacker, James A. '53		Schober, James M. '83
	Lai, Eric K. '09		Mandics, Peter A. '61		McGhee, Bryan W. '67		Shimp, Alan B. '55		Tumay, Ph.D., P.E., Mehmet '05
	Martin, Bryan Ray '89		Matsuo, Roy M. '59		Nix Jr., Frank E. '60		Staeble, Robert L. '77		Wolf, Enrique Bernardo '67
	Rasmussen, Nicholas R. '68	CO I	Whissen, Robert E. '56		Spencer, Carson Scott '00		Tyrrrell, David H. '58	LA B	Maute, John K. '81
	Richardson, John L. '56	CO A	Blakeley, James E. '78	GA B	Morgan, Scott Robert '94		Van Fange, Reinold M. '73	LA I	Calvin, Angela Tello '88
CA A	Fujihara, Glenn Y. '74		Dadd, Jeffery Scott '97	ID A	Anderson, Nicholas Justin '09		Young, Robert C. '69		Kareh, Ahmad Ragheb '85
	Grotelueschen, John Henry '06		Dallemand, Barbara L. '91		Barton, Milton Francis '50		Young, Robert G. '44		Stagg, Charles H. '68
	Livingston, Breanna Hart '11		Thaemert, David Karl '89		Mende, P.E., Eric W. '80	IN B	Badger, David Harry '53	LA A	Giroir, Donald A. '62
	Miles, Erica Hwang '97	CO E	Wolfgram, Elizabeth Anne '08		Morrison, Robert C. '75		Bechtel, Morris Alan '64		Judice, Reggie P. '75
	Moore Jr., Victor E. '61	CT A	Bronstein, Philip Jason '12		Shryock, Abraham Lee '10		Dekker, Don L. '61		Pham, Jerry '90
	Schneider, P.E., Kenneth J. '58		Lowen, Steven B. '84		Wiegiers, Ph.D., Brandy Sue '02		Gemmer, Baron G. '85	LA E	Randazzo, Bert J. '92
	Thorne, Douglas Boyd '61		Peters III, Edward E. '50		Wimer, Burnell D. '85		Pepper, Dennis J. '80		Bahret, Gary Stratton '90
CA E	Kovar, Linda Y. '81	CT B	Tatarliev, Gavrail Todorov '11	IL A	Becker, Richard Charles '58		Williamson, Robert John '10		Gardner, Chris S. '91
	Krigger, Marc Danny '88		Daumais, Derek Edward '97		Boresi, Arthur Peter '48		Eymann, Earl D. '49	IN I	Dickens, Michael Loren '10
	Marcy, William L. '53		Evvits Jr., Joseph Kenneth '80		Frizzi, Rudolph P. '87		Gross, Thomas J. '82		Ford, Ph.D., Kevin Anthony '82
CA Z	Chun, Tori Leimomi '10		Gajda, John F. '65		Gust, Lawrence Alan '93		Krauss, Norman E. '58		Lamoreau Jr., Earl B. '86
	Lee, Mario John '79		Kou, Jine-Wen '85		Hafele, Joseph C. '59		Metayer, Alan Patrice '99		Legatos, P.E., Nicholas A. '55
	Oven, Mark J. '75		Rey, Donald P. '78		Hall, Wilfred B. '75		M		

DONORS, CONTINUED

MDA	Ragone, Paul P. '67		Herrst, Leonard R. '55		Jacobson, Geoffrey L. '76		Miller, Desiree Angela '09		Rodriguez, Armando M. '02
	Slack, Albert J. '76		Kaufmann, Daniel George '92		Jaquish, Frederick J. '81		Rupe, Robert C. '72		Tatum, Brian A. '85
MDB	Aberg, John R. '73		Ness, Valoree J. '73		Schepis, Randy Scott '83		Sisk, Michael Andrew '66	TN A	Chamness, Mark F. '77
	Bloom, Seymour '59	MS A	Brackett, C. Ann Odum '83	NY1	Klinger, Allen '57		Voit, David E. '66	TN E	Newbill, Mark Eugene '10
	Busch, Ronald G. '83		Chandler, Grant Garner '07		Lee, William '77	OR B	Sorrentino, Roger C. '93	TN Z	Shroyer, Edward Elvin '00
	Chang, Maria Kuomei '11		Davidson, John Howlett '90		McMahon, James M. '79	OR I	Hickey, Trevor John '12	TX A	Aziz, Dolly '04
	Fenstermacher, Ph.D., Thomas '80		Kyzar, R. Andy '67		Mullan, Philip J. '57	PA A	Carnali, Joseph Oreste '78		Boles, Brian D. '74
	Grill Jr., Philip A. '44		Maxwell, Theresa G. '80		Nelson, Ivan '60		Carnali, Leslie Goodwin '78		Buckner, John P. '67
	Guess, Arthur L. '49	MOA	Bade, Darrell Dean '73	NYK	Serkes, Ira M. '70		Cigich, Stephen Mark '78		Eeck, Aarne E. '54
	Haney Jr., William Samuel '57		Bryan, J. Kent '66	NYM	Frantz, Christopher John '88		Dreyer, Darlene Anne '97		Fraivillig, Kurt Leonard '12
	Luber, Joseph L. '49		Goolsby, Jerry Dale '91	NYN	Maddaus, Alan Donn '97		Frey, John H. '82		Harrell, Jay T. '83
	Rosenstock, P.E., Steven J. '85		Lange, Stephen Joseph '85		Barker, John A. '10		Galgion, Robert J. '43		McCarty, Frederick B. '49
	Shearman, Randall J. '85		Nguyen, Bao Anh Thanh '12		Coates, Ph.D., P.E., Donald '64		Hartman, George S. '43		McWilliams, Hobart Francis '59
MDI	Earp, David Thomas '97		Pepple, Robert L. '51		Handley, James R. '82		Heffernan, Robert Booth '70		Mendias, Mary K. '80
MDA	Battaglia Jr., Michael A. '07		Rice, Donald L. '69		McHale, Brian Christopher '02		Hicks, Robert C. '49		Morrow, Jack D. '72
MDE	Akpa, Okechukwu '04	MOB	Carte, Michael Ray '11	NYE	Bruzzzone, Anthony F. '12		Lewanda, David Benjamin '02		Nasas, Robert J. '65
	Diallo, Alioune H. '06		Cline, David W. '87		Cleary, Thomas F. '73		Nevis, Benjamin E. '55		Peevey, Amy Marie '99
	Smith, Darius O. '12		Coffman, James D. '60		Delsdon, Lawrence R. '78		Solender, Peter Edward '62		Persyn, Steve G. '71
MAA	Abbatello, James Martin '01		Dreisewerd, Douglas W. '66		Elkaslasy, Samy '10		Walsh, Christopher D. '88		Stell, Thomas Robert '12
	Boggio, Joseph E. '58		Hanser, Andrew David '92		Eschbacher, Robert M. '73		Waters Jr., Thomas Edward '07		White, William T. '51
	Danti, Bernard R. '56		Hargrave, Aaron Tyler '02		Polise, Anthony T. '71	PA B	Binford, Jack C. '53	TX B	Godek, Michael S. '12
	Dworkin, Larry '58		Hiebert, P.E., Yoelit S. '81		Rutherford, Kathleen Marie '83		Frick, T. Scott '93	TX I	Dobbin, Douglas G. '83
	Guerci, Harold B. '48		Johler, Craig B. '67	NYO	Schuessler, Anne Murphy '87		Fuller, Donald Brian '92		Rossen, Richard Gary '74
	Osowski, John J. '77		Shank, Donald R. '67	NYI	Bailey, John W. '65		Groff, Richard Eugene '96	TX A	Atkinson, Daniel Olin '54
	Pobuk, John Robert '80		Vandergriff, Leland E. '71		Boughner, Arnold R. '96		Hurley, Francis X. '63		Bunker, Dan Byron '59
	Potts, Brian Francis '10	MOI	Borgwald, Kenneth J. '65	NYP	Frank, Ian Joseph '09		Johnson, Michael Benjamin '08		Burk, Dannie O. '68
MAB	Calvano, Charles Natale '70		Burns, Steven M. '81	NYT	Ferreira, Antonio Manuel '97		Kempf, Dwight C. '81		Campbell, Thomas M. '55
	Chiappetta, Vincent F. '73		Franz, Donald Roy '55	NYA	Olenik, Anthony Michael '08		Okrent, Scott '00		Colley, Leilani B. '85
	Fynsk, Arthur W. '50		Mustoe, Anthony McDowell '09		Borden, Thomas Andrew '11		Soltys, Peter W. '77		Cravens Jr., James W. '61
	Harris, Marvin Sims '55		Reeves, Barry L. '56		Brewer Jr., Albert Sidney '08		Steiner, Donald F. '73		Hagan, Edward Emmett '39
	Lippitt, A. Warren '72		Shelly, Iris Lynn '12		Burton, P.E., William E. '62		Stover, Joshua Benjamin '09		Knutson, James LeRoy '55
	Luthringer, George F. '56		Wessling, Donald R. '60		Corcoran, Kermit C. '04		Tate, Duane C. '67		Latta, John S. '60
	Nathanson, Josef '63	MOE	Reed, Mark Alexander '12		Gidney Jr., Robert S. '61	PA I	Au, Tunga '43		Lock, Jack A. '53
	Silveston, Peter L. '51	MTA	Cornelius, David Michael '93		Hine, David E. '80		Bhatt, Mukul Harshad '12		Mulhestein Jr., Lado '59
	Thompson, Hugh A. '62		Darkenwald, Gregory Dale '93		Ingram, William P. '70		Carey, Michael J. '79		Pardue, Lon H. '63
	Wandrico, John L. '46		Webber, Briemann Dale '12		Norville, John Albert '58		Fugate, David W. '84		Samson, Charles H. '47
	Zimmerman, William R. '48	MTB	McElfresh, Nathan Alan '93		Seullin, Ronald L. '72		Gordon, Robert W. '60		Sinclair, Leigh Anne '09
MAA	Clark, Robert Allan '57		Michel, Rodney Lee '04		Shuford Jr., G. E. '65		Hart, Terence J. '81		Snauffer, Mark J. '87
	Fisher, Evelyn C. '74		Weatherhead, Murray D. '85	NC I	Needham, William D. '72		Markowitz, Michael I. '74		Thomas, Daniel P. '02
	Fogel, Arlene Beck '77	NEA	Ceerle, Chad Adam '07		Shealy, Malcolm T. '96		Silvey, Jeffrey David '96	TX E	Caldwell, Florence A. '83
	Harvey, Sean Michael '91		Lang, Oscar Alfredo '79		Webster, Dale E. '85	PA A	Bartusiak, R. Donald '77		Carmichael, P.E., Bruce A. '93
	Kaklamanos, James '08		Neal, Gordon W. '44		Wells, Joseph F. '49		Fling, Richard T. '54		Cole, Joseph D. '65
MAE	Dow, Benjamin L. '88		Peterson, Brian Kent '66	NC A	Austin Jr., P.E., George W. '86		Lehr, Harry J. '58	TX Z	Cooke, Mike P. '76
	Galante, Pasquale E. '69		Pyle, Eliot Lawrence '56		Dubler, Richard Dean '62		Marsh, Elbert L. '59		Chapman, Roy D. '68
	Gould, Daniel Patrick '09		Renner, Kenneth R. '74		Sanders, Miriam P. '80		Oppenheimer, P.E., Joel K. '79	TX H	Athey, Rebecca M. '07
	Greenleaf, Francis D. '42		Stetson, Laverne E. '62		Tolley, Ph.D., P.E., Patricia '88		Seremetis, Constantine M. '81		Barzin, Nazam '93
	Harding, John G. '88	NHA	Brucker Sr., Paul B. '83	NCE	Pasquini, John R. '93		Walkup, William Guy '50		Bhatt, Tanay Mahendra '05
	Lerner, Herbert A. '50		Gleske, Indulis U. '70	NDA	Meyer, Lawrence L. '56	PA E	Bera, John P. '70		Brant, Kelly Miller '88
	Marcinuk, Robert A. '72		Gilbert, Marc P. '77		Severtson, Todd W. '83		Chan, Chek Man '10		Dye, Steve Edgar '82
	Sexton, Ralph D. '74		Hewes, Robert P. '86	NDB	Bach, Jonathan D. '10		Cook, Stanley C. '03		Koerlein, P.E., David Eliot '98
MAZ	Liati, Irene '82		Johnson-Battista, Christine '87		Brindle, Kristine H. '78		Jacobs, Robert E. '68	TX I	Merrett, N. Rhys '77
	Miller, Kendall G. '79		Knapp, Robert E. '57		Christianson, Eric L. '79		Lundergan, Robert G. '64		Thomas, Fay Elaine '98
	Richardson, Alan M. L. '70	NJ A	Cook, Harold Frederick '07	OHA	Ehlerst, Katherine Marie '10		Quin, James R. '66	TX K	Williams, Donald Craig '89
	Steenstra, Curtis William '88	NJ B	Etz, Stephen Paul '90		Herman, Zelek S. '67		Schroeder, Karl R. '49	TX A	Carter, Jason O. '87
MAH	Vaicenti, Robert E. '82		Ruff, Alexandra J. '12		Kuhlman, William Duesing '88	PA Z	Boycock, Stephen J. '84		Carter, Norhanani B. '87
MAO	Bing, James Michael '92		Ruopp, John A. '70		Schurr, Charles A. '43		Craighead, J. Jeffrey '78		Figueroa, Fernando Xavier '98
	Oseni, Salewa T. '96		Smith, Christian E. '56		Soula, Donald F. '48		Hrebien, Leonid '75		Karki, Abhishek '12
	Vasilos, Thomas '50	NJ I	Alonso, P.E., Adalberto M. '83	OHB	Vignos, James Henry '55		Hunt, Thomas R. '84	TX M	Olukou, Steven Olayemi '87
MAI	Mashia, Daniel Jude '95		De Cosimo, Lawrence P. '69		Abot, Ph.D., Jandro L. '93		Levendog, Darvin L. '60		Payne, Robert Juealin '06
	Masi, James V. '60		Edwards Jr., Andrew '47		Bolchak, Jeffrey Raymond '01		Mladin, Catalina M. '97	UT B	Christensen, Todd Gregory '99
	Zawacki, David Vincent '98		Garcia, Elizabeth '66		Guenzi, Charles E. '74	PA H	Miller, Donald K. '59	UT I	Jackson, Brandon Marshall '01
MI A	Andersland, Orlando Baldwin '52		Heller, James E. '65		Smith, George E. '63	PA O	Forcier, E. John David '72	VA A	Olsen, Kettie Lynn '97
	Bullock, Andrew D. '81		Kennedy, Peter D. '49		Stecher, Mark Joseph '09	PA I	Glessner, Alfred J. '64		Clem, Kenneth R. '69
	Butchbaker, Allen F. '57		Liang, Jing '11		Wessels, Robert P. '78	PA A	McClellan, Karl R. '80		Coleman, George W. '45
	Conklin, Daniel L. '65		Lieberman, Benjamin '10	OHI	Cipriani, Benjamin Ryan '03	PA A	Christian, Robert Francis '07		Kuningham Jr., Harold L. '73
	Kostrzewa, Audrey Sue '86		Rossi, Richard J. '77		Cook, James H. '65		Grisnik, Stanley P. '83		Kolovich, Paul Kevin '10
	Othmer, Hans George '66		Singalewitch, Joseph D. '50		Crabill, Thomas Buskirk '62		Terhune, Edward A. '80		Mudd, Courtney P. '65
	Potvin, Deborah L. '91		Singer Jr., Frederick '50		Keller, Philip S. '84	PA M	Flynn, Steelton Wall '11		Reid, Robert E. '64
	Scheid, Daniel Courtney '70	NJ A	Chen, Ephraim Jonathan '09		Marsh, Steven Allen '93		Nicholas, Kathleen Sara '12		Rosen, Mitchel C. '82
	Williams, Robert G. '59		Goldstein, Ethan Lauf '12		Marsh, Belinda A. '80	PR A	Brana-Mulero, Francisco J. '74	VA B	Elliott Jr., Marion B. '53
MI B	Burnette, Keith T. '64	NMB	Maienschein, Jon L. '74		Stewart, Orald L. '56		Cruz-Acevedo, Denny '85		Fletcher, Ronald E. '69
	Eldridge, John L. '84		Agogino, Karen L. '79		Swanson, Robert J. '61		Martinez, Jonathan Alexis '07		Hall, Charles D. '70
	Hupy, Craig A. '13		Buck, Cindy Jo '90		Warner, William G. '73		Rodriguez, Jose E. '85	VA I	Cowen, Kenneth R. '90
	Luttinen, Gail Luttinen '68	NMI	Eaton, Edwin A. '99		Wilkins, Scott A. '72		Serrano-Vargas, Heidi '10	WAA	Hunt, P.E., Robert E. '97
	Markwardt, Donald D. '57	NYA	Kruse, Walter Anthony '07	OHA	Wortendyke Jr., Peter R. '86	RI B	Bessacini, Anthony Frank '62		Betts, Frank Patrick '90
	Oliver, Bruce L. '63		Choi, Yeon Sub '07		Benson, Jay A. '87	SC A	Croce, Paul Anthony '62		Steiner, Alan R. '87
	Shroff, Avante C. '65		Lawson, Derek Michael '09		Markley, Robert Lee '65		Calcutt, Walter Wade '91		Strombach, Gail Michael '96
	Thoune, Diane Lynn '98		Schneider, Bethany Noelle '12		Shoemaker, Terry R. '83	SC B	Gonzalez, Ralph Peter '91	WAB	Baxter, Donald Wallace '74
	Wiersema, Ronald G. '57	NYB	Bennett, Walter Scott '63	OHE	Shoup, Jerry Franklin '60		Henry, Peter James '08		Bennett, James G. '50
MI I	Balachander, R. S. '87		Bunn, K. Wayne '67		Bonner, Gail K. '82	SC I	Anessi, Thomas Joseph '56		Hirzel, David M. '63
	Brown, Mark R. '80		Chivily, Philip S. '90		Frowker, Daniel Joseph '12		Forcier, E. John David '72		Miller, P.E., Steven S. '84
	Buller, Andrew A. '60		Gumalis, Anthony J. '81		Heckelmeier, James D. '62		Hass, USAF Ret., Paul H. '56		Stover, James C. '43
	De Boer, Douglas F. '78		Olson, John Frederick '64		Jones, Michael T. '87		Kelso, William G. '60		Teitenberg, Tony Mark '89
	Durbin, James R. '66		Parr, Helen Kim '78		Lisy, Stephen '77		Lucas, Barry H. '83		Turi, Michael Allen '07
	Easton, Archie Harter '85		Todd, Richard F. '49		Rielinger, James J. '62		Suitt, Thomas H. '48		Williams, Harvey R. '59
	Fleishman, Morton Robert '54	NYI	Berggren, P.E., Robert W. '69	OHZ	Randolph, Brian Walter '82	SD A	Anderson, Roger Alan '79	WAI	Soto, Mark Douglas '90
	Funkhouser, Ph.D., Chloee '05		Chow, Francis M. '96		Walker, Edward P. '74		Anderson, Sandra Bauer '79		Wong, Tommy S. H. '06
	Gray, Nancy F. '69		Furman, William M. '82	OHH	Breaux, Patrick Regis '97		Dahl-Stammes, Knut H. '80	WAA	Daquinisto, John Fred '65
	Hale, Kimberly O'Donnell '93		Leggett, Joseph H. '40		Dyson, Craig Stephen '91		Fersdahl, Mark Curtis '02	WVA	Johnston, John W. '73
	Harper, Glenn E. '61		Miller, John B. '69		Hannan, Shawn Michael '95		Graham, Keith Douglas '51		Marne, Philip C. '72
	Mehlhorn, Ph.D., Thomas A. '74		Pabisz, Ronald A. '96		Lloyd, Kenneth Bertram '61		Hansen, Kyle Ernest '10	WVB	Jarvis, David A. '81
	Reither, Harold F. '50		Patsos, Daniel Alexander '05		Spinelli, Christopher John '05		James, Blake Andrew '12		Thompson, David Wayne '87
	Rudy, Sara Jean '82		Savrick, Martin '60		Szmerkovsky, Andrew G. '04		Peterson, Ray Dean '80		Titlow, P.E., Brian E. '97
	Sabraouni, Rebecca Corry '81	NYA	Schmidt, Richard Q. '56	OHO	Carbaugh, Karen F. '86	SD B	Wienacht, Daniel J. '84	WIA	Chesner, Ramon '58
	Schepis, Deborah Kalef '83		Zimmerli, Fred H. '47		Collins, Brittany Nicole '10		Bienfang, Cory Lane '09		Epping, Erin L. '80
	Sterngold, Henry '43		Altes, Richard Alan '64		Dant, Lynne Elizabeth '89	TN A	Davis, Wesley Harold '12		Salkowski, William Joseph '57
	Wieser, James B. '77		Brown, Matthew A. '85	OHI	Henfing, Richard Anthony '06		Adams, Michael Eugene '91		Terman, Terry V. '62
MI A	Hemminger, Joseph A. '69		Dumouchel, Matthew Paul '08		Bash, Michelle Lynn '06		Bounds Jr., Beryl L. '78		Tubbs, Dennis H. '86
	Kudlac, Gregory Alan '86		Ku, Katharine '71		Chelmins, David Thomas '08		Breedlove, Harold K. '77		Wachtl, William W. '44
	Kudlac, Maureen Dorsey '86		Lux, Jeffrey P. '86		Liesner, Kevin R. '84		Bryan, Catherine B. '84	WIB	Anderson, Ronald J. '55
MI E	Hornby, Richard William '71		Munch, William D. '76		Matsick, Stephen W. '73		Griffith, Linuel H. '57		Ames, Kurt D. '70
	Paterson Jr., P.E., John M. '68		Ng, Benjamin '81		Schwab, Sarah Helen '02		Henderson Jr., Henry L. '81		Colasanti, Regis J. '65
	Schlaps, Edgar H. '79		Nickles, John Edward '52		Winkelman, Lawrence Carl '78		Hurt, William W. '58		Coleman, David J. '74
MI Z	Landis, Richard W. '69		Powers, David Thomas '59	OHK	Bunnell, Robert Lee '76		Kennedy, Earl Powell '60		Conrad, Jack G. '70
	Reuter, David F. '73		Ramsdell, John D. '76		McCarthy, Stephen Joseph '07		Lindsay Jr., Raymond S. '74		Lancaster, John T. '61
	Schickler, John F. '65		Sinder, Stuart J. '65		Moseley, Dale Jay '77		Oliver, Edward E. '66		Petrie, Adolore F. '51
	Sisolak, Jeffrey A. '88	NYE	Alphonse, Gerard A. '58		Pritchard, C. '55		Perkins, Catherine P. '80		Ries, John N. '63
MI H	Boos, Nathan S. '09		Heller, Robert I. '63	OHA	Esseniy, Alexander J. '77		Perkins, Charles Joseph '80		Schnabl, Val J. '67
	Roman, P.E., Jeffrey Michael '01		Probst, Ronald F. '48		Smith, Michael Angelo '92		Pitcher, William Franklin '60		Schroder, Gary J. '86
	Schowitz, Peter G. '88	NYZ	Choi, Stephen '73	OHM	Levay, Anthony Joseph P. '00		Shuppert, Jason Richard '97		Wilant, Mark L. '71
MI I	Rossi, Robert E. '85		Tierman, Frank V. '56		Rathburn, Richard K. '58	TN B	Griswold, Glenda Kay '86	WIF	Otto, Michael J. '76
MI K	Osage, William Todd '88	NYH	Demarinis, Bernard D. '68	OHE	Hendley, Grace Rebecca '12		Griswold, Victor Jon '86	WIA	Puetz, P.E., Cameron A. '08
MNA	Anderson, Rodney M. '77		Eumale, Charles '63	OK A	Granato, Matthew Adolph				

