THE BENT

OF TAU BETA PI | The Engineering Honor Society | SUMMER 2012

I Robot Comes of Age
Engineering the Heavens
Fellows and Scholars

CHAPTERS

ALUMNUS CHAPTERS

• *denotes active chapter*

District 1
- Central Connecticut, Hartford

District 2
- Buffalo, NY
- Long Island Suburban, NY
- Newark, NJ
- New York, NY
- • *Rochester, NY*
- Schenectady, NY
- • *Southern Tier, Binghamton, NY*

District 3
- Lehigh Valley, Bethlehem, PA
- • *Philadelphia, PA—New, established June 2010.*
- 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
- • *Central Florida, Orlando*
- Daytona Beach, FL
- Gainesville, FL
- Miami, FL
- Midlands, Columbia, SC
- Piedmont, Clemson, SC
- Puerto Rico
- Tampa Bay, FL
- West Palm Beach, FL

District 6
- • *Bluegrass, Lexington-Frankfort, KY*
- Central Alabama, Birmingham
- • *Great Smoky Mountains, Knoxville-Oak Ridge, TN*
- • *Louisville, KY*
- Greater Gulf Coast, Mobile, AL
- Mid-South, Memphis, TN

District 7
- Central Michigan, Lansing
- Cincinnati, OH
- Dayton, OH
- • *Southeastern Michigan, Detroit*
- Flint, MI
- • *Grand Rapids, MI*
- • *Ohio's North Coast, Cleveland*
- Columbus, OH

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

District 9
- Rolla, MO
- St. Louis, MO

District 10
- • *Houston, TX*

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

District 12
- • *Front Range, CO/WY*
- Salt Lake City, UT

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

COLLEGIATE CHAPTERS (245)

Chap.	*Dist.*	*Institution*
AL Α	6	Auburn Univ.
AL Β	6	Univ. of Alabama
AL Γ	6	Univ. of Ala. at Birmingham
AL Δ	6	Univ. of Ala. in Huntsville
AL Ε	6	Univ. of South Alabama
AK Α	14	Univ. of Alaska Fairbanks
AZ Α	13	Univ. of Arizona
AZ Β	13	Arizona State Univ.
AZ Γ	13	Northern Arizona Univ.
AR Α	9	Univ. of Arkansas
CA Α	15	Univ. of California, Berkeley
CA Β	16	California Inst. of Technology
CA Γ	15	Stanford Univ.
CA Δ	16	Univ. of Southern California
CA Ε	16	Univ. of California, Los Angeles
CA Ζ	15	Santa Clara Univ.
CA Η	15	San Jose State Univ.
CA Θ	16	California State Univ., Long Beach
CA Ι	16	California State Univ., Los Angeles
CA Κ	16	California State Univ., Northridge
CA Λ	15	Univ. of California, Davis
CA Μ	15	Calif. Poly. St. Univ., San Luis Obispo
CA Ν	16	California State Poly. Univ., Pomona
CA Ξ	16	San Diego State Univ.
CA Ο	16	Loyola Marymount Univ.
CA Π	16	Northrop Univ. (inactive)
CA Ρ	15	California State Univ., Fresno
CA Σ	16	Univ. of California, Santa Barbara
CA Τ	16	Univ. of California, Irvine
CA Υ	15	California State Univ., Sacramento
CA Φ	15	Univ. of the Pacific
CA Χ	16	California State Univ., Fullerton
CA Ψ	16	Univ. of California, San Diego
CA Ω	16	Harvey Mudd College
CA ΑΑ	15	California State Univ., Chico
CA ΑΒ	16	Univ. of California, Riverside
CA ΑΓ	15	San Francisco State Univ.
CA ΑΔ	15	Univ. of California, Santa Cruz
CA ΑΕ	16	Univ. of San Diego
CO Α	12	Colorado School of Mines
CO Β	12	Univ. of Colorado at Boulder
CO Γ	12	Univ. of Denver (inactive)
CO Δ	12	Colorado State Univ.
CO Ε	12	Univ. of Colorado at Denver
CO Ζ	12	United States Air Force Academy
CT Α	1	Yale Univ.
CT Β	1	Univ. of Connecticut
CT Γ	1	Univ. of Hartford
DE Α	3	Univ. of Delaware
DC Α	4	Howard Univ.
DC Β	4	Catholic Univ. of America
DC Γ	4	George Washington Univ.
FL Α	5	Univ. of Florida
FL Β	5	Univ. of Miami
FL Γ	5	Univ. of South Florida
FL Δ	5	Univ. of Central Florida
FL Ε	5	Florida Atlantic Univ.
FL Ζ	5	Florida Inst. of Technology
FL Η	5	Florida A&M Univ.-Florida State Univ.
FL Θ	5	Florida International Univ.
FL Ι	5	Embry-Riddle Aeronautical Univ.
GA Α	5	Georgia Inst. of Technology
GA Β	5	Mercer Univ.
ID Α	14	Univ. of Idaho
ID Β	12	Idaho State Univ.
ID Γ	12	Boise State Univ.
IL Α	8	Univ. of Illinois at Urbana-Champaign
IL Β	8	Illinois Inst. of Technology
IL Γ	8	Northwestern Univ.
IL Δ	8	Bradley Univ.
IL Ε	8	Southern Illinois Univ. at Carbondale
IL Ζ	8	Univ. of Illinois at Chicago
IN Α	8	Purdue Univ.
IN Β	8	Rose-Hulman Inst. of Technology
IN Γ	8	Univ. of Notre Dame
IN Δ	8	Valparaiso Univ.
IN Ε	8	Trine Univ.
IA Α	11	Iowa State Univ.
IA Β	11	Univ. of Iowa
KS Α	9	Univ. of Kansas
KS Β	9	Wichita State Univ.
KS Γ	9	Kansas State Univ.
KY Α	6	Univ. of Kentucky
KY Β	6	Univ. of Louisville
KY Γ	6	Western Kentucky Univ.
LA Α	10	Louisiana State Univ.
LA Β	10	Tulane Univ. of Louisiana
LA Γ	10	Louisiana Tech Univ.
LA Δ	10	Univ. of Louisiana at Lafayette
LA Ε	10	Univ. of New Orleans
ME Α	1	Univ. of Maine
MD Α	4	Johns Hopkins Univ.
MD Β	4	Univ. of Maryland
MD Γ	4	United States Naval Academy
MD Δ	4	Univ. of Maryland Baltimore County
MD Ε	4	Morgan State Univ.
MA Α	1	Worcester Polytechnic Inst.
MA Β	1	Massachusetts Inst. of Technology
MA Γ	1	Harvard Univ. (inactive)
MA Δ	1	Tufts Univ
MA Ε	1	Northeastern Univ.
MA Ζ	1	Univ. of Massachusetts at Amherst
MA Η	1	Boston Univ.
MA Θ	1	Univ. of Massachusetts Lowell
MA Ι	1	Western New England Univ.
MI Α	7	Michigan State Univ.
MI Β	11	Michigan Tech. Univ.
MI Γ	7	Univ. of Michigan
MI Δ	7	Univ. of Detroit Mercy
MI Ε	7	Wayne State Univ.
MI Ζ	7	Kettering Univ.
MI Η	7	Lawrence Technological Univ.
MI Θ	7	Oakland Univ.
MI Ι	7	Univ. of Michigan-Dearborn
MI Κ	7	Western Michigan Univ.
MI Λ	7	Grand Valley State Univ.
MN Α	11	Univ. of Minnesota-Twin Cities
MN Β	11	Univ. of Minnesota, Duluth
MS Α	6	Mississippi State Univ.
MS Β	6	Univ. of Mississippi
MO Α	9	Univ. of Missouri-Columbia
MO Β	9	Missouri Univ. of Science & Technology
MO Γ	9	Washington Univ.
MO Δ	9	Univ. of Missouri-Kansas City
MT Α	12	Montana State Univ.
MT Β	12	Montana Tech of the Univ. of Montana
NE Α	9	Univ. of Nebraska-Lincoln
NV Α	15	Univ. of Nevada, Reno
NV Β	16	Univ. of Nevada, Las Vegas
NH Α	1	Univ. of New Hampshire
NH Β	1	Dartmouth College
NJ Α	2	Stevens Inst. of Technology
NJ Β	2	Rutgers Univ.
NJ Γ	2	New Jersey Inst. of Technology
NJ Δ	2	Princeton Univ.
NJ Ε	2	Rowan Univ.
NM Α	13	New Mexico State Univ.
NM Β	13	Univ. of New Mexico
NM Γ	13	New Mexico Inst. of Mining & Tech.
NY Α	2	Columbia Univ.
NY Β	2	Syracuse Univ.
NY Γ	2	Rensselaer Polytechnic Inst.
NY Δ	2	Cornell Univ.
NY Ε	2	New York Univ. (inactive)
NY Ζ	2	Polytechnic Inst. of Brooklyn (inactive)
NY Η	2	City College of CUNY
NY Θ	2	Clarkson Univ.
NY Ι	2	Cooper Union School of Engineering
NY Κ	2	Univ. of Rochester
NY Λ	2	Pratt Inst. (inactive)
NY Μ	2	Union College
NY Ν	2	SUNY at Buffalo
NY Ξ	2	Manhattan College
NY Ο	2	SUNY at Stony Brook
NY Π	2	Rochester Inst. of Technology
NY Ρ	2	Polytechnic Institute of New York Univ.
NY Σ	2	Alfred Univ.
NY Τ	2	Binghamton University
NY Υ	2	United States Military Academy
NC Α	4	North Carolina State Univ. at Raleigh
NC Β	4	Univ. of N.C. at Chapel Hill (inactive)
NC Γ	4	Duke Univ.
NC Δ	4	Univ. of North Carolina at Charlotte
NC Ε	4	North Carolina A&T State Univ.
ND Α	11	North Dakota State Univ.
ND Β	11	Univ. of North Dakota
OH Α	7	Case Western Reserve Univ.
OH Β	7	Univ. of Cincinnati
OH Γ	7	Ohio State Univ.
OH Δ	7	Ohio Univ.
OH Ε	7	Cleveland State Univ.
OH Ζ	7	Univ. of Toledo
OH Η	7	Air Force Inst. of Technology
OH Θ	7	Univ. of Dayton
OH Ι	7	Ohio Northern Univ.
OH Κ	7	Univ. of Akron
OH Λ	7	Youngstown State Univ.
OH Μ	7	Wright State Univ.
OH Ν	7	Cedarville Univ.
OH Ξ	7	Miami Univ.
OK Α	9	Univ. of Oklahoma
OK Β	9	Univ. of Tulsa
OK Γ	9	Oklahoma State Univ.
OR Α	14	Oregon State Univ.
OR Β	14	Portland State Univ.
OR Γ	14	Univ. of Portland
PA Α	3	Lehigh Univ.
PA Β	3	Pennsylvania State Univ.
PA Γ	3	Carnegie Mellon Univ.
PA Δ	3	Univ. of Pennsylvania
PA Ε	3	Lafayette College
PA Ζ	3	Drexel Univ.
PA Η	3	Bucknell Univ.
PA Θ	3	Villanova Univ.
PA Ι	3	Widener Univ.
PA Κ	3	Swarthmore College
PA Λ	3	Univ. of Pittsburgh
PR Α	5	Univ. of Puerto Rico
RI Α	1	Brown Univ.
RI Β	1	Univ. of Rhode Island
SC Α	5	Clemson Univ.
SC Β	5	Univ. of South Carolina
SC Γ	5	The Citadel
SD Α	12	South Dakota School of Mines & Tech.
SD Β	11	South Dakota State Univ.
TN Α	6	Univ. of Tennessee
TN Β	6	Vanderbilt Univ.
TN Γ	6	Tennessee Tech. Univ.
TN Δ	6	Christian Brothers Univ.
TN Ε	6	Univ. of Memphis
TN Ζ	6	Univ. of Tennessee at Chattanooga
TX Α	10	Univ. of Texas at Austin
TX Β	13	Texas Tech Univ.
TX Γ	10	Rice Univ.
TX Δ	10	Texas A & M Univ.
TX Ε	10	Univ. of Houston
TX Ζ	10	Lamar Univ.
TX Η	10	Univ. of Texas at Arlington
TX Θ	13	Univ. of Texas at El Paso
TX Ι	10	Southern Methodist Univ.
TX Κ	10	Prairie View A & M Univ.
TX Λ	10	Texas A & M Univ.-Kingsville
TX Μ	10	Univ. of Texas at San Antonio
UT Α	12	Univ. of Utah
UT Β	12	Brigham Young Univ.
UT Γ	12	Utah State Univ.
VT Α	1	Univ. of Vermont
VT Β	1	Norwich Univ.
VA Α	4	Univ. of Virginia
VA Β	4	Virginia Polytechnic Inst. & State Univ.
VA Γ	4	Old Dominion Univ.
VA Δ	4	Virginia Military Inst.
VA Ε	4	Virginia Commonwealth Univ.
WA Α	14	Univ. of Washington
WA Β	14	Washington State Univ.
WA Γ	14	Seattle Univ.
WA Δ	14	Gonzaga Univ.
WV Α	4	West Virginia Univ.
WV Β	4	West Virginia Univ. Inst. of Technology
WI Α	8	Univ. of Wisconsin-Madison
WI Β	8	Marquette Univ.
WI Γ	8	Univ. of Wisconsin-Milwaukee
WI Δ	8	Milwaukee School of Engineering
WI Ε	8	Univ. of Wisconsin-Platteville
WY Α	12	Univ. of Wyoming

the **Bent** *of* Tau Beta Pi — The Engineering Honor Society

Summer 2012
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Founded at Lehigh University, South Bethlehem, Pennsylvania, June 15, 1885, by Edward H. Williams Jr., A.B., A.C., E.M., Sc.D., LL.D. (1849-1933). Key and name registered in U.S. Patent Office. Member, American Society for Engineering Education and (co-founder) Association of College Honor Societies. Affiliate, American Association for the Advancement of Science.

Features

Calif. Alpha Epsilon Installed 14

Dr. Asimov's Automatons 16
by Alan S. Brown

Engineering the Heavens.................... 21
by Trudy E. Bell

TBΠ Names 200 Scholars 26

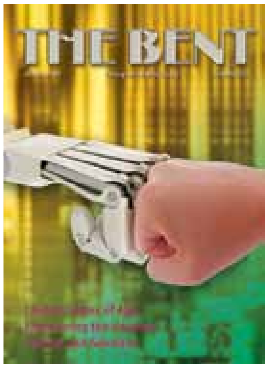
TBΠ Names 40 Fellows 31

ON THE COVER:

Alan Brown looks at how Isaac Asimov's robot fiction foretells the future and the problems we could face.

In a separate feature, we look at the ways engineering lets us look into the heavens.

Cover artist: Dali Polivka



Reports

3 ....Constituion Amendments Ratified
5 ....Executive Council Meetings
39 .....Staying Involved

Departments

2 ....Council's Corner
4 ....Editorial
6 ....Letters
8 ....Who's Who
10 ....Lyle's Law
12 ....District Doings
40 ....Brain Ticklers
42 ....Brain Ticklers
46 ....In the Colleges
47 ....Alumnus Notes
48 ....Insignia

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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

The Power of Thought

The brain averages about 70,000 thoughts a day. This equates to roughly a thought every 0.7 seconds if you are awake from 7 a.m. to 10 p.m. The brain requires approximately 500 calories each day to function (25 percent of a 2,000 calorie regime). It is the largest consumer of energy in our bodies, and our bodies will starve muscles rather than starve the brain. Our bodies have a built-in mechanism to protect the brain.

With 70,000 thoughts flashing through our minds, every thought cannot be consciously digested. It is proven that our brains absorb upwards of 400 billions of bits of information, yet we are only aware of about 2,000 bits of information, mostly concerning body functions, immediate environment, and passage of time. Therefore, you must choose the thoughts to dwell on to truly harness the power of thought.

Someone once told me that a belief is simply a thought you keep repeating. *A belief is just a thought you keep repeating.* I refocused my mind after I accepted this premise. Thoughts like "there are no jobs out there" must be positively transformed into "I can seek ways to use my skills that I haven't thought of before." These echoing messages will become your beliefs.

The power of thought to overcome adversity is incredible. I've read a few books on the cultural revolution in China, and one in particular was *Life and Death in Shanghai*. The author was imprisoned for six and half years and tortured daily to confess to being a western spy. Ms. Nein Cheng kept her morals, kept her mind, and kept her thoughts as her own. Not many people have the fortitude or the tenacity to resist the brutality of the Red Guard as Cheng did. She is a reminder that we are the keeper of our minds and filter of our thoughts.

In the fall of 1994, I was President of the Florida Alpha Chapter. The University of Florida is a very large school, yet Gainesville is not a megalopolis of industry. My predecessors provided no financial advice or fundraising ideas, and support from student government was a foreign concept to engineers back then. The Dean's office was willing to provide support, but sending invitations to 400 potential members easily consumed $500.

It felt like the movie *Moneyball*. We were the Oakland A's, trying our best to do something with what seemed like nothing. In the end, Florida Alpha won the R.C. Matthews Most Outstanding Chapter Award for those two semesters because a team of dedicated underdogs committed to the same thought—**we will succeed.**

It was the mindset of that team to pull, push, and propel the chapter to a new level of achievement. I am not sure we would have done so well if we had a large bankroll. I tend to think that having money doesn't make one a success. Don't get me wrong; I know money helps as I've seen the amazing work some of our chapters do with their fundraising efforts. Yet I firmly believe, we'd still see them conduct outstanding activities without oodles of money. Chapter success, much like corporate success, relies on the leadership of people. These leaders would succeed whether given $50 or $500. When teams rally behind a goal, nothing can stop them.

One exercise I use for building team spirit is called "brainstorming of the positive." Participants write the pros on the left side of a typical T-bar, but a huge "X" is placed on the right side where cons are normally placed. You don't need to brainstorm the negative because the world is replete with negativity. People are eager to tell you your idea isn't realistic, you can't do that, you aren't allowed to do that, that's not been done before, or that's not how it's done. This exercise starts to implant a unified set of thoughts into everyone's mind: We can do this; We are smart enough; We have the necessary resources; We are committed to achieving our goal.

The exercise itself is simple. You and your team members only talk about the positive resources. A Tau Beta Pi Chapter exercise might include: Tom has a car and can provide transportation; Sue's uncle owns the pizzeria; Max has 300 Facebook friends; Tau Beta Pi has a good rapport with the Dean and the support of ΤΒΠ professors; Headquarters will provide image materials; Grants are available for MindSET and Greater Interest in Government projects; Solange always answers her emails in a timely manner.

Practice this exercise often. We all need motivation as life moves through the valleys. Remember, a *belief is just a thought you keep repeating*. Believe in your own greatness.

—**Solange C. Dao,** P.E., *Florida Alpha '95, Vice President*

Constitutional Amendment Ratified

The 2011 Convention approved two amendments to the Constitution and Bylaws of Tau Beta Pi and sent it to the chapters for ratification. In accord with the Association's amending procedure, with 238 chapters eligible to vote, 179 or more affirmative chapter votes are required to ratify an amendment, and 60 or more negative votes would defeat it.

Headquarters received 198 valid ballots by the voting deadline of April 1, 2012 (plus 11 invalid for lack of a chapter quorum). The proposed amendments were therefore ratified.

Amendment	Outcome
1. Update the retirement provisions for Headquarters staff to meet current practices. Const. Art. V, Sec. 2-4.	1. Ratified by chapter vote; 190 affirmative, 8 negative.
2. Add a fourth alumnus member to the Fellowship Board and clarify the Board's duties. Const. Art. IV, Sec. 2 (g) 2.	2. Ratified by chapter vote; 193 affirmative, 5 negative.

"THE BEST PEOPLE" ENGINEERING JOB BOARD

Through a partnership with Job-Target, Tau Beta Pi has a state-of-the-art job board. Members can post resumes, browse over 1,000 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*.

POWERED BY JOBTARGET

Send THE BENT to Me

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

☐ I enclose $60, for which I shall expect to receive THE BENT for life. I will keep you informed of any change of address.

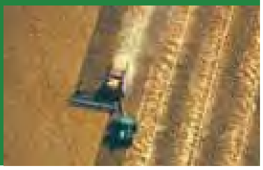
☐ I enclose $12.50 as the first payment for a BENT Life Subscription. Remind me to send $12.50 each year for the next four years.

☐ I enclose $10, which will keep me on the mailing list of THE BENT for one year. I would 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 ________



Opportunities for Change

Change can be uncomfortable, difficult, or even painful. However, change is an inevitable part of life and can be exciting and rewarding. My life over the past 18 months has been filled with changes from getting married and moving to a new state to taking on a new role with Tau Beta Pi. My first ten months with ΤΒΠ have also involved a lot of change. A fellow Tau Bate recently commented to me that coming up to speed with everything at ΤΒΠ Headquarters must be like 'drinking from a fire hose.' There are certainly days when new experiences come fast and furious, but I have enjoyed the water so far!

My wife and I recently bought a house in Knoxville. Our new house is very different from our one in Michigan. We have a large wooded backyard and numerous shrubs and bushes. I learned the hard way that you should always keep both hands on the hedge trimmer's handles. Seven stitches and a month later, the middle finger on my left hand is back to normal. Change can be painful.

Some noteworthy changes are underway at ΤΒΠ as well. I thought you might be interested in some of them.

Lyle's Laws

Sadly, you will find the last of our very popular *Lyle's Laws* in this issue of THE BENT. We have been blessed with 40 spectacular articles from Lyle over the past 10 years. On behalf of many people, I would like to express our gratitude to Lyle for his devoted service to the Association. We have some new articles planned to fill the void, but nothing can replace the fantastic wisdom that Lyle has shared with us over the years.

Chapter Communications

The students who participated in the focus groups at the 2011 Convention provided numerous constructive ideas to improve the organization and simplify the experience of being a chapter officer. One of the ideas that has already been implemented is a shift to more electronic communication. This has been ongoing for many years, but January saw us shift to providing routine chapter communications via email and posts to our website instead of information being mailed. This has not been an easy or pain-free process, but chapter officers are pleased with this new format of information dissemination. For the 2012 Convention, our communications and materials distribution will be handled through email and the website. This will be a big change, but it is an opportunity to make information easier to disseminate and retrieve.

The Road Show

As I've been traveling around the country, I've been able to arrange a number of alumni gatherings. To date, I've had the fortune of meeting with alumni in Manhattan Beach, CA; Denver, CO; Detroit, MI; Chicago, IL; and Minneapolis, MN. More gatherings over the summer and fall are being planned as I write this editorial. We will post the dates and locations on our alumni website, www.tbp.org/alumni, as soon as they are finalized. We will also post the information to our Facebook and LinkedIn groups, and I hope you will join us!

Record Preservation

Tau Beta Pi has amassed a large number of documents in our 127-year history. We've started the process of digitizing these records so nothing will be lost. While our home on the campus of the University of Tennessee is great, we've seen our building experience a fire and several floods. Earlier this year, we completed scanning of the entire set of Michigan Alpha catalog cards. These cards are now easily accessible from our computers at Headquarters. There are no plans to eliminate our existing paper catalog cards, but we want to ensure all our important documents are archived. This process will take time, but it is vital to the preservation of our Association's history.

Continued Constants

Change can be difficult, but it can also be a welcome opportunity. Even as some things change, many important things do not. Integrity and excellence are still our core principles. THE BENT will continue to be delivered to your mailbox (or inbox) each quarter. Chapters will keep initiating new members. Fellows and scholars will continue to be supported financially. This is an exciting time to be a member, and I look forward to navigating these changing times with you.

Until Later,

EXECUTIVE COUNCIL MEETINGS

The Executive Council met via teleconference on March 21, April 18, and May 16, 2012.

The Council appointed *J.W. Steadman, Ph.D., P.E., WY A ’64*, to a three-year term on the Outstanding Advisor Selection Committee and *George K. Miyata, WA Δ ’10*, as a District Director with a term ending June 30, 2015. The Council accepted requests from Districts 3 and 16 to add an additional director.

The Council approved awarding up to 200 scholars and 40 fellows for the 2012-13 academic year.

The Council accepted Executive Director Gomulinski’s 3rd quarter financial report.

The Council reviewed plans for funds from the estate of *Charles O. Forge, CA Γ ’56*, but took no action at this time. The Council adopted a resolution to accept a gift from the estate of Kathleen and *Robert D. Sickafoose, IL B ’50*.

Executive Director Gomulinski presented information on digitizing the catalog cards. The Council approved a plan and funding to update the website using a design submitted by a collegiate chapter.

Councillor Pih provided an update on the April 5 meeting of the Vision Development Group. Councillor Earle provided an update on the MindSET program including plans for a MindSET presentation at the ASEE Conference in June.

Councillor Pih reported on plans for an Engineering Futures Planning Committee meeting scheduled for May. A meeting of all Engineering Futures Facilitators is planned for June.

