Magazine of the Society of Women Engineers

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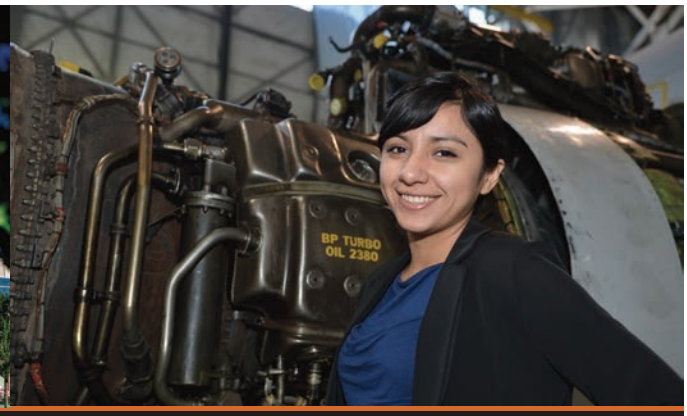
SPRING 2015

SWE at sixty-five: women engineers you should know

Reflections on SWE's 65th Anniversary • Bullying at Work • Annual Literature Review



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FEATURES

SWE at sixty-five: women engineers you should know

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ABOUT SWE:
The Society of Women Engineers (SWE), founded in 1950, is a not-for-profit educational and service organization. SWE is the driving force that establishes engineering as a highly desirable career aspiration for women. SWE empowers women to succeed and advance in those aspirations and be recognized for their life-changing contributions and achievements as women engineers and leaders.

Magazine of the Society of Women Engineers
SWE

DEPARTMENTS

WEBINARS

SWE is committed to offering professional development programs that cater to the Society's diverse membership. Presented by experts, these programs span the topics of innovation, integrating life and work, and management. Following is a sampling of webinars SWE is offering in 2015. If you miss the initial presentations, you can still view them under the Learning section at www.SWE.org. Visit the website for more information on upcoming webinars.

▲ **Voices from the Field: Improving Your Outreach Efforts via *FIRST*® Collaboration**
Jan. 28
Presenter: Carla Proulx, FIRST

▲ **I Have a Mentor — Now What Do I Do?**
Feb. 3
Presenter: Alaina Levine, Quantum Success Solutions

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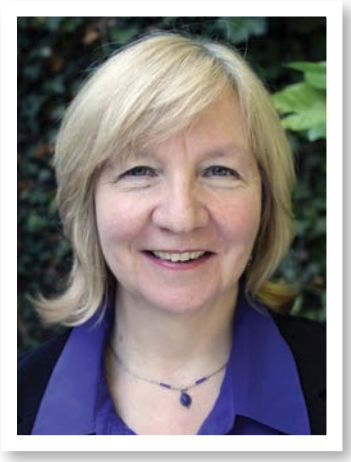
SWE at 65: Telling the Stories of Women Engineers

Women's History Month, SWE's 65th anniversary, and our annual review of the social science literature on women in engineering all figure prominently in this issue. This year's theme for Women's History Month is "Weaving the Stories of Women's Lives." How well this corresponds with our commemoration of the Society's anniversary, as we examine both the "SWE story" and some of the individual lives that contributed to SWE's narrative and the larger story of women in engineering. And while SWE is celebrating an anniversary, so, too, is the women's history movement, as this year marks the 35th anniversary of the National Women's History Project.



The Society's first president, Beatrice Hicks, P.E., was convinced that SWE would grow into "a large and powerful organization." It was a bold statement to make back in 1950, when the fledgling organization's membership was quite small and based primarily on the East Coast. In the context of Hicks' vision, editorial board member Betsy Homsher looks at key aspects of SWE's growth and development. Turn to page 24 to learn more.

In honor of the 65th anniversary, we also celebrate the contributions of women who have carried out SWE's mission with little fanfare or recognition. Please see "SWE at 65: Women Engineers You Should Know," beginning on page 28. Our overview is by no means definitive — that would require much more than a single article or book. Some of the women we highlight may be familiar because their accomplishments in the discipline have afforded a certain stature within the engineering community, but they are mostly far removed from fame in the conventional meaning of the word. Other women are quite unknown beyond a small sphere, but their contributions are nonetheless significant. Please enjoy our telling of their stories, our "weaving" of their lives. As we honor their lives, we honor the lives and contributions of all those who have advanced the Society's mission.

Looking at today's workplace, contributor Seabright McCabe addresses a phenomenon that has gained increasing attention. Her article, "Bullying at Work: Evolving Toward Zero Tolerance," discusses the impact of bullying behavior in the overall work environment, and efforts to blunt it both in the United States and overseas. See page 36.

Our annual review of the social science literature on women in engineering, and more generally, science, technology, engineering, and math, has been SWE's gift to the profession for more than a dozen years. Interestingly, in its early years, the Society gathered data on prospective SWE members and furnished it to governmental agencies to develop authoritative information on women in engineering because there was so little knowledge available.

This year's analysis of the literature takes into consideration recent and controversial claims that sexism and discrimination are not factors in the low numbers of women in academic science; rather, inequalities both subtle and blatant do not exist, and women opt out as a matter of personal choice. Yet, framing the low numbers of women as a matter of "choice" conveniently ignores the obstacles posed by bias and discriminatory practices and attitudes, and undermines efforts to examine and change structures and institutions. Turn to page 40 for the analysis; the bibliography begins on page 53.

How well this corresponds with our commemoration of the Society's anniversary, as we examine both the "SWE story" and some of the individual lives that contributed to SWE's narrative and the larger story of women in engineering.

Returning to Beatrice Hicks' assertion — that SWE would grow into a "large and powerful organization" — her vision has come to fruition, due to the combined efforts of many members and supporters.