242 Companies Match Gifts to Tau Beta Pi!

The following 242 companies and foundations match gifts made by their employees to Tau Beta Pi. Their support is gratefully acknowledged by the Association. All matching gifts are allocated to the Tau Beta Pi Fellowship and Scholarship Programs to provide stipends for engineering undergraduate and graduate students. We welcome three new firms (*).

3Com Corporation	CITGO Petroleum Corporation	ING Foundation	Progress Energy Inc.
A. Foster Higgins & Co. Inc.	Citigroup Foundation	Ingersoll-Rand Company	QUALCOMM
Abell-Hanger Foundation	Clark Construction	Ingredion, Inc.	Quantum Chemical Corporation
Adobe Systems Incorporated	The Clorox Company	Instron Corporation	R.J. Reynolds Tobacco Co. Foundation
Aetna Foundation Inc.	The Coca-Cola Company	Integrity Applications Incorporated	Ralston Purina Company
AIG	Cognis Corporation	The J.P. Morgan Chase Foundation	RELTEC Corporation
Air Products & Chemicals Inc.	Computer Associates Internatl. Inc.	The James River Corp. Foundation	Rexnord Foundation
AK Steel Foundation	Comsat Corporation	Jim Beam Brands Co.	Roche Colorado Corp.
Albemarle Corporation	ConocoPhillips	Johnson Controls Foundation	Rockefeller Family & Associates
Allegheny Technologies	Constellation Energy	Juran Institute Inc.	Rockefeller Financial Services Inc.
Allegro Microsystems Inc.	Control Components Inc.	Kellogg Brown & Root	Rogers Corporation
Alliant Energy Foundation Inc.	Cordant Technologies Inc.	Kellwood Company	Rolm Corporation
Alliant Techsystems Inc.	Countrywide	Kimberly-Clark Foundation Inc.	SPX Foundation
Allo Source	Covidien	Kraft Foods	Saint-Gobain Corporation Foundation
Altria Group Inc.	Cray Research Foundation	Lennox International Inc.	Schneider Electric/Square D Foundation
Amax Foundation Inc.	Crayola LLC	Leo Burnett Company Inc.	Sempra Energy
AMD Foundation	CSG Systems Inc.	Loiederman Soltesz Associates Inc.	Shaklee U.S. Inc.
American Petroleum Institute	Cytec Industries Inc.	The Lubrizol Foundation	Shell Oil Company
American Ref-Fuel Company	David L. Babson & Company Inc.	LyondellBasell	Siemens
American Transmission Co. LLC	Dell	M.W. Kellogg Company	Silicon Laboratories Inc.
Amgen Foundation	Dignus, LLC	M/A Com Inc.	Southern California Gas Company
Amsted Industries Foundation	DirectTV	Macy's Foundation	Southwest Power Pool
Analog Devices	Duke Energy Foundation	Mallinckrodt Speciality Chemicals Co.	St. Jude Medical
Apache Corporation	Duracell USA	Markman Inc.	Stanley Black & Decker
Apple Inc.	Ecolab *	Massachusetts Financial Services Co.	The Sun Microsystems Found. Inc.
Applera Corporation	EG & G Chandler Engineering	Massachusetts Mutual Life Insurance Co.	TCF Foundation
Armstrong Foundation	El Paso Energy	May Department Stores	Teledyne Technologies Inc.
ARS Products LLC	Elsevier Science	McDonald's Corporation	Tellabs Operations Inc.
ASARCO Foundation	Emerson Electric Company	McGraw-Edison Company	Texas Instruments Foundation
ASC Geosciences Inc.	Engineering Design & Testing Corp.	Meadwestvaco Foundation	Thomson Reuters
Ashland Inc.	Enterprise Products Company	Metso Automation	The Toro Company Giving Program
Atlantic Richfield Foundation	EOG Resources Inc.	Microsoft Corporation	Toyota Technical Center, USA Inc.
Atmos Energy *	Equistar Chemicals, LP	MidAmerican Energy Company	Transamerica Corporation
Attachmate Corporation	Eriesson Inc.	The Millipore Foundation	TransCanada PipeLines
Avago Technologies Inc.	Erie Manufacturing Company	Mobil (Retirees)	Tribune Company
BAE Systems	Esterline Technologies	Mondelez International Foundation	Turner Industries, Ltd.
Ball Corporation	Exelon	Motorola Foundation	Tyco
Bay Networks Inc.	Expedia Inc.	Motorola Mobility	TyCom (U.S.) Inc.
BEA Systems	Fair, Isaac and Company Inc.	National Instruments	UFE Inc.
Bemis Company Foundation	Fannie Mae Foundation	NEPERA Inc.	Unilever U.S. Foundation Inc.
BHP Billiton	FleetBoston Financial Corporation	Network Associates	Union Pacific Corporation
The Blount Foundation	Fluke Networks Inc.	Newmont Mining Corporation	United Technologies
The BOC Group Inc.	FM Global Foundation	Nissan North America Inc.	The UPS Foundation
The Boeing Company	Freeport McMoRan Foundation	Nokia Inc.	Verizon Foundation
Boston Scientific Corporation	Freudenberg Spunweb Co. *	Northrop Grumman Foundation	Virginia Power/North Carolina Power
BP Foundation Inc.	The Gap Inc.	NOVARTIS	W.K. Kellogg Foundation
Bristol-Meyers Squibb Foundation	Gartner Group	NRG Energy Inc.	Wachovia Foundation
Buckeye Pipe Line Co.	GE Foundation	Nuevo Energy Company	Washington Mutual
C.I.T. Financial Corporation	Genentech	Occidental Petroleum Corp.	Waste Management Inc.
Callaway Golf Company	General Reinsurance Corp.	Owens-Illinois	Wheelabrator Air Pollution Control Inc.
Carolina Power & Light Co.	General Signal	Pacific Enterprises	Williams
Centerpulse Orthopedics Inc.	GenRad Foundation	Pathfinder Global Group Inc.	Wisconsin Energy Corp. Found. Inc.
CertainTeed Corporation Foundation	Goodrich Foundation	Pella Rolscreen Foundation	WRC Inc.
Champion International Corp.	Google	The PepsiCo Foundation	Xeel Energy Foundation
Charles S. Mott Foundation	Guidant Foundation	Petrotech Inc.	XE Corporation
Chemical Bank	Harcourt General Inc.	The Pew Charitable Trusts	Xerox Foundation
Chevron	Hewlett Packard	Pfizer Inc.	Xilinx
Ciba Corning Diagnostics Corp.	Household International	Pitney Bowes	Yarway Corporation
CIENA Communications Inc.	Illinois Tool Works Foundation	Polaroid Foundation Inc.	Zeon Chemicals L.P.
Cingular	IMCERA Group Inc.	Potash	
Cisco Systems Inc.	IMO Industries Inc.	Power & Telephone Supply Co.	

Executive Council Meetings

(Continued from page 5)

Bent was approved. Annual subscriptions remain at \$10 per year, but the 4-year subscription for new members was raised to \$12 from \$8.40 and the life subscription was raised to \$75 from \$60. A new electronic-only life subscription will be offered at \$40. The Council reviewed a proposal to allow non-recruiting advertising in *The Bent* and directed Executive Gomulinski to study the matter in more detail.

A proposal to allow District 14 to have three Directors was approved on a three-year trial basis. The Council accepted a proposal to have the Association celebrate Pi Day to help elevate the public's perception of Tau Beta Pi.

Executive Director Gomulinski reported on Headquarters including staff development, the annual audit, and the new accounting system. The Council requested Mr. Gomulinski to prepare policies regarding social media use and gift card purchases.

Plans for the 2013 Convention in Ames, IA, on October 31-November 2 were reviewed. Social activities for each evening were approved, and an invitation to Ralph A. Rockow, *OH Γ '58*, to be the keynote speaker was approved. A plan to offer an expanded series of professional development sessions on Thursday was accepted.

The Council approved amendments to the Constitution and Bylaws to be reviewed by the 2014 Convention. Amendments include eliminating the position of cataloger, eliminating the Convention assessment, and granting a Convention vote to the Director of Alumni Affairs. The Council also approved a proposal for a general revision of the Constitution and Bylaws to be considered at Convention.

Preliminary petitions for new collegiate chapters from the local honor societies at Embry-Riddle Aeronautical University-Prescott and Indiana University-Purdue University Indianapolis were reviewed. Councillor Pih and President Simonson were named the Council's representatives on the inspection visits.

The Executive Council met via teleconference on September 18, 2013.

A petition from the alumni in the Colorado Springs area was reviewed, and the Council granted them a charter for the Colorado Springs Alumni Chapter.

The Council voted a TBP Distinguished Service Award to retiring District Director Jason A. Corl, *CA Θ '06*. S.L. DeChenne, *WA B '12*, was appointed as a District 14 Director and S. Rokni, *CA X '05*, was appointed as a District 16 Director, both with terms ending June 2016.

Twelve MindSET grants from eight chapters totaling \$2,594 were approved.

The Council reviewed plans for the 2013 Convention in Ames, IA. The Council approved proposals to have

the members of the Student Advisory Board attend and to show the movie *Pandora's Promise*. The schedule, agenda, and charges to the committees were approved with adjustments. Councillor Pih will coordinate with the HQ staff for arrangements for the VIPs attending Convention.

A proposal from the SAE regarding a formal agreement regarding the freshman scholarship program was reviewed. The Council requested changes to the agreement that Executive Director Gomulinski would present to SAE.

The Executive Council met in Ames, IA, on October 30, 2013.

The Council enthusiastically voted five TBP Superior Service Awards and eight Resolutions of Appreciation to retiring advisors of the collegiate chapters. They also voted Outstanding Service Awards to Ellen S. Styles, *AL Δ '85*, and Rodger F. Smith, *WI A '64*, for their 27 and 30 years of respective service to the Association.

A request from the alumni in the Huntsville, AL, area was reviewed, and a charter for the Huntsville Alumni Chapter was granted. The Council appointed Executive Director Gomulinski as the installing deputy for the Ann Arbor Area, Boston, Central Jersey, Colorado Springs, and Huntsville Alumni Chapters at a convenient date for the groups and Mr. Gomulinski.

John S. Walker, *PA B '82*, and Edward D. Basta, *OH E '82*, were appointed to the Financial Review Committee. The 2012-13 report of the auditor and the auditor's management letter were reviewed and approved. The report from Major Gifts Officer Sherry D. Jennings-King was accepted.

The Engineering Futures Program facilitator recruitment, appointment, training, certification, and administrative requirements document were approved. The Council requested that the documents be updated to include references to current documents instead of embedding the documents.

A District Director was removed due to a lack of response regarding the director's continued interest in serving in this role.

Plans for the 2014 Fellowship Program were reviewed including approving the allowable substantial financial aid at a level to allow all recipients to receive the stipend.

The partnership agreement with the Society for Automotive Engineers to award six \$1,000 scholarships was extended for an additional year.

The recommendation to give the J.D. Froula Most Improved Membership Award to Kentucky Alpha was accepted.

Executive Director Gomulinski reported on the increasing costs of health care coverage for the HQ staff. The Council requested that he study the matter in more detail and present possible options to minimize cost increases.

Profiles in Leadership #4

Hector de J. Ruiz: Persisting with Vision, Dreams

A poor Mexican kid from a border town who wanted to be an auto mechanic, Hector Ruiz rose through education and determination—and early mentors—to be CEO of AMD and take on Intel. Now he is mentoring Hispanic youth to go after their dreams.

by Trudy E. Bell © 2014 Trudy E. Bell

“I HAD THE JOB of chasing down the chickens to kill for dinner,” recalled Hector Ruiz of his childhood in Piedras Negras, Mexico, just across the Rio Grande from Eagle Pass, TX, 150 miles southwest of San Antonio. From age 7 (around 1952), Hector began contributing income to his parents and three sisters as a shoeshine boy. When he was 13, a silver-haired missionary from Ohio named Olive Givin who attended the same Methodist church as his parents began hiring Hector to run errands or do yard work.

From Shining Shoes To Ph.D.

One day, Ruiz recalled, Miss Givin asked him what he hoped to do after graduating from high school. “I love cars,’ I said. ‘You’ll need to know English because all the manuals are in English,’ she said.” She began tutoring him in English and suggested he consider attending the Texas high school in Eagle Pass. So as a sophomore, every day he drove four other students in his grandfather’s 1941 Chevy two-door coupe across the U.S. border to Eagle Pass High School. At first, Ruiz struggled with subjects taught in a foreign language, but he sought coaching and stuck with it—graduating in 1964 as class valedictorian.

But Miss Givin wasn’t done with him. “How good an auto mechanic do you want to be?” she asked. ‘I want to be the best,’ I said,” Ruiz

What does it mean to be a leader? In this series “Profiles in Leadership,” Tau Beta Pi is exploring that essential question through the lives of member engineers who attained leadership positions in their fields.

recounted. “All the best auto mechanics go to university and take mechanical engineering,’ she said, but I protested, ‘My family is poor—they can’t afford college.’” Texas had a law on the books, however, guaranteeing any valedictorian from a Texas high school attendance at a Texas public college tuition-free. It said nothing about the student’s citizenship. When faced with objections from various administrators

and officials, Ruiz quietly but repeatedly made his case: he graduated from a Texas high school at the top of his class. “That was where I first learned the value of persistence.” He was admitted to the engineering department of the University of Texas, Austin—and Miss Givin shocked his parents by offering to pay for his first year’s room and board.

By the end of his first year, Ruiz was drawn to electrical engineering (“not a good name for the major, which encompassed solid state physics and quantum electronics”). Seeing his aptitude, several professors offered him work in their labs, unusual then for an undergraduate. Lab work

plus scholarships and assistantships financed his next three years at UT Austin through graduation in 1968. Offered a fellowship at Rice University, he went straight on to graduate school, earning his Ph.D. in 1973.