Plans for the 2012 Convention in Lexington were reviewed and a schedule was approved. The Council reviewed plans for the 2012 and 2013 meetings of National Officials.

The Council reviewed partnership proposals from two different companies; however, additional information was requested before making a decision on either proposal.

ΤΒΠ Directory

Executive Council

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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*, # 10, 811 W. Cherry Ave., Flagstaff, AZ 86001. *(norman@tbp.org)*

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The Limits of Logic

•The three letters about the role of "feelings" [Spring 2012] took me back to 1939 and my troubled immersion into Algebra. My dad, a scientist and rigorously logical thinker (I bear the scars!), observed, "Look at your answer and ask yourself, 'Is it reasonable?' " Therein lay The Law and the Prophets.

Jack W. Osgood, P.E., MI A '49

•It wasn't until I read the letters in the Spring 2012 issue of THE BENT that I was reminded that I also had an example of Lyle's Laws: The Limits of Logic.

My first job after college in 1963 was at The Martin Company in Middle River, Maryland, where I made friends with several other young engineers. One was a logical fellow who was in the market for a new car. Of course, this was before the days of computer spreadsheets, but he set up one with paper and pencil, listing the categories he thought important. At this late date I don't recall them, but they included things like price, gas mileage, head and leg room, trunk space, comfort, ride, and handling—he test drove all the candidates.

He assigned a weight to each category, gave each car a score in each category, multiplied the values, and summed the results. The winner was Nash Rambler. He thought it over for a while, modified a few values, and recalculated. The answer this time was Nash Rambler. After a few more modifications the result was Buick Skylark, which he purchased, and drove happily ever after.

John S. Ludwick NY B '62

Killer Apps

•Since graduating I have read THE BENT with interest, and I have supported the Society because it is a significant focal point for all engineers **but**, I have never clipped an article. **Until**, I read the "Searching for that Killer App!" article. You captured the essence of what engineers do—they convert knowledge into solutions **and** they have fun on the way. Keep up the great work.

Jeffrey T. Palmer, SC A '70

Ethical Decision Making

•"Ethical Decision Making in Today's Engineering Classrooms" [Spring 2012] is very good. I have some more complications (as if you didn't provide enough!). Consider "Ethical Decision Making in Practice" on page 19. If I refuse to work on the E cigarette, someone else will, so I'm hurting myself while not doing any good. On the other hand, maybe someone will notice what I did and be emboldened to do the right thing when it's her or his turn.

In some countries, you can be killed for bucking the system, so you might think that the only good that can come of your action is to make you feel good about yourself until they kill you (going to heaven or hell is yet another consideration that I won't go into). On the other hand, the Arab Spring began by one person immolating himself. One noble act (or action from frustration) can do a lot of good.

Another complication, of course, is that you and I may have different ideas of right and wrong and good and bad. This happens within one culture, religion, and country as well as across cultures, religions, and countries

Again, consider the Arab Spring: the rulers and ruled have very different ideas about these things.

E. Ted Grinthal, NY E '62

•I read the article on "Ethical Decision Making in Today's Engineering Classrooms" with interest as I have spent the bulk of my professional career working in the areas of business ethics education. I have seen many talented educators develop creative ways to address questions of professional ethics training, both within graduate and undergraduate business education as well as in executive and company contexts.

I believe that too often we ask the wrong questions when it comes to ethics education for the professions. I believe the article mentioned above, although thoughtful and well organized, is an example of asking the wrong questions. The focus in this piece, and the focus in most professional ethics education, tends to be on asking and answering the question "What is the right thing to do?" Admittedly this is an important question, especially in a world where technology often seems to be outstripping our ability to consider its moral implications and where globalization presents questions and challenges that often were unanticipated in our formal education.

Nevertheless, many of the most ubiquitous and important ethical challenges professionals face are nothing new. They are variations on questions of honesty, respect, fairness, and compassion. They are very often questions to which we know the answers. Just because we may know what we think is right, does not mean we know how to get it done, effectively and without self-destructing.

For this reason, an emphasis upon the analytics of ethics, as we see in the organized stakeholder analysis shared in the article, goes only part of the way to preparing future engineers for the kinds of realities they will face in their careers. This kind of model, logical and clear as it may be, gives little attention to the questions of "action." After completing the analysis, the authors insert another step in their model, simply directing us to "Act." Admittedly they acknowledge that this is often the most difficult part of the whole process, but that is where they leave us!

I believe we would make more progress in preparing future engineers or business managers or even lawyers and doctors to behave in an ethical manner in their careers if we went beyond the reasoning models offered in this article. Giving students the chance to research and prepare to voice and enact their values—and if we gave them the opportunity to

REHEARSE such scripts and action plans and engage in peer coaching to refine and enhance them—would truly be education for responsible and ethical professionals.

A new approach to values-driven leadership development called "Giving Voice To Values" (GVV – www.GivingVoiceToValues.org) attempts to address this need. Although developed for business education, schools of engineering (and law and medicine) are beginning to consider the approach for their own use and even engineering-heavy companies have adapted the approach for their internal education purposes. Giving Voice to Values is available for free and offers a simple and accessible way to develop our own "moral competence." The GVV approach invites us to ask "What If" we were going to act according to our values, and then to apply all the same skills and resources we would apply to any engineering or business problem to questions of values and ethics. Ideally, our best approach is then rehearsed with peers in order to make it robust and credible. One of the principles of this approach is that ethical challenges are a normal part of our lives, and they should be approached as opportunities to be who we already want to be, at our best.

Mary C. Gentile, Ph.D.

Asbestos Issues

•As a life subscriber of THE BENT, I feel obligated to offer my opinion relative to an item in the Spring 2012 issue of THE BENT. In response to the opinions expressed concerning the failure of the World Trade Center, it's important to explain again that the behavior of the massive columns relative to horizontal impact is not as columns but as vertical beams supported only by the relatively light floor structure. As such, the columns did not possess the capacity to restrain the giant jets from getting into the buildings and spewing their gasoline that led to their collapse.

Lawrence Fischer, P.E., NY Ι '55

Honorifics

•It is appropriate that when a list of names is presented that all people on the list have honorifics (Mr., Mrs., Ms., Dr., Prof., etc.) or that none have them. To list people–some with honorifics and other without–is considered bad taste and is simply not done in "high class" organizations. It suggests that those without honorifics are somehow on a lower scale, and, in sophisticated circles, is considered insulting to those denied an honorific. If you want to acknowledge a doctorate and you do not want to use Mr. or Ms. for those on the list without them then you need to do so with appropriate letters after the names of those with doctorates and use no honorifics at all.

Neil Yeoman, P.E., NY Z '56

[Editor's Note: We appreciate your observation. My predecessor noted this problem as well, and we are working to ensure a consistent format is used throughout the magazine. No offense was intended!]

Brain Ticklers

• Thanks for the Brain Ticklers. I love working on them!

James D. Rubin, MI Γ '82

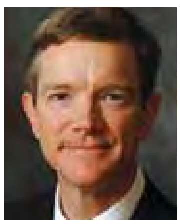
Steven E. Koonin, Ph.D, *California Beta '72,* has left the post of Under Secretary of Energy for Science at the U.S. Department of Energy for a position at the Institute for Defense Analyses. He was previously chief scientist for BP Plc, guiding technology strategy. Koonin joined BP in 2004 following a 29-year career at the California Institute of Technology as a professor of theoretical physics.

Richard H. Truly, *Georgia Alpha '59,* has been elected to a three-year term as a councillor of the National Academy of Engineering. He is a retired U.S. Navy vice admiral and was the first former astronaut to head NASA as the agency's administrator. Truly went on to lead the Georgia Tech Research Institute from 1992 to 1997 and the National Renewable Energy Laboratory from 1997 to 2005.

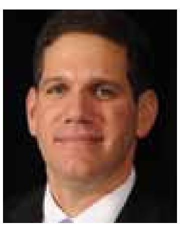
Joseph E. Gott, P.E., *Maryland Beta '81,* is chief engineer and director of capital improvements at the Naval Facilities Engineering Command (NAVFAC) in Washington, DC. He began his civil service career as a fire protection engineer. Gott is responsible for the navy's military construction program; medical facilities design; anti-terrorism/force protection, and ocean facilities. He oversees an annual budget of more than $5 billion.

Michael J. Massimino, Ph.D, *New York Alpha '84,* has joined Rice University's space institute as executive director. The astronaut, on loan from NASA's Johnson Space Center, is a veteran of two Shuttle missions. The institute and center are streamlining collaborations. Last September marked the 50th anniversary of Houston's selection as site of the Manned Spacecraft Center, now JSC.

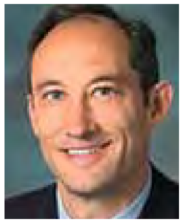
Norman W. Loney, Ph.D, P.E., *New Jersey Gamma '77,* top, and **Edmund G. Seebauer,** Ph.D, *Illinois Alpha '82,* have been elected as fellows of AIChE. Loney is a professor and chair of the department of chemical, biological and pharmaceutical engineering at New Jersey Institute of Technology. Seebauer is professor and head of the department of chemical and biomolecular engineering at the University of Illinois at Urbana-Champaign.



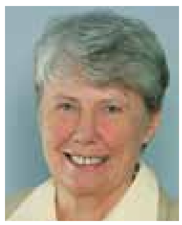
Lawrence D. Sloan, *Pennsylvania Delta '85,* is president and CEO of the Society of Chemical Manufacturers and Affiliates (SOCMA), and has been elected as the 2012 board chairman of the Council of Manufacturing Associations (CMA). The CMA is made up of more than 200 associations from every sector of manufacturing.



James R. Miller, *Indiana Alpha '86,* is vice president, world operations, at Google Inc. He joined Google in 2010 and served previously as executive vice president of Sanmina-SCI Corporation, responsible for industrial, cleantech, multimedia, and automotive businesses. Miller was formerly a vice president at Cisco.

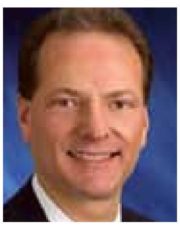


Maria M. Klawe, Ph.D, *California Omega '73,* has joined the board of directors at semiconductors and communications giant Broadcom. She became president of Harvey Mudd College in 2006, after serving as dean of engineering and a professor of computer science at Princeton University. Klawe joined the board at Microsoft in 2009. She is a past president of the Association of Computing Machinery and a member of the board of Math for America.

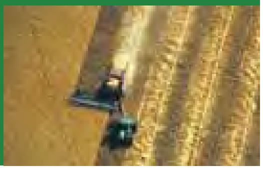


James A. Milke, Ph.D, P.E., *Maryland Beta '76,* is 2012 president of the Society of Fire Protection Engineers. He is a professor and chair of the department of fire protection engineering at University of Maryland. Milke has served on the Society's Board of Directors since 2004.

Henry Samueli, Ph.D, *California Epsilon '75,* has been awarded the Global Semiconductor Alliance's Dr. Morris Chang Exemplary Leadership Award, the GSA's most prestigious award, which recognizes exceptional contributions to the industry. Samueli is co-founder and chief technology officer of Broadcom.



W. Gary Gates, *Iowa Alpha '72,* has been re-elected by the Nuclear Energy Institute for another term as chairman of its board of directors. He is president and chief executive officer of the Omaha Public Power District and took on the NEI post in 2009. Gates joined OPPD in 1972 and was appointed president and CEO in 2004.



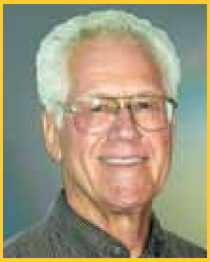
The Final Law...of Love

During World War II, there was a concerted effort to induce people to drive less and thereby save gasoline for the war effort. Part of this campaign was the production of the "Victory Bike", a very basic but serviceable bicycle. My sister acquired one of these bikes with the plan that she would ride it to the one-room country school where she, at the tender age of eighteen, was the sole teacher. While that plan was largely unrealized due to the uncertain condition of the country roads, the bike served the family well. When the war ended, that sister moved out to marry her fighter pilot, my other sister moved out to seek her fortune in the big city and my one brother who had not left to fight the war–as had three others–discovered internal-combustion-based transportation. That left me with the by now dilapidated old bike. Better than nothing, but barely so.

In the months after V-J Day, American industry shifted with amazing speed to the production of civilian goods. Among the best of those goods–in the eyes of a 12-year-old boy–were bicycles and one day there appeared in the window of the local hardware store the most gorgeous, bright red, Schwinn bicycle one could imagine. It was love at first sight. I discussed this affair with my father and he offered a bit of advice. "Never fall in love. It makes you do foolish things." I've thought about this advice a lot over the years and, well, sorry, Dad, but I think you were wrong. At least in part. While love may make you do foolish things, I believe that for our own fulfillment, we do need to fall in love. Indeed, I shall be so bold as to state, in three parts, Lyle's Law of Love: Love somebody. Love some thing. Love some place. Let's look at these individually.

Love somebody. It is hard to imagine anyone going through life without ever truly loving another person, but I suppose it can happen. Oh, what a bleak life that must be. Even Plato, a pretty practical guy, said, "And he whom Love touches not walks in darkness."

Some of us are fortunate in having people who are easy to love. I love my wife. I love my children. I cannot imagine doing otherwise. But there must be people who don't have the good fortune of knowing the easy-to-love. And there are those who are unwilling to give up the self-interest that makes it difficult to love someone else. For these people, obeying this part of this law will be difficult but not, in my opinion, impossible. I venture, here, into waters I am not qualified to sail, but I believe that everyone is capable of giving love and will undoubtedly be the better for having



A Note in Closing

To everything there is a season. Everything must have a beginning and an ending. Recognizing this, I discussed with Jim Froula a few years ago how best to end the series of Lyle's Laws. We decided–or perhaps more accurately, I proposed and Jim agreed–that ten years and forty laws would be a good place to stop. Hence, the fortieth and last law is printed here.

To say that this has been a rich experience for me would be a great understatement. Writing always helps clarify one's thoughts and certainly my thoughts require clarification. Some laws have come easily, while others have resisted their birth throughout hours of anguish, as I looked at or thought about that computer screen with nothing on it but a title. In the end, however, the deadline won out and the law was published.

My greatest reward, of course, has been the reaction of my readers. Response to the laws has been overwhelmingly positive and for your comments and letters, I am most grateful. I have been especially gratified to hear from so many of you that you are using Lyle's Laws in your courses, from ethics to design to just a handout as a supplement to a basic engineering course. Believing that I am having some influence on practicing engineers feels good, but to think that I may also be helping to mold the engineers of tomorrow is positively exhilarating.

Enduring Thanks

It has been suggested that we publish a book that is a compilation of Lyle's Laws and we will investigate that possibility. There are many routes to publication today and perhaps one of them will work out.

In conclusion, I want to express my thanks to Jim Froula who suggested the Lyle's Laws series and has continued to be supportive and constructive over the ensuing decade. My thanks, also, to the nameless editors–with whom I have occasionally disagreed–for improving the articles. I also want to thank my wife, Dorothy, and my children for their comments and encouragement as the laws have trickled out. And finally, of course, my enduring thanks to the readers of THE BENT who have been so generous of their comments. If you have gained half as much from the reading as I have from the writing, your time and mine have been well spent.

done so. Remember the song from the musical *South Pacific*? "You've Got to be Taught to Hate." Well, maybe you can be taught to love, too.

Love some thing. There are all kinds of "things". As a matter of fact, I guess there is nothing that is not a thing except that we generally differentiate between things and people although technically, a person is a thing. But I digress. In this part of the law I am not referring to the physical things–such as bicycles–that, while perhaps enriching our lives and expanding our experiences, can be generally categorized as property. I am thinking instead about what might be broadly classified as institutions: nations, universities, clubs, companies, churches, professions, to name a few. Sir Walter Scott wrote, "Breathes there the man with soul so dead who never to himself hath said, This is my own, my native land?" Saying that would be an expression of pride, an expression of love for one's country, the kind of pride and love that anyone might have for their alma mater or company or any other institution.

How about our own profession of engineering? Do we engineers recognize that engineering is a profession with a long, proud history? That engineering is of paramount importance in determining the future of civilization? That we are bound by shared knowledge and shared ethics to other engineers around the world? If we do, and if we don't have "a soul so dead", we will have pride in–and love for–the engineering profession. And we will be better for it, and so will our profession. I fear that in our zeal for teaching our engineering students all the technical knowledge we feel they need to succeed, we fail to tell them about the glories of our profession, its rich history and its relation to civilization. If we paid more attention to the broader picture of whom and why we are, I think it would inspire a greater respect for and, yes, love of, the engineering profession.

Love some place. We live in a mobile society. While some people stay close to where they were born, many–especially the more educated–pursue a dream or an opportunity that takes them far afield. My wife and I have lived on both coasts and in the middle, and in another country. Our children did not grow up where they were born nor do they live where they grew up. This mobility can be exciting and will certainly broaden our perspectives. There is a danger, however, that so much moving about can deter us from identifying with any particular place. I believe we are the better if we have a place or some places that make our hearts beat faster when we return. It may be "the green, green grass of home" but it is more likely, in this age of mobility, to be a place we have lived or visited or, most fortunate of all, where we now live. What could be better than to love where you live?

Long time readers of Lyle's Laws may think I have gone astray in going from professional and behavioral advice to the esoteric topic of love. But the goal of the Laws is to help the reader to be more successful and, indeed, happier. With that being the goal, how can I neglect something so central to our beings as love? My father asserted that love makes you do foolish things, even though you don't really want to. Even here, I think he got it wrong. Love makes you want to do things that others might consider foolish. There is a big difference between, "I will do this because I love you" and "Because I love you, I want to do this."

In the end, Lyle's Law of Love is not only a law, but also my wish for you, my faithful readers.

—**Lyle D. Feisel,** Ph.D., P.E., *Iowa Alpha '61*

District 4

The 34th annual Tau Beta Pi District 4 Conference was hosted by the Maryland Gamma Chapter, of the United States Naval Academy, in Annapolis, Maryland, March 30 - April 1. Student members and chapter advisors from 17 collegiate chapters were in attendance, totaling 74 guests from six states.

The conference began with a welcome from the Naval Academy's Dean and Provost, Dr. Andrew T. Phillips. An ice breaker session led by D4 Directors, an update on the Association from Executive Councillor Dr. Jonathan Earle, and an Engineering Futures session concluded the morning's activities.

After lunch in King Hall, attendees participated in a District Interactive Chapter Exchange (DICE) session. Next, the midshipmen gave a tour of the Academy's laboratories. Keynote speaker CAPT Jack Nicholson, USN, Ph.D., P.E., *MD Γ '81*, gave a presentation on autonomous underwater vehicle research being done at the Academy.

The District Chapter Recognition Awards went to DC Alpha, Maryland Epsilon, and Maryland Gamma for projects done throughout the year. The next D4 Conference will be hosted by the North Carolina Epsilon Chapter in Greensboro, NC.

—**Jason D. Metzger,** *MD Γ '12,* Chapter President

District 6

This year's District 6 Conference offered a preview of the 2012 Tau Beta Pi Convention with Kentucky Alpha, of the University of Kentucky, as the host chapter at the Hyatt Regency Lexington hotel.

The conference began Friday evening with a tour of the Alltech brewery, followed by dinner at the UK Digital Village theater, sponsored by Parsons Brinckerhoff, and concluded with an Engineering Futures session.

Saturday began with breakfast at the Hyatt, sponsored by GE Appliances, DICE, and chapter project presentations. The group of collegiate and alumni members then gathered at the UK Boone Center for an etiquette luncheon, sponsored by Gallatin Steel. Business was finished up at the Ralph G. Anderson Student Commons.

The conference ended at the leadership retreat mansion of Steve and Martha Polston, *KY B '70* and *TN A '79* respectively, with a home-cooked meal and a fire on the porch for socializing and roasting marshmallows.

—**Kassy M. Lum,** *KY A '10,* District 6 Director

District 7

The Ohio Alpha Chapter at Case Western Reserve University hosted the District 7 Conference in Cleveland, Ohio, Saturday, March 31.

Attendees were treated to dinner at Li Wah restaurant on Friday evening and enjoyed the Cleveland nightlife afterwards.

On Saturday, students participated in a *Sim Semester* activity to help the incoming officers prepare for the next school year.

A warm welcome home was given to TBΠ Executive Director Curt Gomulinski, *MI E'01*, and his wife Tricia Gomulinski, *SD A '98*. Curt, a former District 7 Director, led a presentation on the condition of the Association. The annual *Battle for Toledo*, a TBΠ themed trivia contest, signaled the conclusion of the D7 conference. Michigan pulled out the win over Ohio in the final round to claim their 8th consecutive title.

—**Andrew J. Flowerday**, *MI I '02*, District 7 Director

District 16

The District 16 Conference, hosted by the California Omega Chapter, was held at Harvey Mudd College in Claremont, California, on April 14. The morning welcome was given by Dr. Donald S. Remer, *MI Γ'65*, advisor to the California Omega chapter. Introductions, ice breakers, and chapter goals for the district were covered before Executive Councillor Jason Huggins provided an update on the Association via a web presentation.

After lunch, a campus tour and group photo preceded a presentation "Making the Case for MindSET" by Scott and Michele Eckersall. The afternoon concluded with an Engineering Futures session, fall conference planning, and evaluations. A group dinner after the adjournment of the conference was held at Casa Blanca.

—**Scott V. Eckersall**, *CA I '96*, District 16 Director

California Alpha Epsilon Installed

PHOTOS: COURTESY OF J. ANTONIO GEREMIA

Chapter Installation
Charter members of California Alpha Epsilon gather with their fellow Tau Bates following initiation.

THE CALIFORNIA ALPHA EPSILON CHAPTER of Tau Beta Pi was installed at the University of San Diego on February 25, 2012. President Larry Simonson, Ph.D., P.E., was the official installing deputy of the Society's 245th collegiate chapter, assisted by Executive Director Curtis D. Gomulinski and District 16 Director Stacey H. Ross.

The 2011 Convention granted a chapter to the Tau Alpha Zeta Engineering Honor Society, represented in Indianapolis, IN, by Joseph G. Ellis, president; Trevor C. Fortuna, vice president; and Susan M. Lord, Ph.D., *NY Δ '87*, advisor.

The University Center on campus was the site of the formal ceremonies of initiation and chapter installation, witnessed by Neal T. Bussett, *CA Ξ '09;* Jinwan Kim, *CA Τ '12;* Phillip J. Patague, *CA Ξ '12;* Sam Rokni, *CA Χ '05;* and Sumedha P. Weerasuriya, *CA Ξ '13.*

The initiation team included: Chau T. Diep, *CA Τ '12;* Tony T. Doan, *CA Τ '12;* Lori J. Jue, *CA Ψ '11;* Kathleen A. Kramer, Ph.D., *CA Ο '86;* Daniel K.T Le, *CA Τ '13;* David M. Malicky, Ph.D., *NY Δ '88;* Michael S. Morse, Ph.D., *LA Β '81;* Rick T. Olson, Ph.D., *IL Α '84;* and the three national officials listed above. Sixteen undergraduate students and twenty-six alumni (identified on the facing page) comprise California Alpha Epsilon's charter members.

Immediately after the formal initiation, the new members were constituted a new chapter in the ceremony of installation conducted by Dr. Simonson. The ceremony included the formal election and installation of the chapter's charter officers and advisors (identified in a photograph caption on the facing page).

At a reception and banquet following the installation, Dr. Kramer, director of engineering, served as mistress of ceremonies, welcomed initiates, visitors, faculty, and friends, and stated her pleasure in having the new chapter on campus. Dr. Simonson and Mr. Gomulinski welcomed the new members into the Association and challenged them to continue their pursuit of excellence and to serve their alma mater and fellow students. Dr. Kramer thanked the 12 ΤΒΠ guests and the many family and friends for making the event a success.

Charter Presentation
Larry A. Simonson, Ph.D., P.E.; Jessica M. Buckley; and Kathleen A. Kramer, Ph.D. (left to right).

Student Initiates

Nathaniel H. Scherrer, Marya Bliznyuk, Brandon A. Kopinski, Elizabeth A. Kimbrell, Andrew P. Wood, Jessica M. Buckley, Blake A. Oliaro, Cristina Leon Heredia, Julie C. Birch, Allen J. Cadreau, Alvin P.M. Javier, Kristian R. Wittman, Aaron J. Paxton, Julie A. Brown, Clark Yin (left to right). Not Pictured: Anthony E. Riesch.

Alumni Initiates

Barbara L. Hammack, Omar Damluji, Stephen A. Muller, Ramon M. Siswojo, Stephen A. Reichert, Schaffer N. Grimm, Yoshitaka Yano, Adam J. Purdy, Michelle Esteban, Zlatko A. Filipovic, Matthew Leigh, Samuel J. Stewart, Louis G. Barrios, Andrew D. Disotell, Joseph G. Ellis, Andrew W. Byrne, Adrian R. Lyons, Christina N. Aneshansley, Andrea M. Warren, Ashlee Enriquez, Spencer C. Anderson, Ali Almatrouk (left to right). Not Pictured: Patrick J. Castagna, Matthew J. Gigli, Christopher S. Steward, Dalia El Tawy.

First Officers and Advisors

Front row (L-R): Chief Advisor Kathleen A. Kramer, Ph.D.; Recording Secretary Julie C. Birch; Corresponding Secretary Cristina Leon Heredia; President Jessica M. Buckley. Back row:Treasurer Alvin P.M. Javier; Advisor Rick T. Olson, Ph.D.; Advisor David M. Malicky, Ph.D.; Advisor Michael S. Morse, Ph.D.; and Vice President Brandon A. Kopinski.

Initiation Team

Front row (L-R): Chau T. Diep; Stacey H. Ross; Kathleen A. Kramer, Ph.D.; Larry A Simonson, Ph.D., P.E.; and Michael S. Morse, Ph.D. Back row: Tony T. Doan; Daniel K.T. Le; Lori J. Jue; Rick T. Olson, Ph.D.; Curtis D. Gomulinski; and David M. Malicky, Ph.D.

Dr. Asimov's Automatons Take on a Life of their Own

Twenty years after his death, author Isaac Asimov's robot fiction offers a blueprint to our robotic future...and the problems we could face

by **Alan S. Brown**

THIS PAST April, the University of Miami School of Law held We Robot, the first-ever legal and policy issues conference about robots. The name of the conference, which brought together lawyers, engineers, and technologists, played on the title of the most famous book ever written about robots, *I, Robot*, by Isaac Asimov.

The point was underscored by Laurie Silvers, president of Hollywood Media Corp., which sponsored the event. In 1991, Silvers founded SyFy, a cable channel that specializes in science fiction. Within moments, she too had dropped Asimov's name.

Silvers turned to Asimov for advice before launching SyFy. It was a natural choice. Asimov was one of the greatest science fiction and science popularizers of his generation. As the author of short stories and more than 500 books, he ranks among the most prolific authors ever.

Greatest Legacy

Yet Asimov believed people would ultimately remember him for his robot stories, which he began writing when he was still a teenager. "He told me that he thought his Three Laws of Robotics would be his greatest legacy," Silvers recalled.

This is no small claim. Asimov's 500 books covered topics as diverse as science, history, religion, and literature. His fiction inspired Nobel Prize winning liberal economist Paul Krugman; conservative politician Newt Gingrich; the inventor of the industrial robot, George Devol; and the pioneering founder of MIT's Artificial Intelligence Laboratory, Marvin Minsky. His science works educated a nation. According to the United Nations, he is the world's twentieth most widely translated author, ahead of Tolstoy, Dickens, and even Plato.

Yet twenty years after his death, Asimov's robot stories are clearly his most influential accomplishment. He published his first story about intelligent robots in 1939, well before the invention of computers or software. Yet by the time he was 21, he had worked out a set of principles that guided how his fictional robots should interact with people.

The Three Laws of Robotics defined by Isaac Asimov, shown in a 1965 portrait, are:
1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given to it by human beings, except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

These became the Three Laws. Today, they are the starting point for any serious conversation about how humans and robots will behave around one another.

As the mere fact of lawyers discussing robot law shows, the issue is no longer theoretical. If robots are not yet intelligent, they are increasingly autonomous in how they carry out tasks. At the most basic level, every day millions of robotic Roombas decide how to navigate tables, chairs, sofas, toys, and even pets as they vacuum homes.

At a more sophisticated level, autonomous robots help select inventory in warehouses, move and position products in factories, and care for patients in hospitals. South Korea is testing robotic jailers.

Life And Death

The United States, South Korea, and Israel all operate sophisticated military drones and robotic land vehicles. Today, human operators control their operation, but militaries around the world are investing heavily in more autonomous systems. The day is approaching when life and death decisions could balance on a mathematical algorithm.

"Robots are approaching a take-off point," said A. Michael Froomkin, the Miami Law professor behind We Robot. He foresees a world in which technology moves so rapidly, we will suddenly find ourselves surrounded by millions of autonomous robots serving and working along side us.

It sounds like a stretch, but Froomkin has seen it before. He began working in Internet law in the early 1990s, when few outside university and military teams had heard the term. Yet even then, engineers had already deployed many of the key standards.

"Some of the early choices, such as how we ignored privacy and security in our standards, had already been made. We could have avoided a significant fraction of today's problems if the engineers who made those choices had been thinking about those issues.

"In robotics, it's still early. The industry has no standards

Graphic design by Roland Liwag/ University of Miami School of Law.

yet. Thanks to events like this one, people can get in on the ground floor and make our concerns known," he said.

The conference was an early attempt to do just that. For example, University of Washington law professor Neil Richards and computer scientist Bill Smart delivered a paper on how the law should think about robots. It quickly evolved into a debate over the nature of autonomous robots themselves.

One group argued that robots are like tools, wielded by users like hammers. Another compared them to horses, which we can train and contain, but which have minds of their own and can escape and cause damage that is not the fault of the owner.

Law Enforcement

The discussions veered in unexpected directions. A group of scholars submitted a paper about robotic law enforcement and asked if we really wanted "perfect" law enforcement. Policing today, whatever its faults and strengths, relies on judgment. Not everyone speeding gets a ticket, but police pull enough of them over to remind everyone else to drive carefully.

"Do we really want a system that is relentless and never looks the other way?" asked Mary Ann Franks, a Miami Law associate professor who analyzed the paper for the conference.

She worries about the social costs of such a system. "It would degrade the ideal of responsible citizenship. We would be following the law due to fear of reprisal, rather than internalizing the law and acting like good citizens," Franks argued. She worried that robotic law enforcement would make citizens more docile.

For two days, discussions spun off in many different directions, from how autonomous military robots might operate to such traditional concerns as liability and contracts. One particular illuminating exchange looked at whether asking a robot to spy on its master would be similar to wiretapping, and if commanding the same robot to ask its owner questions whose answers would incriminate him or her crosses the line when it comes to invasion of privacy.

It was exactly the kind of debate Isaac Asimov would have loved.

Asimov was born in Russia in 1920, the same year Czechoslovakian playwright Karel Capek coined the term "robot". It comes from the term "serf," and Czechs used it to describe toil or drudgery. Along with the word robot, Capek also gave the world one of its most enduring plot lines. In his play, *R.U.R.*, the robots rebel against their masters, who doomed them to a life of cruel servitude.

Asimov understood this plot. When he was three, his family moved to Brooklyn and his father eventually opened a candy store. When he was not going to school or doing homework, Asimov was learning about robots—and a lot else—from the pulp fiction magazines in his father's candy store.

Pulp fiction was not high art. Printed on cheap paper with untrimmed edges, it combined fast-paced stories, square-jawed heroes, menacing villains, and lurid artwork prominently featuring scantily clad women. Science fiction pulps were similar, except the villains were usually aliens or mechanical monsters that turned on their creators with alarming frequency.

Asimov's father wanted his children studying so they could attend college, not reading pulps. But young Isaac would point to titles that prominently featured the word "science" and argue that these pulps were educational.

Yet even as a teenager, Asimov had a problem with robots turning on their masters. This was because he wanted to be a scientist, and also read widely about science and engineering.

"I didn't think a robot should be sympathetic just because it happened to be nice," he later explained in "The Word I Invented," a 1980 essay. "It should be engineered to meet

Rebelling robots attack their masters in this photo of a 1922 production of Karel Capek's play *R.U.R.*

Digital Predator Prowls The Skies

A Hellfire missile is launched from a Predator unmanned aerial vehicle, top. U.S. Air Force Captain Richard Koll, left, and Airman 1st Class Mike Eulo, above, perform function checks after launching a Predator at Balad Air Base, Iraq recently. Captain Koll, the pilot, and Airman Eulo, the sensor operator, will handle the Predator in a radius of approximately 25 miles around the base before handing it off to personnel stationed in the United States to continue its mission. Both are assigned to the 46th Expeditionary Reconnaissance Squadron. Below, a Hellfire missile impacts an armored vehicle during a test firing exercise.

certain safety standards as any other machine should in any right-thinking technological society. I therefore began to write stories about robots that were not only sympathetic, but were sympathetic because they couldn't help it."

Just as screwdrivers have hilts, electrical wires have circuit breakers, and elevators have friction brakes, Asimov thought robots should have built-in mechanisms to keep them from harming the people.

By the time Asimov was 19, he had earned a master's degree in chemistry from Columbia University. (He received his Ph.D. in biochemistry after World War II.)

He was also an established science fiction author. He had published his first story at 17, and soon came under the influence of John W. Campbell, the new editor of th magazine *Astounding Science Fiction.*

Before Campbell, the "science" in science fiction was tenuous at best. Spaceships sailed between stars as if the speed of light posed no barrier. John Carter fell sleep and woke up naked on Mars. Aliens had giant brains, but no one ever explained how their puny bodies could generate enough energy or blood flow to keep them thinking.

Campbell demanded something different. He wanted real people, often scientists and engineers, and real—or at least believable—science. Since starships could not exceed the speed of light, his writers had them "fold" space or detour through higher dimensions. His aliens had psychologies. Asimov's robots had "positronic" brains.

Campbell expected science fiction stories to probe technology's implications. As Asimov's contemporary, Frederick Pohl, explained, "A good science fiction story should be able to predict not the automobile but the traffic jam." Asimov, an early Campbell favorite, excelled in just those kinds of logical gymnastics.

Although Campbell rejected Asimov's first robot story, "Robbie," he later remembered that a character had said, "He just can't help being faithful and loving and kind. He's a machine—made so." This later morphed into the First Law of Robotics, that robots must protect human life.

Campbell bought Asimov's second story, "Reason," two years later. In it, a character said, "Those robots are guaranteed to be subordinate." That suggested the Second Law, that robots must follow human commands.

"Liar!", published one month after "Reason," laid the foundations for the robotic laws saying: "On no conditions is a human being to be injured in any way, even when such injury is directly ordered by another human."

Came Together

Everything came together in "Runaround," published in October 1941 when Asimov was 21. It concerned two engineers on Mercury who desperately needed selenium to cool their living quarters. They send a robot to get it. Instead of returning, they find the robot circling a pool of selenium and acting drunk.

The reason? The engineers had not told the robot that they would die without the selenium. The robot followed their command (Second Law) until it got close to the selenium, which was in a dangerous location. It then backed off to preserve itself (Third Law). When it was safe, it turned around to get the selenium, then backed off again.

The robot was caught in a loop and could not accept new instructions. One engineer broke the loop by exposing himself to danger. This caused the robot to default to the First Law in order to protect his life. They then gave the robot instructions that emphasized their need, and the robot retrieved the selenium.

The Three Laws were implicit in "Runaround," but it took Campbell to spell them out in a letter to Asimov. "It always seemed to me that John invented those Laws, but whenever I accused him of that, he always said that they were in my stories and I just hadn't bothered to isolate them. Perhaps he was right," Asimov wrote.

"Liar!" and "Runaround" solidified the Three Laws, but more importantly, they anticipated "the traffic jam"—the contradictions inherent in trying to control intelligent robots through a simple set of rules.

The ability of Asimov's robots to think for themselves often led to conflict. In "Liar!", for example, a robot develops the ability to read people's minds and lies to everyone to keep from hurting their feelings. In "The Evitable Conflict," robots running the economy decide they must hurt some humans in order to benefit the majority, effectively taking over the world in order to help us.

Asimov's stories explore these contradictions. In them, robots act bizarrely when under stress, develop emotional attachments, and sometimes even rationalize the right to harm humans. One robot develops its own religion. Another sues to be declared a person. Asimov's robot mysteries, starting with *The Caves of Steel* in 1953, pair a robotic investigator with a detective who dislikes robots.

Asimov's stories probed the Three Laws' limitations and failures. These contradictions have moved from theory to fact as the gap between fiction and smart and/or autonomous robots narrowed over the past decade.

Spoken Commands

Artificial intelligence has certainly come a long way. Apple's Siri, which understands spoken commands well enough to run iPhone applications, is just the latest example. Other AI applications summarize news, trade stocks and bonds, unearth paper trails among legal documents, and manage aircraft check-in and cargo—all without human intervention.

AI is driving autonomous robots. Nowhere is this more evident than in driverless vehicles. Eight years ago, in *The New Division of Labor*, economists Frank Levy and Richard Murnane analyzed which tasks humans and computers did best. Humans, they argued, topped machines when rules were difficult to understand. One example was driving a truck while reacting to road and traffic conditions.

Their argument made sense. That same year, the U.S. Defense Advanced Research Projects Agency (DARPA) sponsored a driverless vehicle challenge. No contestant went further than seven miles on the straight, 150-mile course.

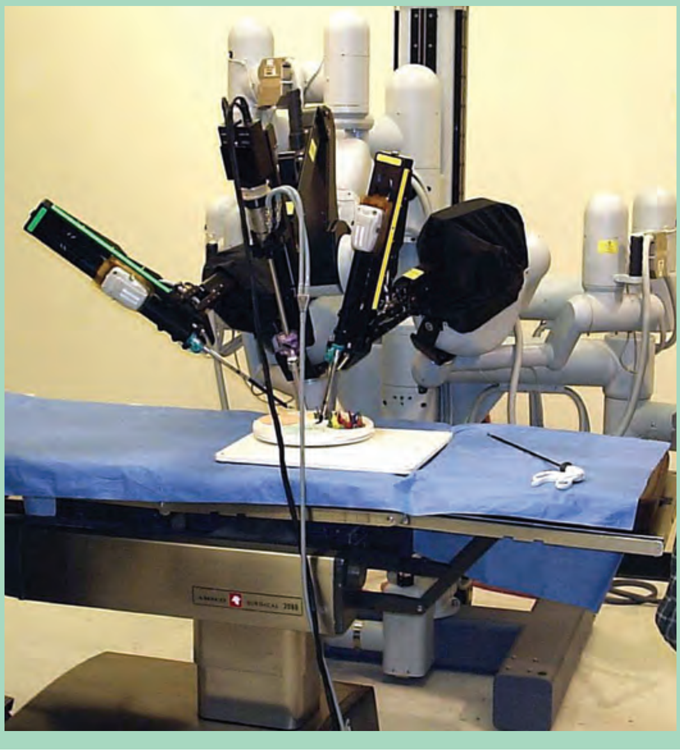
Three years later, six autonomous vehicles completed the DARPA Urban Challenge, a 60-mile course through an abandoned military base with street signs, stoplights, and merging traffic.

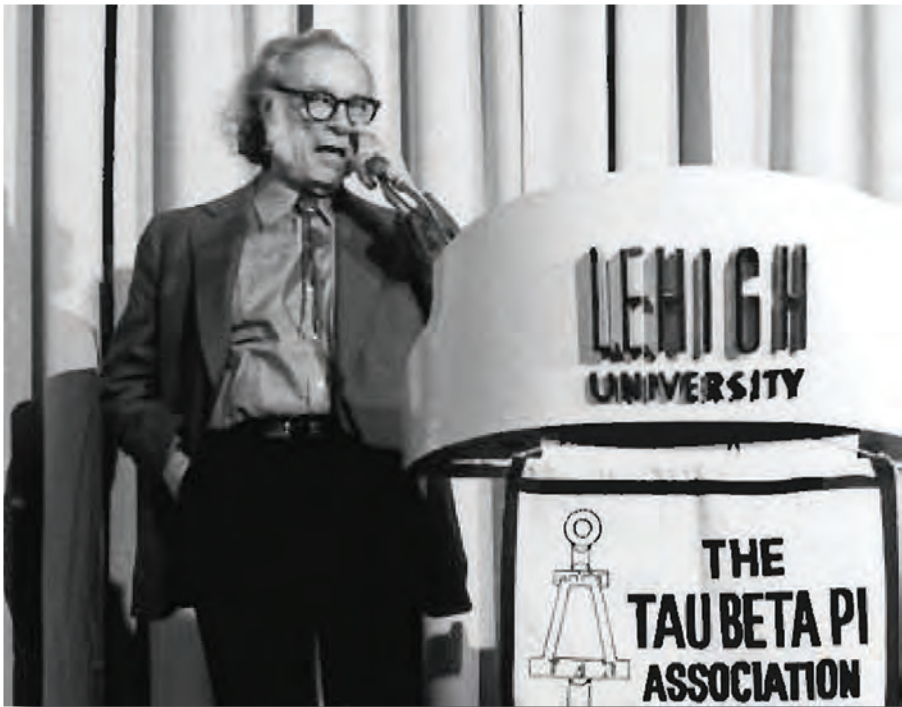
Last year, Google unveiled its fleet of autonomous cars. It has logged more than 200,000 miles on city streets and highways with only minor human intervention. More recently, Google launched an autonomous racing car team, and Mercedes-Benz and Cadillac disclosed that they are developing vehicles to navigate stop-and-go traffic autonomously.

Ten years ago, military robots existed only in laboratories. By 2009, the United States had deployed more than 7,000 drones and 12,000 ground robots. South Korea and Israel use robots to patrol their borders. Humans guided all

They've Come A Long Way

The Japanese "karakuri" tea-serving automaton, above, was built around 1800, above. "Karakuri" means "mechanism" and they were typically spring-powered. The da Vinci surgical system below is controlled by a surgeon from a console. It is commonly used for prostatectomies, and increasingly for cardiac valve repair and gynecologic surgical procedures





Guest speaker Isaac Asimov speaks at the ΤΒΠ 100th anniversary celebration in 1985.

these robots, but militaries around the world are developing more autonomous warrior robots. Some will pack weapons.

In *Wired for War*, Peter Singer, a military analyst at the Brookings Institute, worried that robots reduced the moral hazard—the personal risk—of going to war. Without casualties, memories, and losses, Singer fears that war could morph into entertainment. In fact, videos of drone attacks have become very popular on the web. Soldiers call them "war porn."

The lawyers and technologists at We Robot struggled with similar concerns. Today's robots exercise only limited autonomy, and even then, only when executing such simple, constrained tasks as bringing medicines to patients or moving warehouse inventory. Tomorrow's robots are likely to have far greater choice about how they perform a broader range of tasks.

That is why some thinkers have developed their own laws of robotics. They range from the earnest (robots must always know they are robots) to the provocative (robots should seek better sources of power and reproduce other robots) to the cynical (military robots should kill only the enemy).

More Pragmatic

Others take a more pragmatic view. Texas A&M computer scientist Robin Murphy and Ohio State Cognitive Systems Engineering Lab director David Woods argue that we need laws that apply to increasingly autonomous but not yet intelligent robots.

Their first law is that since humans deploy robots, any discussion of safety and ethics must consider human-robot systems rather than robots alone. Second, robots must obey only appropriate commands, and only from a limited number of people. Third, robots should protect themselves, but only after they transfer control of whatever they are doing (like driving or surgery) to humans.

As robots grow more capable, the line separating autonomy from intelligence is likely to grow fuzzier. After all, a robot may not have any sense of its own "personhood," but then, neither does a horse. Yet both robots and horses can modify their behavior based on what they learn from experience. In this way, a robot is more like a horse than a hammer, and no one would argue that horses have no intelligence.

As robots become smarter and more independent, what kind of rules might bind them to humans? Michael Anissimov, director of advocacy at Singularity Institute for Artificial Intelligence, which was founded to develop safe AI software, grappled with that problem in 2004. He asserted that it is "not so straightforward to convert a set of statements into a mind that follows or believes in those statements."

A robot, he explained, could easily misapply laws in complex situations if it did not understand their original purpose. Instead of laws, Anissimov believes we must create "friendly AI" that loves humanity.

He may be right. Yet as the participants showed, it is not easy to develop hard and fast rules for a rapidly changing technology. This is especially true for robotics, which relies on open-source software modified by dozens and perhaps hundreds of users and components made by scores of different companies.

In Spain, Qbo, a small robot company, is tapping all these sources to build mobile utility robots that speak and respond to voice commands, play music, change television channels, and find information on the Internet. They can also upload information to cloud computers, so a Qbo that learns to recognize an object in Madrid can share that information with a Qbo in Barcelona.

Right now, the system is new and there are not a lot of Qbo robots in circulation. But imagine a world in the not-to-distant future where millions of autonomous robots share what they have learned that day over the cloud. On powerful servers, machine learning programs will sift through the information, finding patterns, drawing lessons, and downloading what they have discovered.

Autonomous robots will learn and modify their behavior in wholly new ways. The results are likely to be far-reaching and unpredictable. We are creating something truly different in the world.

Perhaps that is why We Robot's logo borrows from Michelangelo's famous depiction at the Sistine Chapel of God imparting life to Adam. Only on the logo, a metallic robotic hand has replaced God's finger. The point is clear: Although man invented robots, our robots are going to change us.

Somewhere, Isaac Asimov is smiling.

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Engineering the Heavens

Pre-photographic astronomers first measured the distances to stars using their eyeballs, thanks to superb engineering by astronomical instrument-makers

by **Trudy E. Bell**

GLANCE UP on a clear starlit night, and the stars seem stationary in their constellations—no wonder for millennia they were even called "fixed" stars, reassuringly useful as aids to terrestrial navigation and surveying. But careful observers from the 17th through the 19th Centuries vigilantly monitored the positions of stars night after night, year after year, decade after decade. They discovered that all those points of light have their own motions in three dimensions—away or towards the earth, across the sky, around one another—all in the invisible thrall of gravity.

In so doing, they also unexpectedly discovered important physical motions of the earth itself, distinguishable from individual stellar motions because the effects were of the wrong magnitude, frequency, or direction, or (the ultimate tip-off) affected all the stars in the sky.

In that pre-photographic era, astronomers measured the movements of the stars using their eyeballs, looking through specialized telescopes of only a few inches aperture. Unlike a regular telescope, basically consisting of a tube with a mirror or lens at one end and an eyepiece at the other on a sturdy movable mount, the emphasis was not only on the optics—and not at all on making the mirror or lens as big as possible to gather light from faint objects deep in space for hand-drawing their physical appearance. Instead, these single-purpose instruments of precision (as they came to be called) were sometimes not even recognizable as astronomical instruments: their telescope tubes were possibly fixed in one position or perhaps obscured by frames, wheels, clamps, microscopes, handles, circles with numbers, bubble levels, plumb bobs, small pools of mercury, or lanterns for illuminating crosshairs made from spiderweb [Fig. 1].

Fig. 1. This 6.4-inch meridian circle by the German instrument makers Adolf and Georg Repsold, installed at the Lick Observatory on Mount Hamilton, CA, in 1884, is almost unrecognizable as an astronomical instrument. The telescope, half-hidden near the center of the image above the half-reclined couch (for the observer to see stars near the zenith), is fixed on an east-west axis rotating in pivots atop the two wood-encased piers. A meridian circle was used to measure the altitude and hour angle of stars crossing the meridian (the vertical plane through astronomical north and the observer's zenith). To quantify instrumental errors and responses to changes in temperature and other ambient conditions, between astronomical observations the meridian circle is calibrated with collimating telescopes such as the one at far left. It is also frequently reversed 180 degrees in the pivots. The reversing apparatus is the odd tripod-like device at the right. Note the tapestry and wooden shelter at right, drawn on rails over the instrument when not in use. [Credit: Richard H. Tucker, *Meridian Circle Observations of 310 Standard Stars.* Publications of the Lick Observatory. Volume IV. 1900.]

All the finely counterbalanced machinery may have even been invented for a specific astronomical task, and was built by optical and mechanical artisans who came to be as famous as the astronomers who used their handiwork.

Who Cared?

Through the exquisite engineering of English and German (and to a lesser extent French and American) astronomical instrument makers, visual positional astronomy came to reign as the "Xtreme Science" of the 19th Century, so effective that visual observing techniques persisted into the 20th Century.

One big quest, which drove astronomers for nearly three centuries, was a race to determine annual stellar parallax—empirical verification of the Copernican hypothesis that the earth orbits the sun, as well as actual measurement of the

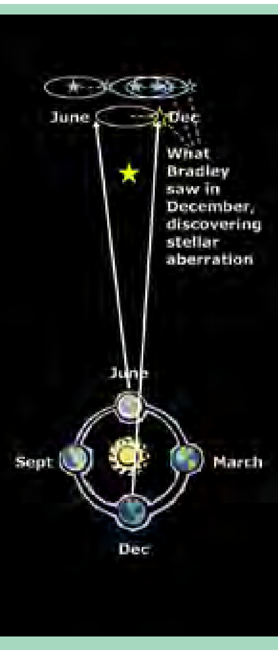

Fig. 2. The maximum effects of parallax, left, and aberration of starlight, right, are three months out of phase—the puzzle that tipped off James Bradley in 1725 that he and Samuel Molyneux were observing something different from parallax. Parallax is the apparent shift in position of a nearby star compared to more distant stars; maximum displacement is observed from opposite sides of the earth's orbit when the earth is approaching or receding from the star; the magnitude of parallactic shift depends on the closeness of the star. Aberration of starlight is the apparent shift in position of all stars forward of the earth's motion in its orbit, due to earth's velocity compared to the velocity of light. Both effects were recognized as conclusive proof of the Copernican heliocentric model. [Graphic: Trudy E. Bell]

gulf yawning between us and a nearby star.