Luck—Good And Bad

Ruiz couldn’t have received an engineering Ph.D. at a worse time. It was 1973, the depths of the aerospace recession after President Richard M. Nixon had



Hector Ruiz, right, then CEO of AMD, presents Microsoft CEO Bill Gates with an AMD-based laptop running Windows Vista at the launch of Vista and Microsoft Office 2007 in New York City in January 2007.

memorably declared following Apollo 17 the previous year that the U.S. would not return to the Moon. NASA and aerospace contractors were laying off scientists and engineers in droves. Jobs were scarce, Ruiz remembered: “One of my peers ended up driving an 18-wheeler.”

But that was also when Ruiz learned the value of connections through Rice University’s tight-knit alumni network. One of his professors called the head of research of Texas Instruments (TI) corporate laboratories, who agreed to meet Ruiz and talk. “We hit it off. He hired me.”

He started in the corporate research laboratories. At that time, integrated circuits were still relatively new and TI was suffering serious problems with manufacturing processes. The company had a culture of appointing a young person to head a problem-solving task force in an area about which he was not expert. So within a year, Ruiz was asked to head a task force to figure out why yields were low in one manufacturing plant. Six months later, the problem was solved. “Knowing very little about a problem is actually quite helpful,” Ruiz observed. “It forces you to look at every detail with fresh perspective void of preconceptions and baggage. It also revealed that a solid engineering background can be useful to any problem.”

During this period Ruiz suffered personal tragedy—and joy. As a college junior in 1967, he had married education major Judith Villegas. Judith was later diagnosed with leukemia. After a long battle, she passed away in early 1976, leaving Ruiz a 31-year-old single father of 4-year-old Hector, Jr. But she also gave him a gift. She told Ruiz that a young widow named Judy whose 4-year-old son Greg attended the same preschool at which Judith taught had just lost her husband to a brain tumor and been left with two children. Judith said, “I hope you have a chance to meet her. She’s a great person.” Ruiz and Judy did meet at a dinner party and were married at year’s end.

‘What Do You Dream Of Doing?’

Around that time at TI, Ruiz met Al Stein, general manager for TI’s integrated circuits division, who became a friend and mentor. One day at lunch in 1978, Stein asked, “What do you dream of doing?” to which Ruiz replied, “I think it would be great to work in another country.” Shortly, Stein left TI to become general manager of Motorola’s Semiconductor Products Group. Soon he telephoned Ruiz and said, “If you come to Motorola, I can offer you a chance to head a factory in Scotland.”

The challenge was tough. Ruiz was to modernize an old factory to produce Motorola’s new 68000 microprocessor chip for the European market. In so doing, Ruiz learned how to build local teams in another country, absorbed a global perspective, and steeped himself in the British and German culture of valuing workers during downturns and reskilling them to be prepared for emerging opportunities.

On his return to the U.S. in 1981, Motorola asked Ruiz to build a brand new factory in Phoenix, AZ, to be the first plant in the world to make integrated circuits using semi-automated lithography and stepper technology. From there, he took charge of Motorola’s research and development, including of then-new gallium arsenide compounds



This Leader In Brief

Full professional name: Hector de Jesus Ruiz

Current position: Chairman and Founder, Advanced Nanotechnology Solutions (ANS); CEO and Founder, Bull Ventures, LLC (consulting firm).

Birthplace: Piedras Negras, Mexico

Highest degree: Ph.D., electrical engineering, Rice University, 1973

Major career highlights: Texas Instruments, 1972–1977 in research and manufacturing. Motorola, 1977–2000, culminating as President, Semiconductor Products (1997–2000). Advanced Micro Devices (AMD), 2000–2009, culminating as Chairman of the Board and Executive Chairman.

Board memberships: 25 past and present, including: RAND Corp. (since 2009); Engineering Foundation Advisory Council, University of Texas, Austin (since 1998); Rice University (2007–2012); President’s Council of Advisors for Science and Technology (2006–2008).

Honors: Over 25, including Distinguished Alumnus at The University of Texas, Austin (2012); Semco Bellwether Award (2009); Triunfado Award, Hispanic Scholarship Fund (2007); Rice University Distinguished Alumnus (2005).

Greatest accomplishment: “Despite my shortcomings as a father, we have three great children and six awesome grandkids.”

Book published: *Slingshot: AMD’s Fight to Free an Industry from the Ruthless Grip of Intel* (Greenleaf Book Group Press, 2013)

Leaders most admired: Pope Francis (current Pope); President Barack Obama “especially after what Robert M. Gates wrote about him in *Duty*”; Robert W. Galvin (1922–2011), CEO of Motorola, 1959–1986.

Family: Wife Judy (married 37 years); daughter Joanna, sons Gregory and Hector; six grandchildren.

Hobbies: “I’m a car fanatic” (currently restoring a 1973 Porsche 911T); bicycling (both road and mountain); guitar; “I’ve started playing golf—a frustrating game.”

Favorite books: *From Good to Great* by Jim Collins (2001), “anything about science, math, or business strategy,” and poetry.

If you could do one thing over: “I would have learned to play golf young. Too often, discussion while playing is a continuation of the corporate meeting, and I could not participate. Also, a person’s character—such as cheating or impatience—comes out on the course.”



TOP: As a student at Eagle Pass High School, Ruiz, left, was part of a team named Number Sense that competed against other Texas high schools in mathematics. CENTER: Ruiz at his graduation from the University of Texas, Austin, in May 1968, stands with his father Gregorio, left, and grandfather Ramon Cardenas. BELOW: Ruiz with wife Judy and four of his six grandchildren, Laura, Anna, Diego, and Makayla, while on vacation zip-lining in Flagstaff, AZ.



for fiber optic communications and high-speed computing.

By 1990, Ruiz had caught the eye of Motorola's new CEO **George M.C. Fisher, Ph.D., Illinois Alpha '62**, who made him general manager of Motorola's paging products group in Boynton Beach, FL. "Motorola was king of the hill in pagers at that time," Ruiz recounted. "Pagers were the most profitable business in the company. Fisher told me, 'I don't want you to go and fix something. I just want you to get experience running a company in a global business. And I'm going to leave you alone.'"

Ruiz's five years there proved to be "a fantastic laboratory for being a CEO that allowed me to grow faster than ever before," he said. Without traditional oversight, "you make mistakes nobody else looks at, and you have to figure out how to fix them and learn from them. But you've then learned what you are strong at and doesn't work, and also absorbed wisdom from a founder. He was a fundamental leader he admired: son of Motorola's when I was debating whether to promote a certain man to become a vice president, I asked Bob how he would handle it," Ruiz recalled. "Bob replied, 'Would you like your son to grow up to be this man? Well, you have your answer.'"

'I want to see that other talented Latino children do not suffer the soft bigotry of lower expectations.'

In 1995, Ruiz was promoted to president of Motorola's semiconductors sector, one of the company's three lines of business—and essentially the former position of his mentor Al Stein. His immediate task, however, was unenviable: move the 1,000-employee headquarters and research labs from Phoenix to Austin, which had become the company's integrated circuits headquarters. "These are people's lives, people's families, whole communities being disrupted," Ruiz ruminated. He drew on his experience in Europe to "spare no energy or dollars to make sure we did this right"—announcing the 1998 move a year in advance, scheduling it for the summer so as not to affect families' school schedules, and assisting with selling houses and finding new ones.

David And Goliath

Just before Christmas 1999, Ruiz was approached by Jerry Sanders, founder and CEO of Advanced Micro Devices Inc. (AMD), about becoming AMD's future CEO. A Fortune 500 company, AMD was second only to Intel Corp. in the manufacturing of the computer microprocessors at the core of almost every business. After discussing the offer with Judy over the holidays, Ruiz decided in January 2000. After 22 years at Motorola, he became chief operating officer of AMD, taking the helm as CEO in 2002.

"AMD was not yet really a global company," he recalled. In the next five years, he grew the annual business with China from \$60 million to over \$1 billion and established a strong presence in Latin America. As excellent as AMD's chips were, however, the company had only about 10 percent of the chip business compared to Intel's 85 percent market share. That mystified Ruiz until irrefutable evidence convinced him and other AMD managers that Intel

had achieved a near monopoly through unfair competition that included intimidation of customers and other unsavory practices.

So scrappy little AMD took a big gamble: it sued the global industry giant. Inside AMD, the lawsuit became code-named Project Slingshot, not only because of its David and Goliath aspect, but also because of Ruiz's experience in Mexico. As a boy, he had become skilled in whirling the same type of leather hunting slingshot that both David and indigenous people in Mexico used to release a smooth round pebble at high speed to nail a can at 20 feet. "From this childhood play," he recounts in his book *Slingshot*, "I learned a lesson that would come in handy as we prepared to combat Intel: When taking a shot, no matter the size of the adversary, what matters most is the strategy—the stone you choose, your position, and your aim."

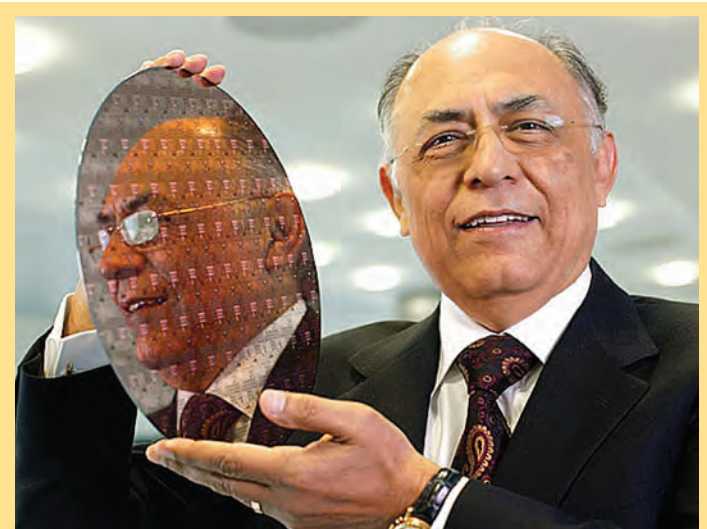
In 2009, the case was settled out of court: Intel agreed to pay AMD \$1.25 billion but without admission of wrongdoing. Ruiz has mixed feelings about the long-term results: "The industry did not benefit as much as I had hoped and expected. I'm not sure the playing field today is as level as it should be. But industry leaders are becoming more in tune with the need to compete fairly so everybody wins."

Today, Ruiz is pursuing what he feels is the next phase in computation and chip design: three-dimensional interconnections, where integrated-circuit connections travel not only in the horizontal plane of the chip, but also vertically to neighboring chips. He has started a new company Advance Nanotechnology Solutions (ANS); the factory, under construction in Utica, New York, is slated to open in early 2015. "This would be the first time in decades that brand new jobs in advanced technology manufacturing are birthed in this country," he observes.

Giving Back

"Without Miss Givin, I would not be here today," Ruiz stated. "I want to see that other talented Latino children do not suffer the soft bigotry of lower expectations." Along with two other Mexican-born high-tech leaders, he co-founded a nonprofit Hispanic Leadership Council in Texas, which coaches people in Latino communities on the challenges of leadership and the importance of becoming strongly involved in all aspects of civil life. And he serves on the board of Breakthrough, an organization devoted to helping children at risk to stay in school and prepare for college.

Trudy E. Bell, M.A., (t.e.bell@ieee.org, www.trudyebell.com, and [@trudyebell](https://twitter.com/trudyebell)), is senior writer for the University of California High-Performance AstroComputing Center (<http://hipacc.ucsc.edu>) and a contributing editor for *Sky & Telescope* magazine. A former editor for *Scientific American* and *IEEE Spectrum* magazines, she has written a dozen books and over 500 articles, 19 of which have won top journalism awards. This profile is her 22nd feature for *The Bent*.



Ruiz, CEO of AMD, holds a 300-millimeter (12-inch) wafer containing 64-bit computer chips, one of the first products produced in 2004 by a new AMD factory just opened in Dresden, Germany.



Ruiz meets with New York Senator Hillary Clinton in January 2007 in her Washington, DC, office.



Ruiz stands among children from Modelo primary school in Piedras Negras, Mexico—which he attended as a child—when AMD set up a computer lab for the school in 2004 as part of the company's 50X15 initiative, to get 50% of the world's population online by 2015.



The University of Texas-Pan American

SINCE 1927, The University of Texas-Pan American has been building communities, changing lives and inspiring the future. Known as the premier university in South Texas, UTPA has shaped the lives of more than 70,000 graduates and continues to graduate more than 3,000 students each year.

The 331-acre campus is bustling with undergraduate and graduate students engaging in hands-on, innovative research and serving their community through student and other civic organizations.

Located in Edinburg, TX, near the border with Mexico, UTPA consistently ranks in the top three of the 100 best U.S. colleges for Hispanics, according to the Hispanic Outlook in Higher Education. It currently ranks third in the nation in the number of bachelor's and master's degrees awarded to Hispanics. *Washington Monthly* named UTPA as the top public master's university in Texas for providing a quality education at a reasonable cost and for excelling in research and community engagement.

UT Pan American offers 54 bachelor's, 55 master's, three doctoral and two cooperative Ph.D. programs within seven colleges. The more than 20,000 undergraduate and graduate students benefit from personal attention and easy access to faculty and staff.

In Fall 2015, UTPA and its sister institution, The University of Texas at Brownsville will merge to become The University of Texas Rio Grande Valley and will include a medical school. With an estimated student enrollment at more than 28,000 students, UT Rio Grande Valley will be one of the largest Hispanic serving institutions in the country.

The college of engineering and computer science (COECS) started as a department within the then-college of science and engineering. Because of the increasing popularity of the engineering program, UTPA formed the COECS in Fall 2010.

The college offers bachelor's degree programs in civil, computer, electrical, manufacturing and mechanical engineering, as well as computer science. The COECS also offers master's degree programs in electrical, manufacturing and mechanical engi-



The bronze Bronc, top left, welcomes university visitors. Students research with faculty, below at left. The computer center, right, is a magnet for students. This article was prepared by the UT Pan American Office of Public Affairs.

neering, along with computer science, information technology and engineering management. The newest academic program, civil engineering, began in Fall 2010 and already has grown to more than 300 undergraduate students.

Undergraduate and graduate students have many opportunities to participate in research projects with faculty. The COECS houses a biomechanics laboratory, nanotechnology center for undergraduate education and its newest research center, the university transportation center for railway safety—which received a \$3 million grant from the U.S. Department of Transportation—all which have students assist in conducting research.

Those students are among the most active in career-related organizations; the college has student chapters of nine professional organizations, including the Society of Hispanic Professional Engineers, the Mexican American Engineers and Scientists, and the Society of Women Engineers.

Their involvement in these extracurricular activities has led to internships and employment at major companies, including Toyota, Northrop Grumman, and Raytheon.

Even before they receive their diplomas, COECS students have helped local communities and businesses solve problems. This includes helping a local city with its comprehensive street assessment inventory and building a machine that creates heating elements for a local company that designs and sells heating and cooling products.

Garnered Accolades

In just three years of its existence, the college already has garnered several accolades.

UT Pan American student teams have earned high rankings in state, regional, national and international contests.

They won first place in the Center for the Commercialization of Electric Technologies, Institute of Electrical and Electronics Engineers, Electrical Engineering Design contest. Civil engineering students came first in the American Society of Civil Engineers (ASCE) Texas Section Centennial Theme Logo and *Spirit of Competition* at the 2013 ASCE Concrete Canoe Competition, and placed second in display at the 2013 National Student Steel Bridge Competition hosted by the American Institute of Steel Construction. Mechanical engineering students have ranked in the top 15 percent in the SAE International Mini Baja competition.

Six mechanical engineering faculty members have won The University of Texas System Board of Regents Outstanding Teaching Awards since it was initiated in 2009. This is one of the nation's largest monetary teaching recognition programs in higher education.

UT Pan American's first multi-million-dollar start-up company, FibeRio Technology Corp., was created based on research conducted by COECS faculty. That research led to the development of Forcespinning™ technology, which uses centrifugal force to create nanofibers.



“UTPA’s engineering programs have established themselves as the premier engineering school in South Texas,” said **Miguel A. Gonzalez-Ramos, Ph.D., Texas Epsilon ’83**, dean of the COECS.

The COECS joins the university’s passion for serving its community through outreach programs including the Hispanic Engineering, Science and Technology initiative, which culminates in a weeklong conference dedicated to encouraging middle and high



school students to pursue STEM careers. The college also hosts its Texas Pre-Freshman Engineering Program in the summer to help high school students strengthen math and science skills as well as foster their interest in STEM fields.

“We need to work with the region and lead the region in their needs for technology and innovation,” Gonzalez said. “I feel this college will play a major role in generating jobs and generating opportunities for the region to have new technology-based economic development. We’ll be able to establish a level of stature that will help us grow both in the technical sense and in the educational sense, the ability to educate more students, and make a greater impact on the region and the nation, because it’s not just about graduating a whole bunch of engineers, it’s providing opportunities for them once they graduate.”



IN THE COLLEGES

SPOTLIGHT

First Degrees Trend

The number of science and engineering bachelor's degrees awarded has increased greatly compared to other disciplines, says a report from the National Student Clearinghouse Research Center.

The increase varied by age as well—between 2009 and 2013, students age 26 and over showed a 25% growth rate in science and engineering degree awards, while traditional college-age students had a 19% rise.

The rate is much smaller for other subjects—9% for older students and 6% for traditional-age students, the report adds. Mathematics and computer science degrees have been the most popular among older students seeking science and engineering degrees.

Science and engineering bachelor's degrees made up about a third of all bachelor's degrees earned in the 2012-13 year.

STEM Jobs Numbers

A fellow at Harvard Law School's Labor and Worklife Program agreed that U.S. students need a solid education in science and math, but said the general claim that the nation has too few engineers and other STEM workers is a myth.

Michael Teitelbaum said, "Many of the claims of shortages that are general across all fields and across the whole country are coming from employers in those particular narrow fields where there actually probably are shortages."

A recent report from the Economic Policy Institute, a think tank based in Washington, DC, found that there are more than enough people to fill most STEM positions.

Lindsay Lowell, a scholar at Georgetown University, who co-authored the report, said, "About half of STEM graduates coming out today don't land a STEM job. You

can expand that to look at people who end up in healthcare, which is not STEM, or end up in STEM management, or just simply say the job is closely related, and you still only come up with two-thirds of people with a STEM degree finding work in a STEM job."

MOOCs Evolving?

"Disappointing" results from the first two years of the massive open online course model are "forcing a rethinking of how college instruction can best use the Internet," reports the *New York Times*.

The article cites research from the University of Pennsylvania's graduate school of education which found that roughly "half of those who registered for a course ever viewed a lecture, and only about four percent completed the courses."

The article notes that even critics of the MOOC concept "do not expect them to fade away," but rather believe they will evolve into other more usable forms.

•*Bloomberg News* reports that out of 841,687 students who enrolled in 17 online courses offered in 2012 and 2013 by Harvard University and MIT, only 43,196 completed them. Andrew Ho, an associate professor in Harvard's Graduate School of Education, who conducted the research, said, "The data are demanding that we think of new metrics beyond certification rates to capture the diverse goals of users."

Partnering Indian College

Michigan Technological University is partnering with Vidya Pratishthan, a college in India, to create a 2-plus-2 doctoral program for faculty, CBS reports from Detroit.

The agreement with the Indian university will create a 2-plus-2 Ph.D. program in mechanical engineering for faculty. "Qualifying faculty will complete the first two years of their" program at Vidya Pratishthan. They will have the opportunity

to take MTU courses online. For the final two years, they will conduct research with MTU faculty advisors in the U.S.

Art of Engineering

Marquette University's college of engineering and the Milwaukee Institute of Art & Design will work together to create something neither could do alone. The goal is to give undergraduate industrial design and engineering students at each institution a combined skill set to help them become creative, innovative problem-solvers.

Robert H. Bishop, *Texas Delta '79*, dean of engineering at Marquette, said, "I envision a student graduating from engineering as they have in the past, but their experience and the type of courses they take will say to an employer that this student has taken the initiative to explore the creative side of engineering without abandoning the principles of engineering."

PEOPLE

Timothy D. Sands, Ph.D., *California Alpha '80*, has been named as



the new president of Virginia Polytechnic Institute and State University and will take office June 1. He is currently executive vice president for academic af-

airs and provost at Purdue University. He currently holds the position of professor of engineering in the school of materials engineering and the school of electrical and computer engineering. Sands launched Purdue's online teaching and learning platform known as Purdue NEXt.

Thomas W. Peterson, Ph.D., *Massachusetts Delta '72*, has become provost and executive vice chancellor for University of California,



Merced. He was assistant director of the engineering directorate at the National Science Foundation and earlier served for 32 years as an engineering fac-

ulty member, department head and dean at the University of Arizona. Peterson is a distinguished research engineer, author and lecturer in the field of aerosol dynamics.

Scott A. Ashford, Ph.D., Oregon Alpha '83, has been named dean of the Oregon State University college of engineering. He had been head of the school of civil and construction engineering at Oregon State since 2007 and earlier served as interim dean. He replaces



Sandra L. Woods, Ph.D., Michigan Alpha '76, who stays on the faculty.

FACILITIES

North Carolina State University will be the site of the first in a series of hubs to be established in a White House plan to build partnerships between universities and businesses to boost manufacturing technology.

At least \$140 million will be invested in the new hub by the U.S. Energy Department as well as businesses and universities, as researchers seek to create new, more efficient semiconductor chips and power devices. President Obama wants to establish up to 45 such institutes but that will require legislation from Congress so they can be financed. The first three are being funded with existing resources.

The initial consortium will seek to invent, design and make new, more efficient semiconductor chips and power devices. Headquartered in Raleigh, it will receive \$70 million over five years from the U.S. Energy Department and at least \$70 million more from the universities, businesses and the state.

Kansas State University, Oklahoma State University and University of Oklahoma engineering programs will share a gift from Oklahoma City-based Dolese Bros. Co. valued at \$210 million.

According to a press release from KSU, the \$70 million worth of stock given to each school, "establishes the (university) foundations as nonvoting majority shareholders in Oklahoma's largest supplier of ready-mix concrete, crushed stone, gravel and sand." Dolese is annually buying back stock from the schools in support of the company's profit-sharing plan and long-term goal of becoming wholly employee-owned.

This results from the vision of the late Roger Dolese. As part of his plan to keep the company privately owned and increase the number of engineers coming from nearby universities, he finalized the charitable partnership prior to his death in 2001. The gift has been announced publicly now that it is complete, although the three universities have benefited from the arrangement since its inception.

Clemson University has dedicated a new \$110 million energy research center. Financed in part by a \$45 million federal stimulus grant, the center houses the world's largest wind turbine test rig, a smaller turbine drivetrain testing rig and a 15-megawatt electric grid test facility.

Duke Energy said innovations from the grid research center will mean a more robust electrical grid that is better protected from computer and physical attacks. The grid simulator will allow manufacturers to test any electrical device from charging systems for electric cars to solar devices.

Lawrence Technological University has received an anonymous \$20 million gift to help fund a planned STEM center. The new gift will go toward equipment and training space in robotics, software engineering, modeling, and other specialty equipment systems.

About half of the gift will go

toward building the revised life sciences and architecture complex, with a newly added Dr. Richard E. Marburger STEM Center. This is named for Lawrence president emeritus **Richard E. Marburger, Ph.D., Michigan Eta '50**, who retired in 1993.

Carnegie Mellon University is to receive a \$10 million investment for research and development from Foxconn, the China-based maker of Apple's iPhone.

CMU will be working with the Pennsylvania government and the manufacturer on an initiative to bring high-tech manufacturing jobs to the state, according to Abby Simmons, a spokesperson for the university. Simmons said the university will work with the manufacturer "to integrate robotics and advanced manufacturing techniques into the company's manufacturing process."

Foxconn, the contract manufacturer to many U.S. tech giants, will spend \$30 million on a new factory in the Harrisburg, PA, area, employing up to 500 people.

Florida State University is the location for a state-of-the-art polysonic wind tunnel that will allow scientists and engineers to conduct aviation and aerospace experiments at speeds as fast as Mach 5.

The tunnel at the Florida Center for Advanced Aero-Propulsion (FCAAP) was created through a \$3.3 million grant from the National Science Foundation. Five years in the making, the building and its facilities provide a testing platform for aircraft and aerospace companies.

It is the first polysonic wind tunnel to be built in 15 years, with newer technology than tunnels used by NASA, and costs less to operate.

Southern Methodist University has received a \$7.75 million gift from Darwin Deason, founder of Affiliated Computer Services, to launch the Darwin Deason Institute for Cyber Security and support the Deason Innovation Gym in SMU's Lyle School of Engineering.



Brain Ticklers

RESULTS FROM

FALL

Perfect

Couillard, J. Gregory	IL	A	'89
*Norris, Thomas G.	OK	A	'56
Norris, Thomas G., Jr.	PA	Γ	'79
Richards, John R.	NJ	B	'76

Other

Alexander, Jay A.	IL	Γ	'86
Anderson, Kurt E.	KS	Γ	'90
Aron, Gert	IA	B	'58
Bohdan, Timothy E.	IN	Γ	'85
Brule, John D.	MI	B	'49
Handley, Vernon K.	GA	A	'86
Heierman, William E.	GA	A	'64
Josephson, William E.	AL	A	'87
Kimmel, Peter G.	Member's spouse		
Kimsey, David B.	AL	A	'71
Lalinsky, Mark A.	MI	Γ	'77
Marrone, James I.	IN	A	'61
Pinkerton, Audrey Smith	TX	A	'90
Pinkerton, Kate	Member's daughter		
Rentz, Peter E.	IN	A	'55
Roggli, Victor L.	TX	Γ	'73
Routh, Andre G.	FL	B	'89
Schmidt, V. Hugo	WA	B	'51
Spong, Robert N.	UT	A	'58
Stribling, Jeffrey R.	CA	A	'92
*Strong, Michael D.	PA	A	'84
Summerfield, Steven L.	MO	Γ	'85
Sutor, David C.	Member's son		
Svetlik, J. Frank	MI	A	'67
Thaller, David B.	MA	B	'93
Voellinger, Edward J.	Non-member		

*Denotes correct bonus solution

FALL REVIEW

Problem 3 (Cryptic Addition) was the hardest regular puzzler, as many respondents found the smallest two solutions, but not the subsequent two. The Bonus question, which required readers to find a solution to two simultaneous equations, received many correct solutions to the equations, but only two readers submitted an answer with the smallest d .

WINTER SOLUTIONS

The entries for the Winter Ticklers will be acknowledged in the Summer column. In the meantime, here are the solutions.

1 The total is **818,181**. It is clear that one of the digits must be 1, for otherwise the total would be a seven-digit number. Thus, the six positive integers must all start with

1, and the first digit of the sum must be 7, 8, or 9 (it can't be 6, which would require all six numbers to be 111,111), but it can't be 7 or 9, because there is no combination of m 1s and n 7s or 9s ($m + n = 6$) that sum to a number ending in 1, 7, or 9, which would be a requirement for the units column. Therefore, the second digit must be 8. Consider the 6 six-digit integers in the form of a 6x6 array, and let (i, j) be the number of 1s and 8s, respectively, in a column. The accompanying table lists the possible values for the sum of a column as a function of the number of 1s and 8s in the column plus the indicated carry from the column to its right. Since each column sum must end in 1 or 8, the values in the table are the only possibilities. Thus, the units column (which has no carry) must be (1, 5) or (0, 6), both of which give a carry of 4, so the tens column is (3, 3) or (2, 4). Since both give a carry of 3, the hundreds column is (0, 6). By similar reasoning, the thousands column is (6, 0) or (5, 1); the ten thousands column is (4, 2) or (3, 3); and the hundred thousands column is (6, 0). Since there are two possibilities for four of the columns, there are $2^4 = 16$ possible totals that can easily be read from the table. In a given column, a 1 and an 8 can be interchanged to eliminate duplicate numbers without affecting the sum. On examination, 12 of the 16 possibilities have duplicate numbers, and three have more than one set of values that give the same sum. Only $818,181 = 111,818 + 111,881 + 111,888 + 118,888 + 181,818 + 181,888$ is the sum of six different numbers in only one way.

No. 1's	No. 8's	Column Sums					
Carry		2	1	5	3	4	0
6	0	8		11			
5	1			18			
4	2		21				
3	3		28			31	
2	4					38	
1	5						41
0	6				51		48

2 There are **377** ways to paint the totem pole so that no two adjacent

animals are both blue. For a totem of N animals, at least $k = N/2$ (N even) or $(N-1)/2$ (N odd) must be yellow, so the number of blue animals must be in the range of 0 to $N-k$. For a totem with m yellow animals, there are $m+1$ places where blue animals can be inserted. To get the total number of different arrangements, sum over the range of blue animals, i.e., $\sum_{n=0}^{N-k} C(N+1-n, n) = C(13, 0) + C(12, 1) + C(11, 2) + C(10, 3) + C(9, 4) + C(8, 5) + C(7, 6) = 1 + 12 + 55 + 120 + 126 + 56 + 7 = 377$, where $C(i, j)$ is the number of combinations of i objects taken j at a time. Alternatively, find the answer for the first few totem sizes by inspection to get $T = 2, 3, 5, 8$ for $N = 1, 2, 3, 4$, respectively, and recognize these answers as part of the famous Fibonacci series. Note that $N_i = F_{i+2}$, where F_j is the j th Fibonacci number. Thus, the answer for a 12 animal totem is $F_{14} = 377$.

3 **FOURTEEN = 35617889**. From the first column of the cryptic for **ELEVEN**, we see that $E = F + S + * + * + 1$ (the 1 is to allow for a carry, which is very likely). Since $F + S$ cannot be less than 3, we see that $E = 6, 7, 8$, or 9. Now, consider the cryptic for **FOURTEEN**. We see that E equals the units digit of $N+N$, so E cannot be 9, because this would require both E and N to equal 9. Try $N = 9$; then $E = 8$, and $T = 7$. Now, it is clear that U must be 6. Also, $F = 2$ or 3, and $S = 1$ or 2. Try $S = 2$; then $O = 5$, and $F = 3$. Finally, we see that R must be 1, so $V = 0$. This makes $L = 4$. So, **FOUR = 3561**, **SEVEN = 28089**, **ELEVEN = 848089**, and **FOURTEEN = 35617889**. Trying other values shows that this is the only solution for **FOURTEEN**. There are thousands of solutions to the cryptics when the $*$'s are considered.

4 There are exactly **148,362,637,348,470,135,821,287,825** possible simple letter substitution codes (but the judges did not require this level of accuracy). Permutations in which

no object remains in its normal position are called derangements. The formula for the number of derangements of n objects is $D_n = n![1 - 1/1! + 1/2! - 1/3! + \dots + (-1)^n/n!]$. The logic for this expression is that there are $n!$ ways to arrange n objects. To get the number of derangements, we must subtract the permutations in which p_i is in its correct position. This is given by $C(n, 1)(n-1)! = [n!/1!(n-1)!]$ $(n-1)! = n!/1!$. But this overcorrects the derangements, so we must add back the cases where p_i and p_j are both out of place, which is given by $C(n, 2)(n-2)! = n!/2!$. But again this overcorrects, so we must subtract the cases where three objects are in correct positions, given by $C(n, 3)(n-3)! = n!/3!$, etc. Thus, we get $D_n = n![1 - 1/1! + 1/2! - 1/3! + \dots + (-1)^n/n!]$. There are several ways to calculate the answer other than evaluating this expression. There are two recursion relationships that can be used: $D_n = nD_{n-1} + (-1)^n$ and $D_n = (n-1)(D_{n-1} + D_{n-2})$. Perhaps the easiest is to observe that the expression in square brackets, when $n = \infty$, is equal to $1/e$, so $D_n \approx n!/e$. For our case, $26!/e$, rounded to the nearest integer, gives the above answer.

5 There are three fundamentally different solutions: (1, 2)(2, 1)(4, 3)(4, 5)(5, 3); (1, 2)(2, 1)(3, 5)(4, 3)(4, 5); and (1, 2)(1, 3)(2, 1)(4, 3)(4, 5), where the first number in each pair is the row number and the second is the column number. All other solutions are rotations or reflections of these three solutions. The 10 different distances for the first two solutions are: $1, \sqrt{2}, 2, \sqrt{5}, 2\sqrt{2}, \sqrt{10}, \sqrt{13}, \sqrt{17}, 3\sqrt{2}$, and $2\sqrt{5}$. We gave credit for any correct solution. It is interesting to note that four of the points are the same for all three solutions, and only the position of the fifth point varies.

.....

Bonus The total number of arrangements is $S_N = (N^4 + 6N^3 +$

$14N^2 + 15N + 6)/6$, where N is the sum of the number of envelopes on one side of the 3×3 array of pigeonholes. Let S_N be the number of solutions for N envelopes on a side. One approach is to find the value of S_N for several small values of N by inspection or computer (a spreadsheet is helpful) and then use this information to develop a polynomial in N . Counting ways to place the envelopes is made easier if you realize that once you specify the four corner values, the other values are fixed. The trick for a given N is to form all the different arrangements of the values of the four corners, where the value of a corner cell can be 0 to N and no two adjacent corners can have a sum greater than N . The notation we used for an arrangement is (a, b, c, d), where the four letters represent the values in the four corners, starting with the upper left and moving clockwise. When $N = 0$, the only solution is (0, 0, 0, 0), so $S_0 = 1$. For $N = 1$, we have (0, 0, 0, 0), (1, 0, 0, 0), (0, 1, 0, 0), (0, 0, 1, 0), (0, 0, 0, 1), (1, 0, 1, 0), and (0, 1, 0, 1), so $S_1 = 7$. Similarly, for $N = 2, 3, 4$, and 5 , you will find that $S_2 = 26, S_3 = 70, S_4 = 155$, and $S_5 = 301$. We can use the calculus of finite differences to find the general relationship for S_N as a function of N . A table of differences for the above values is shown below. The fact that the fourth difference is constant means that the desired equation is a quartic polynomial, which, in terms of differences, has the following form: $S_N = S_0 + N\Delta_1 + N(N-1)\Delta_2/2! + N(N-1)(N-2)\Delta_3/3! + N(N-1)(N-2)(N-3)\Delta_4/4!$. Using the leftmost values from the table gives $S_0 = 1, \Delta_1 = 6, \Delta_2 = 13, \Delta_3 = 12$, and $\Delta_4 = 4$. Substituting these values and simplifying gives: $S_N = N^4/6 + N^3 + 7N^2/3 + 5N/2 + 1$, or in terms of the least common denominator, $S_N = (N^4 + 6N^3 + 14N^2 + 15N + 6)/6$.

N	0	1	2	3	4	5
S_N	1	7	26	70	155	301
Δ_1		6	19	44	85	146
Δ_2			13	25	41	61
Δ_3				12	16	20
Δ_4					4	4

Computer Bonus The two numbers are $3,015,986,724 = 54,918^2$ and $6,714,983,025 = 81,945^2$. The approach is to pick a five-digit number, square it, and see if the square contains all 10 digits. If so, reverse the five-digit number and repeat the process. If this square contains all 10 digits, you have the answer. If not, go on to the next five-digit number. You can start your search at $1,023,456,789^{0.5} = 31,992$, the square root of the smallest ten-digit number with all different digits, and end at $99,380$, the square root of the largest such number. Also, since, by the rule of 9, any ten-digit number containing 10 different digits is divisible by 9, you only need to check five digit numbers divisible by 3. Starting with 31,992, successively add 3 to generate trial numbers. You only have to test 10 out of every 30 possibilities or a maximum of 22,462 trials to find the above unique answer.

NEW SPRING PROBLEMS

1 In the domino game Mexican Train, holding a double can be a problem, since when a double is played, a second domino of the same denomination must be played immediately, or else a domino from the bone pile must be drawn; and, if it doesn't match the double, you lose control of your train. The other night, I was playing Mexican Train with friends using a double 12 set (a double 12 set includes every two number combination from 0-0 through 12-12); and, in picking a hand of 11 dominos, I got four doubles. What is the probability of this?

—H.G. McIlvried III, PA Γ '53

2 Solve the following cryptic addition:

LETTERS
 ALPHABET
 SCRABBLE

All the usual rules apply. Each letter represents a different digit, and the same letter always represents the same digit. There are no leading zeros. This one is fairly easy, so, as

Hercule Poirot would say, give the little gray cells some exercise and try it without a computer.

—*Classic Puzzles*
by Gyles Brandreth

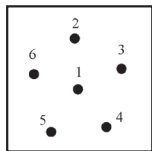
3 Suppose the moon had a hole along its axis and an astronaut dropped a golf ball in at the north pole. What would be the ball's speed (km/h) as it passed the center of the moon on its way to the South Pole? Assume the moon is a perfect sphere with a radius of 1,737 km, a uniform specific gravity of 3.346, and frictionless travel of the ball. Use $G = 6.674 \times 10^{-11} \text{ m}^3/\text{kg s}^2$.

—**R.W. Rowland, MD B '51**

4 The door to Prof. Adams laboratory has one of those keypad locks that requires entering five digits to open. Unfortunately, he has a hard time remembering the combination, but he has figured out a way to determine it. The five digits are all different, and he has observed that the first two digits form a perfect square, while the last two digits form a smaller perfect square. Also, the middle digit is the smallest. If he arranges the five digits to form all possible five-digit integers (leading zeros allowed) and adds all these numbers, the sum is a palindrome, with each of its digits a multiple of three. What is the combination?