The concept of parallax is simple: surveyors call the technique triangulation. As the earth moves around the sun, a closer star observed first from one side of the earth's orbit and then, six months later, from the opposite side, should appear to shift position back and forth compared to more distant stars. The magnitude of the parallactic shift would depend on the star's distance from the earth: closer stars should display a larger annual parallax than farther ones.

No Scientific Proof

When Nicholas Copernicus died in 1543 and left the world his deliberately posthumous magnum opus *De Revolutionibus Orbium Coelestium (On the Revolution of the Celestial Spheres)*, hypothesizing a heliocentric planetary system, he had no scientific proof that the earth orbits the sun. Indeed, he was incorrect in sticking to the Aristotelian concept that planets followed perfectly circular orbits centered on the sun. Over the next 180 years, Johannes Kepler derived three mathematical laws that described planetary orbits as ellipses with the sun at one focus; Galileo first turned a telescope skyward and observed that Venus went through phases similar to the phases of the moon that were readily explainable if Venus orbited the sun; and Isaac Newton showed (among other things) that Kepler's laws and elliptical orbits were explained by universal gravitational attraction among masses. These and other major developments gave a heliocentric system physical street cred, so to speak; well into the 18th Century, however, the motion of the earth around the sun had not been empirically verified by direct observation (the annual parade of the constellations notwithstanding).

Most Newtonians felt that lack of detectable parallax was due to the extreme distance of the stars; by 1718, Edmond Halley (yes, later famous for predicting the return of what we now call Halley's Comet), calculated that based on the best measurements up to then, the fixed stars had to be at least 20,000 to 30,000 times farther than the sun. In short, the lack of detectable parallax was an instrumental issue, which (to use modern language) simply put a lower bound on the closeness of stars. There was only one way to find out: build instruments precise enough to allow detection. But how good did such measuring instruments need to be?

First, a brief crash course on small-angle positional astronomy essentials for engineers.

Since time immemorial, visual astronomers have measured—and still measure—celestial angles in the very non-metric/non-SI system of degrees, minutes, and seconds of arc. (Radio astronomers also use radians, but radio astronomy was founded by electrical engineers.) There are, of course, 360 degrees in the full celestial sphere, 180 from horizon through the zenith to horizon. A degree is about twice the diameter of the full moon. An arcminute is 1/60th of a degree (take it up with the Babylonians). An arcsecond is 1/60th of an arcminute.

The arcsecond is so important to positional astronomers that it's worth dwelling here more than, well, a second. How small is a second of arc? Introductory astronomy books are full of unhelpful comparisons such as it's the angle subtended by a dime at about 2.5 miles, or a third of a millimeter at the length of a football field. Here's an astronomically meaningful comparison of my own: if the moon (which is 2,140 miles across) subtends an angle of about 0.5 degree, then 1 arcsec is roughly 1/1,800th the diameter of the moon—about 1.2 miles at the distance of the lunar orbit.

Thus, an angle of 0.1 arcsec—positional astronomy territory that became accessible to pre-photographic visual observers in the 19th Century through instruments of precision—represents a distance of just 0.12 mile or 627 feet across on the moon. Put another way, to an imaginary positional astronomer on the moon looking back at the earth, measuring an angle of 0.1 arcsec at the distance of the earth would mean pinpointing the distance between the Washington Monument in Washington, DC., and Caesar's Palace in Las Vegas, Nevada, to an accuracy of a city block.

Celestial Motions

In 1725, wealthy British amateur astronomer Samuel Molyneux contacted George Graham, an eminent London clockmaker credited with (among other inventions) the deadbeat clock escapement, the mercury compensated pendulum, the orrery, and the precision micrometer screw, which allowed him to devise calipers and other measuring instruments of unparalleled accuracy. Molyneux commissioned Graham to build a new type of astronomical instrument called a zenith sector: a telescope of less than 4 inches aperture but 24¼ feet long, installed vertically on the wall of Molyneux's chimney in his mansion in Kew. The tube was suspended from a pivot near the top so it could move through only a slight angle, simply to measure differences in the north-south positions of stars as the rotation of the earth caused stars to drift from east to west overhead.

Molyneux asked Oxford University professor of astronomy James Bradley to help carefully measure the position

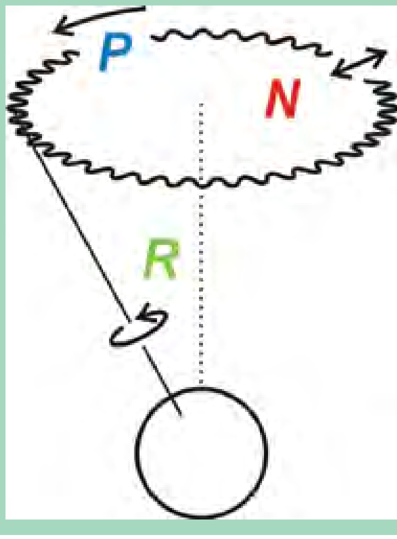

Fig. 3a, right, shows the earth's rotational axis (R) sweeping a large circle in the sky in about 26,000 years, radically changing the direction of astronomical north; this precession (P) was known even to the ancient Greeks. Nutation (N), is a nodding oscillation of precession, discovered by James Bradley in the mid-18th Century. Both effects are due to the gravitational effect of the Sun and the Moon on the earth's equatorial bulge, and affect the positions of all the stars in the sky. Cool fact: Nutation also changes the latitude of the Tropics of Cancer and Capricorn on the earth, as shown in Fig. 3b, above. Markers beside the Zaragoza-Victoria road in northern Mexico denote the drift. [Credits: Diagram: Dr. H. Sulzer, Photo: Roberto González.]

of Gamma Draconis, the brightest star in the constellation Draco (despite being designated with the third letter of the Greek alphabet gamma or γ) that passed almost directly through the zenith of London. Over several nights in December 1725, to their amazement, Molyneux and Bradley measured γ Draconis passing increasingly south of its anticipated position; over the next few months, it slowly returned north, reaching a maximum northerly position in June 1726 about 40 arcsecs north of its most southerly extent.

Baffled because the direction and timing of the star's movements were three months out of phase from what would have been expected from annual parallax in the direction of that star [Fig. 2], in 1727 Bradley commissioned Graham to build another zenith sector, which could pivot through an angle of 6¾ degrees on either side of the zenith, so as to observe some 200 stars throughout the year. After extensive testing, Bradley was confident the new zenith sector could detect angles as small as 0.5 arcsec.

After observing that other stars also traced out little circles or ellipses of the identical magnitude (diameter or major axis of about 40 arcsecs), Bradley had an epiphany about the cause. The star positions were displaced due to the combination of the motion of the earth in its orbit (about 18 miles or 30 km per second) and the speed of the light from the star (about 186,000 miles or 300,000 km per second), an effect he called the aberration of starlight. The position of each star in the sky is slightly displaced forward of the earth's direction of movement; the little circles or ellipses were a projection of the plane of the earth's orbit toward that star's direction in the sky. The aberration of starlight was itself an unexpected definitive empirical proof that the earth indeed orbits the sun—indeed, the first empirical verification of the Copernican heliocentric model. Although no one had yet measured the speed of light, discrepancies in the timings of the eclipses of Jupiter's moons from different positions in the earth's orbit had already shown that the speed of light was finite; from angular measurements of stellar aberration, Bradley calculated that the earth's orbital velocity had to be 1/10,210th the speed of light—accurate to about one percent.

While quantifying aberration of starlight, Bradley serendipitously stumbled across another unexplained apparent motion to the fixed stars, which kept him carefully observing. In 1748, he announced a further discovery: a nutation, or nodding motion, to the well-known larger motion of precession. Both precession and nutation originate from the gravitational pull of the sun and moon on the equatorial bulge of the earth. The spinning earth is not a precision gyroscope. Its rotational axis points not in one fixed direction, but over 26,000 years sweeps out an enormous circle, inexorably changing the direction of astronomical north (no, Virginia, Polaris has not always been, nor will forever be, our North Star). Precession is an effect large enough that it was discovered by the naked-eye ancient Greek astronomer Hipparchus two millennia before Bradley. It systematically moves every star one way on the celestial sphere by an amount and direction that depends on the star's position, ranging up to a maximum of 50 arcsecs per year.

What Bradley had additionally discovered was an oscillation to precession: the earth's rotational axis actually precesses in a rickrack wiggle with an amplitude of about 9 arcseconds and a period of about 18.6 years—traceable to the gravitational effect of the moon's orbital plane itself revolving once every 18.6 years [Fig. 3].

Despite the observational care of Bradley and instrumental skill of Graham, Bradley never detected any evidence of parallax for γ Draconis. Because of his confidence in the precision of Graham's zenith sector, Bradley concluded "it seems very probably that the parallax of it is not so great as one single second; and consequently that it is above 400000 times farther from us than the sun." (Bradley's lower bound, equivalent to six light-years, was correct: γ Draconis has an annual parallax of just 0.022 arcsec, and is 147 light-years distant—nearly 9.7 million times farther than the sun.)

"Most Glorious Triumph"

What was needed was still better instrumentation, plus some assurance even absent parallax that a star an astronomer chose to observe was actually quite nearby.

By 1840, three astronomers in three different countries using three different instruments—and after subtracting out the effects of precession, nutation, and aberration—independently and simultaneously measured annual paral-

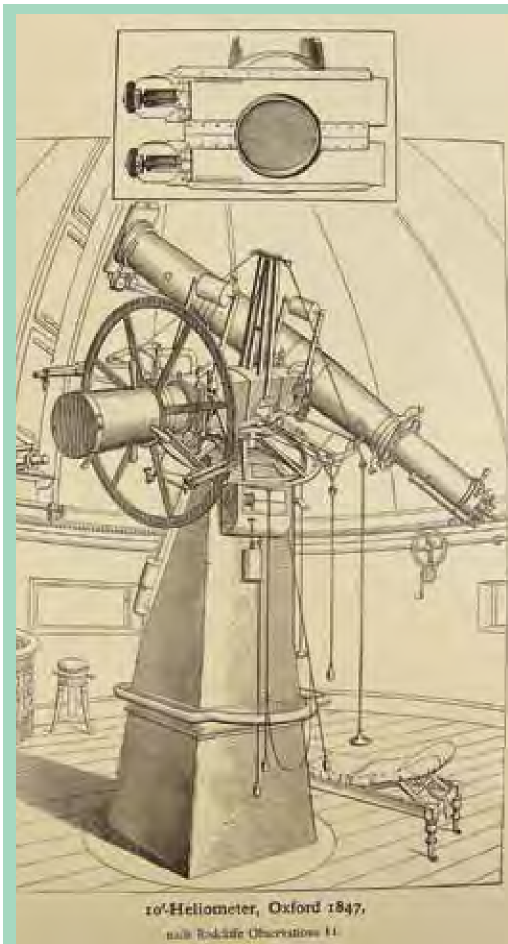

Fig. 4. The 7.5-inch heliometer at the Radcliffe Observatory at Oxford University, made by the Repsold brothers of Hamburg, was installed in 1848. Also called a divided-lens micrometer, its lens—like that of the Fraunhofer heliometer used by Friedrich Bessel at the Königsberg Observatory—was cut in half [inset at top], and one half slid away from the center of the other in order to measure small separations between celestial objects with great accuracy. [Credit: Joh. A. Repsold. *Zur Geschichte der Astronomischen Messwerkzeuge von 1830 bis 1900*. Leipzig: Verlag von Emmanuel Reinicke, 1914.]

laxes to three different nearby stars. They had all (wisely) picked their stars not because of their brightness, but because of their fast proper motions (movements across the line of sight), figuring that any stars clipping quickly across the sky must be nearby neighbors.

Friedrich Wilhelm Bessel—the same mathematician famous for Bessel functions—used a superb heliometer of 6.2 inches diameter at the Königsberg Observatory in East Prussia, built by the supreme instrument-maker Joseph von Fraunhofer of Munich (famous for discovering the dark absorption in the spectrum of sunlight that are still called Fraunhofer lines). The Königsberg heliometer was also known as a divided-lens micrometer: yes, first Fraunhofer figured a perfect lens—one quite large for the era—and then he had the courage to saw it in half so that one semicircular half-lens could be shifted with respect to the other to superimpose images of two stars in the field of view and precisely measure their angular separation.

Bessel's secret to success in measuring the parallax of his chosen star 61 Cygni (which has such a large proper motion—a whopping 5 arcsecs per year—that it was nicknamed the "Flying Star") was not just his care in the actual measurements. His success also lay in his extraordinary rigor in spending five full years—1829 to 1834—calibrating the optics, the mechanics, and the measuring scales, in all meteorological conditions, so as to document the behavior of the heliometer across the full range of possible observing conditions. Why? As wonderfully summarized by one nineteenth-century writer in *The North American Review,*

> When the astronomer undertakes to measure these minute angles, he finds Nature warring against him with all her powers. In the air above she never ceases to mix currents of hot and cold air, and thus keeps the telescopic image of every star in unceasing agitation,—like the image of the sun in a running stream. Expanding his instrument by heat, and contracting it by cold, she disarranges its most delicate adjustments, changes its form, twists its supports, and moves its microscopes. She blows a grain of sand under his spirit-level, and his observation is worthless. She will not even allow the most solid foundation of his instrument to rest immovable, but, alternately causing the ground beneath to swell with moisture and contract with drouth, keeps it in continual disturbance. ... The success with which the astronomer can carry on his battle depends on his foresight in anticipating Nature's attacks, and his ingenuity in devising means to thwart her.

In the early 19th Century, there evolved two approaches to building the best instruments of precision: the English style and the German style. Benjamin Apthorp Gould, the U.S. astronomer who founded *The Astronomical Journal,* which is still published, was one of half a dozen astronomers instrumental in bringing German methods to the United States. He observed that the English style was "designed for securing absolute uniformity of circumstances in all observations" whereas the German style was designed "for attaining as great diversity of circumstance as is consistent with retaining the same degree of accuracy." Put another way, the English style sought to attain precision by minimizing error, whereas the German style sought precision by recognizing that error was always present and ever changing, so the astronomer must constantly monitor and quantify error.

The German style was due in large part to Bessel's theory of instrumental errors, which effectively created a new art of observation. Defects that can be measured and allowed for are as good as nonexistent. In December 1838, after only a year of final visual observations, Bessel showed the power of this error-quantification approach: he announced that he had determined the parallax of 61 Cygni to be less than a third of an arcsecond (0.314 arcsec), implying its distance was 660,000 times farther than the Sun or about 10.4 light-years away. The modern value for 61 Cygni's parallax is 0.287 arcsec—within 10 percent of Bessel's initial measurement—placing the star 11.4 light-years from the earth. (Both sets of measurements from the other two observers were much less definitive than Bessel's.

In 1841, in awarding the gold medal of the Royal Astronomical Society to Bessel, Royal Astronomical Society president Sir John Herschel called the measurement of the distance to a star "the greatest and most glorious triumph which practical astronomy has ever witnessed."

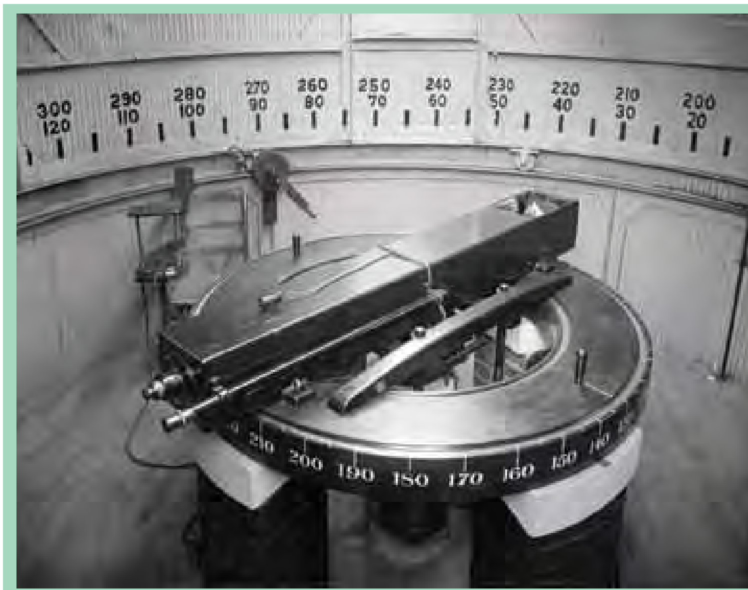

Fig. 5. Almucantar installed at Case School of Applied Science (now Case Western Reserve University) in 1900 is another instrument of precision looking very different from a traditional telescope. Like the original almucantar designed by Seth Carlo Chandler, it times rising or setting stars transiting (crossing) a fixed horizontal circle parallel to the horizon. The 6-inch telescope is the large rectangular box with an eyepiece at the left; light from a star is directed into the instrument by the angled flat mirror at its far end. Almost frictionlessly, the telescope rotates only in azimuth (instead of in altitude, like a meridian circle), as it rests on a heavy ring-shaped float in a trough of mercury. [Credit: Royal Astronomical Society, London.]

Even today, such exotica as extrasolar planets around other stars in our own Milky Way galaxy, supermassive black holes in the center of the Milky Way and other galaxies, and the abundance of invisible dark matter throughout the universe are not discovered by being directly seen. Instead, their existence is inferred in part from the telltale patterns of movements of individual stars, masses of stars within galaxies, or entire galaxies. Spectroscopy, which can measure changes in position along the line of sight (the famous red or blue Doppler shifting of spectral lines for objects receding or approaching), is one essential tool in ascertaining motions, but is a latecomer to the party. The invention of spectroscopy is usually credited to Bunsen and Kirchoff in 1859. Only angular position measurement can detect changes in a celestial object's position across the line of sight—its proper motion.

Hipparchus to Hipparcos

The precision of relatively small instruments allowed visual astronomers to detect such minute variations in the positions of stars that they actually identified changes in the earth itself. One famous example is that discovered by Seth Carlo Chandler, Jr., who measured latitudes and longitudes for a number of geodetic missions of the U.S. Coast Survey, and sought to design a latitude-finding instrument free of finicky adjustments to bubble levels. He designed a telescope to float on a mercury bearing that he called an almucantar [Fig. 5], whose 4-inch lens was built by American optician John Clacey and its mechanical parts by French instrument-maker G.F. Ballou. Chandler tested it for 50 nights in 1884 and 1885, making observations accurate to a few hundredths of an arcsecond—in so doing, discovering a complex wandering, wobbling motion of astronomical north with a period of about 14 months that could not be accounted for by instrumental or personal error. Such variation in latitude or polar motion is now recognized as being due to motions of fluid material in the earth's mantle.

The ultimate triumph of precise astronomical position-finding was the *Hipparcos* satellite, whose results are still being analyzed. By the late 20th Century, the limitations the moving earth and variable atmosphere and "warring Nature" put on astrometric measurements from ground-based instruments ultimately led to the European Space Agency's design of the **Hi**gh **P**recision **Par**allax **Co**llecting **S**atellite—named *Hipparcos* as a nod to Hipparchus, who discovered precession—to measure the positions and motions of stars from geostationary transfer orbit. Operated 1989–1993, its relatively small (11.4-inch or 29-cm) telescope determined the proper motions and parallaxes of more than 120,000 stars with a median accuracy of 0.001 arcsecond.

Folks, 0.001 arcsec is the angle subtended by 6.27 feet at the distance of the Moon—about the height of a suited astronaut. Let's hear it for the engineering of astronomical instrument-makers.

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Tau Beta Pi Names
200 Scholars for 2012-13

THE FELLOWSHIP BOARD announced the selection of 200 TBΠ Scholars from 328 applicants for senior-year study in the 2012-13 academic year. Scholarships of $1,000 or $2,000 are given to members on the competitive bases of scholarship, campus leadership and service, and promise of contributions to the engineering profession, with consideration given to economic need and academic commitment. This 14th group brings the total to 1,316 Scholars. Additional scholar biographies are posted on www.tbp.org.

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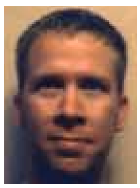
CIARA IS A CHEMICAL ENGINEERING MAJOR at Howard University and first in her class with a 4.0 G.P.A. She is active on campus in several organizations, including community service chair of the NSBE, candidate for student vice president of the college of engineering, and as an undergraduate researcher. This summer she will intern with ExxonMobil and hopes to secure a full-time position upon graduation.

Isamar Rosa Plata, *Nagel Scholar No. 40*

ISAMAR IS DOUBLE MAJORING IN CIVIL ENGINEERING AND MATHEMATICS at the University of Puerto Rico and ranks first in her class. She is studying in Japan as a Boren Scholar and has participated in summer research programs at MIT and Williams College. As an international math competitor, she has won several medals. She will pursue a doctorate in civil engineering with a focus on sustainable structures.

Aaron P. Baker, *Dodson Scholar No. 45*



AARON IS A CHEMICAL ENGINEERING MAJOR and first in his class at South Dakota School of Mines & Technology. A father of two, he is involved in research related to using semiconductor chips for real-time detection of cancer cells. His Ph.D. plans will focus on the medical industry. During his military service, he was awarded a Navy and Marine Corp Achievement Medal.

Michael L. Balch, *Dodson Scholar No. 46*

MICHAEL IS MAJORING IN CHEMICAL ENGINEERING at the University of New Hampshire. He has been involved with research projects beginning his freshman year, most recently, using computer modeling to study biochemical processes. He will pursue a doctorate in biochemical engineering and plans to intern at an engineering firm and eventually work for a small biotechnology company.

Michelle R. Benz, *Dodson Scholar No. 47*

MICHELLE IS A CHEMICAL ENGINEERING MAJOR at the University of North Dakota. Her extracurricular activities include president of the AIChE chapter, president of the University Engineers' Council, and mentor and tutor through the SWE. Upon graduation, she will seek entry-level employment as a process engineer. She also plans to continue promoting engineering as a future career to young adults.

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Stabile No. 161	Travis A. Davis	SD A '13	Mechanical Engineering
Stabile No. 162	Jesse A. Diaz	FL H '13	Mechanical Engineering
Stabile No. 163	Harrison S. Edwards	NV A '13	Mechanical Engineering
Stabile No. 164	Christine E. Evans	AL B '13	Mechanical Engineering
Stabile No. 165	Kay B. Freckleton	UT A '15	Mechanical Engineering
Stabile No. 166	Brian G. Gray	NH A '13	Mechanical Engineering
Stabile No. 167	Robert J. Griffin	TN Γ '12	Mechanical Engineering
Stabile No. 168	Jason D. Guss	NY T '13	Mechanical Engineering
Stabile No. 169	Jessie Guthals	SD A '13	Mechanical Engineering
Stabile No. 170	John P. Harrington	NY Π '13	Mechanical Engineering
Stabile No. 171	Nicholas C. Hensel	NY Π '14	Mechanical Engineering
Stabile No. 172	Benjamin J. Hockman	DE A '13	Mechanical Engineering
Stabile No. 173	Tanvir Jahan	NY H '13	Mechanical Engineering
Stabile No. 174	Sarah E. Johnson	AL B '13	Mechanical Engineering
Stabile No. 175	Trevor D. Kjellsen	SD B '13	Mechanical Engineering
Stabile No. 176	Matthew J. Krott	PA B '13	Mechanical Engineering
Stabile No. 177	Ina A. Kundu	AZ A '13	Mechanical Engineering
Stabile No. 178	Kyle K. Mackay	UT Γ '13	Mechanical Engineering
Stabile No. 179	Charles R. Mccullough	AL B '12	Mechanical Engineering
Stabile No. 180	Haley J. McKee	KS A '13	Mechanical Engineering
Stabile No. 181	Kyle J. Nible	SD A '13	Mechanical Engineering
Stabile No. 182	Karen Nielson	UT Γ '13	Mechanical Engineering
Stabile No. 183	Stephen R. O'Flynn O'Brien	NC Δ '13	Mechanical Engineering
Stabile No. 184	James M. Pallardy	MT A '13	Mechanical Engineering
Stabile No. 185	Samantha M. Pettus	CO B '14	Mechanical Engineering
Stabile No. 186	Anh T. H. Pham	SD A '13	Industrial Engineering
Stabile No. 187	Bethany S. Powell	IN Δ '13	Mechanical Engineering
Stabile No. 188	John P. Prato Matthews	CA Φ '13	Mechanical Engineering
Stabile No. 189	Neola G. Putnam	OH N '13	Mechanical Engineering
Stabile No. 190	Nathan M. Robert	MA B '13	Mechanical Engineering
Stabile No. 191	Thomas P. Rogers	NY Θ '14	Mechanical Engineering
Stabile No. 192	Najmus Saqib	AK A '13	Mechanical Engineering

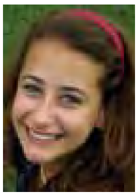
Juliet L. Schwartz, *Dodson Scholar No. 48*

Juliet is majoring in biomedical engineering at the University of Southern California. She is involved in biomechanics research and volunteers as a tutor for the USC Joint Educational Project, which teaches STEM subjects at elementary schools. She plans to apply to graduate school to continue research and application related to combating medical and

Christopher L. Yankaskas, *Dodson Schol. No.49*

Chris is a biochemical major at the University of Maryland, Baltimore County, and ranks first in his class. He spends ten hours a week as an undergraduate researcher focused on the study and morphology of fungus. Chris is an Eagle Scout and former member of the university rugby club. He plans to enter medical school and practice internal medicine.

Christina E. Agneta, *GEICO Scholar No. 29*

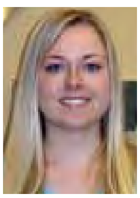


Christina is majoring in chemical and molecular engineering with a specialization in materials science at SUNY at Stony Brook University. On campus, she is an active member of AIChE and a resident assistant. Her future plans include research related to molecular modeling and industry work on the East Coast.

Ellen R. Edwards, *GEICO Scholar No. 30*

Ellen is a nuclear engineering major at Purdue University. She is president of the square dance club and has co-op experience working with a nuclear design engineer. She will pursue work at a lab or research group to gain experience with nuclear engineering. She plans to attend graduate school and focus on fusion as a source of electric power.

Madison R. Herman, *GEICO Scholar No. 31*

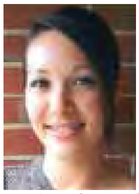


Madison is a chemical engineering major at the University of Toledo. She is an officer in Phi Sigma Rho, the social sorority for women in engineering. After graduation, she would like to participate in a volunteer abroad program. Her goal is to attain a Ph.D. and work in the medical industry or attend medical school.

Jimmy C. Higgins, *GEICO Scholar No. 32*

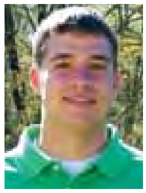
Jimmy is majoring in electrical engineering and ranks first in his class at the South Dakota School of Mines & Tech. He has secured an internship in the power engineering field. After working, he plans to return and pursue graduate degrees. He is an officer in the vet's organization and is a former technician in the U.S. Navy.

Kimberly A. Hull, *GEICO Scholar No. 33*



Kimberly is majoring in computer engineering at North Carolina State University. She will pursue a master's degree in her field and a co-op position at a company focused on turning ideas into manufactured products. She plans to create a prototype product for her senior design project and continue her stellar academic record.

Ross A. Simons, *GEICO Scholar No. 34*



Ross is majoring in civil engineering at Michigan State University with minors in Spanish and mathematics. This summer he will study abroad in Turkey after completing his internship with Marathon Petroleum Corp. His career goals include working for an international company and attaining a Ph.D. in sustainable energy.

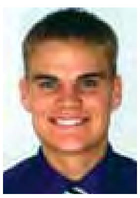
Matthew S. Summers, *GEICO Schol. No. 35*

Matthew is a chemical engineering major at Washington State University. He has been offered an internship with BP in Anchorage, Alaska. Last year, he was a varsity member of the WSU Men's Crew Team and worked with a research group focused on biomaterials. His goal is to work internationally and pursue graduate degrees.

Chin Gian Hooi, *Campbell Scholar No. 25*

Chin is an aerospace engineering major at the Embry-Riddle Aeronautical University. Fluent in five languages, he plans on continuing on to graduate school in an effort to "empower everyone to fly." He has set up a company to research and manufacture unmanned aerial vehicle drones. His career goal is to build commercial "flying cars."

Brian D. Kass, *Campbell Scholar No. 26*



Brian is majoring in mechanical engineering at the University of Iowa. His extracurricular involvement includes being a member of the Hawkeye Marching Band, an undergraduate teaching assistant, and an engineering tutor. After graduation he will enter the workforce and hopes to become an engineering manager and continue to volunteer in his community.

Madhav Baral, *Scribner Scholar No. 18*

Madhav is double majoring in mechanical and nuclear engineering at Idaho State University. He is a tutor and grader of Engineering Physics and an undergraduate researcher involved in research of a "smart" prosthetic hand. He plans to attain a master's degree and focus on energy and the environment.

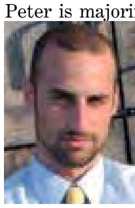
Breana K. Pabst, *Scribner Scholar No. 19*

Breana is majoring in chemical and biological engineering at Montana State University. She is very active with her local chapter of Engineers Without Borders. She will travel this summer to Kenya and help install a composting latrine. She also secured funding for a research project on the latrine compost. She will pursue a career in renewable energy or

Jared D. Smith, *Scribner Scholar No. 20*

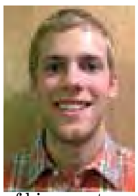
Jared is an environmental engineering major at Clarkson University with a 4.0 G.P.A and first in his class. He is secretary of the Clarkson Community Orchestra, cofounder of the Clarkson track and field teams, and involved with the campus international study committee. He has an internship with the U.S. EPA and plans to pursue graduate degrees.

Peter N. Bowers, *Bose Scholar No. 6*



Peter is majoring in mechanical engineering at the University of Hartford and ranks first in his class. He is president of the CT Γ chapter of TBΠ and part of a math research project. He will return for a second internship at an acoustical consulting firm and plans on studying in Brazil. He plans to start a career or attend grad school.

Clark J. Ennis, *Mentor Scholar No. 9*

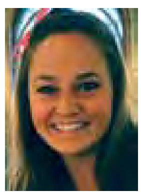


Clark is a mechanical engineering major at Iowa State University. While in high school, he participated in two service trips to build a girls' school in Uganda. This has shaped his research interests in energy conversion and consumption. He will pursue a Ph.D. focused on the conversion of biomass to energy. He is proficient in Spanish and Chinese and plans to study in Singapore.

John Spencer Hall, *Alford Scholar No. 7*

Spencer is double majoring in aerospace engineering and Physics with minors in mathematics and English from Mississippi State University. This summer he will study at the University of Oxford (UK). He will pursue graduate degrees in applied physics and focus professional research on the applications of plasma and condensed matter.

Hannah L. Cooling, *Schwaller Scholar No. 2*



Hannah is a chemical and biochemical engineering major at the Colorado School of Mines where she is President of the CO A chapter of TBΠ. She is a varsity member of the Mines Cross Country and Track teams and a three-time Academic All-Conference selection. This summer she will travel to China to work at the Dalian Univ. engineering program.

See additional bios at *www.tbp.org*.

Tau Beta Pi Fellows for 2012-13

THE FELLOWSHIP BOARD selected 40 Tau Beta Pi Fellows for 2012-13, 21 of whom will receive $10,000 cash stipends for one year of graduate study and 19 who have other extensive financial aid for their year of advanced work. Implemented by President A.D. Moore in 1929, the Fellowship Program has provided over $5,500,000 to 964 stipend recipients.

Now in its 79th year, the Fellowship Program remains a principal philanthropic activity of the Association and continues to receive strong support from alumni. The program was initiated with funds from the operating budget of the Society, including the eventual transfer of fees from deceased life subscribers of THE BENT. It was first enlarged in 1938 by a gift from the Southern California Alumnus Chapter, and in 1948 the first Alumnus Fellowship was awarded. Since that time, gifts from alumni, industry, friends, and the earnings of the invested Fellowship Fund have all contributed to these awards.

Matching gifts to the Association from 230 companies on behalf of their TBΠ employees are allocated to fellowships and scholarships, and the society truly appreciates this support.

In addition to its own awards, TBΠ selects recipients for named fellowships, which are administered just as other society fellowships.

The TBΠ–Stark Fellowship is named for Donald A. Stark, who contributed much to progress in the fluid-power industry. This award, given for the 35th time, is presented to a fellow who plans graduate study in engineering with emphasis in the field of fluid power or fluid mechanics. Stipends are provided by the earnings from a $150,000 gift to TBΠ in 1986 from the Donald A. and Jane C. Stark Charitable Trust.

Twenty-eight fellowships are named for members. The TBΠ–Williams Fellowship, established to honor the Association's Founder, Dr. Edward H. Williams Jr., *PA A 1875*, is awarded to a candidate who plans to work toward a doctoral degree and enter the engineering teaching profession.

Two fellowships honor former TBΠ Presidents. The one named for Charles H. Spencer, *MI Γ 1896*, who served during 1936-47, is awarded for the 57th time. It is presented to the member who has made significant contributions to his or her collegiate chapter. The Harold M. King Fellowship honors the 1954-58 President, *MA A 1910*, whose special interest was in the student branches of the national technical societies. Given for the 51st time, the King Fellowship is awarded for outstanding participation in volunteer technical-society work.

Fifteen named awards are sponsored by the late William Fife, *CA A '21*, who bequeathed the earnings of an irrevocable trust for TBΠ fellowships. They are named in honor of his father, James Fife.

Walter E. Deuchler Sr., *IL A 1910*, left a bequest in 1979 to endow a fellowship for graduate study in water supply, wastewater treatment, and ecology.

Two fellowships recognize former Secretary-Treasurers. The Matthews Fellowship is awarded for the 15th time and honors R.C. "Red" Matthews, *IL A 1902*, who served as Secretary during 1905-12 and as Secretary-Treasurer in 1912-47. Red died in 1978 at the age of 99. The 15th Nagel Fellowship is awarded in honor of Robert H. Nagel, P.E., *NY Δ '39*, who served as Secretary-Treasurer in 1947-82 and Editor of THE BENT during 1942-82. Bob died in 1997.

The Hanley Fellowship is named for Mary A. and Edward P. Hanley, *IL B '42*, who left a bequest in 2007.

The Anderson Fellowship is named for Mabel E. and Marshall Anderson, *MI Γ '32*, who left a bequest to the society in 2005.

The Lynnworth Fellowships are named for Lawrence C. Lynnworth, *NY E '58*, TBΠ Fellow No. 140, and matched by the GE Foundation.

The Arm Fellowship is named for Rena M. and David L. Arm, *PA E '30*, who left a bequest in 2007.

The inaugural Forge Fellowship is named for Charles O. Forge, *CA Γ '56*, who left a bequest in 2010.

The first Zimmerman Fellowship is named for Marlin U. Zimmerman Jr., *MD A '44*, who left a gift of $200,000 to TBΠ in 2010.

The Centennial Fellowship, given to that fellow who the board determines is most outstanding, commemorates TBΠ's 100th anniversary.

The TBΠ–Sigma Tau award commemorates Clarel B. Mapes, Sigma Tau's former national president and secretary-treasurer, and perpetuates the memory of Sigma Tau, former national engineering honor society which merged with TBΠ in 1974.

The TBΠ–Best Fellowship commemorates Ina C. and Raymond A. Best, *NY Γ '33*, and is for a member to acquire an M.B.A. at Rensselaer Polytechnic Institute. There was no applicant.

Tau Beta Pi received 265 fellowship applications. Board members Darrell W. Donahue, Susan L.R. Holl, Jammie L.H. Jamieson, and Director of Fellowships D. Stephen Pierre Jr. made the selections on March 30. Fellows are introduced on the following pages.

FELLOWSHIP	RECIPIENT	CHAPTER	FIELD OF ADVANCED STUDY
Centennial No. 27	Benjamin W. Gasser	AL Δ '11	Mechanical Engineering—Mechatronics
Fife No. 153	Jennifer L. Cooper	MA A '12	Biomedical Engineering
Fife No. 154	Christina E. Darling, E.I.	SC A '12	Civil Engineering
Fife No. 155	Kyle M. Dunning, E.I.	MO Δ '12	Civil Engineering
Fife No. 156	Clayten N. Greenwell	KY A '12	Structural Engineering
Fife No. 157	Duff R. Harrold	CA Y '11	Sustainability
Fife No. 158	Charles A. Holt, E.I.	TX Δ '12	Structural Engineering
Fife No. 159	Sarah Elizabeth McCandless	KS A '12	Aerospace Engineering
Fife No. 160	Yichao Pan	IN Γ '12	Mechanical Engineering
Fife No. 161	Alyssa Joy Rose Hensley	NM Γ '12	Chemical Engineering
Fife No. 162	Joshua L. Solomon, E.I	TN Z '12	Automotive Engineering
Fife No. 163	Dmitriy Timerman	NY A '12	Biomedical Engineering
Fife No. 164	Jeffrey B. West	OH I '12	Robotics
Fife No. 165	Matthew A. Williams. E.I.	KS A '12	Mechanical Engineering
Fife No. 166	Yifan Zhang, E.I.	WY A '12	Petroleum Engineering
Fife No. 167	Luz Angela Zidziunas	NJ Γ '11	Civil Engineering
Spencer No. 57	Kaitlyn F. Mallett	MI I '12	Mechanical Engineering
King No. 51	Christopher C. McComb	CA P '12	Mechanical Engineering
Sigma Tau No. 39	Megan E. Godsey	KS A '12	Biomedical Engineering
Stark No. 35	Krista M. Kirievich	OH B '12	Aerospace Engineering
Williams No. 33	Yoke P. Leong	IL Γ '12	Mechanical Engineering
Deuchler No. 32	Andrew D. Matsumoto	WA Δ '12	Environmental Engineering
Matthews No. 15	David E. Korenchan	IL A '12	Bioengineering
Nagel No. 15	Kalman A. Katlowitz	NY I '12	Bioengineering
Hanley No. 8	Daniel J. Preston	AL B '12	Mechanical Engineering
Anderson No. 6	John R. Lewandowski	OH A '12	Mechanical Engineering
Lynnworth No. 5	Joseph M. Argento	NY Ξ '12	Electrical Engineering
Lynnworth No. 6	Michael J. Hand III	MI Γ '12	Electrical Engineering
Arm No. 4	Jeffrey D. O'Brien	IN Γ '12	Mechanical Engineering
Forge No. 1	Craig M. Western	CA Δ '11	Mechanical Engineering
Zimmerman No. 1	Sheniqua R. Brown	DC A '12	Chemical Engineering
TBP No. 791	David S. Bergsman	WA A '12	Chemical Engineering
TBP No. 792	Claude S. Bridges IV	AL Δ '12	Systems Engineering
TBP No. 793	Erinn C. Dandley	MA Z '12	Chemical Engineering
TBP No. 794	Nicholas J. DeLuca	MD Γ '12	Aerospace Engineering
TBP No. 795	Nimit Jain	CT A '12	Bioengineering
TBP No. 796	Matthew R. LaRue	IN Δ '12	Electrical Engineering
TBP No. 797	Timothy M. Moeller	IN Γ '12	Aerospace Engineering
TBP No. 798	Robert A. Sinko	OH Ξ '12	Mechanical Engineering
TBP No. 799	Vahagn F. Yeranossian	OH A '12	Chemical Engineering

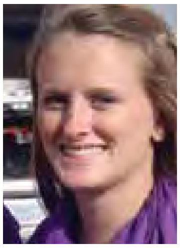
Centennial Fellow No. 27

Benjamin W. Gasser

Ben received his bachelor's degree in mechanical engineering in 2011 from the University of Alabama in Huntsville. He was first in his class with a 4.0 G.P.A. and served as TBΠ Chapter President. Ben plans to attend Vanderbilt University and start graduate studies by working on a master's degree and doctorate in medical mechatronics. He aims to research beyond strict mechanical design, studying intelligent mechatronics capable of mimicking human motion and adapting to the user. He hopes to learn and build a strong collaborative network at Vanderbilt. This will prepare him for a research career in medical device development in either a device company or in the world of academia. Ben believes that although prosthetics has received a recent boost from returning injured veterans, it still has a long way to go and he wants to be part of that process. He has also been active in TeenPact Leadership Schools, teaching government and leadership to high school students.

Fife Fellow No. 154

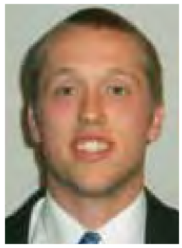
Christina E. Darling, E.I.



Christy has graduated from Clemson University with a B.S. in biosystems engineering. She was first in her B.E. group, passed the F.E., and was TBΠ Chapter President. Christy's interest lies in water movement, hydrology, and its effects on the natural and manmade environment. Her next planned move is to work on a master's at Virginia Tech in the environmental water resources or biological systems engineering programs. Her passion for hydraulic movement stems from childhood experience of the force and impact of water. It was shaped by flooding in her hometown of Richmond, VA, due to Hurricane Gaston, volunteer work in Mississippi after Hurricane Katrina, and the aftermath of the BP oil spill. Graduate studies will be aimed at increasing her knowledge of modeling systems and problem resolution in natural and manmade water systems. Christy believes availability of clean water and control of water's destructive qualities are worldwide concerns.

Fife Fellow No. 156

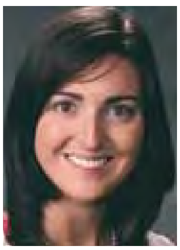
Clayten N. Greenwell, E.I.



Clay received a B.S. in civil engineering from the University of Kentucky. He plans to go for a master's degree at either UK or Purdue University. Initial research was in hydrosystems and water systems. He is now focusing on structures with a strong interest in design-build. Current research is in bridge repair and reinforcement. This has included using carbon strengthening that can be epoxied onto damaged bridges as an alternative to bolting up steel plates or rebuilding the entire structure. Clay is now interested in structural building design. He has held various jobs in the private sector. Work with a highway contractor led to bidding, leadership, and construction experience, while a post at a property management company taught him about running a company and communication skills. He has always considered being a teacher and would like to be a professor and researcher; however, plans include becoming a P.E. and working in industry for a least five years.

Fife Fellow No. 153

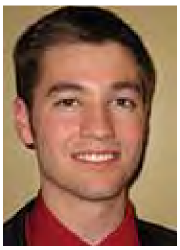
Jennifer L. Cooper



Jennifer received her B.S. in biomedical engineering from Worcester Polytechnic Institute, where she served as TBΠ Chapter President. She plans to stay at WPI for graduate studies focused on her research for a novel scaffold to improve wound healing. There is a large need for skin substitutes to treat burns and chronic ulcers. She will work on a cell-derived matrix with angiogenic qualities that is comparable to native dermis. Jennifer hopes to not only gain experience of laboratory techniques, technical writing, and data analysis, but to also provide insight and crucial data on tissue engineering to the medical community. Her ultimate goal is at least one published paper and possibly obtaining funding to continue her research. From there, she plans to work in industry as a biomedical engineer, seeing herself as one day leading a company into the future of medicine and saving lives. As an intern, she took part in training and was able to pass the exam for Lean Six Sigma, a concept for much of industry.

Fife Fellow No. 155

Kyle M. Dunning, E.I.



Kyle has graduated with a B.S. in civil engineering at the University of Missouri-Kansas City, where he was top of his group. He is pursuing a master's with plans to advance research on carbon nanotube (CNT) carbon reinforcement to improve the material's usefulness and cost-effectiveness. Kyle believes the nation's crumbling infrastructure and inefficient design call for a reinvention of the way we build and repair. Civil engineering appears to have reached a plateau where we linger in technologies developed decades ago. Kyle has already researched in improving concrete design and use. Now he plans to look at ways of mixing CNTs with concrete to optimize strength and durability. He is considering a Ph.D., although his ultimate desire is to enter the workforce and become a Professional Engineer. In the end, he wants to help the engineering community advance into a more innovative and sustainable future.

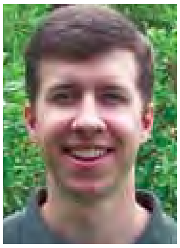
Fife Fellow No. 157

Duff R. Harrold

Duff has received a master's in mechanical engineering at California State University, Sacramento, where he was top of his class and group. He hopes to pursue a Ph.D. program at University of California, Davis, studying energy and sustainability with a focus on converting biomass to fuel. Another objective is to work on the development of engineering education from primary school level through to university. Duff graduated earlier with a B.S. in biochemistry and worked for two years in enzyme research. Interest in the energy field as a social issue led him into engineering and rebuilding his foundation. This process included a two-year stint at a community college, three years at Sacramento State, and two internships. He is now looking at research in thermochemical biomass conversion and properties of charcoal as they relate to emissions. Another interest is a UC Davis program pairing engineering Ph.D. students with elementary teachers to develop innovative STEM curricula.

Fife Fellow No. 158

Charles A. Holt, E.I.



Chase graduated with a B.S. in civil engineering at Texas A&M University at the top of his class and group, with a 4.0 G.P.A. Next objective is a master's in structural engineering at Texas A&M to help complete his knowledge of the way structures behave and how to build one from the ground up. He has already gained valuable work experience during two summer internships putting up steel buildings and the placement of concrete structures. Chase plans to take extra courses on concrete and steel design, as well as classes on mechanics, finite element, and dynamics. He had great expectations for a design studio course, where he will get to apply everything he has learned to a project. Graduate school aim is to learn to design a structure to be safe, economical, constructible, and functional by improving his understanding and knowledge base. Chase has already helped to build a water distribution system in Costa Rica, a well in Guatemala, and a food distribution warehouse in Haiti.

Fife Fellow No. 159

Sarah Elizabeth McCandless

Sarah Elizabeth has graduated with a B.S. in aerospace engineering from the University of Kansas. This is to help achieve Her ultimate ambition is to develop systems which support and sustain life in space. Her graduate studies include Ae.E. and geophysics, and she believes studying these two subjects will help her bridge the gap between engineering and science, so that they more fully understand each other. Courses she plans to pursue include space habitat design, aerospace environment, flight dynamics, space life sciences, evolution of planetary systems, and space plasmas. She hopes to work with NASA's Graduate Student Researchers Program in order to apply her skills to existing problems. Study abroad, potentially at the International Space University in France, is another goal. She believes future space exploration is a global effort and that it will produce incredible innovation not only beyond our planet, but across all areas of society on earth.

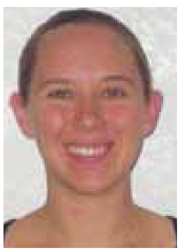
Fife Fellow No. 160

Yichao Pan

Yichao graduated from University of Notre Dame, where he served as TBΠ Chapter President, with a B.S. in mechanical engineering. He is taking the F.E. exam and plans graduate studies in mechanical engineering (green manufacturing). His plans include a Ph.D. toward his objective of developing manufacturing technologies for a more sustainable world and helping recovery from financial crisis. With a higher degree, he would be able to facilitate positive global change through mechanical engineering. Yichao hopes to be a professor and that one day, he can direct his own laboratory. He could become a consultant promoting new, green technologies to manufacturing companies. His chapter's Chief Advisor credits Yichao with using his energy and creative spirit to revitalize Indiana Gamma in areas like expanding programs and inducting a strong group of new members. His rare example of commitment and leadership will serve him well in graduate school.

Fife Fellow No. 161

Alyssa Joy Rose Hensley



Alyssa maintained a 4.0 G.P.A., graduating first in her group and department with a B.S. in chemical engineering at the New Mexico Institute of Mining and Technology. She served as TBΠ Chapter President. Alyssa is taking the F.E. exam and plans graduate studies in chemical separation and purification, specifically water recycling. In addition to improving the health of millions of people worldwide, she sees this as a critical part of the modern economy. Water is vital for chemical plants, as a solvent, coolant, heating vapor, and is often a by-product. Alyssa wants to research current techniques and learn to apply them to smaller scale operations. Her ultimate career goal is to work with organizations like Engineers Without Borders and Engineering World Health to improve lives around the world with clean water. She believes her master's program will mean a deeper look at chemical engineering principles and research. This will equip her for future challenges such as difficult settings and limited resources.

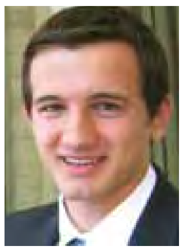
Fife Fellow No. 162

Joshua L. Solomon, E.I.

Joshua has received a bachelor's in mechanical engineering from the University of Tennessee at Chattanooga. He was top of his class and group and served as TBΠ Chapter President. His ambition is to be a design engineer for a top automotive company. When Volkswagen announced it was building its first production plant in the U.S. in his hometown Chattanooga, Joshua worked successfully to win a prized VW internship. His interest in cars grew, along with his interest in Volkswagen, and he began studying German. This led to an internship in Germany and, while working at a university there, he researched fiber-reinforced composites. Joshua has concluded that his real talent lies in working with advanced materials used in vehicles. He has applied to graduate schools in Germany, where the curriculum requires working in cooperation with industry. After graduation, he will work there aand then eventually bring his skills back to the U.S.