—Adrian Somerfield
in *New Scientist*

5 In the accompanying figure, connect nine pairs of points with straight line segments in such a way that no three of the six points are the vertices of a triangle. Present your answer as nine two-digit integers, where the two digits are the numbers of the points being connected, for example, 14, 16, 46, ... would indicate 1 and 4 connected, 1 and 6 connected, 4 and 6 connected, etc. Of course, this is not an allowed arrangement, because 146 is a triangle.



Math Puzzles for the Clever Mind
by Derrick Niederman

Bonus Select a random point in a unit square. What is the expected distance of this point from the lower left-hand corner of the square? We want an exact answer expressed in terms of common mathematical functions, such as log, sine, etc.

—**Stephen E. Bernacki, MA A '70**

Double Bonus A magic square is an $N \times N$ array of numbers such that the sum of each row, column, and main diagonal is the magic sum. The most famous magic square is the *lo shu* (shown here), which is claimed to be thousands of years old.

2	9	4
7	5	3
6	1	8

What we want is a 3×3 magic square that, in addition to a magic sum, has the added property that the sum of the products of the three numbers in each row equals the sum of the products of the three numbers in each column, and this also equals the sum of the products of the three numbers in each of the two main diagonals, i.e., if the numbers in the rows are (a, b, c) , (d, e, f) , and (g, h, i) , then $abc + def + ghi = adg + beh + cfi = aei + ceg$. Although the nine numbers in the magic square must

Letters to the Editor

(Continued from page 9)

The Bent, I was saddened when his last article was published in 2012. To my pleasant surprise, a republication of Lyle's law #5, was included in the Summer issue of *The Bent*.

My question is, why not republish one of Lyle's 40 laws in each future issue of *The Bent*? It should stimulate sales of his Book, increase donations to Tau Beta Pi, and make readers, like my self, happy. I'm sure there are hundreds of new members that have not seen these articles, and thousands more that would like to read them again.

Arnold Eusebio, MI E '52

[Editor's Note: We realize that *Lyle's Laws* continues to be a favorite among our readers. However, we very rarely reprint material in the magazine as space is at a costly premium in the magazine, and there is a great deal of new information to

be nine different positive integers, they do not need to be consecutive. It is relatively easy to find such a square by computer, but we want an algorithm that generates all fundamentally different squares, that is, squares in which the nine entries have no common factor.

—*A Gardner's Workout*
by Martin Gardner

Send your answers to any or all of the Spring Brain Ticklers to **Curt Gomulinski, 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 Spring column is the appearance of the Summer *Bent* in early July. The method of solution is not necessary, unless you think it will be of interest to the judges. We welcome any interesting problems that might be suitable for the column. The Double Bonus is not graded. Curt will forward your entries to the judges who are **F.J. Tydeman, CA Δ '73; D.A. Dechman, TX A '57; J.C. Rasbold, OH A '83**; and the columnist for this issue, **H.G. McIlvried III, PA Γ '53**.

share with our members. There may be a time when Lyle and I agree to reprint another law, but we have no plans to so on a regular basis. We do hope to make all of the past laws available to subscribers through the website in the near future.]

"THE BEST PEOPLE" ENGINEERING JOB BOARD

Through a partnership with JobTarget, Tau Beta Pi has a state-of-the-art job board. Members can post resumes, browse over 1,300 engineering jobs, faculty positions, and internships, and employers may browse resumes.

New opportunities are posted on our home page daily and a full list of openings are available by visiting tbp.org/pages/ForMembers.





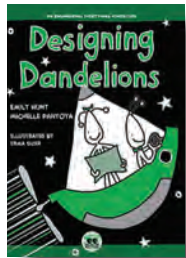
AUTHORS

Gary K. Evans, Virginia Alpha '77, is vice president for enterprise agile enablement at Bank of America. He has written *Hired! A Guide to Reemployment for the Rest of Us*. This provides guidance on job search and employment based on Evans' 17



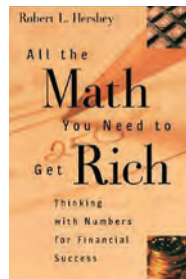
years of software consulting looking for work every day. It is for people who know how to do a job but really do not know how to find a new one. Publisher is CenterMark Books.

Emily M. Hunt, Ph.D., Texas Beta '01, is a West Texas A&M University



associate professor of mechanical engineering. She and Texas Tech professor Michelle Pantoya have written *Designing Dandelions* to get children excited about STEM. It tells how two aliens crash land on Earth and use problem-solving skills to return to their planet. Hunt and Pantoya have published other children's books and saw a need to tell children what a STEM career means. Publisher is Texas Tech University Press.

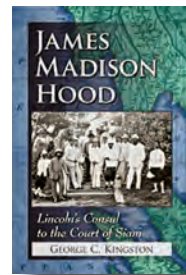
Robert L. Hershey, Ph.D., P.E., Massachusetts Delta '63, is a consulting



engineer in energy and environmental projects in Washington, DC. He has written *All the Math You Need to Get Rich* which describes the necessary tools to make informed decisions about personal finances. Written in a lighthearted style, the

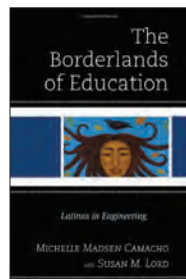
book moves step by step through sample problems that will help readers make their own day-to-day decisions. It explains difficult concepts so that even the math-phobic reader will be able to understand. Publisher is Open Court.

George C. Kingston, Ph.D., New York Xi '70, has written *James*



Madison Hood: Lincoln's Consul to the Court of Siam. Hood was the real U.S. consul in the novel *Anna and the King of Siam*. He was previously a merchant ship captain, legislator in Massachusetts and Illinois, industrialist, and land speculator. Hood lived large and was not above extra legal maneuvering to support his lifestyle. His life is a tour through the politics, economics, and deal making of the mid-19th century. Publisher is McFarland.

Susan M. Lord, Ph.D., New York Delta '87, is professor of electrical



engineering at the University of San Diego and a CA AE Advisor. She has co-authored, with sociologist Michelle Madsen Camacho, *The Borderlands of Education:*

Latinas in Engineering which studies problems in STEM education. Sponsored by the National Science Foundation through a gender in science and engineering grant, the authors bridge disciplines to illuminate the forces that shape engineering culture. Publisher is Lexington Books. (See Who's Who on page 6)

Apratim Mukherjee, Pennsylvania Epsilon '14, is a mechanical engineering major, with a minor in eco-



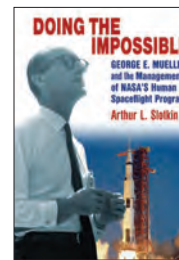
nomics. He has written *Paper Boats*, a collection of poems and short stories ranging across love and bomb blasts, the Venetian ballad, and the insanity of hope. Publisher is Readers Paradise of New Delhi.

Philip Pressel, New York Epsilon '59, spent 30 years as an engineer



with the Perkin-Elmer Corp. He authored *Meeting the Challenge: The Hexagon KH-9 Reconnaissance Satellite*. It tells of the spy in the sky that provided key photographic intelligence to the U.S. and was one of the most complicated systems ever put into orbit. Pressel was project engineer for design of the cameras. Publisher is the American Institute of Aeronautics and Astronautics.

Arthur L. Slotkin, Alabama Alpha, '68, was an executive vice president at Science Applications International Corporation. He has written



Doing the Impossible: George E. Mueller & the Management of NASA's Human Spaceflight Program. **George E. Mueller, Ph.D., Missouri Beta '39**, was associate administrator of the NASA Office of Manned Space Flight from 1963-69. He was instrumental in developing *Saturn V* which led to the *Apollo* program and played a key part in the design of *Skylab*, earning the nickname, "father of the space shuttle." Publisher is Springer.



CHAPTER ETERNAL

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

- AL A '56 **Williams III, Edward F.**; September 29, 2013.
'62 **Laughlin, Michael J.**; no details.
- AL B '35 **Sturdevant, Robert Noyes**; August 15, 1997.
'39 **Coleman, Charles Hamilton**; January 16, 2007.
'40 **McDonald Sr., Charles Duncan**; May 12, 2012.
'48 **Gogan, Harry Leo**; April 26, 2013.
'51 **Hines Jr., James Thomas**; August 28, 2013.
'52 **Toland, Trenton Earl**; October 28, 2013.
'53 **Burdin, Walter W.**; May 31, 2011.
'56 **Gioiello, John A.**; 2010.
- AL Γ '39 **Jeffcoat Jr., Harry**; March 28, 2013.
- AK A '39 **Beistline, Earl Hoover**; December 14, 2012.
- AZ A '61 **Howie, Richard Earl**; January 23, 2014.
'67 **Smith, Ronald T.**; July 25, 2013.
'81 **Baxter, William Harry**; August 21, 2012.
- AZ B '49 **Lincicome, James R.**; December 5, 2002.
'61 **Giaquinto, Edward Vedder**; February 1, 2014.
- AR A '39 **McLoad, Kenneth Wehrli**; August 11, 1995.
'39 **Russum, Leonard White**; December 10, 2013.
'50 **Bryan, Billy B.**; January 3, 2010.
'60 **Ramoly Jr., Brinton M.**; no details.
'82 **Miller, John Norman**; January 1, 2009.
- CA A '37 **Pearson, John L.**; July 17, 2011.
'48 **Schnapp, Ruth Gordon**; January 1, 2014.
'49 **Lowry Jr., Ralph**; November 28, 2013.
'50 **Hart, William E.**; July 30, 2013.
'51 **Bullock, Donald B.**; no details.
'64 **Mayo, Ronald Atkin**; 2010.
- CA Γ '39 **Ginsberg, Bernard Ralph**; September 15, 2011.
'40 **Ballhaus Sr., William Frank**; August 16, 2013.
'51 **Gard Jr., Jesse J.**; August 6, 2013.
'98 **Taskar, Benjamin**; November 17, 2013.
- CA Z '58 **Egan, William F.**; December 2012.
- CA H '67 **Chidester, Craig Lynn**; January 27, 2014.
- CA I '72 **Lansley, Gregg Martin**; November 25, 2007.
- CA O '39 **Ritter, Robert Louis**; June 20, 2001.
- CO A '39 **Corlew, Jack Stephenson**; April 18, 2008.
'39 **Rose, Kenneth Eugene**; October 2, 1994.
'44 **Stanger, Martin**; no details.
- CO B '36 **Austin, Garry Heckman**; July 21, 2012.
'39 **Stepanek, Joseph Edward**; January 31, 2008.
'40 **Maughan, Robert F.**; November 29, 2013.
'51 **Keller, Jack**; November 10, 2013.
'77 **Garbarino, Gerald L.**; no details.
- CT A '39 **Meriam, James Lathdrop**; July 18, 2000.
- CT B '80 **Wolfe, Robert Lee**; no details.
- DE A '42 **La Penta, Samuel Peter**; October 7, 2012.
'48 **Krinsky, Herman Y.**; March 3, 1997.
- FL A '46 **Drexel, Arthur**; July 8, 2009.
- FL B '39 **Condom, Augusto R.**; March 30, 2000.
- FL Γ '80 **Jones, Patricia Elizabeth**; November 2013.
'94 **Rowland, Dianne Mondrosch**; no details.
- FL Δ '39 **Forberg, Richard Atwood**; June 14, 2007.
- GA A '38 **Hutchinson, Joseph F.**; December 24, 1997.
'39 **Geiger, Lawton DeLany**; August 19, 1996.
'39 **Harris, Lucian Jefferson**; January 10, 2007.
'43 **Epsten, Stephen H.**; February 9, 2013.
'49 **Baugh, Edgar G.**; December 6, 2011.
- ID A '44 **Parish, William R.**; December 29, 2012.
'46 **Stewart, Richard B.**; August 14, 2009.
- IL A '36 **Hendricksen, William Edward**; March 22, 1999.
'38 **Robertson, James Mueller**; November 22, 2012.
'39 **Chao, Bei-Tse**; March 2, 2011.
'39 **Dick, James Fred**; October 10, 2003.
'39 **Dillow, Noel Eugene**; January 15, 1996.
'41 **Hang, Daniel Frank**; December 15, 2013.
'43 **Kesler, Clyde E.**; December 30, 2011.
'43 **Longmire, Conrad Lee**; March 22, 2010.
'44 **Fenoglio, Pete**; December 27, 2013.
'44 **Greanias, Evon Constantine**; March 30, 2013.
'46 **Bohl, Robert W.**; 2006.
'46 **Burtness, Roger William**; March 23, 2013.
'46 **Ormsbee, Allen Ives**; July 13, 2012.
'47 **Curtis, James Owen**; May 28, 2013.
'49 **Smith, Harry Degan**; December 9, 2010.
'50 **Knoebel, Howard W.**; no details.
'51 **Shugart, John W.**; January 23, 2011.
'53 **Klick, Donald W.**; November 2013.
- IL B '39 **Jaffee, Robert Isaac**; November 28, 1991.
- IL Γ '39 **Jacobson, Roland Arnold**; May 7, 1996.
'55 **Kuby, William C.**; no details.
'56 **Dompke, Richard Kenneth**; January 14, 2014.
'72 **Dunn, William E.**; December 31, 2011.
- IN A '37 **Buchanan, Lloyd Willis**; August 27, 2005.
'38 **Baals, Donald Delbert**; June 16, 2013.
'38 **Hill, Henry F.**; May 2, 2004.
'39 **Dixon, Charles Edwin**; December 31, 2007.
'39 **Langworthy, Clark**; September 27, 2013.
'39 **McEachron, William Donald**; June 10, 2012.
'39 **Riise, Harold Norman**; October 14, 2013.
'39 **Stevens, William Park**; May 12, 2012.
'44 **Oberreutter, Paul W.A.**; September 12, 2007.
'47 **North, Warren J.**; April 10, 2012.
'50 **Wuestenhagen, Franz Fredrick**; September 3, 2013.
'51 **Groninger, Richard D.**; August 3, 2012.
'58 **Nelson Jr., Wallace Emanuel**; no details.
'65 **Stellhorn, William H.**; August 29, 2013.
'72 **Retzner, Joseph William**; October 21, 2013.
- IN Δ '40 **Tatman, William R.**; December 30, 2006.
- IN E '39 **Teagno, Joseph Robert**; September 3, 2005.
- IA A '36 **Oberg, Marvin F.**; January 12, 2011. [*Centenarian 80*]
'39 **Hays, Floyd Derwood**; October 30, 2001.
'42 **Austin, Robert R.**; April 14, 2010.
'50 **McCombie, John E.**; August 17, 2011.
'56 **Sraders, Guntis**; May 22, 2013.
- IA B '34 **Mosher, Kenneth R.**; January 30, 2004.
'39 **Eddy, Franklin Orson**; April 27, 2004.
'43 **Brown, Elwyn S.**; May 4, 2013.
'67 **Seaba, Peter J.**; September 30, 2012.
- KS A '35 **Boughton, Fred Willard**; August 11, 1999.
'39 **Curtin, Edward Lee**; November 2, 2007.
'39 **Robinson, Thomas B.**; January 16, 2006.
'46 **Hayenga, Ronald A.**; November 15, 2013.
'46 **McAneny, Laurence Raymond**; January 30, 2013.

	'48	Banks, Paul Irving; no details.		'39	Cardillo, Joseph Samuel; June 3, 2007.
	'49	Von Waaden, Carl E.; June 23, 2013.		'39	Opdyke, Edward Grover; June 28, 2001.
	'60	Griffith, Bobby D.; December 19, 2013.		'39	Peck, Donald Stewart; January 9, 2001.
KS B	'50	Bernhart, Walter Daniel; March 30, 2007.		'39	Schroth, Thomas W.; September 8, 2000.
	'01	Wetzel, Timothy Eugene; December 28, 2011.		'39	Sklarsky Jr., Richard Alan; July 6, 2006.
KY A	'69	Shuman, Raymond B.; no details.		'42	Powell, Ray B.; December 16, 2010.
KY B	'39	Reynolds Jr., Wilmer; April 10, 2009.		'49	Holland, Thomas K.; no details.
	'52	Yantz, Robert Charles; January 4, 2013.		'51	Hopkins, Walter; September 1, 2003.
LA A	'38	Detman, Roger Foster; June 12, 2007.		'53	Martinson, Ronald M.; December 13, 2013.
	'39	Neubig Jr., Thomas Ashton; December 18, 2006.	MI Δ	'50	Thomas, Joseph Thomas; January 22, 2014.
	'39	Potin, Prosper Liebert; August 27, 2000.	MI E	'39	Thomas Jr., Jacob Earl; October 22, 2011.
	'39	Purser, Paul Emil; September 8, 2003.		'67	Johnson, Charles Rayner; February 14, 2008.
	'39	Sandifer Jr., James W.; December 23, 2008.	MI Z	'39	Canner, Herman Martin; December 1, 2011.
	'39	Sperier, Wesley Joseph; July 29, 2012.		'39	Gavagan, James A.; February 25, 2002.
	'45	Richard, Charles B.; August 27, 2013.	MN A	'49	Sawyer, Tom W.; December 20, 2013.
	'50	Ayau, Manuel F.; August 4, 2010.		'54	Wood, Roger C.; July 17, 2013.
LA B	'39	McNamara, Edward Joseph; August 3, 1999.	MS A	'39	Smith Jr., Henry Grady; May 12, 2002.
	'39	Rittiner, Lloyd James; August 5, 1991.	MO A	'45	Naka, Fumio Robert; December 21, 2013.
	'39	Wetzel, Albert John; December 26, 2009.		'56	Blohm, Edward G.; April 12, 2013.
LA Γ	'34	Snyder Jr., William Marion; January 4, 2012.	MO B	'39	Ellis, William Reed; October 27, 2005.
ME A	'39	Hill, Charles St. John; September 11, 2004.		'39	Pearl, William Thomas; July 5, 2010.
MD A	'37	Davis, Wells Lawrence; December 18, 2007.		'48	Stoecker, Wilbert F.; September 5, 2010.
	'38	Hartke, Martin Jerome; May 4, 1989.		'50	Patten, Robert Ivan; December 2, 2013.
	'39	Schad, Theodore MacNeeve; October 19, 2005.		'59	Neumeier, Leander A.; January 7, 2014.
	'39	Snodgrass, John Irwin; April 19, 2012.		'63	Poush II, Kenneth A.; November 24, 2013.
MD B	'38	Browning, John Richard; May 13, 2007.		'64	Boeger, James H.; April 21, 2012.
	'38	Diggs, Robert Schnepfe; October 4, 1996.		'82	Peecher, Steven K.; November 18, 2012.
	'61	Fullarton, David Coleman; January 24, 2014.	MO Γ	'39	Wills, Charles Edward; January 9, 2007.
	'63	Robey, Donald Lee; October 26, 2013.		'47	Moder, Joseph J.; December 14, 2012.
MA A	'38	McKenna, George William; May 28, 1999.	MT A	'35	Umhoefer, Robert; September 22, 2013. [<i>Centenarian 97</i>]
	'39	Abel, Walter Lewis; November 1, 2003.		'38	Fitch, William Chester; October 3, 2008.
	'39	Alcock, John Powell; October 25, 2005.		'39	Link, Peter Joseph; October 3, 2006.
	'39	Humphrey Jr., Harold William; May 26, 2012.		'39	Olson, Austin Carlen; June 15, 2011.
	'39	Nims Jr., Albert Armstrong; June 12, 2009.		'41	Harty, William M.; August 15, 2002.
	'40	Shlora, Ray B.; May 30, 2008.	NJ A	'39	Schmidlin, Albertus Ernest; July 18, 2006.
MA B	'39	Holley, Myle Joseph; October 7, 2005.		'40	Eger Jr., George William; October 19, 2002.
	'39	Jamison, Will Brown; March 6, 2004.		'42	Crandall, Stephen H.; no details.
	'39	Laubach Jr., James Howard; September 24, 2009.	NJ B	'39	Kuebler, Alfred August; no details.
	'39	Ryder Jr., Charles Tripp; March 30, 2007.		'39	Smoke, Edward Joseph; December 28, 2006.
	'39	Wingard Sr., William Fleming; May 30, 2013.	NJ Γ	'35	Weller, Monroe R.; October 10, 2013. [<i>Centenarian 84</i>]
	'46	Marsten, Richard B.; March 26, 2010.		'39	Knight, Ralph Merton; June 2, 2010.
	'48	Gould, Leonard A.; September 8, 2012.	NJ Δ	'39	Hay, A. Donald; no details.
	'50	Abbanat, Robert Frederick; June 8, 2010.	NY A	'43	Schwarz, Ralph J.; no details.
	'51	Glenzel, Harold Slade; January 6, 2014.		'64	Gryte, Carl Campbell; December 31, 2010.
	'61	Omura, Masayuki; October 26, 2013.	NY B	'37	Robinson, William John; September 1, 1992.
	'66	Tang, Wilson H.; January 5, 2012.		'39	Horsman, Robert Beverly; August 2, 2005.
MA Δ	'39	Burden, Robert Prentice; October 30, 1998.		'48	Ericson, Carl Hilmer; January 23, 2014.
	'39	Ghublikian, John R.; March 18, 2011.	NY Γ	'38	Kennedy, Floyd D.; October 16, 2005.
	'39	Harrington, Robert Lee; March 8, 2000.		'41	Burns, Jay Robert; October 21, 2013.
	'39	Maude, William Aldrich; February 21, 2005.		'45	Merdinger, Charles J.; December 13, 2013.
	'42	Coar, Richard John; December 29, 2013.		'54	Ansell, George Stephen; August 30, 2013.
MA E	'39	Barzelay, Martin Edward; April 27, 2009.		'55	Fox, Robert William; January 25, 2014.
MA Z	'55	Bochman, Raymond A.; no details.	NY Δ	'39	Steele II, Joseph M.; December 17, 2004.
	'60	Dixon, Donald Lee Brown; February 8, 2013.		'47	Klion, Sanford; November 29, 2013.
MI A	'39	MacOمبر, John Wilson; no details.	NY E	'39	Krason, Ferdinand Carol; April 17, 2009.
	'47	Smollett Jr., Roy J.; November 20, 2012.		'51	Lowe, Warner S.; no details.
	'53	Condon, Dennis Earl; December 4, 2013.		'54	Muller, Richard Louis; November 27, 2013.
MI B	'39	Moberg, Norman Albert; May 4, 2005.	NY Z	'39	Drenick, Rudolf Freud; September 24, 2010.
	'39	Torreano, Peter Frank; May 1, 2012.		'49	Fine, Gilbert S.; December 9, 2013.
	'42	Granfors, Carl Elmer; December 5, 2011.		'49	Kleinman, Robert B.; 2010.
	'43	Haskell, Henry M.; December 11, 2001.	NY H	'40	Taub, Herbert; February 8, 2003.
MI Γ	'30	Harrington, R. Paul; no details.		'43	Echtman, Lionel; July 14, 2010.
	'36	Stevens, Robert Munger; May 18, 2005.		'44	Brenner, Egon; December 15, 2011.
	'37	Walter, Fred Rudolph; March 30, 2013.		'46	Del Toro, Vincent; July 5, 2006.
	'39	Belden, Donald Holden; February 2, 2013.		'46	Deresiewicz, Herbert; June 8, 2008.

- NY A '39 **Riccitiello Sr., Michael**; August 21, 2011.
 NY N '43 **Strauss, Howard E.**; November 13, 2013.
 NC A '40 **Frazier Jr., Thomas R.**; December 28, 2013.
 '40 **Hamme, John V.**; January 11, 2010.
 '48 **Gadsden, Cecil M.**; February 2012.
 NC Γ '39 **Kraybill, Edward Kready**; June 22, 2004.
 '39 **Whitted Jr., Hugh Edwin**; December 12, 1994.
 '57 **Vaughan Jr., James Willard**; December 4, 2013.
 OH A '40 **Swartwout, Denton Kenyon**; January 21, 2014.
 '41 **Levstik, Emil Louis**; August 27, 2013.
 '48 **Fabert Jr., Herman A.**; April 29, 2007.
 OH B '39 **Delcamp, Robert Mitchell**; January 7, 2012.
 '43 **Howe, Robert Theodore**; February 23, 2011.
 OH Γ '35 **Shupe, Hollie Wentz**; July 20, 1987.
 '37 **Goodwin, Harry Brimhall**; January 12, 2005.
 '39 **Fischer, Carl David**; November 2, 2011.
 '39 **Kenan, Thomas Augustine**; November 27, 2004.
 '41 **Needham, Robert L.**; January 3, 2014.
 '47 **Kolbas, John Michael**; October 17, 2013.
 '50 **Stettner, Donald H.**; no details.
 '61 **McKarns, James Stephen**; November 9, 2012.
 OH Δ '54 **Noonan, John Thomas**; December 3, 2012.
 OH Z '39 **Hope, James Franklin**; October 10, 2012.
 '39 **Luzius, Elmer William**; December 15, 2003.
 '65 **Grove, Gail Harold**; March 14, 2008.
 OH H '56 **Kalisch, Robert Burns**; December 16, 2013.
 '68 **Smith, Russell H.**; April 2, 2013.
 OH Θ '38 **Gill, Joseph Edward**; no details.
 '66 **Keckan, Karl A.**; August 9, 2010.
 OH I '39 **Samborn, Alfred H.**; March 19, 2009.
 '52 **Buxton, Dale E.**; September 24, 2013.
 OK A '50 **Smith, William P.**; no details.
 OR A '37 **Gray, Theodore Hatala**; March 18, 1989.
 '39 **Aungst, Ray C.**; April 5, 1997.
 '39 **Dudley, Darle William**; April 11, 2003.
 '49 **Cockeram, Donald James**; February 26, 2013.
 PA A '29 **Pelizzoni, Eugene Attillio**; August 8, 2001.
 '38 **Cushing, George Butler**; November 11, 2013.
 '39 **Lempert, Irving Edmund**; August 31, 2011.
 '44 **Miltenberger Sr., Robert S.**; December 28, 2013.
 '49 **Stockham, Herbert Cannon**; November 26, 2013.
 '56 **Chen, John C.**; no details.
 PA B '41 **Grafinger, Louis N.**; 2012.
 '49 **Bernhard, Richard Alan**; January 20, 2014.
 '52 **Repogle, Joe O.**; December 20, 2013.
 '53 **Miller, Charles LeRoy**; December 17, 2013.
 PA Γ '35 **Sharbaugh, William James**; April 24, 2013.
 '37 **Buckman, Donald Glenn**; no details.
 '39 **Kruper, Andrew Paul**; August 19, 2005.
 '39 **Roberts, George Adam**; February 15, 2013.
 '39 **Westerman, Arthur B.**; February 18, 1996.
 '42 **Williams Jr., Max L.**; September 18, 2013.
 PA Δ '39 **Koliner, Ralph**; September 8, 2010.
 '39 **Showers, Ralph Morris**; September 8, 2013.
 '41 **Ware, Willis Howard**; November 22, 2013.
 PA E '35 **Raver, Roland**; November 18, 2013. [Centenarian 102]
 '38 **Crouch, George William**; April 9, 2013.
 PA Z '39 **Brown, Frederick DeWitt**; May 20, 2004.
 '39 **Eisen, Nathan**; September 10, 1999.
 '47 **McDowell, Joseph W.**; March 12, 2010.
 '48 **Abriola, Joseph Leon**; May 30, 2013.
 '53 **Gillum Jr., Willard**; May 26, 2011.
 '53 **McPhillips, James W.**; December 4, 2013.
 PA H '48 **Leiby, David Wilbur**; September 23, 2013.
 '49 **Lulay, Arthur**; August 27, 2009.
 PA Θ '39 **Burke, John William**; May 13, 2008.
 '73 **Mulroy, Edward Francis**; January 21, 2009.
 PA Λ '56 **Spiecha, John Joseph**; November 15, 2013.
 SC Γ '45 **Iselin, Donald Grote**; March 9, 2012.
 '49 **Kunze Jr., Walter E.**; August 2, 2010.
 '53 **Heiberg III, Elvin R.**; September 27, 2013.
 SD A '44 **Sandvig, Robert LeRoy**; November 25, 2010.
 '74 **Greenfield, Gregory G.**; April 21, 2011.
 SD B '33 **Johnston, Leonard Earnest**; no details.
 TN A '35 **Sansom, Richard Elroy**; December 5, 2002.
 '47 **Prescott, Wallace S.**; December 27, 2013.
 '48 **Cantrell Jr., Franklin Marion**; January 29, 2014
 '48 **Higgs, Joe Garland**; December 20, 2013.
 '50 **Edwards, Keith A.**; August 23, 2013.
 '56 **Wilson, Clement Card**; January 25, 2014.
 '59 **Davis, Billy J.**; December 11, 2013.
 '70 **Dougherty Jr., Edward M.**; June 18, 2005.
 TN B '39 **Stifler, William Warren**; February 11, 1988.
 '48 **Anderson, Wendell G.**; December 22, 2013.
 TN Δ '43 **Jett, George B.**; July 14, 1998.
 TX A '39 **Bodemuller, Rudolph**; November 7, 2012.
 '39 **Buchanan, George R.**; June 18, 2010.
 '46 **Schaller, Donald F.**; 2012.
 '48 **Horsak, Rudolph J.**; October 24, 2000.
 '52 **Goldsmith, Clifford Ray**; January 10, 2014.
 '60 **Boyd, Ronnie Dean**; December 18, 2013.
 TX B '39 **Walker, Clinton Samuel**; July 13, 2012.
 '42 **Hash, Edgar**; April 6, 2011.
 '50 **Hart, Thomas Pritchett**; January 9, 2014.
 TX Δ '35 **Hubby, Laurence M.**; December 17, 1988.
 '39 **Bailey, John A.**; April 1, 2009.
 '39 **Maurer Jr., John James**; November 10, 1998.
 '50 **Denman Jr., Joe Carter**; January 7, 2014.
 '57 **Culver, Claude Caryll**; October 25, 2013.
 '61 **Herod, Bobby Dean**; September 3, 2011.
 '63 **Friedenwald, Robert L.**; 2013.
 TX Θ '66 **Martinez, Ralph**; 2013.
 UT A '47 **Hayes, Robert D.**; May 28, 2013.
 '54 **Collins, Dudley Munn**; July 6, 2011.
 VA A '51 **McCormick, Fred C.**; October 23, 2013.
 '53 **Newlon Jr., Howard H.**; October 25, 2012.
 VA B '38 **Lafon, William Madison**; April 25, 1996.
 '39 **Hibbard Jr., Walter Rollo**; February 24, 2010.
 '40 **Maloney, Elbert S.**; January 6, 2014.
 '42 **Mateer, Melvin Joseph**; January 25, 2014.
 '49 **Lee, Burton Pierce**; January 18, 2014.
 WA A '26 **Shiomi, Roy Yoshiyuki**; October 29, 1991.
 '45 **Connally, Robert E.**; August 28, 2011.
 '50 **Dore, James Ernest**; November 18, 2013.
 '61 **Mattson, George E.**; no details.
 WA B '32 **Southworth, Donavan**; no details.
 '39 **Shirk, Ivan A.**; January 27, 2002.
 '39 **Tweet, John Hastings**; December 7, 2006.
 '39 **Zier, Harold George**; April 28, 2000.
 '43 **Luck, Leon D.**; September 27, 2009.
 '52 **Janecek, Lionell J.**; January 20, 2013.
 WV A '55 **Porterfield Sr., David W.**; May 3, 2013.
 '63 **Vest, Charles M.**; December 12, 2013.
 WI A '39 **Stupich, Charles Joseph**; October 11, 2002.
 '41 **Roberts, Frank Bostwick**; January 7, 2014.
 '46 **Eiseman Jr., Frederick B.**; April 6, 2013.
 WI B '33 **Kinzelman, Gerald W.**; September 7, 2007.
 '39 **Brendler, Joseph S.**; January 6, 2007.
 '39 **Ruehmer, Walter E.**; November 8, 2011.
 '45 **Haas, Robert S.**; December 7, 2013.
 '51 **Knight, Donald O.**; December 7, 2006.
 WY A '39 **Tobin, Robert Emmet**; May 4, 2009.

CHAPTERS

ALUMNI CHAPTERS (68)

District 1 • denotes active chapter

- Boston, MA
- Central Connecticut, Hartford
- District 2**
- Buffalo, NY
- Central Jersey, NJ
- Long Island Suburban, NY
- Newark, NJ
- New York, NY
- New York Capital District, NY
- Rochester, NY
- Southern Tier, Binghamton, NY
- District 3**
- Lehigh Valley, Bethlehem, PA
- Philadelphia, 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
- Huntsville, AL
- Louisville, KY
- Mid-South, Memphis, TN
- District 7**
- Ann Arbor Area, MI
- Central Michigan, Lansing
- Cincinnati, OH
- Dayton, OH
- Southeastern Michigan, Detroit
- Flint, MI
- Ohio's North Coast, Cleveland
- Columbus, OH
- West Michigan, Grand Rapids
- District 8**
- Chicago Area, IL
- Central Illinois, Urbana-Champaign
- Milwaukee, WI
- District 9**
- Rolla, MO
- St. Louis, MO
- District 10**
- New Orleans, LA
- Texas Gulf Coast, Houston
- District 11**
- Ames, IA
- Minnesota, Twin Cities, MN
- District 12**
- Colorado Springs, CO
- Front Range, CO/WY
- Salt Lake City, UT
- Treasure Valley, Boise, ID
- District 13**
- El Paso, TX
- Phoenix, AZ
- Sun City, AZ
- District 14**
- Columbia River Basin, Richland, WA
- Portland, OR
- Puget Sound, Seattle, WA
- District 15**
- Sacramento, CA
- San Francisco Bay Area, CA
- San Francisco Peninsula, Palo Alto, CA
- District 16**
- Southern California, Los Angeles

CA O	16	Loyola Marymount Univ.
CA P	16	Northrop Univ. (inactive)
CA P	15	California State Univ., Fresno
CA S	16	Univ. of California, Santa Barbara
CA T	16	Univ. of California, Irvine
CA Y	15	California State Univ., Sacramento
CA Φ	15	Univ. of the Pacific
CA X	16	California State Univ., Fullerton
CA Ψ	16	Univ. of California, San Diego
CA Ω	16	Harvey Mudd College
CA AA	15	California State Univ., Chico
CA AB	16	Univ. of California, Riverside
CA AF	15	San Francisco State Univ.
CA AA	15	Univ. of California, Santa Cruz
CA AE	16	Univ. of San Diego
CO A	12	Colorado School of Mines
CO B	12	Univ. of Colorado at Boulder
CO G	12	Univ. of Denver (inactive)
CO A	12	Colorado State Univ.
CO E	12	Univ. of Colorado at Denver
CO Z	12	United States Air Force Academy
CT A	1	Yale Univ.
CT B	1	Univ. of Connecticut
CT F	1	Univ. of Hartford
DE A	3	Univ. of Delaware
DC A	4	Howard Univ.
DC B	4	Catholic Univ. of America
DC F	4	George Washington Univ.
FL A	5	Univ. of Florida
FL B	5	Univ. of Miami
FL G	5	Univ. of South Florida
FL A	5	Univ. of Central Florida
FL E	5	Florida Atlantic Univ.
FL Z	5	Florida Inst. of Technology
FL H	5	Florida A&M Univ.-Florida State Univ.
FL Θ	5	Florida International Univ.
FL I	5	Embry-Riddle Aeronautical Univ.
GA A	5	Georgia Inst. of Technology
GA B	5	Mercer Univ.
ID A	14	Univ. of Idaho
ID B	12	Idaho State Univ.
ID G	12	Boise State Univ.
IL A	8	Univ. of Illinois at Urbana-Champaign
IL B	8	Illinois Inst. of Technology
IL G	8	Northwestern Univ.
IL A	8	Bradley Univ.
IL E	8	Southern Illinois Univ. at Carbondale
IL Z	8	Univ. of Illinois at Chicago
IN A	8	Purdue Univ.
IN B	8	Rose-Hulman Inst. of Technology
IN G	8	Univ. of Notre Dame
IN A	8	Valparaiso Univ.
IN E	8	Trine Univ.
IA A	11	Iowa State Univ.
IA B	11	Univ. of Iowa
KS A	9	Univ. of Kansas
KS B	9	Wichita State Univ.
KS G	9	Kansas State Univ.
KY A	6	Univ. of Kentucky
KY B	6	Univ. of Louisville
KY G	6	Western Kentucky Univ.
LA A	10	Louisiana State Univ.
LA B	10	Tulane Univ. of Louisiana
LA G	10	Louisiana Tech Univ.
LA A	10	Univ. of Louisiana at Lafayette
LA E	10	Univ. of New Orleans
ME A	1	Univ. of Maine
MD A	4	Johns Hopkins Univ.
MD B	4	Univ. of Maryland
MD G	4	United States Naval Academy
MD Δ	4	Univ. of Maryland Baltimore County
MD E	4	Morgan State Univ.
MA A	1	Worcester Polytechnic Inst.
MA B	1	Massachusetts Inst. of Technology
MA G	1	Harvard Univ. (inactive)
MA Δ	1	Tufts Univ.
MA E	1	Northeastern Univ.
MA Z	1	Univ. of Massachusetts at Amherst
MA H	1	Boston Univ.
MA Θ	1	Univ. of Massachusetts Lowell
MA I	1	Western New England Univ.
MI A	7	Michigan State Univ.
MI B	11	Michigan Tech. Univ.
MI G	7	Univ. of Michigan
MI Δ	7	Univ. of Detroit Mercy
MI E	7	Wayne State Univ.
MI Z	7	Kettering Univ.
MI H	7	Lawrence Technological Univ.
MI Θ	7	Oakland Univ.
MI I	7	Univ. of Michigan-Dearborn
MI K	7	Western Michigan Univ.
MI A	7	Grand Valley State Univ.
MN A	11	Univ. of Minnesota-Twin Cities
MN B	11	Univ. of Minnesota, Duluth
MS A	6	Mississippi State Univ.
MS B	6	Univ. of Mississippi
MO A	9	University of Missouri-Columbia
MO B	9	Missouri Univ. of Science & Technology
MO G	9	Washington Univ.
MO Δ	9	Univ. of Missouri-Kansas City
MO E	9	Saint Louis University
MT A	12	Montana State Univ.
MT B	12	Montana Tech. of the Univ. of Montana
NE A	9	Univ. of Nebraska-Lincoln
NV A	15	Univ. of Nevada, Reno
NV B	16	Univ. of Nevada, Las Vegas
NH A	1	Univ. of New Hampshire
NH B	1	Dartmouth College
NJ A	2	Stevens Inst. of Technology
NJ B	2	Rutgers Univ.
NJ G	2	New Jersey Inst. of Technology
NJ A	2	Princeton Univ.
NJ E	2	Rowan Univ.