Fife Fellow No.163

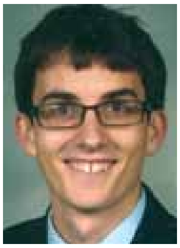
Dmitriy Timerman



Dmitriy is a biomedical engineering graduate of Columbia University, where he served as TBΠ Chapter President and led rankings for his group with a 4.17/4.333 G.P.A. He is starting graduate studies in biomedical engineering and medical imaging. Dmitriy will continue to concentrate on ways to make diagnostic and interventional imaging give physicians and scientists a better view inside the human body. He believes that advances in imaging will revolutionize biomedical engineering during his career, and his goal is to be a major contributor. To achieve this, he will combine research in imaging and neuroscience. He is already working on a technique for blood flow and oxygen use in the brain for neurosurgeons to use during operations. Alongside research, he intends to be active in innovation and social entrepreneurship. Dmitriy's eventual plan is to work on local and international projects to produce biological devices. He also plans to continue serving as a community leader.

Fife Fellow No. 164

Jeffrey B. West



Jeffrey is a mechanical engineering graduate of Ohio Northern University, where he maintained a 4.0 G.P.A. and served as TBΠ Chapter President. He spent two summers working on development of Cleveland, OH, city lots for community gardens and local food production. Jeffrey then developed an interest in research, specifically in robotics, where he is starting graduate studies towards a Ph.D. He plans to investigate interaction between humans and assistive robotics designed for rehabilitation or shared tasks. New robotic platforms, he believes, must be designed with both function and human perception in mind to increase human acceptance and trust of the machine, as well as efficiency. For example, rehabilitation patients who interact with more capable systems featuring intuitive controls may develop deeper trust in robots to aid their therapy. Jeffrey plans to follow a career in research, either as a university professor or at a government funded research laboratory.

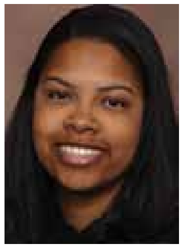
Fife Fellow No. 166

Yifan Zhang, E.I.

Yifan graduated first in his group and department with a B.S. in petroleum engineering at the University of Wyoming. He maintained a 4.0 G.P.A., passed the Fundamentals of Engineering exam and is going on for his master's. Growing up in an oilfield, he always wanted to be a petroleum engineer. He has decided to focus on carbon dioxide sequestration. Yifan believes it is vital for his native China, the #1 emitter of CO_2, to develop sequestration technology. He has already had internships in geology, carbon dioxide, and rock/fluids, and will work on at least one of these topics for his master's and Ph.D. Yifan finds it fascinating that CO_2 produced through natural processes has been stored in geologic formations for hundreds of millions of years. That has inspired people to look to this technology. He believes sequestration has great potential to relieve climate change and to help the engineering profession increase flexibility by cutting greenhouse gas emissions.

Spencer Fellow No. 57

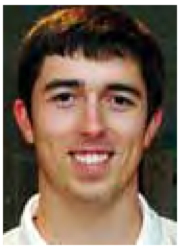
Kaitlyn F. Mallett



Kaitlyn completed a bachelor's in mechanical engineering at the top of her class and group at the University of Michigan-Dearborn, where she served as TBΠ Chapter President. She completed a concurrent major in engineering mathematics. Graduate studies at Michigan in Mech.E. with a focus on dynamics and vibrations are her next move, and she has been recommended for admission to a Ph.D. program. She also plans to continue her mathematical education. Kaitlyn has been involved in research into mechanical properties of certain biocomposites under loading, and the behavior of the corneoscleral shell of the mammalian eye. These tissues deform under stresses, including the actions of diseases like glaucoma. She has learned the significance of thinking deeply about research results and not jumping to conclusions; so she plans to continue studying cellular biomechanics. The research process is very rewarding for her and she is looking forward to carrying this out in a laboratory over the next year.

Fife Fellow No. 165

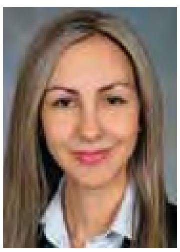
Matthew A. Williams, E.I.



Matthew graduated first in his class and group at the University of Kansas with a 4.0 G.P.A. and a B.S. in aerospace engineering. He is pursuing graduate studies in mechanical/aerospace engineering and has passed the Fundamentals of Engineering examination. A continuing internship led to his decision to work on non-linear control systems with an emphasis on wind turbines and wind farms. The industry needs control systems, and he plans to develop regulation systems for entire wind farms. Turbines will be networked to communicate with each other and react to environmental conditions. This would make them more efficient and safer to operate. Matthew believes there will be more demand for such control systems as wind power becomes more popular and governments are pushed towards cleaner energy sources. He hopes to promote the profitability and the scale of wind energy to reduce, and even eliminate, the need for subsidies and tax breaks.

Fife Fellow No. 167

Luz Angela Zidziunas



Angela has completed a bachelor's in civil engineering at the New Jersey Institute of Technology, ranking first in her class and group, with a 4.0 G.P.A. She is going on to graduate school, planning to concentrate on building design and analysis. This would be based on a sustainable approach, choosing materials that can survive and preserve the environment as well as making efficient use of funds. Angela would then join a large structural design company and gain the experience required for professional certification. Her ultimate goal is to start her own consulting firm to apply her experience to the environmental and structural fields. She is a married mother of three children and balances her engineering studies with work at Joseph Environmental LLC, a Newark, NJ, consulting firm she co-owns with her husband. This involves remedial and repair services for the cities of Newark and New York, as well as working closely with agencies such as the EPA.

King Fellow No. 51

Christopher C. McComb

Chris graduated from California State University-Fresno with a B.S. in mechanical engineering. He placed first in his class and group, achieved a 4.0 G.P.A., and served as TBΠ Chapter President. Chris is entering a Ph.D. program at Carnegie Mellon University. His dissertation will be on large-scale design optimization, with applications to renewable energy. Focus will be on siting offshore wind farms and the design of concentrated solar power plants. He has been an undergraduate intern at the National Renewable Energy Laboratory working on wave energy converters. Other internships included structural engineering, consulting and working as a student assistant at CalTrans. Chris will pursue a postdoctoral position, then a full engineering position, at a Department of Energy laboratory, preferably at the NREL. After about 10 years, he plans to seek a tenure-track teaching position at the University of California, then devote the rest of his life to teaching, research, and mentoring.

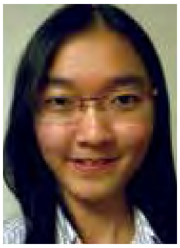
Sigma Tau Fellow No. 39

Megan E. Godsey

Megan is a chemical engineering graduate of the University of Kansas, where she finished first in her class and group with a 4.0 G.P.A. She has applied to graduate schools, seeking to combine her interest in biology with the knowledge from her degree to create products that directly improve people's lives. Megan has been interested in gene therapy for some time and has been looking at the introduction of small interfering RNA (siRNA) into cells in the body. This helps treat conditions with a genetic component. Her focus is searching for ways to deliver the siRNAs to the correct cells with the ultimate aim of producing a therapeutic tool. Specifically, she hopes to develop a technique to help prevent joint degradation in rheumatoid athritis sufferers. She would like to find a way of delivering the treatment orally, as opposed to the current therapy using site injection. This is where she wishes to make a contribution during graduate school and her career.

Williams Fellow No. 33

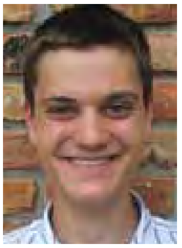
Yoke P. Leong



Yoke is graduating with a master's in mechanical engineering at Northwestern University, where she studied under a four-year scholarship from the Malaysian Public Service Department. She is pursuing a Ph.D. and her study objective is to learn to increase the quality of higher education in her homeland and to start her own research group. Her passion for robotics developed from a project on simulation and control of an artificial finger. Existing prosthetic arms do not usually come with a dexterous hand. She plans to give amputees more manual control, and is looking into development of a robotic hand. She believes this project will also help her to forge partnerships with private and government organizations. Improving leadership skills is one of the objectives of her doctorate program. She also plans to strengthen her teaching skills, acquiring feedback from students to polish her technique. Then she will go on to become an inspiring teacher and an innovative researcher.

Matthews Fellow No. 15

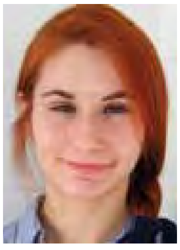
David E. Korenchan



Dave has received his B.S. in bioengineering and physics from the University of Illinois at Urbana-Champaign, where has was TBΠ Chapter President. Ranking first in his class and group, he maintained a 4.0 G.P.A. Dave expects to be accepted into a Ph.D. program at one of the nation's top universities for biomedical engineering. He believes engineers and researchers are on the verge of developing and marketing novel micro/nano-electromechanical systems (MEMS/NEMS) for highly accurate, inexpensive, and portable bioparticle detection. After gaining his doctorate, he plans to work with a healthcare company to bring such diagnostic devices to medical professionals so they can use this new technology to save lives. He is particularly interested in exosomes, small particles whose release from cells may indicate initial tumor formation. Their study could lead to a new method of early cancer detection using BioMEMS devices to find them in blood or cultured cells.

Stark Fellow No. 35

Krista M. Kirievich



Krista is an aerospace engineering graduate of the University of Cincinnati, where she was first in her group. She plans to stay there for graduate studies. She will be working on fluid mechanics in relation to current aerospace technologies like aircraft engines and advanced flight vehicles. Working with General Electic Aviation, she will be developing ways to include unsteady flow effects into turbomachinery design. This is important in near-stall conditions. Simulations in this field are computationally very expensive and it is important to find a more efficient way to model this behavior. Krista has already studied wind turbine design and computational fluid dynamics. Future work will cover topics like propulsion systems, combustion, heat transfer, compressible flow, and turbomachinery. Her master's degree will give her a greater understanding of these topics, and help her gain the conceptual understanding and skills needed for a career in the aerospace industry.

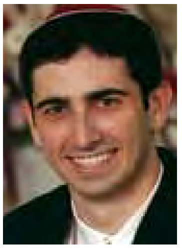
Deuchler Fellow No. 32

Andrew D. Matsumoto

Andrew graduated at the top of his department with a B.S. in civil engineering at Gonzaga University, where has was TBΠ Chapter President. He has applied to graduate schools to start working towards a Ph.D. in environmental engineering, and is taking the F.E. exam. Andrew's passion is solving environmental contamination problems. This stems from watching his mother and grandparents suffer from illnesses linked to the pesticides sprayed on their family farms. He plans to specialize in environmental process engineering, with the focus on contaminant transport and remediation in soil and groundwater. He is aiming at a career as an environmental researcher, professor, and policy advocate, fighting for tougher restrictions on pollution. Andrew spent two summers interning at the Hanford Nuclear site working on a soil dessication system to immobilize Technetium-99 threatening the Columbia River. This preceded his receipt of a 2010 Goldwater scholarship.

Nagel Fellow No. 15

Kalman A. Katlowitz



Vigi graduated at the top of his class and group at Cooper Union with a B.S. in interdisciplinary engineering and a G.P.A. of 4.0. He plans to continue his studies for an M.D./Ph.D., an eight-year program to train a new generation of Ph.D. students who apply their knowledge to medicine. Just as his interdisciplinary track in engineering allowed him to combine the electrical, chemical, and biomedical fields, he believes a physician-scientist can combine the best of both worlds. One can only understand truly how to improve the system by being immersed in it. Vigi is particularly interested in neuroscience, specifically interactions between our neural systems and electronics. He believes technology is close enough to begin understanding this largest enigma in the body. His dual background in medical research and engineering uniquely qualifies him for this field. The brain must be approached computationally, biochemically, electrically, and in so many other fashions.

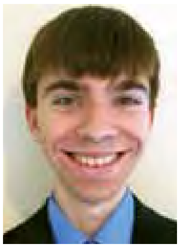
Hanley Fellow No. 8

Daniel J. Preston

Dan graduated top of his class and group at the University of Alabama with a B.S. in mechanical engineering and a G.P.A. of 4.0. He is continuing Mech.E. studies at graduate school and has applied to take the F.E. exam. Studies will focus on meeting the growing demand for renewable energy to counter the decline in fossil fuel production. He believes the sun is the most promising raw source of energy and that research in two areas is already making photovoltaic cells more efficient and economically viable. These are innovations in multijunction cells and using optics to concentrate the solar power applied to PV cells. Dan is interested in researching the latter and looking at ways of cooling the panels to maximize power production. He plans include a Ph.D., and becoming a researcher and professor at a renowned university with a strong STEM program. This would help to find a solution for the impending energy crisis, and spread knowledge about renewable sources.

Lynnworth Fellow No. 5

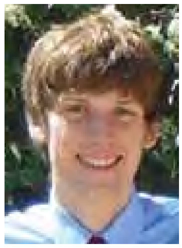
Joseph M. Argento



Joseph graduated with a bachelor's in electrical engineering at Manhattan College, where he is starting graduate studies. He will be working on an M.S. in electrical and computer engineering, which he plans to complete in a single year, and then go on for a doctoral degree while working in the field. Joseph has planned a graduate curriculum to make him quickly contribute to robotics and engineering as a whole. It will be focused on autonomous systems, specifically AI, machine learning, algorithms and controls. He chose autonomous systems after seeing an unmanned air combat system as an intern at Northrop Grumman Aerospace Systems. The aircraft not only had to be controllable from thousands of miles away, but also had to do things like land autonomously on the deck of a moving aircraft carrier. He has been Chapter Treasurer and intends to stay active in the campus community and with Tau Beta Pi by becoming a student advisor.

Arm Fellow No. 4

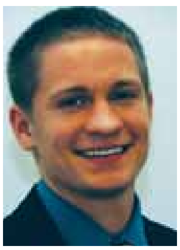
Jeffrey D. O'Brien



Jeff graduated first in his department with a B.S. in mechanical engineering from the University of Notre Dame. Graduate studies will be aimed at a Ph.D. in Mech.E. so that he can eventually work as a research and development engineer creating new products and improving existing technologies. He plans to specialize in the relatively new field of computational combustion (CC) which has many applications in the power, aviation, and automotive industries. Jeff has always been interested in how engines and power plants work. Once he began to understand how they function, he became enthralled by the science involved. Spending summers with General Electric, he learned that controlling emissions and improving fuel performance are important design problems that are difficult to solve experimentally. He wants to make CC a more reliable and efficient tool for predicting combustion performance. This will allow cheaper and enhanced engines and turbines.

Anderson Fellow No. 6

John R. Lewandowski



John received a bachelor's in mechanical engineering from Case Western Reserve University, where he maintained a 4.0 G.P.A., and placed first in his group and department. He was also a senior captain in varsity baseball, and plans to take the F.E. exam when sporting commitments permit. John plans graduate studies in mechanical engineering and management science. On entry to Case Western, he was extremely interested in medical school, but changed to Mech.E. after an internships with the functional electrical stimulation laboratory there. He wanted to not only come up with his own design problems, but also to find the solutions. John wants to stay involved with design, and after completing his doctorate would ultimately be interested in technological consulting. This would allow him to make the biggest impact on others in a wide variety of industries. His long-term goal is to develop and market a cheaper material, or revolutionize a current material used within the body, for implant devices.

Lynnworth Fellow No. 6

Michael J. Hand III

Mike graduated first in his department and group with a B.S. in electrical engineering at University of Michigan-Ann Arbor. He had a 4.0 G.P.A. there and is staying at Ann Arbor to pursue a master's in control systems engineering. This would lead to improving the efficiency and sustainability of existing systems by developing more advanced control algorithms. He is fascinated by ways of stabilizing and governing the behavior of an unstable system. Mike plans research on system-controller integration to achieve better results than more classical approaches. This summer, he was interning at Whirlpool, with a project on control categories to save energy and cut waste in appliances like refrigerators and washer/dryers. After graduation, he plans to explore areas of technology previously considered inaccessible, like flight of open-loop unstable aircraft and robotic bipedal locomotion. He will be prepared for a job in controls engineering or to go on for a doctorate in control systems.

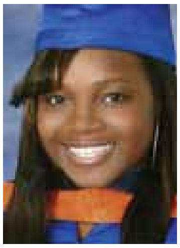
Forge Fellow No. 1

Craig M. Western

Craig graduated first in his class and mechanical engineering department at the University of Southern California with a 4.0 G.P.A. He is going on for a master's in Mech.E. and plans to continue for a Ph.D. Internships and his research have made him interested in robotics, which provides an ideal mix of theory, implementation, software, and hardware. They have also developed his skills in hardware design, control, and programming. Robotics also provides potential for entrepreneurship and leadership roles to emerge from the field's growing applications. He aims to become a leader in industry, academia, or a mix of the two—as do many leading talents in the field. Craig also believes that breadth of knowledge is critical, particularly for business ventures. He prides himself in engaging in a range of pursuits. For example: he spent a year in Taiwan as a Luce Scholar and is confident that the resulting intermediate-level Mandarin and knowledge of local culture will benefit his engineering and business activities.

Zimmerman Fellow No. 1

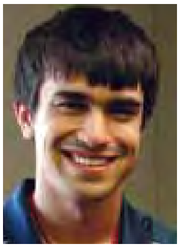
Sheniqua R. Brown



Sheniqua is a chemical engineering graduate of Howard University, where she ranked first in her group. Her field of study was determined by the personal experience of three family members losing their battles with cancer at relatively young ages. Throughout her undergraduate career, interactions with individuals in engineering, science, and humanity courses showed that even small contributions can make major impacts on a community. This led to a desire to improve the lives of others through research. Work on nanoparticle fabrication exposed her to the vast capabilities of nanoscience and technology in healthcare. Sheniqua's desire to focus on this field was confirmed by an internship at a pharmaceutical company. Her special interests are biomaterials, drug delivery and nanomedicine. She plans to pursue a doctorate in chemical engineering, and work on research and development in the pharmaceutical industry. After a career in industry, she plans to become a university professor.

Tau Beta Pi Fellow No. 791

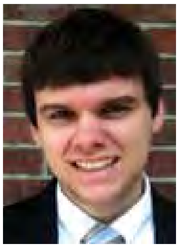
David S. Bergsman



David graduated from the University of Washington with a B.S. in chemical engineering ans is going on to graduate school for a Ph.D. He plans to make significant advances in pharmaceuticals, nanotechnology or energy-related fields. David plans to contribute to future generations of engineers as a professor, producing new intellectual property while sharing expertise with undergraduates. He has already written a program regarding chemical equilibrium in large systems, and this simulation is currently being used to detect planets with earth-like living conditions. The planned focus for graduate school will be surfactants and surface modification. He is particularly interested in the use of surface-modified gold nanoparticles for detecting and treating cancer cells. David takes great pleasure in simplifying difficult concepts, which led him to become a teaching assistant. Directing and encouraging his peers has been a fantastic experience, which he hopes to continue as a professor.

Tau Beta Pi Fellow No. 792

Claude S. Bridges IV



Claude has graduated from the University of Alabama in Huntsville with a dual major bachelor's in industrial and systems engineering and mathematics. He placed first in his class and group with a 4.0 G.P.A. He is staying at Huntsville for graduate studies to work on a master's in systems engineering. Currently, he is fascinated by the integration of systems in healthcare areas like hospitals and the manufacture of biomedical instrumentation. Claude is checking out employment possibilities that might help with study plans. He might consider a career path opportunity in healthcare engineering as a serious alternative for his future. However, he would like his next move to be as a research assistant or graduate teaching assistant for engineering courses. Upon obtaining a master's (or even possibly achieving a doctorate), he will look for a long-term career that would incorporate his interests in both research and health systems.

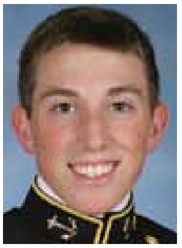
Tau Beta Pi Fellow No. 793

Erinn C. Dandley

Erinn is a chemiical engineering graduate of the University of Massachusetts at Amherst. Graduate studies for a Ph.D. will allow her to continue conducting and advancing research in the field of biomedical engineering. Combining skills from her undergraduate career, like problem solving, time management, and determination, with knowledge from graduate school, she hopes to successfully combat disease. Two research experiences dealing with cancer, one on drug delivery and the other on metastasis, have led Erinn to conclude that she wants to do this sort of problem solving for the rest of her life. After completing her master's, she plans to work for a small company focused on developing treatments for cancer, malaria, HIV/AIDS, or heart disease. Such an environment will mean that she can make major contributions. This will also allow Erinn to utilize her effective and creative skills which will be sharply honed while pursuing her Ph.D.

Tau Beta Pi Fellow No. 794

Nicholas J. DeLuca



Nick has graduated with a B.S. in aerospace engineering at the United States Naval Academy. He is taking the F.E. exam and is going on for his master's in Ae.E. Nick is destined for the U.S. Marine Corps and his aim is to become a naval aviator. He first "slipped the surly bonds of earth" with his first flight at the age of six, and obtained his private pilot's certification during his senior year of high school. After graduate education, he will go to military flight school. Later, Nick will have a chance to apply for the U.S. Naval Test Pilot School. As a Marine Corps test pilot, he would be in a position to analyze and improve on experimental platforms with potentially extraordinary implications. This path will prepare him to lead future aerospace design programs in and out of the military. Pursuing a master's in aerospace systems will make him an engineer who can see the whole picture, yet have the knowledge and analytical ability to deal with specific problems as they arise.

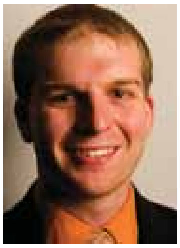
Tau Beta Pi Fellow No. 795

Nimit Jain

Nimit maintained a 4.0 G.P.A., graduating first in his group and department with a B.S. in biomedical engineering at Yale University. Next move is work towards a biomedical/bio-engineering Ph.D. program. He decided to dedicate his life to engineering solutions to biomedical problems when he was diagnosed with Type 1 diabetes at the age of 16. Graduate-level classes already taken range from mathematical modeling to medical image processing. An example of research accomplishments so far includes development of computational methods to accurately assess biological parameters. Nimit worked as an intern in surgical device development at Carl Zeiss Meditec in Germany. His ultimate goal is to set up his own laboratory as a professor to develop medical devices and imaging techniques for conditions like diabetes, malaria, and cataracts. Nimit believes that the ability to synthesize knowledge from across several disciplines holds the key to solving even the most complicated biomedical problems.

Tau Beta Pi Fellow No. 796

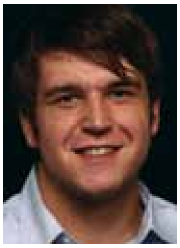
Matthew R. LaRue



Matthew received his B.S. in electrical engineering from Valparaiso University, where he was TBΠ Chapter President. He is taking the F.E. exam and is going on for graduate studies in E.E. Matthew started learning about military radar systems and radio frequency (RF) engineering during an internship with the Air Force Research Labs. His research will be in the design of high power transmitter technologies for ultra-wideband, multi function operations. The focus will be on technologies to deliver unparalleled bandwidth and power. This could lead to transmitter architecture allowing simultaneous radar, communications, and navigation operations via a single aperture. Thus, versatility could revolutionize communications for the military, NASA, and commercial users. Outside the classroom and laboratory, Matthew's sporting interests have included volleyball and floor hockey. He captained the Valparaiso University competitive ballroom dancing team and performed with the dance ensemble.

Tau Beta Pi Fellow No. 798

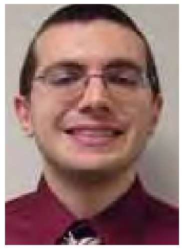
Robert A. Sinko



Bobby is a mechanical engineering graduate of Miami University, where he was first in his class and group with a 4.0 G.P.A. He is taking the F.E. exam and is pursuing an advanced degree in Mech.E. as part of his goal to become a professor. Having been a tutor throughout college, he discovered that he has a passion for teaching. Bobby hopes to continue research so that one day he can consider himself an expert in his chosen specialty. He has already spent two summers as a NASA intern, focusing first on system design and analysis, then more on theoretical research. Independent research at Miami for the past two years included work on smart materials. He also traveled abroad to work at the Korea Advanced Institute of Science and Technology, having both experience of working with international colleagues and an impactful cultural experience. He believes that graduate school will help him advance the engineering community in the future, while achieving his own goals.

Tau Beta Pi Fellow No. 799

Vahagn F. Yeranossian



Vahagn completed a bachelor's in chemical engineering at the top of his class with a 4.0 G.P.A. at Case Western Reserve University. Next move is graduate school with the objective of a Ph.D. from a thesis dealing with solar cell or energy storage development. He would then like to work in a research or development lab for either a company or a national laboratory, creating longer-lasting and more efficient solar cells or batteries. After several years of research, he plans to become a university professor and pursue his own research, while helping future students reach their own goals, and advance their fields. Vahagn was TBΠ Chapter President at Case Western, and he worked to use Tau Beta Pi as an umbrella organization for engineering student groups to help them achieve projects in the community. He believes this can enable student groups with little funding to complete projects that require cross-departmental cooperation. This has been met by support from student groups, as well as TBΠ members.