NJ Z	2	The College of New Jersey
NM A	13	New Mexico State Univ.
NM B	13	Univ. of New Mexico
NM G	13	New Mexico Inst. of Mining & Tech.
NY A	2	Columbia Univ.
NY B	2	Syracuse Univ.
NY G	2	Rensselaer Polytechnic Inst.
NY Δ	2	Cornell Univ.
NY E	2	New York Univ. (inactive)
NY Z	2	Polytechnic Inst. of Brooklyn (inactive)
NY H	2	City College of CUNY
NY Θ	2	Clarkson Univ.
NY I	2	Cooper Union School of Engineering
NY K	2	Univ. of Rochester
NY A	2	Pratt Inst. (inactive)
NY M	2	Union College
NY N	2	SUNY at Buffalo
NY Π	2	Manhattan College
NY O	2	SUNY at Stony Brook
NY Π	2	Rochester Inst. of Technology
NY P	2	Polytechnic Institute of New York Univ.
NY Σ	2	Alfred Univ.
NY T	2	Binghamton University
NY Y	2	United States Military Academy
NC A	4	North Carolina State Univ.
NC B	4	Univ. of N.C. at Chapel Hill (inactive)
NC G	4	Duke Univ.
NC A	4	Univ. of North Carolina at Charlotte
NC E	4	North Carolina A&T State Univ.
ND A	11	North Dakota State Univ.
ND B	11	Univ. of North Dakota
OH A	7	Case Western Reserve Univ.
OH B	7	Univ. of Cincinnati
OH G	7	Ohio State Univ.
OH A	7	Ohio Univ.
OH E	7	Cleveland State Univ.
OH Z	7	Univ. of Toledo
OH H	7	Air Force Inst. of Technology
OH Θ	7	Univ. of Dayton
OH I	7	Ohio Northern Univ.
OH K	7	Univ. of Akron
OH A	7	Youngstown State Univ.
OH M	7	Wright State Univ.
OH N	7	Cedarville Univ.
OH Σ	7	Miami Univ.
OK A	9	Univ. of Oklahoma
OK B	9	Univ. of Tulsa
OK G	9	Oklahoma State Univ.
OR A	14	Oregon State Univ.
OR B	14	Portland State Univ.
OR G	14	Univ. of Portland
PA A	3	Lehigh Univ.
PA B	3	Pennsylvania State Univ.
PA G	3	Carnegie Mellon Univ.
PA Δ	3	Univ. of Pennsylvania
PA E	3	Lafayette College
PA Z	3	Drexel Univ.
PA H	3	Bucknell Univ.
PA Θ	3	Villanova Univ.
PA I	3	Widener Univ.
PA K	3	Swarthmore College
PA L	3	Univ. of Pittsburgh
PA M	3	Penn State Erie, The Behrend College
PR A	5	Univ. of Puerto Rico
RI A	1	Brown Univ.
RI B	1	Univ. of Rhode Island
SC A	5	Clemson Univ.
SC B	5	Univ. of South Carolina
SC G	5	The Citadel
SD A	12	South Dakota School of Mines & Tech.
SD B	12	South Dakota State Univ.
TN A	6	Univ. of Tennessee
TN B	6	Vanderbilt Univ.
TN G	6	Tennessee Tech. Univ.
TN Δ	6	Christian Brothers Univ.
TN E	6	Univ. of Memphis
TN Z	6	Univ. of Tennessee at Chattanooga
TX A	10	Univ. of Texas at Austin
TX B	13	Texas Tech Univ.
TX G	10	Rice Univ.
TX Δ	10	Texas A & M Univ.
TX E	10	Univ. of Houston
TX Z	10	Lamar Univ.
TX H	10	Univ. of Texas at Arlington
TX Θ	13	Univ. of Texas at El Paso
TX I	10	Southern Methodist Univ.
TX K	10	Prairie View A & M Univ.
TX L	10	Texas A & M Univ.-Kingsville
TX M	10	Univ. of Texas at San Antonio
TX N	10	Univ. of Texas-Pan American
UT A	12	Univ. of Utah
UT B	12	Brigham Young Univ.
UT G	12	Utah State Univ.
VT A	1	Univ. of Vermont
VT B	1	Norwich Univ.
VA A	4	Univ. of Virginia
VA B	4	Virginia Polytechnic Inst. & State Univ.
VA G	4	Old Dominion Univ.
VA Δ	4	Virginia Military Inst.
VA E	4	Virginia Commonwealth Univ.
WA A	14	Univ. of Washington
WA B	14	Washington State Univ.
WA G	14	Seattle Univ.
WA A	14	Gonzaga Univ.
WV A	4	West Virginia Univ.
WV B	4	West Virginia Univ. Inst. of Technology
WI A	8	Univ. of Wisconsin-Madison
WI B	8	Marquette Univ.
WI G	8	Univ. of Wisconsin-Milwaukee
WI Δ	8	Milwaukee School of Engineering
WI E	8	Univ. of Wisconsin-Platteville
WY A	12	Univ. of Wyoming

COLLEGIATE CHAPTERS (249)

Chap. Dist.	Institution
AL A	6 Auburn Univ.
AL B	6 Univ. of Alabama
AL G	6 Univ. of Ala. at Birmingham
AL Δ	6 Univ. of Ala. in Huntsville
AL E	6 Univ. of South Alabama
AK A	14 Univ. of Alaska Fairbanks
AZ A	13 Univ. of Arizona
AZ B	13 Arizona State Univ.
AZ G	13 Northern Arizona Univ.
AR A	9 Univ. of Arkansas
CA A	15 Univ. of California, Berkeley
CA B	16 California Inst. of Technology
CA G	15 Stanford Univ.
CA Δ	16 Univ. of Southern California
CA E	16 Univ. of California, Los Angeles
CA Z	15 Santa Clara Univ.
CA H	15 San Jose State Univ.
CA Θ	16 California State Univ., Long Beach
CA I	16 California State Univ., Los Angeles
CA K	16 California State Univ., Northridge
CA A	15 Univ. of California, Davis
CA M	15 Calif. Poly. St. Univ., San Luis Obispo
CA N	16 California State Poly. Univ., Pomona
CA Σ	16 San Diego State Univ.



FAMILIES

Centenarians

Eighty-seven members have previously reached their second century and been recognized in *The Bent*. The full list is available at www.tbpi.org under Distinguished members. We have identified eight more gentlemen:

Marvin F. Oberg, *IA A '36*
b. November 28, 1909
d. January 12, 2011

Charles E. Woodward, *MA A '31*
b. September 3, 1910
d. September 24, 2011

Paul E. Queneau, *NY A '33*
b. March 20, 1911
d. March 31, 2012

Lloyd T. Keefe, *IN A '35*
b. October 17, 1911
d. March 17, 2012

Emiel E. Belzer II, *SD A '34*
b. May 29, 1912
d. March 13, 2013

James S. Westwater Sr., *MI B '34*
b. December 6, 1912
d. March 3, 2013

Robert R. Umhoefer, *MT A '35*
b. March 9, 1913
d. September 22, 2013

Simon Ramo, *UT A '33*
b. May 7, 1913

Bi-Spousal

The names of 815 Tau Beta Pi couples have appeared in *The Bent*. To this most popular category, we welcome 16 additional couples.

Carla S. Bossard, *CA Y '84*
John A. Bossard, *UT A '84*

Spencer D. Cook, *WI Δ '08*
Victoria C. Cook, *WI Δ '08*

Donna S. Cowell, *PA B '83*
Daniel C. Senft, *PA B '83*

Diana L. Dean, *CO Z '89*
Michael R. Fink, *CO Z '76*

Megan D. Feazell, *LA Γ '07*
Stephen A. Feazell, *LA Γ '07*

Brittany J. Gonzalez, *CA M '13*
Antonio E. Gonzalez, *NY A '13*

Madeline M. Harper, *OH Θ '11*
Eric S. Harper, *OH Θ '11*

Jessica R. Hickey, *CA Ξ '88*
Robert W. Hickey, *CA Ξ '88*

Kathlie S. Jeng-Bulloch, *TX E '11*
William P. Bulloch Jr., *TX A '70*

Michelle K. Jirak, *IA A '08*
Jason E. Jirak, *IA A '08*

Betty L. Niermann, *SC Γ '97*
Michael L. Niermann, *SC Γ '98*

Mary C. Flower Lemaster, *OH I '88*
Bruce E. Lemaster, *OH I '87*

Jorge A. Montesdeoca, *LA Γ '11*
Samantha G. Montesdeoca, *LA Γ '10*

Andrew A. Morrison, *WY A '10*
Leah L. Morrison, *WY A '10*

Cynthia M. Pionke, *TN A '82*
Christopher D. Pionke, *TN A '81*

Christy W. West, *AL B '96*
Kevin N. West, *VA A '96*

Multi-Generation

Here are more families with at least two successive generations.

The Allen Family
James P., III, *MA B '56*
Karen Allen Lynch, *NY Γ '86*
Michael F. Lynch, *NY Γ '87*
Kevin K., *ME A '02*
Andrew M. Lynch, *NY Γ '14*

The Antonio Family
John K., *TX D '84*
Victoria J., *OK A '13*
Nicole S., *OK A '16*

The Augustine Family
Norman R., *NJ Δ '57*
†Greg E., *TX Δ '85*

The Ballard Family
†H. Grady, *SC A '42*
Henry G., Jr., *SC A '92*
Tony L. Dyer, *SC A '13*

The Ballhaus Family
†William F., Sr., *CA Γ '40*
William F., Jr., *CA A '67*

The Barker Family
Carl V., *TN A '75*
Alan M., *TN Γ '06*

The Basham Family
Everett F., Sr., *AZ A '59*
Everett F., Jr., *CA A '90*

The Beagles Family
†Robert, *OR A '41* (grandfather)
John R. Herr, *CA Σ '12*

The Boak Family
Thomas I.S. III, *NY Δ '69*
Geoffrey T., *MA Θ '04*

The Brumbaugh Family
†John A., *IN A '49*
Steven T., *KS Γ '76*
Jeffrey S., *NC A '06*
Sarah B. Snell, *NC A '08*
Scott A., *KS Γ '79*
Jesse M., *TX B '06*

The Capuzzi Family
Lynda A., *PA Θ '71*
Angelo M., *PA Θ '71*
A. Michael, *NY I '01*

The Corey Family
Marion W., *MS A '54*
Mark W., *MS A '79*
Nannette C., *MS A '87*

The Cribb Family
Ashlee T., *GA A '87*
†Richard M., *GA A '87*
Matthew T., *GA A '15*

The Dankovich Family
Louis J., III, *OH E '69*
Louis J., IV, *CO B '12*

The Daudelin Family
Abraham N. *VT A '63*
Douglas S., *NY Γ '79*
Vickey L. Coats, *PA Z '85*
Jonathan, *NJ Γ '13*

The Deuchler Family
†Walter E., Sr., *AL A 1910*
Walter E., Jr., *IL A '51*

The Duscha Family
Lloyd A., *MN A '45* (grandfather)
Hannah M., *MA A '12*

The Faidley Family
LeVern W., *IA A '67*
Galen W., *IA A '00*
LeAnn E., *IA A '00*

The Gadsden Family
Cecil M., *NC A '48*
Amy W., *VA A '82*

The Gardineer Family
Bayard G., Jr., *MA B '52* (grandfather)
Bayard G., IV, *NJ A '11*

The Gatecliff Family
George W., *MI A '65*
Christine Arnold, *MI A '89*

The Giolma Family
†Francis V., *PA A '35*
J. Paul, *FL A '69*

The Goldhaber Family
Jerome C., *IL B '50* (grandfather)
Tanya S., *MA B '10*

The Gryte Family
Carl C., *NY A '64*
Anne-Marie, *NY A '98*

The Hastings Family
Mardi C., *OH A '76*
Susan M., *GA A '13*

The Hemler Family
Patrick J., *PA A '86*
Paul J., *MD A '13*
Sarah L., *MD A '15*

The Hilchey Family
Karen M., *NY N '81*
Richard W., *MA E '81*
Christopher J., *MD B '09*

The Hillman Family
Frank W., *IL A 1905* (grandfather)
Gordon W. Anderson, *NY A '59*

The Hurlbert Family
†Gordon C., *WI B '46*
David R. Volpe, *MI Z '74*
Michael D. Volpe, *TN B '06*

The Jenkins Family
Charles M., *MS B '81*
Charles S., *MS B '14*

The Jones Family
Edwin C., *WV A '25*
Edwin C., Jr., *WV A '55*

The Jones Family
Thomas G. Jr., *IN B '49* (grandfather)
Peter M. Southworth, *WA A '03*
Andrew Southworth, *WA A '08*

The Kretz Family
William H., Jr., *MO A '45* (grandfather)
Christopher J., *MI A '04*

The Le Blond Family
†Chester S., *IL B '39*
Peter C., *IL A '75*

The Lemott Family
Steve R., *IA A '67*
Meegan O., *PA B '99*

The Lesieutre Family
George A., *MA B '81*
William A., *PA B '12*

The Lof Family
John L.C., *CT B '38*
Richard J.A., *NH A '71*

The Low Family
James M., *CA A '83*
Brandon K., *IN A '14*

The Devine-Lowrie Family
Sara W. Devine, *TN A '78*
James B. Lowrie, *NC A '12*
Alexandra B. Lowrie, *NC A '14*

The Lundberg Family
John V., *OH A '71*
Daniel P., *NY A '05*

The McCormick Family
†Paul Y., *NY B '43*
Paul Y., *PA E '77*

The Marrone Family
James I., *IN A '61*
James D., *IN A '87*

The Mattei Family
Norma Jean, *LA B '82*
Helen C., *LA E '15*

The Michels Family
Ann E., *IA B '76*
Ryan F., *NY A '07*
Eric J., *SC A '13*

The Notaro Family
Frank, *NY N '57*
Frank J., *NY N '85*
John, *NY N '57*

The Pearson Family
John L., *CA A '37*
J. Lawrence, *CO A '64*

The Peck Family
John H., *MI B '68*
John H., Jr., *MI B '94*

The Plaut Family
Jeffrey S., *NY A '68*
Justin S., *CA A '12*

The Queneau Family
†Paul E., *NY A '33*
Paul B., *NY A '64*

The Reynolds Family
George A., Jr., *SC A '83*
William A., *SC A '16*

The Schaertl Family
Lisa K., *SD A '84*
George J., *MD A '09*
Casey L., *NY A '14*

The Schaettle Family
Robert F., *WI A '79*
Karl B., *OK A '13*

The Schwalbenberg Family
Robert, *NJ A '77*
Peter J., *NJ E '13*

The Seidel Family
Mark N., *MA B '83*
Robert N., *TX A '10*

The Stephens Family
John L., *WA B '51* (grandfather)
Joshua M. Pederson, *WA B '03*
Daniel J. Pederson, *WA B '06*

The Thiemann Family
Peter E., *NY A '79*
Carolyn L., *NY B '11*

The Thompson Family
Dianne M., *WI A '79*
William A., *WI A '78*
Patricia A., *MI B '15*

The Thompson Family
†Robert W., *CA A '50*
Susanna C., *CA E '90*
David R., *CA M '99*

The Trautman Family
†DeForest L., *PA A 1916*
DeForest L., Jr., *PA A '42*

(Continued on next page)

The Way Family
Kyle J., *CO B '84*
Dylan J., *CO B '15*

The Weaver Family
Christopher S., *CA Y '81*
Alexander F., *CA Y '16*

The White Family
James A., *MS A '62* (grandfather)
Abigail Wooldridge, *KY B '11*

The Young Family
James R., *AZ A '80*
Matthew L., *AZ A '14*

Siblings

The Bent publishes here the names of brother and sister members, as well as twins as indicated.

The Ambrose Family
Kimberly J., *DE A '15*
Kelly L., *DE A '10*

The Armentrout Family
Amy L. Hutcherson, *WV A '96*
Thomas E., *WV A '01*

The Benaim Family
Shely, *FL B '11*
Melanie, *FL B '13*

The De Jesus Vega Twins
Marisel, *PR A '12*
Marisely, *PR A '12*

The Dickman Twins
Christopher A., *AZ B '14*
Joshua P., *AZ B '14*

The Brewer Twins
Mandy N., *MT B '15*
Melanie M., *MT B '15*

The Clauser Twins
† Francis H., *CA B '34*
† Milton U., *CA B '34*

The Craven Family
Clyde W., Jr., *TN A '61*
Susan K. Whatley, *TN A '76*
Timothy A., *TN A '78*
Ayana, *TN A '85*

The Dichoso Family
Travis J., *DC B '13*
Diogenes A., *DC B '15*

The Heller Twins
Alex. J., *NV B '14*
Daniel T., *NV B '14*

The Libeer Twins
Anthony B., *KS A '16*
William B., *KS A '15*

The Magner Twins
Eamonn N., *KY A '15*
John P., *KY A '15*

The Liu Twins
Lawrence Y., *AL A '15*
Jeffrey Y., *AL A '15*

The Mark Family
Charles D., *VT A '03*
Jeremy A., *OH A '05*

The Mitsumori Family
Kyle Y., *MD Γ '91*
Lee M., *DC A '88*

The Nijsure Twins
Gauri C., *MO E '13*
Gayatri C., *MO E '14*

The Singhvi Twins
Divya, *NY Δ '15*
Somya, *NY Δ '15*

The Soroka Family
Margaret T., *NJ Δ '06*
Andrew Z., *NJ Δ '08*

The Summers Family
Benjamin D., *CA Γ '11*
Theodore R., *NH B '12*

† Member is deceased.

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



Send us your witty caption for this photo from our archives, and if it is judged one of the best, you will win a TBPI t-shirt.