Tau Beta Pi Fellow No. 797

Timothy M. Moeller

Tim is an aerospace engineering graduate of the University of Notre Dame where he was top of his department. Internships included a summer at NASA-funded Blue Origin, where he began development of cryogenic insulation for the company's first LOX/LH2 vehicle. He is staying in aerospace for graduate studies, planning to obtain a research position at an institution with a strong space systems research program. Particular interest lies in research on overall vehicle design and optimization, astrodynamics, or spacecraft robotics. After gaining a master's, he expects to go on for a Ph.D. He will then seek a systems engineering job with a company or in a laboratory at the cutting edge of exploration technology. Tim wants to be part of the next generation of spacecraft or exploration missions, contributing to discovering all about our solar system. He would like to end his career as manager of a design team or research laboratory, so that he can pass on his expertise to the next generation of engineers.

STAY INVOLVED WITH TAU BETA PI

Don't let your graduation be the end of your involvement with Tau Beta Pi! We are actively working with alumni across the country to reactivate and reinvigorate alumnus chapters. Opportunities for participation in the MindSET, District, and Engineering Futures Programs are available as are positions as chapter advisors. All alumni are encouraged to join our LinkedIn and Facebook groups to learn about the latest activities going on in Tau Beta Pi.

To connect with alumni in your area, visit: www.tbp.org/alumni/involve.cfm.

To learn more about volunteer opportunities, visit: www.tbp.org/pages/ForMembers/Volunteer/Potential.cfm.

To attend an alumni gathering check dates and locations: in your area: www.tbp.org/alumni/.

Pictured to the right is an alumni gathering held in Minneapolis in May 2012.

Brain Ticklers

RESULTS FROM WINTER 2012

Perfect			
Eisenhauer, William D.	OR	Β	’94
Jones, John F.	WI	Α	’59
Kimsey, David B.	AL	Α	’71
*Mangis, J. Kevin	VA	Α	’86
Prince, Lawrence R.	CT	Β	’91
*Rasbold, J. Charles	OH	Α	’83
Schmidt, V. Hugo	WA	Β	’51
Silver, Robert E.	NY	Ρ	’80
Slegel, Timothy J.	PA	Α	’80
Smith, Ronald E.	PA	Α	’86
Stein, Gary M.	FL	Δ	’04
Vegeais, James A.	IL	Α	’86
Other			
Alexander, Jay A.	IL	Γ	’86
Aron, Gert	IA	Β	’58
Bird, David W.	VT	Α	’74
Bohdan, Timothy E.	IN	Γ	’85
Brule, John D.	MI	Β	’49
Couillard, J. Gregory	IL	Α	’89
deVitry, David M.	PA	Η	’97
Giannini, Mark C.	CA	ΑΓ	’13
Handley, Vernon K.	GA	Α	’86
Havas, Donald W.	NY	Ν	’67
Jones, Donlan F.	CA	Ζ	’52
Kern, Peter L.	NY	Λ	’62
Lalinsky, Mark A.	MI	Γ	’77
McDonough, Thomas J.	MO	Β	’11
Melancon, Thomas B.	WA	Β	’79
Rentz, Peter E.	IN	Α	’55
Shaffer, Daniel A.	OH	Ν	’11
Shevenock, Stephanie A.	MI	Η	’13
Sigillito, Vincent G.	MD	Β	’58
Spong, Robert N.	UT	Α	’58
Stetson II, Scott B.	CA	Τ	’12
Stribling, Jeffrey R.	CA	Α	’92
Strong, Michael D.	PA	Α	’84
Summerfield, Steven L.	MO	Γ	’85
Svetlik, J. Frank	MI	Α	’67
Voellinger, Edward J.	Non-member		
Wiesner, Jeffrey J.	WI	Α	’77
Wiesner, David J.	Son of member		

* Denotes correct bonus solution

WINTER REVIEW

Winter No. 3, about determining the six-digit lock combination, was by far the most popular Tickler with many entries, most giving the correct unique answer. The Bonus problem, about finding all the unique circular paths starting and ending in the center of a 5x5 checkerboard, was extra difficult with only two correct answers.

Fall Recap. Because of a computer glitch, we missed acknowledging two entries for the Fall 2011 column: **Eamonn T. Harter,** *ID Γ ’06*, (perfect) and **Lawrence R. Prince,** *CT B ’91*.

Also, **Gert Aron,** *IA B ’58*, has submitted a clever solution to Fall Tickler No. 1 (about the cost of turkeys). Since there are 72 = 8(9) turkeys, the cost ($x67.9y) must be divisible by both 8 and 9. Divisibility by 8 means the last 3 digits are divisible by 8. For 79y to be divisible by 8, y must equal 2. Divisibility by 9 means the sum of the digits is divisible by 9; for x+6+7+9+2 = x+24 to be divisible by 9, x must equal 3, so the cost is $367.92.

SPRING SOLUTIONS

Readers’ entries for the Spring problems will be acknowledged in the Fall BENT. Meanwhile, here are the answers:

1 O/NE + T/WO + S/IX = NI/NE decodes as 6/24 + 7/56 + 9/18 = 21/24. The approach is to try various values for NE; picking NE fixes I since NINE is divisible by 9 and also fixes T since TEN is divisible by 7. As an example, try NE = 12; then I = 5, T = 7, and NI/NE = 15/12. A little trial will show that the left hand side can barely exceed 1, so NE = 12 will not work. Try NE = 24; then I = 1, T = 7, and NI/NE = 21/24. Since O and X must be even, O must be 6 or 8, and X must be 0, 6, or 8. A little trial will quickly arrive at the above solution.

2 N integers can be arranged into a strictly increasing sequence followed by a strictly decreasing sequence in $2^{N-2} - 1$ ways, when reversals are not considered different arrangements and there are at least two members in each sequence. Since N is a member of both sequences, the remaining $N - 1$ integers must be divided into two groups with X integers in one group and $N - X - 1$ in the other. This can be done in $T = [C(N\text{-}1, 1) + C(N\text{-}1, 2) + C(N\text{-}1, 3) + \ldots + C(N\text{-}1, N\text{-}2)]/2$ ways, where $C(i, j)$ is the number of combinations of i objects taken j at a time. The factor of 2 arises because half the permutations are reversals of the other half. Once the split is made, there is only one permutation that leads to an ascending followed by a descending sequence. Now, $(1 + 1)^Z = C(Z, 0) + C(Z, 1) + C(Z, 2) + \ldots + C(Z, Z) = 2^Z$. Since each group must have at least one number, T does not include $C(Z, 0)$ and $C(Z, Z)$. Since $Z = N\text{-}1$, $T = (2^{N-1} - 2)/2 = 2^{N-2} - 1$.

3 The solution with the smallest positive value of $(x + y + z)$ is $x = 21$, $y = -168$, $z = 154$, which sum to 7. The secret to solving this equation is realizing that 987,654,321 – 8(123,456,789) = 9. Let 987,654,321= A and 123,456,789 = B. Then, $nA - 8nB = 9n$, where $x = n$ and $y = -8n$. Let $x + y + z = m$. Then, $9n + z = m^3$ and $n - 8n + z = z - 7n = m$. Eliminating z gives $16n = m^3 - m = m(m - 1)(m + 1)$, which is solvable in integers if 16 divides $m(m - 1)(m + 1)$. There are an infinite number of solutions, the one with the smallest positive m being $x = 21$, $y = -168$, $z = 154$, and $m = 7$.

4 The length of the field is 1248 meters, and the strip is 24 meters wide. Let L = length of a field and S = width of the unplowed strip. Then, the area of a field $A_F = 100L$ and the area of the strip $A_S = 2(L + 100)S - 4S^2 = A_F/2 = 50L$, or $2S^2 - (L + 100) S + 25L = 0$. Solving for L gets $L = 2S(50\text{-}S)/(25\text{-}S)$ which has four integer solutions.

S	L
15	105
20	240
23	621
24	1248

The only L whose digits form an increasing sequence is 1248.

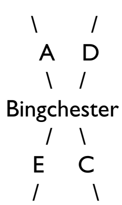
5 The gambler’s probability of throwing a 7 with one standard die and one loaded die is 1/6, the same as if he had two standard dice. Let $p(x)$ be the probability of throwing an x with the loaded die and $P(x)$ be the probability of throwing an x with the standard die. Then, the probability of throwing a 7 is $p(1)P(6) + p(2)P(5) + p(3)P(4) + p(4)P(3) + p(5)P(2) + p(6)P(1)$, but $P(i) = 1/6$ for $i = 1$ to 6 and $\sum p(i) = 1$, so the probability of throwing a 7 is 1/6. Thus, no matter how his die is loaded, the gambler's probability of throwing a 7 is still 1/6.

Bonus The order of the integers 1 through 32, arranged in a circle so that the sum of each adjacent pair is a perfect square, is 1-8-28-21-4-32-17-19-30-6-3-13-12-24-25-11-5-31-18-7-29-20-16-9-27-22-14-2-23-26-10-15-1 (or its reverse). This problem is much easier to solve once you realize that certain combinations must occur; this considerably cuts down the size of a decision tree. Because each integer must contribute to two sums and the only possible sums for 25 through 32 are 36 and 49, the following combinations must occur: (4-32-17), (5-31-18), (6-30-19), (7-29-20), (8-28-21), (9-27-22), (10-26-23), and (11-25-24). Also, we must have (9-16-20), since the only sums that 16 can be part of are 25 and 36, but 20 can be used only once, so we can extend (7-29-20) to (7-29-20-16-9), which we can further extend by adding (9-27-22) to give (7-29-20-16-9-27-22). Now, the only other possibility for 18 is 7, since 36 would require using 18 again, so we can extend further to (5-31-18-7-29-20-16-9-27-22). Now, for 19 we need 6 or 17, but 6 would form a loop; therefore, we have (6-30-19-17-32-4). Finally, 8 cannot be paired with 17 or 28 (already used), so must be paired with 1 extending (1-8-28-21). At this point a manageable decision tree completes the solution.

Computer Bonus. Repeatedly applying the algorithm, if N is even, divide by 2 and if N is odd, multiply by 3 and add 1, to a positive integer N always eventually results in 1. For integers up to 10,000, the number 6171 requires the most steps, reaching a maximum value of 975,400 at step 78 before ending at 1 at step 261.

NEW SUMMER PROBLEMS

1 Bingchester is an important junction where train lines cross thus:



In addition, roads parallel the train tracks. A, C, D, and E represent stations on the lines whose distances from Bingchester by road are: A, 4 miles; C, 7 miles; D, 10 miles; and E, 7 miles. The areas between A, C, D, and E are covered by impenetrable woods so it is impossible for anyone to get from one of these places to another without passing through Bingchester either by road or by train.

An extract from the timetable reads thus:

A dep: 9:15	C dep: 9:10
B arr: 9:23	B arr: 9:27
B dep: 9:25	B dep: 9:30
C arr: 9:44	A arr: 9:38
D dep: 8:55	E dep: 8:58
B arr: 9:26	B arr: 9:22
B dep: 9:29	B dep: 9:25
E arr: 9:53	D arr: 9:56

Trains run every 15 minutes, precisely on time, so that the time of a previous or following train can be determined by subtracting or adding 15 minutes.

The most famous attraction in Bingchester is the Moaning Lisa, hung in the train station. Unfortunately, someone has defaced the picture by adding a beard and mustache. The picture was seen unadorned by several people at 9:25:30, and the damage was discovered at 9:28:30.

Five men are suspected of the desecration, and one is certainly guilty. The five suspects make the following true statements:

Paul: I saw Ron in A at 9:14 and I was in E at 9:52.
Quentin: I was in E at 9:01, and in C at 9:58.
Ron: I was in D at 10:09. I left my bicycle at A.
Sam: I was in C at 8:56, and in D at 10:03.
Ted: I was in A at 9:40, and in E at 8:59.

They all have bicycles which they can peddle at a steady speed of 15 m.p.h. They can take their bicycles on the train, but no one rides anybody else's bicycle. Two of their bicycles were found at Bingchester after the defacing.

Whose bicycles were they? What were the exact movements of all five suspects? Who defaced the Moaning Lisa?

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

2 Solve the following cryptic multiplication, where each different letter represents a different digit: ABCDEF = BCDEFA x M.

—*The Crucible*

3 On an analog watch, in less than half a second after the precise time that the second hand passes one of the twelve hourly marks, the minute hand passes over the hourly hand. If this occurs before noon, at what time do the minute hand and hour hand coincide?

—Source Unknown

4 What is the minimum number of people, born on random days in 1981, that need to be in a room to have at least 50% probability that either there are (at least) two pairs of persons who have the same birthday or there are three (or more) people who share a common birthday or both?

—D.A. Dechman, *TX A '57*

5 What is the minimum number of knights that can be placed on a standard 8x8 chess board, so that every square (including those occupied by knights) is threatened by a knight and what is such a configuration? A square is threatened if a knight can move to that square on its next move. A knight moves two squares in one direction and one square in another direction (perpendicular to first direction) to end up on a square of opposite color. The move can occur even if intervening squares are occupied. Present your answer as an 8x8 grid with 'o' representing an unoccupied square and 'N' representing a square occupied by a knight. Hint: the minimum is less than 16.

—*Amusements in Mathematics*
by H. E. Dudney

Bonus. A rigid, uniform rod one meter long is held leaning against a frictionless, vertical wall at a 30 degree angle to the horizontal by a peg

(Continued on page 45.)

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.*

AL Α '49 **Dodd, Richard P.;** September 11, 2004.
'55 **Lipham, James A.;** May 12, 2010.
AL Β '37 **Kilpatrick, Lewis R.;** April 24, 2007.
'37 **Spence, James R.;** November 13, 2001.
'37 **Witherspoon, John F.;** May 8, 1995.
'39 **Geschwind, Bruce F.;** February 1, 2012.
'42 **Jordan, William D.;** April 3, 2011.
'47 **Swearingen, Robert L.;** February 18, 2010.
'49 **Musick, Victor S.;** February 15, 2012.
'57 **Bercaw, James D.;** February 28, 2012.
AZ Α '49 **Still, Arthur R.;** no details.
'57 **Lohman, Martin O.;** July 26, 2011.
AR Α '38 **Jackson, John R.;** no details.
'54 **Wentz, James L.;** January 11, 1989.
CA Α '48 **Winters, Harry K.;** March 2, 2011.
'58 **Forsen, Harold K.;** March 7, 2012.
CA Β '42 **Hall, Warren A.;** June 24, 1990.
'46 **Gryder, John W.;** January 26, 2012.
CA Δ '43 **Mannes, Robert L.;** no details.
'45 **Wilson Jr., George C.;** March 5, 2012.
CA Ε '56 **Roberts, Sanford B.;** January 18, 1997.
'66 **Randle, Robert E.;** August 30, 2007.
'69 **Davis, Richard W.;** February 27, 2001.
'69 **McLain, Howard M.;** June 30, 1996.
'69 **Root, George W.;** April 17, 2002.
'71 **McAllister, Patrick S.;** January 29, 2011.
'73 **Huang, Christina C-C;** no details.
'73 **McAtee, Lawrence R.;** July 9, 2008.
'77 **Choi, Francis K.H.;** November 18, 1993.
'83 **Brady, David A.;** May 21, 2010.
'86 **Caldwell, Douglas W.;** August 21, 2010.
CA Ζ '38 **Ruth Jr., Leo W.;** February 16, 2003.
'39 **Mascovich, Joseph S.;** October 2, 1996.
'42 **Burson, Thomas W.;** no details.
'44 **Coane, William V.;** March 5, 2007.
'44 **D'Angelo, Elmer M.;** October 12, 1994.
'49 **Johnson, Charles H.;** November 4, 1995.
'49 **Peterson, Jack A.;** March 6, 1996.
'50 **Fisher, Eugene J.;** July 17, 2010.
'50 **McMahon, Howard M.;** October 5, 2008.
'51 **Rodgers, Peter W.;** August 18, 2003.
'55 **Chock, Kenneth J.;** no details.
'55 **Travis Jr., Leonard J.;** August 17, 1998.
'55 **Vadnals, Norman P.;** October 24, 1999.
'57 **Chin, Bing Chung;** December 8, 2009.
'64 **Walsh, Larry R.;** August 7, 2009.
'65 **Bolin, Robert C.;** November 22, 2007.
'69 **McGuirk, James P.;** July 12, 2011.
CA Η '65 **Evans, Jane Gillespie;** December 1, 2011.
CA Θ '08 **Okada, Gary Kazuo;** August 13, 2010.
CA Κ '71 **Ashcraft, Melvyn D.;** May 10, 2008.
CA Ν '59 **Bernick, Robert L.;** February 19, 2008.
CA Τ '93 **Li, John;** November 4, 2010.
CA Υ '83 **Pantiskas, Carl A.;** February 17, 2012.
CO Α '34 **Nelson, Ted W.;** February 23, 2011.
'58 **Vansickle, Gerald E.;** November 13, 2011.
'61 **Coffman Jr., Franklin D.;** August 7, 2011.
'87 **Ash, Daniel I.;** March 3, 2009.
CO Β '47 **Nobles, Wilbur D.;** June 6, 2011.
'54 **Braudaway, David W.;** December 25, 2011.
CO Δ '48 **Zwiep, Donald N.;** April 14, 2012.
CT Β '80 **Pommer, Leslie M.;** March 14, 2009.
DE Α '39 **Healy II, John E.;** November 26, 1996.
DC Β '64 **Faulstich Jr., Albert J.;** October 8, 2003.
'64 **Loiselle, Richard A.;** November 4, 2011.
'68 **Markowski, John V.;** October 3, 2011.
FL Β '72 **Schwarz, Lily T.;** June, 2011.
'90 **Marker, Carl Richard;** March 11, 2012.
GA Α '38 **Brasfield, Joseph D.;** December 7, 1984.
'39 **Thrash, William G.;** July 4, 2011.
'46 **Brearley Jr., Harrington C.;** August 26, 2011.
'46 **Donaldson, Merle R.;** November 11, 2011.
'47 **Smith, Edwin H.;** August 8, 2011.
'48 **Fowler, Edgar T.;** March 22, 2001.
'48 **Richards, Stephen M.;** June 12, 2003.
'49 **Johnson, Willard T.;** January 8, 2012.
'50 **Mahaffey Sr., Daniel E.;** no details.
'52 **Conger, Robert D.;** September 20, 2011.
'52 **Schleich, William T.;** May 6, 2011.
'56 **Anderson, Ray C.;** August 8, 2011.
'69 **Potts, Wallace B.;** June 29, 2006.
'73 **Miller Jr., James D.;** October 10, 2007.
'82 **Stanton, Brock A.;** July 12, 2008.
IL Α '37 **Trachtenberg, Robert;** May 26, 2004.
'37 **Zmeskal, Aldrich;** March 18, 2007.
'42 **Landon, Richard W.;** April 18, 2010.
'42 **Peters, Max S.;** June 20, 2011.
'57 **Norris, James M.;** October 17, 2011.
'58 **McCartney, William B.;** November 5, 2011.
'60 **Healy, John M.;** July 17, 2008.
'61 **Pisterzi, Michael J.;** March 2, 2008.
'63 **Gimnig, Edwin J.;** no details.
'63 **Loubsky, William J.;** no details.
'66 **Levin, Michael A.;** September 26, 2010.
'82 **Sum Jr., Robert N.;** August 6, 2011.
'87 **Erlebacher, Seth A.;** December 16, 2011.
IL Γ '42 **Skaistis, Stanley J.;** 2009.
'47 **Hayford, John W.;** February 5, 2012.
'57 **Mouradian, Edward M.;** April 4, 2009.
IL Ζ '50 **Dehmlow, Louis H.T.;** December 15, 2002.
IN Α '37 **Staley, Ronald W.;** February 15, 2004.
'48 **Nasser, Mitchell;** February 3, 2012.
'48 **Zimmerly, John F.;** no details.
'51 **Fahr, Irvin W.;** March 1, 2006.

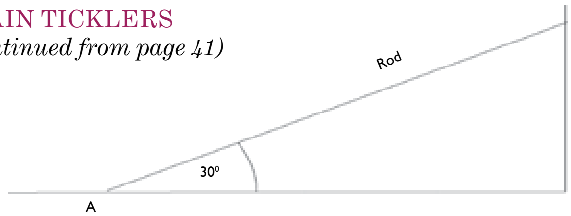
'53 **Gleitz, Jay F.;** October 18, 2010.
'57 **Hokanson, John L.;** May 20, 2011.
'63 **Dallas, Stephen W.;** May 4, 2011.
'65 **Radewan, Clark H.;** December 26, 2011.
'71 **Alexander, Ronald K.;** June, 2010.
IN B '37 **Wischmeyer, Carl R.;** October 7, 2009.
IN Γ '42 **Degnan, Thomas F.;** December 4, 2009.
'45 **Lee, Lawrence H.;** November 7, 2007.
IA A '37 **Harrison, William H.;** November 24, 2004.
'37 **Peck, Robert E.;** no details.
'37 **Warrington, Francis C.;** September 25, 2002.
'42 **Cairns, Jack A.;** no details.
'50 **Schweers, Albin H.;** March 2, 2012.
'60 **Schwenk, Vernon L.;** November 22, 2011.
'74 **Legg, Ted J.;** no details.
IA B '49 **Dempsky, Clarence J.;** May 16, 2009.
'49 **Guetzko, Gene E.;** April 22, 2010.
'49 **Voelckers, William W.;** July 15, 2009.
KS A '37 **Sorenson, Waldemar R.;** January 23, 1997.
'42 **Prior, Roger A.;** October 30, 2011.
'46 **Dresser, Calvin V.;** 2012.
'52 **Dunwoodie, Duane E.;** December 1, 2011.
'55 **Daniels, George A.;** July 30, 2011.
'61 **Whipple, Paul H.;** December 16, 2011.
KY A '58 **May, Aubrey D.;** no details.
KY B '48 **Davis, Ansel L.;** February 4, 2012.
LA A '51 **Gibbs, Robert B.;** May 6, 2010.
'59 **Sturgis, James D.;** no details.
'63 **Cheatham, Bernard L.;** April 25, 2012.
'99 **Boussert, Benjamin Pierre;** 2005.
LA Γ '51 **Barnwell Jr., William A.;** May 20, 2011.
ME A '41 **Bell, Kenneth D.;** June 22, 2004.
MD A '40 **Myers, Arthur K.;** October 28, 2011.
'97 **Monaco, Anthony;** July 3, 2011.
MD B '48 **Lord Jr., Milbourne E.;** April 9, 2012.
'50 **Mueller, Edward J.;** January 16, 2008.
'59 **Jarrell, Edward C.;** March 13, 2012.
'60 **Bonder, Seth;** October 29, 2011.
MA A '37 **Lyman, Richard J.;** August 16, 2009.
'39 **Roszko, Edward;** September 20, 2010.
'41 **Gurney, Gordon T.;** July 20, 2008.
'42 **Ames, William L.;** December 27, 2001.
'47 **Knoll, Daniel W.;** November 22, 2011.
MA B '42 **Knox Jr., Harry E.;** February 2, 2012.
'43 **Hahn, Raymond E.;** January 7, 2012.
'46 **Peirce, William H.;** March 10, 2012.
'47 **Schneider, Herbert A.;** May 6, 2009.
'48 **Baruch, Jordan J.;** October 26, 2011.
'51 **Lenz, Charles E.;** May 8, 2003.
'52 **Howard, George T.;** 2011.
'57 **Crews, John Benjamin;** April 21, 2012.
'63 **Ricketts Jr., Alan W.;** December, 2011.
'66 **Cukor, Peter M.;** February 18, 2012.
MA Δ '45 **Mussoni, Frank L.;** November 26, 2011.
'50 **Shoolman, Alan R.;** September 4, 2010.
'62 **Cox, Richard E.;** February 7, 2012.
MA E '51 **Jannetti, James E.;** March 5, 2012.
MI A '37 **Wills, Harry C.;** April 8, 2011.
'42 **Dent, Wilford C.;** January 22, 2012.
'51 **Crampton, Lee B.;** December 14, 2011.
'51 **Erhart, Donald L.;** February 17, 2012.
'55 **Park, Gerald L.;** no details.
'55 **Rood, John W.;** September 6, 2011.
'57 **Fox, Robert D.;** July 20, 2011.
'57 **Snyder, George E.;** April 1, 2012.
MI B '00 **Kerbleski, Emily Frances;** February 16, 2004.
MI Γ '37 **Klaasen, Gerald;** October 9, 1992.
'37 **Quinsey, William E.;** no details.
'45 **Bouwkamp, Gerald R.;** March 4, 2012.
'46 **Silversmith Jr., Joseph H.;** May 30, 2010.
'48 **Ahlbeck, Richard A.;** April 19, 2012.
'51 **Tendick Jr., Frank H.;** March 21, 2012.
'52 **Miller, Robert H.;** March 14, 2012.
'55 **Lowery, Richard L.;** April 24, 2008.
'65 **Parrish, George D.;** April 26, 2009.
MI E '48 **Harms, William O.;** February 18, 2012.
MI H '43 **Fawcett, John R.;** February 4, 2012.
MN A '35 **Silberman, Edward;** July 5, 2011.
'44 **Hauser, Cavour H.;** January, 2011.
'45 **Thiesse, Elmer E.;** September 12, 2008.
'48 **Maki, Ralph L.;** February 26, 2011.
'55 **Barker, Richard M.;** December 19, 2011.
MS A '50 **Cornish III, Joseph J.;** January 3, 2012.
'68 **Parker, Thomas H.;** September 6, 2010.
MO A '52 **Clemmens, William C.;** September 18, 2010.
'59 **Baker, John N.;** December 25, 2008.
MO B '55 **Miles, John B.;** January 23, 2012.
'64 **Raney, Edward M.;** February 14, 2012.
'68 **Phelps, Richard W.;** no details.
MO Γ '50 **Ochs, Gerard R.;** April 15, 2012.
'86 **Larson, Donald B.;** December 3, 2011.
MT A '61 **Mock, Edward A.;** May 26, 2010.
'02 **Morstad, Blake Walden;** January 1, 2005.
NJ A '48 **Muchmore, Donald E.;** October 24, 2011.
NJ B '45 **Alexander, Henry R.;** March 16, 2012.
'51 **Moravek, Joseph J.;** April 13, 2012.
NJ Γ '40 **Daley, Joseph F.;** September 13, 2010.
'42 **Johnson, Thomas W.;** November 28, 2010.
'48 **Klein, Louis C.;** December 29, 2001.
'55 **Schleicher, Walter R.;** February 9, 2012.
'83 **Hofmann, Peter D.;** December 9, 2011.
NM A '53 **Lunsford, Jesse V.;** February 22, 2011.
'56 **Maggard, Samuel P.;** December 7, 2011.
NY A '41 **Bankoff, Seymour G.;** July 14, 2011.
'48 **Wilson, Richard H.;** January 13, 2011.
'49 **Johnson, Stanley L.;** January 20, 2012.
'56 **Okean, Herman C.;** January 30, 2011.
'63 **Nelson, Richard B.;** May 14, 1997.
NY B '38 **Hovemeyer, William E.;** September 13, 2011.
'42 **Lee, Edward T.;** December 26, 2011.
'43 **Greaves, Robert W.;** April 20, 2011.
'49 **Root, Lawrence E.;** August 16, 2011.
'52 **Boland Jr., Carl D.;** June 27, 2009.
'58 **Vanek, Richard P.;** no details.
'62 **Bender, Clifford E.;** August 8, 2011.
NY Γ '37 **Stearns, Thornton;** January 6, 2005.
'43 **Wooding, Robert R.;** April 11, 2012.
'50 **Roderick Jr., Charles;** March 25, 2012.

'52 **Horton, John T.;** November 30, 2010.
'53 **Freeman, David R.;** April 29, 2011.
'53 **Hartfield, Richard A.;** March 13, 2010.
NY Δ '34 **Corson, Dale R.;** 2012.
'43 **Allen, Harry C.;** January 3, 2012.
'44 **Haines, Lawrence A.;** August 5, 2003.
NY Ε '44 **Lofaso, Anthony J.;** July 3, 2011.
'47 **Hansell, Paul D.;** December 13, 2011.
'59 **Burns, Gilbert;** 2012.
NY Ζ '44 **Jacobsen, Fred M.;** June 7, 2004.
NY Η '40 **Savage, Norton;** February 7, 2012.
'45 **Laskin, Irving;** August 27, 2009.
'50 **Oppenheimer, Robert M.;** October 16, 2011.
NY Θ '53 **Gale, Earl H.;** April 13, 2010.
NY Ι '41 **Yalow, Rosalyn S.;** May 30, 2011.
NY Κ '44 **Van Ness, Hendrick C.;** November 6, 2008.
'47 **Kirkpatrick, Edward T.;** November, 2007.
NY Μ '60 **Buckley, Joseph R.;** April 9, 2012.
'82 **Garde, Kenneth E.;** February 26, 2010.
NY Ρ '82 **Polster, Daniel J.;** August, 2010.
NC Α '50 **Smetana, Frederick O.;** May 27, 2011.
'53 **Baker, H. William;** October 12, 1999.
NC Β '37 **Star, Joseph;** December 16, 1998.
NC Γ '63 **Husa, Gary W.;** October 10, 2010.
ND Α '57 **Ingerson, Barry W.;** December 28, 2009.
OH Α '37 **Zavesky, Robert J.;** July 28, 2010.
'43 **Korach, Alfred R.;** February 3, 2011.
'55 **Armstrong, Jack Lionel;** February 10, 2012.
'84 **Ganzer, Keith M.;** January 29, 2012.
OH Β '40 **Cunningham, William J.;** August 1, 2005.
'47 **Lippert, Ralph E.;** December 15, 1994.
'51 **Ellert Jr., Frank J.;** January 14, 1992.
OH Γ '36 **Craig, Joseph F.;** no details.
'37 **Wise, Harold F.;** January 30, 2002.
'40 **Wendschuh, Walter C.;** March 27, 2012.
'41 **Caldwell, Henry G.;** December 4, 1998.
'43 **Shultheis, Clarence D.;** December 25, 2011.
'43 **Smith, Andrew N.;** November 27, 2009.
'47 **Aronoff, Milton;** no details.
'49 **Best, William E.;** August 26, 2005.
'54 **Byrer, Thomas G.;** May 9, 2011.
'62 **Etter, Charles E.;** August, 2010.
'66 **Blaser, Dwight A.;** July, 2007.
'68 **Roche, Robert E.;** December 11, 2011.
'74 **Scott, James R.;** July 7, 2011.
OH Θ '53 **Thomas, Richard F.;** August 9, 2011.
'67 **Goffee, James A.;** October 17, 2005.
OH Ι '57 **Stahl, John P.;** October 12, 2010.
OH Κ '49 **Stevenson, Leroy M.;** October 22, 2003.
OK Α '61 **Sharp, William R.;** February 29, 2012.
OR Α '37 **Peck, Eliot R.;** December 22, 2007.
'48 **Edgerton, Roy C.;** June 12, 2011.
PA Α '39 **Helwig, Ralph W.;** October 21, 2007.
'43 **Davy, Samuel J.;** March 13, 2012.
'65 **McGowin, Charles R.;** January 22, 2011.
PA Β '40 **Pergrin, David E.;** April 7, 2012.
'43 **Burkhart, Edsel J.;** April 25, 2006.
'51 **Sinfelt, John H.;** May 28, 2011.
'53 **Polleck, Richard E.;** January 17, 2012.
'58 **O'Brien, Donald J.;** May 23, 2010.
PA Γ '37 **Shull, Clifford G.;** March 31, 2001.
'38 **Winslow, George H.;** August 21, 2008.
'49 **Charpie, Robert A.;** October 13, 2011.
'51 **Sverdrup, Edward F.;** October 20, 2011.
PA Δ '51 **Cutler, Eli;** August 22, 2003.
'51 **Hochschild, Edgar F.;** April 8, 2011.
'55 **Snyder, Richard A.;** July 15, 2011.
PA Ε '39 **Sawyer, Herbert A.;** February 8, 2010.
'52 **Boorujy, Robert H.;** April 12, 2011.
PA Ζ '35 **Moors, August Joseph;** no details.
'48 **Goodwin, David P.;** no details.
'48 **Toor, Herbert L.;** July 15, 2011.
'56 **Turner Jr., George H.;** no details.
PA Η '44 **Strange, Charles A.;** September 15, 2001.
'53 **Larrabee, Robert D.;** no details.
PA Ι '51 **Porter, William C.;** December 6, 2011.
SC Α '47 **Skinner, Norman W.;** no details.
'52 **Lefort Jr., Henry G.;** May 4, 2011.
'60 **Coleman III, Forrest H.;** March 25, 2012.
'61 **Welch III, Thomas Cooper;** April 18, 2012.
SC Β '50 **Palmer, Thomas A.;** September 26, 2011.
SC Γ '47 **Graves Jr., Charles B.;** March 29, 2011.
'49 **Wannamaker III, William W.;** September 23, 2006.
'53 **Hucks Jr., Robert P.;** October 12, 2006.
'86 **Schrump, Erik Jon;** March 31, 2012.
SD Α '49 **Brich, Clair R.;** March 9, 2011.
'49 **Krogstrand, Kermit Allen;** March 30, 2009.
'80 **Huether, William J.;** October 22, 2008.
'80 **Williams, Bruce H.;** no details.
SD Β '40 **Dyson, John D.;** no details.
TN Α '42 **Wagner, Joseph P.;** December 10, 2000.
'47 **Hutto, John F.;** September 25, 2000.
'51 **Naundorf III, Charles H.;** September 2, 2007.
'54 **Paulus, James E.;** April 11, 2012.
'70 **Green, Ronald F.;** October 26, 2011.
'88 **Leonetti, Netti E.;** no details.
TN Β '70 **Shultz, Frances R.;** December 4, 2011.
TN Ε '91 **Stephens, Carol Elizabeth;** July 30, 2011.
TX Α '39 **Gustafson, Wilbur E.;** March 1, 2006.
'46 **Reed, Robert L.;** January 8, 1988.
'48 **Schryver, Edwin J.;** no details.
'48 **Tudzin, Nathan;** September 5, 2010.
'52 **Jones, Morris B.;** January 6, 2012.
'58 **Greenstreet Jr., Wilbur H.;** April 29, 1997.
'58 **Larkam, Charles W.;** no details.
'58 **Pugh, J. Dwight;** March 27, 2012.
TX Β '42 **Curry, James K.;** August 18, 1995.
'50 **Malone, Billy C.;** September 17, 2011.
TX Γ '45 **Rich, Hershel M.;** February 17, 2012.
'56 **Davis, Lionel E.;** no details.
'57 **Paxson Jr., Ernest B.;** March 29, 2012.
TX Δ '42 **Hardie III, Bradford;** October 23, 1999.
'43 **Scott, Roger P.;** November 6, 1992.
'49 **Norfleet, Guy R.;** January 7, 2011.
'52 **Waggoner, Raymond C.;** January 30, 2012.
'59 **Lohman, Tommie Edward;** February 4, 2012.
'74 **Ognoskie, Jimmy W.;** no details.
TX Ε '41 **Prengle, H. William;** February 15, 2005.

TX Z '68 **Tarte, Robert D.;** March 1, 2007.
TX H '79 **Truitt, G. Austin;** July 14, 2011.
TX Θ '83 **Sype, Teresa T.;** April 15, 2011.
TX I '79 **Strava, Thomas M.;** November 12, 2011.
VA A '42 **McDaniel, Robert S.;** February 14, 2012.
'43 **Smith, Emerson W.;** April 24, 2012.
'44 **Moore III, Clarence P.;** December 4, 2005.
'46 **McKenney, Malcolm S.;** no details.
'47 **Connair, Paul H.;** September, 2009.
'49 **Kite, Jacquelin B.;** December 24, 2010.
VA B '37 **Cauley, Philip W.;** no details.
'45 **Doerschuk, Albert P.;** December 31, 2006.
'48 **Hughes Jr., Stevens;** October 28, 1999.
'48 **Jordan, Robert E.;** August 24, 2011.
'49 **Grimsley, W. Clayton;** August 26, 2009.
'49 **Watkins, John C.;** February 13, 2001.
WA A '39 **Alexander, George W.;** December 19, 1999.
'44 **Erikson, Jay A.;** April 19, 2012.
'49 **Corwin, Patricia B.;** September 13, 2011.
'49 **Tamada, Henry S.;** June 26, 2011.
'52 **Powell Jr., David T.;** May 1, 2007.
'53 **Knudson, Rodney O.;** November 23, 2011.
'56 **Crowe, Clayton T.;** February 5, 2012.
'60 **Packard, Kerry;** December 23, 2009.
WA B '37 **Slate, Herbert B.;** February 6, 1998.
'42 **Langdon Jr., Robert S.;** January 30, 2012.
'56 **Eichelberger, Frank;** December 27, 2010.
WV A '37 **Sperow, Leon H.;** May 23, 2009.
'73 **Claypool, James G.;** no details.
WI A '37 **Wallace, Everett C.;** July 28, 1998.
'39 **Huppler, John J.;** December 8, 2011.
'44 **Dodd, Richard A.;** November 18, 2011.
'44 **Garside, Wayne H.;** February 3, 2012.
'48 **Petrie, Willard Channing;** September 12, 2004.
'63 **Molander, Roger C.;** March 25, 2012.
WI B '37 **Weber, John H.;** October 24, 2010.
'46 **Meyer, John R.;** December 30, 2010.
'59 **Determan, James H.;** December 23, 2011.

BRAIN TICKLERS

(Continued from page 41)



at point A (where the stick touches the ground) on a frictionless, horizontal surface. If the peg is suddenly removed, what is the horizontal speed of the center point of the rod as it passes point A?

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

Computer Bonus. In how many ways (order matters) can 14 married couples be seated in chairs numbered consecutively 1 to 28 about a round table in such a manner that there is always one man between two women and none of them is ever next to his own wife?

—100 Great Problems of Elementary Mathematics by Heinrich Dorrie

Postal mail your answers to any or all of the Brain Ticklers to **Curt Gomulinski, Tau Beta Pi, P. O. Box 2697, Knoxville, TN 37901-2697,** or email to *BrainTicklers@tbp.org* plain text (no HTML, no attachments). The cutoff date for entries to the Summer column is the appearance of the Fall *Bent* during early October. The method of solution is not necessary, unless you think it will be of interest to the judges. We also welcome any interesting new problems that may be suitable for use in the column. The Computer Bonus is not graded. Curt will forward your entries to the judges, who are: **H.G. McIlvried III,** *PA Γ'53*; **D.A. Dechman**, *TX A'57*; **J.L. Bradshaw**, *PA A'82*; and the columnist for this issue,

—F.J. Tydeman, *CA Δ '73*

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SPOTLIGHT

White House Call To Women
The White House Council on Women and Girls has called on more women to seek science, technology, engineering, and math careers in a report that studied the state of women's employment.

The council found that those working in STEM fields earn about a third more than women in other jobs. The council wrote that it's "especially disconcerting" that women make up only 25% of the STEM workforce, which is expected to grow by nearly 20% over the rest of the decade."

•A new report from the Institute for Women's Policy Research found fewer women nationwide are getting degrees in STEM fields. Although women in such careers will earn one-third more than those in other jobs, the number of women nationwide attaining STEM associate degrees has dropped 26 percent since 2000.

Cyber-Security Hiring
As computer threats become more coordinated and complex, Boeing and other defense contractors are bolstering their cyber-security staffs. The *Los Angeles Times* reported, "A generation ago, the brightest engineers in the aerospace industry were typically recruited from Ivy League universities and other prestigious institutions." Now, "contractors are broadening the hiring pool as they hunt for savvy young computer whizzes at local colleges."

Florida Poly Created
As Florida's other universities are about to see their coffers drained by $300 million in state funding, Gov. Rick Scott has signed a bill creating Florida Polytechnic. Acknowledging worries about a financial commitment amid a sluggish economy, Scott said Florida Polytechnic's focus on science, technology, engineering and math will "generate a positive return."

In a written statement, the governor told taxpayers the new university will not put extra financial strain on the state university system. Florida Polytechnic will receive millions of dollars in funding previously allocated to USF Polytechnic, he said.

The Tampa Tribune said: "Under the legislation, USF Poly moves toward elimination starting June 30 and Florida Polytechnic is established July 1. The accelerated process means the new campus will need to quickly build up infrastructure to operate outside the USF system. That means creating a board, hiring a president and building an administration, not to mention creating an alumni network, endowment fund and fundraising operation—all the defining features of a standalone university."

Chinese Students Trend
The number of Chinese students enrolling at Michigan State University has soared by more than 400% during the last four years, reports the *Detroit Free Press.* This mirrors a national trend that experts say is attributed to increasing personal wealth and limited higher education opportunities in China. At the University of Michigan, enrollment of Chinese students "grew 19% from 2010 to 2011. And at Michigan Technological University, only in-state enrollment and students from Wisconsin outpace the number of students from China."

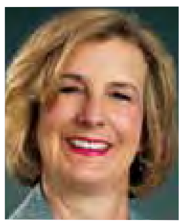
PEOPLE

L. Rafael Reif, Ph.D., *Massachusetts Beta '73,* has been named as the 17th president of MIT. The institute's provost since 2005, he led the design and implementation of the strategy that allowed MIT to weather the global financial crisis, and drove the growth of MIT's global strategy. Dr. Reif promoted a major faculty-led effort to address challenges around race and diversity; and led MIT's role in edX, the recently announced partnership between MIT and Harvard University. He has been at MIT since 1980 and is currently professor of emerging technology.

Photo: Dominick Reuter

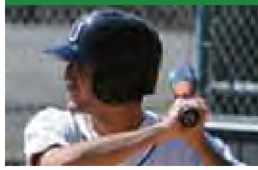
Kenneth F. Galloway, Ph.D., *Tennessee Beta '62,* has been chosen as president-elect of the American Society for Engineering Education. He is Vanderbilt University school of engineering dean and a professor of electrical engineering. He will assume the presidency in June 2013. Galloway's past service to the ASEE includes chair of the engineering deans council public policy pommittee.

Cheryl B. Schrader, Ph.D., *Indiana Delta '84,* has become chancellor of Missouri University of Science and Technology. She was associate vice president for strategic research initiatives and former engineering dean at Boise State University. Schrader is one of only a few women engineers who currently serve as university chancellors or presidents across the country and the first female chancellor for Missouri S&T.



P. Barry Butler, Ph.D., *Iowa Beta, '79,* has appointed one of his former colleagues to take his old job as engineering dean at the University of Iowa. He is chemical engineering professor **Alec B. Scranton,** Ph.D., *Iowa Beta, '85,* who had been interim dean since Butler was appointed the school's provost.

Jon A. Wickert, Ph.D., *California Alpha '85,* has been named as senior vice president of Iowa State University and provost of the college of engineering. He is currently engineering dean.



Connecticut Beta

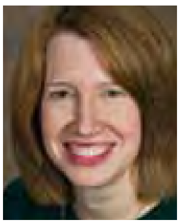
G. Michael Howard, Ph.D, '57, is professor emeritus at the University of Connecticut, having joined the newly-formed chemical engineering department in 1961. Posts included associate dean of engineering, acting department head, member of the university senate, and chair of the athletic advisory committee. National posts included chairing the AIChE national program committee on education.

DC Alpha

Legand L. Burge III, Ph.D, '92, is chief technology officer of IT firm LL Burge & Associates in Washington, DC. His areas of interest include distributed/high-performance and wireless/mobile systems.

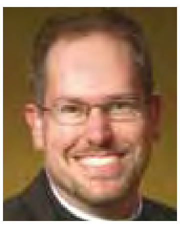
Maryland Alpha

Anne Skaja Robinson, Ph.D, '87, has been named chair of the department of chemical and biomolecular engineering at Tulane University. A former TBΠ Fellow, She had been on the faculty at the University of Delaware for 14 years and is a researcher in biochemical engineering.



New York Kappa

Richard R. Andre, '96, was ordained a Roman Catholic priest in New York City on May 19, as a member of the Missionary Society of St. Paul the Apostle (The Paulist Fathers). He now serves as associate pastor of Blessed John XXIII University Parish at the University of Tennessee in Knoxville. Rich was a 1997 TBΠ Laureate and an Engineering Futures Facilitator from 1998 to 2005. He invites anyone visiting TBΠ headquarters to stop by his office, only six blocks away.



New York Zeta

Charles H. Forsberg, Ph.D, P.E., '66, has retired from Hofstra University where he was an associate professor, teaching mechanical engineering and computing. He has also been active in the Long Island section of ASME.

North Dakota Alpha

John W. Craft, '67, has retired from Boeing, where he was a technical fellow in space and communications. Craft joined Boeing in 1967 and is now farming in Spiritwood, ND.

Ohio Gamma

James M. Gaughan, '84, has joined air traffic flow management (ATFM) provider Metron Aviation to lead advanced research and engineering services. He came from Lockheed Martin, where he was most recently program director of a $320 million program to secure public transportation in New York City by providing Integrated Electronic Security Systems (IESS).

Texas Kappa

Michael Oluwagbemi, '05, became a Professional Engineer in Texas in December 2011. A project manager at WorleyParsons Group Inc, the 2004 TBΠ Scholar also holds a project management certification from the Project Management Institute.

Puerto Rico Alpha

Concepcion N. Burgos-Rubio, Ph.D, '89, and Maria Guntin-Burgos celebrated their 25th anniversary on December 20, 2011 in Mayaguez, PR.

Washington Alpha

Terrence K.H. Wong, '75, recently retired from the U.S. State Department after 46 years of combined U.S. Army and U.S. Government service. He received the State Department Secretary's Career Achievement Award. His last assignment was as chief of the East Asian and Pacific Affairs Division at the Office of Area Management, Bureau of Overseas Buildings Operations.

Wisconsin Delta

Carol M. Smith Cayo, '12, and **Austin A. Meier,** '12, have helped the university gain the first ever, back-to-back national honor of having Academic All-Americans in the same sport. Cayo was named Academic All-American of the Year for Division III women's basketball (the only one in the country). Last year, Meier received the same honor for men.

Write Your Own Alumnus 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 *alumnote@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

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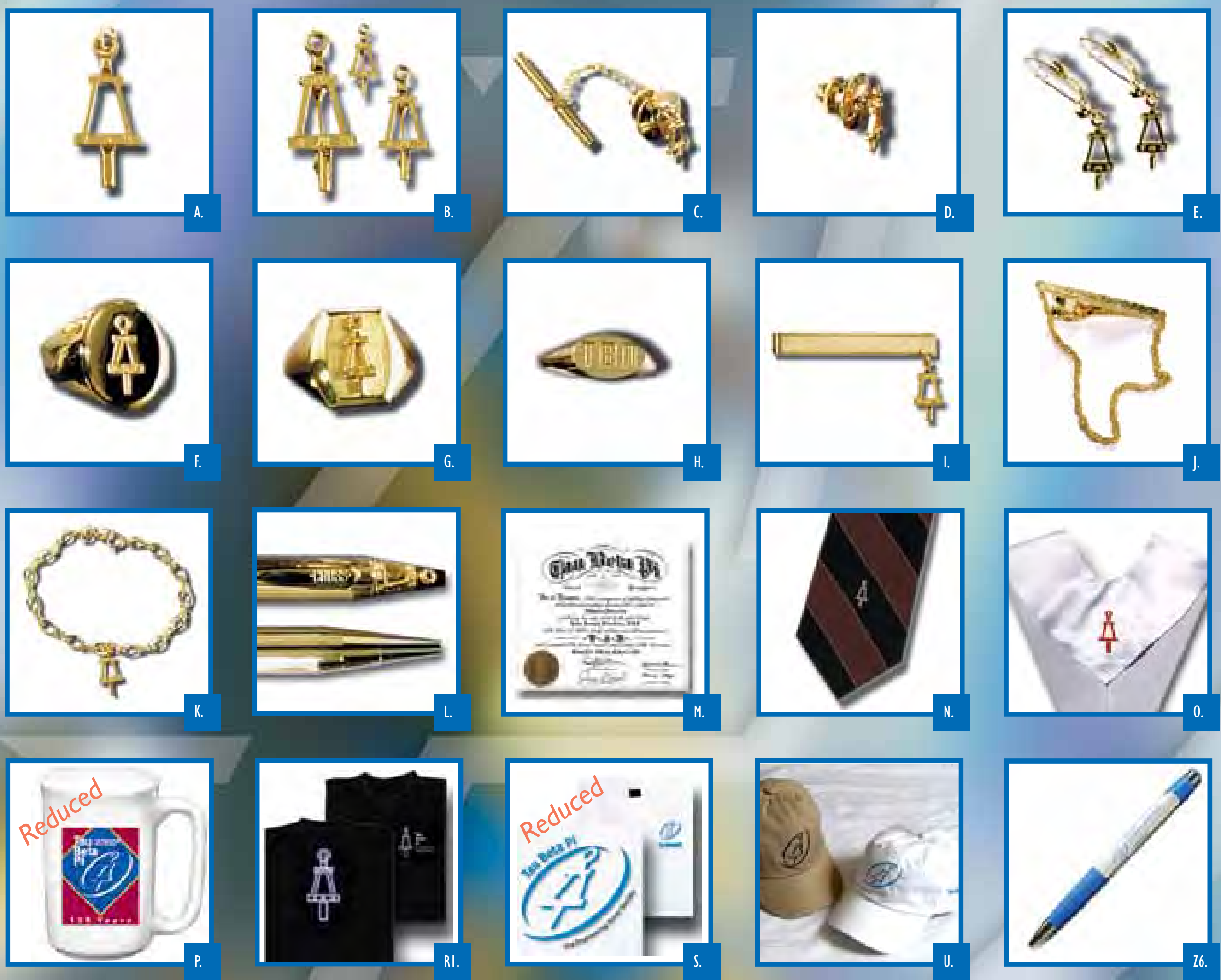

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