Published in the Winter 1961 *Bent*, it shows **Stephen D. Moxley**, *AL B 1922*, looking through the Iron Curtain into then Czechoslovakia from a West German bunker. He was on a tour as Alabama state chair of the Radio Free Europe Fund.

The picture for Winter Caption Contest, right,

showed **Solomon J. Harwi**, *PA A 1886*, left, and **Ralph S. Healy**, *MD B 1913*, during the 1947 initiation banquet in New York City.

There was a three-way tie for the best caption! Here are the winning witticisms:

"They told me it is the world's first clip-on microphone. I hung it on my tie and dang near choked to death!"—**Larry A. Marcus**, *VA B '72*.

"So tell me, when you wrap your right hand around the microphone pole with your fingers in the direction of the conventional current, and with the resulting magnetic field generated by the electric current passing through the pole, what is the direction of the magnetic north pole your thumb should point to?"—**Yi-Hsien Doo**, *P.E. MI Z '81*.

"Someday in the future someone will be able to wear this microphone on their lapel." (Lavolier)—**Edward S. Matukonis**, *PA A '73*.

Congratulations!





Engineers In The History Of Technology

How we love our jazzy automobiles and electronic widgets. Society marvels at the newest technologies, but often overlooks their origins. *Masterworks of Technology: The Story of Creative Engineering, Architecture, and Design*, by E.E. Lewis, Ph.D., helps us to reflect on our progress and appreciate the challenges in today's technological advances.

Compared to most others in its category, Lewis' volume takes an unusual approach by treating engineering creativity/design as a process. In generally chronological sequence, from circa 3000 B.C., he treats the human engineer-designer's interaction with the technological product, relating it to knowledge of underlying sciences and state-of-the-art design. He unfolds his story skillfully as an artisan in his own right in portraying innovative creators and their challenges, making readers feel they are watching the old television series, *You Are There*.

Lewis is qualified for his task. A long-time member of the Northwestern University faculty, he has written extensively on reliability and nuclear engineering. In *Masterworks*, he meshes his insights with a talent for explaining technical subjects to the layman.

The author focuses early on the central theme: what is engineering? Admitting that defining it is "difficult," he quickly leads the reader to the answer. He does so by contrasting the original Latin, *ingeniatiorem*, representing creativeness, against the combined Greek *teche* ("art or skill") and *logia* ("science or study"). Lewis then treats various historical developments, including some taken from his own experience.

Opening with his visit to the oldest of the Egyptian pyramids, the author probes its construction. He then shifts to the apprentice-journeyman-master vocational path of an artisan in a craft guild, telling how the craftsman's skills were applied to refinements of the wagon wheel. Such a craftsman combined his cumulated experience and knowledge in a trial-and-error approach to his work. Lewis then gives a fascinating account of construction of cathedrals of the Middle Ages, citing Our Lady of Chartres, which has now stood almost 800 years as a result of lessons learned in earlier rebuildings.

The author leads us to the role of conceptualization as a human cognitive tool. Although mankind had long possessed the ability to envision things, leaps in engineering design did not occur until the ability to conceive a product could be followed by the capability to capture



Masterworks of Technology: The Story of Creative Engineering, Architecture, and Design, by E.E. Lewis (Prometheus Books, 2004, pp. 328)

a three-dimensional concept onto a medium such as paper. Leonardo da Vinci's marvelous contributions are evidenced in his notebooks by his ability to transform ideas into sketches, marking a turning point for engineering. Eventually this most basic step became part of modern computer-aided design (CAD), bringing achievements now taken for granted.

Lewis then reveals the major influence of the steam engine. Here we see the advances brought first by Newcomen and then by Watt, which fueled the industrial revolution, starting in England and spreading to America. Steam power reshaped the technological landscape and raised our standard of living.

The author offers good coverage of advances leading to human flight, presenting the Wright Brothers' contributions, including wing warping and use of wind tunnels. These

and other innovations produced breakthroughs in flight in the years 1903-1930. Later he details improvements which led to the Boeing 777 with fly-by-wire controls, sophisticated aerodynamics, and efficient engine sizing.

Lewis discusses Henry Ford's revolutionary impact on mass production, including introduction of interchangeable parts and the assembly line. From the author's coverage, we can appreciate how cumulative advances in integrated design and production enabled the ultrashort product cycles for today's sophisticated vehicles.

To close his account, Lewis comments on *Project Apollo*. Against the backdrop of the popular euphemism, he highlights the true meaning of "rocket science," telling how the manned lunar landing was achieved with the *Saturn V* and its *F-1* booster engines. Presenting the unprecedented challenges in Apollo engineering, Lewis reinforces the book's core theme, noting that in modern times science and the scientific method have become increasingly interrelated with engineering. Citing engineers' efforts to overcome early combustion instability of the *F-1*, Lewis contrasts science-for-the-sake-of-science with scientific investigations for *Apollo-Saturn* engineering problem solving. The latter is what we today label R&D, but in the engineering context is also called research, development, test, and evaluation, or RDT&E.

Lewis' coverage is reasonably balanced and identifies the lesser known persons in technological progress. It is recommended, not only for individuals, but also for the profession to help dispel public misunderstandings and show how engineers produce the marvels of their age.

—Philip H. Kitchens, *Louisiana Gamma '67*



ALUMNI NOTES

Florida Gamma

W. Brent Nixon, Ph.D., P.E., '95, is president and CEO of engineering consulting and material sciences firm CTL Group. He has spent the past 11 years as a corporate officer and vice president of science and engineering at Environmental Chemical Corporation (ECC). During his U.S. Air Force career, Nixon held several senior engineering management roles and taught at the Air Force Institute of Technology.



Indiana Alpha

Deborah L. Grubbe, P.E., '77, has been elected to the National Academy of Construction. Currently president of Operations and Safety Solutions, Grubbe was cited for her contributions to engineering management and to safety in the process industries. Deborah is a fellow of the AIChE and of the Institution for Chemical Engineers in the United Kingdom.



Maryland Gamma

David T. Earp, '97, is president at Walker Diving Underwater Construction, LLC, based at Hammon, NJ. He previously served for 10 years as a U.S. Navy officer, diver and SEAL before attending business school at Dartmouth College. He is also a principal of construction company EG Home, LLC.



Capt. J.W. "Jack" Nicholson, USN, Ph.D., P.E., '81, is an assistant professor in the weapons and systems engineering department at the United States Naval Academy. His research interests include underwater robotics and navigation systems, and he is founder of the USNA's unmanned underwater vehicle program. Nicholson is a former commander of the Ohio class ballistic missile submarine *USS Wyoming*.

Massachusetts Eta

John A. Scaramuzzo Jr., '87, is a senior vice president at SanDisk and general manager of the enterprise storage solutions team. Before joining SanDisk, John was president of SMART Storage Systems where he was responsible for driving and expanding the company's technology leadership and storage business in the enterprise, OEM and channel markets, as well as in the related cloud, big data and vertical industries.



Missouri Beta

Breck R. Washam, P.E., '90, is a vice president and St. Louis, MO, regional office general manager for Burns & McDonnell. Washam joined the employee-owned engineering, architecture, construction, environmental and consulting solutions provider in 1990.



Missouri Gamma

Norma J. Taber, '80, has received a distinguished alumni achievement award from Albion College. She has spent 30 years with the MITRE



Corporation, currently as a lead systems engineer, contributing to improvements in air traffic operations. Currently, Taber is working on the next generation of departure flow management software. She established a scholarship for women in pre-engineering at Albion to encourage those considering the profession.

Missouri Epsilon

Adnan Gabeljic, '14, who just concluded a four-year playing career at Saint Louis University, was selected by Sporting Kansas City in the second round of the Major League Soccer SuperDraft. A mechanical engineering major who is expected to graduate with honors in May, Gabeljic earned a spot on the Atlantic 10 Conference All-Academic team and was a two-time Academic All-District selection.



New York Gamma

JoAnn L. Johnson, D.V.M., '92, is practice manager at Meadowbrook Veterinary Clinic in Peoria, IL. She gained her doctorate in veterinary medicine at Cornell University and then a MBA from SUNY at Buffalo.

John L. Ziegler, Ph.D., '06, is a computational fluid dynamics researcher with the Alliance for Sustainable Energy, operating contractor for the Department of Energy National Renewable Energy Laboratory



(NREL) in Golden, CO. NREL has obtained funding for research that increases the efficiency of converting biomass to fuel. Ziegler's role is to format and run simulations to increase efficiency and fuel output.

New York Delta

Daniel J. Lacks, Ph.D., '87, is a professor of chemical engineering at Case Western Reserve University. He led a group of master's students to Yangon Technological University in Myanmar to teach a two-week class on engineering entrepreneurship. The U.S. State Department believes this is the first American college course to be taught in Myanmar. Lacks has been visiting Myanmar as part of the Fulbright Specialist Program following the peaceful 2012 elections.



North Carolina Gamma

Benjamin J. Aitken, '02, is a patent attorney with Jenkins, Wilson, Taylor & Hunt, P.A., in Durham, NC. Prior to attending Duke University School of Law, he worked as a mechanical engineer. Aitken provides experience of patent preparation and prosecution before the U.S. Patent and Trademark Office and foreign patent offices. His experience further includes patent litigation, along with preparation and prosecution of trademark and copyright applications.



Justin W. Jaworski, Ph.D., '03, is a lead researcher on a project studying the mysteries of Canadian owls' stealthy flight that could improve design of vehicles from aircraft to submarines. Jaworski



ski, an assistant professor in Lehigh University's department of mechanical engineering and mechanics, said, "We're looking at the physiology of the wings, comparing them to other birds and then trying—both through theory and replicate experiments—to figure out what the physics are that are making them quieter than other birds."

John M.E. Storey, Ph.D., '86, has been elected a fellow of the Society of Automotive Engineers. He was recognized for his pioneering techniques in the characterization of exhaust emissions, as well as his work for the diesel fuel sulfur rule and "multiple contributions to the development of the lean exhaust emissions control." He works at the Oak Ridge National Laboratory's fuels, engines and emissions research center.



Ohio Eta

Christopher J. Augeri, Ph.D., '07, now runs a company, Thought-Puzzle LLC, which develops business intelligence applications to facilitate understanding an organization's customers, competitors, and core operations. His experience spans stints in government, academia, industry and some non-profit volunteer gigs.



Ohio Kappa

Robert T. Jubin, Ph.D., '77, received the 2013 Robert E. Wilson Award from the American Institute of Chemical Engineers (AIChE). The award recognized his contributions in the areas of nuclear fuel reprocessing and radioactive waste treatment and his chemical engineering achievements



in the nuclear industry. Jubin works in the Oak Ridge National Laboratory's nuclear security and isotope technology division.

Washington Alpha

Gerald H. Peterson, '66, has been awarded the IEEE Educational Activities/Standards Association's Standards Education Award. This was for "visionary development of e-learning modules on technical standards enhancing the knowledge and skills of students, academics, and engineering practitioners." Peterson is retired from AT&T Labs and Lucent Bell Labs.



Washington Beta

Eid M. Mejjel, '13, has become an electrical engineer in the maintenance department at Yanbu Aramco Sinopec Refining Company (YASREF) Ltd. This is a joint venture set up by Saudi Aramco and China Petrochemical Corporation (Sinopec) to build and operate a full conversion refinery in Yanbu Industrial City on the Red Sea coast of Saudi Arabia.

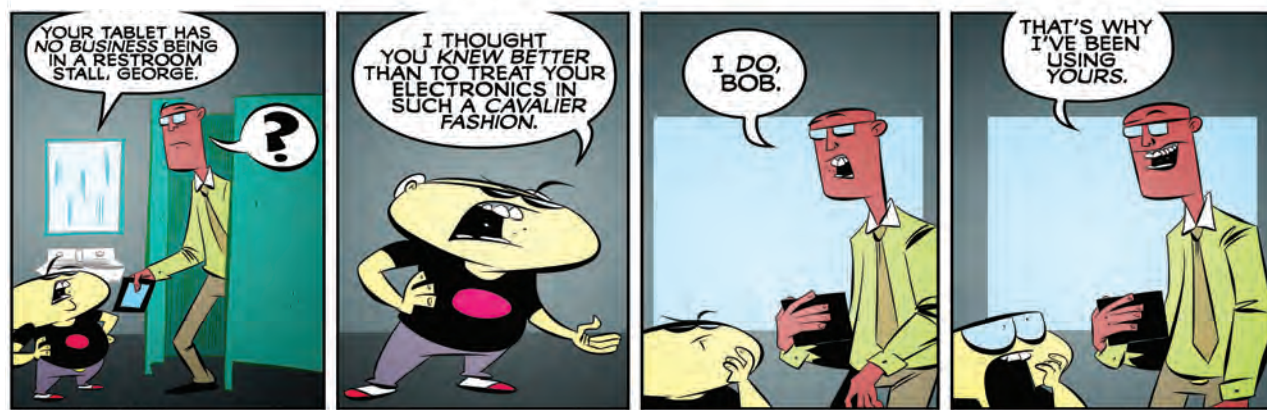
Wyoming Alpha

Andrew A. and Leah L. Morrison, '10, have welcomed a son, Matthew Malachi, born September 6, 2013.

Write Your Own Note!

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

The PC Weenies



© 2013 KRISHNA M. SADASIVAM WWW.PCWEENIES.COM

WITH PERMISSION FROM KRISHNA M. SADASIVAM, TN A '95

Advertisers' Index

ADVERTISER	WEB ADDRESS	PAGE NO.
Cummins	www.careers.cummins.com/TBP	Cover 4
Lincoln Labs	www.ll.mit.edu/employment	5
NCEES	www.ncees.org/practiceexams	3
NCEES	www.ncees.org/licensure	11
NRL	http://hroffice.nrl.navy.mil	9
NSA	www.nsa.gov/careers	Cover 2

Member Benefits

SEE COMPLETE LIST at tbp.org/memb/benefits.cfm

- **GEICO**—additional discounts on automobile insurance.
- **LinkedIn**—join 15,000 members in our official group for professional networking and career discussions. (Search: Tau Beta Pi Engineering Honor Society)
- **Local Hospitality**—access to a worldwide inventory of hotels at exclusively discounted rates.
- **LTCFP**—long-term care outreach and education program with access to favorable rates on long-term care insurance.
- **My Home Benefits**—moving discounts & real-estate services.
- **PPI**—discounts on professional licensing exam review materials (FE/EIT, PE, LEED, & more).
- **TBP Job Board**—post a resume online and browse through hundreds of engineering jobs at top companies.

Tau Beta Pi Insignia

Integrity and Excellence in Engineering

Call 800-TAU-BETA, or visit the online store at www.tbp.org/store.cfm for complete pricing and availability of colors and sizes. Orders are accepted online, over the phone, or by mailing this form with payment.

Member's Name: _____ TBP Chapter & Class: _____

Shipping Address: _____ Day Phone: _____

_____ Email: _____

Item Description	Quantity	Price
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Mail your order and check to:
 TAU BETA PI
 P.O. BOX 2697
 KNOXVILLE, TN 37901-2697

Total Amount Enclosed: _____

ORDERING INFORMATION: ALLOW 8 WEEKS FOR DELIVERY OF JEWELRY & CERTIFICATES & 12 WEEKS FOR DELIVERY OF CUSTOM-MADE RINGS.

TAU BATES...

Show your Commitment to Excellence.

10k Gold \$146 -148



Gold finish \$28/29

OFFICIAL ENGRAVED BENT CHARM/PIN

10k Gold \$90 -74



Gold finish \$20/27

SMALL BENT CHARM/PIN

10k Gold \$89



Gold finish \$24

TIE TACK/ RECOGNITION BUTTON

\$555



SIGNET RING 10K YELLOW GOLD

\$515



SEAL RING 10K YELLOW or WHITE GOLD

\$57



TIE BAR (BENT NOT INCLUDED)

\$45




STERLING SILVER TIE TACK

\$13



MEMBER CERTIFICATE

\$28



GRADUATION STOLE

\$15




HONOR CORD

3 for \$5



INK PENS BLUE/BLACK

\$89



CROSS PEN

\$14



WHITE HAT

\$15



COFFEE MUG 2-sided imprint, 15oz.

\$42



GOLF SHIRTS (GREG NORMAN) \$52

\$18




RADIANT T-SHIRT (XXL-\$20)

\$15



XXXL \$17 SILVER/NAVY or GOLD/BLACK T-SHIRT

\$18



PINK V-NECK T-SHIRT (XXL-\$21)

\$16




GREY T-SHIRT (XXL-\$18)

\$28



HOODIES (XXL-\$30)

\$6



BENT FLAT CASTING

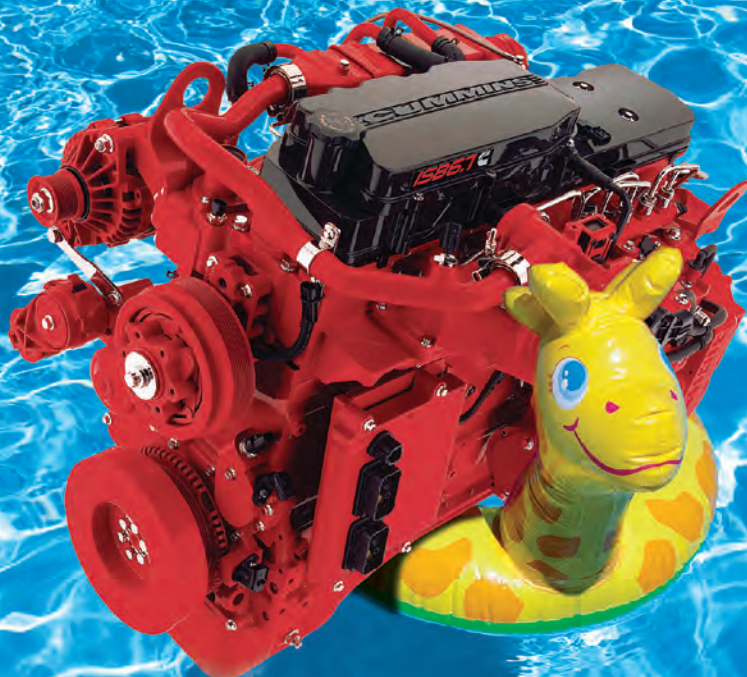
\$12



BRONZE PAPER-WEIGHT CASTING

Order Your TAU BETA PI
Official Insignia

AT WWW.TBP.ORG (PAYPAL) OR CALL (800/828-2382) FOR CREDIT CARD ORDER.



No, this isn't one of those ordinary jobs.

Every day, people depend on Cummins to do some extraordinary things in some unusual places. Sometimes we're under the hood of a truck lowering emissions. Other times we're using generator exhaust to heat a swimming pool in China.

This is a work environment where doing something exceptional and thinking beyond your desk is more than part of the job. It is the job.

<http://careers.cummins.com/TBP>



MEMBER OF
Dow Jones Sustainability Indices
In Collaboration with RobecoSAM



Working Right. | careers.cummins.com