Anne M. Perusek

Director of Editorial & Publications
anne.perusek@swe.org

SWE's 65th Anniversary

As we celebrate our 65th anniversary this year, we can look back over the decades to see numerous examples of how SWE has supported women in their efforts to build meaningful careers and satisfying lives.

Recently, *SWE Magazine* received a typed letter via regular postal mail from a SWE founding member, who wrote to us during the East Coast snowstorms this winter. ■

It's cold and it's snowy … I had received the current SWE Magazine, and I read through it … The magazine is really very handsome, the articles were mostly interesting, but one thing is really bewildering me: One page titled SWE Anniversaries — Celebrating 50 years. What are they celebrating? An old friend from Connecticut sort of disappeared some years ago. She was a talented violist and there were about a half-dozen SWE ladies in our group, none of whom are still alive except me. Our members are still operating; I still receive information. Karen Horting's article about the SWE on John Oliver's program was just terrific. My son had called me — we both are fans — and I passed the word along.

I often wonder how many of us really original SWE-ers are around. Our originals were largely from New York, New Jersey, and Philadelphia, and I remember them spreading across the country. I think that I am the 13th SWE member — isn't that interesting?

Sincerely,
Evelyn Fowler
Stamford, Connecticut

Traditionally, the Readers Forum has provided an opportunity to respond to articles or comment on topical issues. Communications are printed on a space available basis; we reserve the right to edit for clarity or to meet space requirements. All opinions are those of the writer and in no way the responsibility of the Society of Women Engineers or *SWE Magazine*.

Send comments, opinions, or observations to swemag@swe.org or by regular mail to: Letters, *SWE Magazine*, Society of Women Engineers, 203 N. La Salle St., Suite 1675, Chicago, IL 60601.

Yet another way to engage with the material in *SWE* is through the Society's social media — Facebook, Twitter, LinkedIn, and Tumblr. Social media is a space that allows like-minded individuals a way to discuss issues and contribute to the conversations started in *SWE Magazine*.

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"Weaving the Stories of Women's Lives"

Marking 35 years of National Women's History Month celebrations in the United States, this year's honorees are women whose work has helped secure other women a place in the historic record.

By Sandra Guy, SWE Contributor

Women's stories — their individual voices, unique experiences, and firsthand accounts of their sacrifices — provide the unifying theme of the month of March and the year 2015: National Women's History Month and the 35th anniversary of the women's history movement, respectively.

"Accounts of the lives of individual women are critically important because they reveal exceptionally strong role models who share a more expansive vision of what a woman can do," according to the National Women's History Project, a Santa Rosa, California-based nonprofit educational organization dedicated to providing information and educational materials that celebrate women's diversity and accomplishments.

The history project celebrates women's stories because they can encourage girls and young women "to think larger and bolder, and give boys and men a fuller understanding of the female experience," according to the project's mission statement.

Underscoring this year's theme

The project's nine honorees this year have written, co-authored, or edited more than 60 books that the National Women's History Project says have collectively contributed to "writing women back into history." The honorees give voice in their unique ways that reflect their places in history dating back to the 1800s. They are:

- **Delilah L. Beasley** (1867-1934) was the first African-American woman to be regularly published in a major metropolitan newspaper and the first author of African-Americans' history in California. Her weekly column for the *Oakland (California) Tribune* gave readers a positive picture of the black community and proved a powerful force behind California's passing its first anti-lynching legislation.
- **Gladys Tantaquidgeon** (1899-2005), co-founder of the oldest American Indian-owned museum in the United States, expert in preserving and reviving traditional Native American practices, and advocate for struggling and imprisoned Native American women. Her collected tribal records and documents proved critical in the Mohegan Tribe's decades-long campaign to gain federal recognition.

"Knowing women's achievements challenges stereotypes and upends social assumptions about who women are and what women can accomplish today." — National Women's History Project

- **Eleanor Flexner** (1908-1995) became a pioneer in the field of women's studies with her 1959 book, *Century of Struggle: The Woman's Rights Movement in the United States*. Her research linked women's work to win the vote to other 19th- and 20th-century social, labor, and reform movements.
- **Polly Welts Kaufman, Ph.D.** (1929-present), a teacher who became a civil-rights activist during an era of school desegregation, ensured that public schools had books by African-American authors and on African-American culture and history. She wrote books and articles on women's history, and was a project director and principal researcher, establishing the Boston and the Portland, Maine, women's history trails.
- **Lynn Sherr** (1943-present), broadcast journalist and author whose award-winning coverage of health care and reproductive rights earned her Planned Parenthood's Margaret Sanger Award. Sherr also helped create calendars filled with primary source documents of women's history before and during the second wave of the 20th century women's movement.
- **Judy Yung, Ph.D.** (1946-present), documented the immigration history of Angel Island and the life stories of the Chinese American women there. As a second-generation Chinese American born and raised in San Francisco's Chinatown, she dedicated her life to reclaiming the history of Chinese Americans.
- **Darlene Clark Hine, Ph.D.** (1947-present), helped establish a doctoral field in comparative black history at Michigan State University based on her focus on black women "who remained at the very bottom of the ladder in the United States."
- **Holly Near** (1949-present) is a founder of what has become known as "women's music," focusing on progressive activist themes. Near was one of the first women to create an independent record company.
- **Vicki L. Ruiz, Ph.D.** (1955-present), is the first Latina historian inducted into the American Academy of Arts and Sciences, as her scholarship and leadership helped shape the field of Chicana history. Dr. Ruiz has published more than 50 essays and 12 books about Latinas and their history in the United States. ■

The National Woman's Party and the Fight for Women's Rights

Reinvigorating the struggle for women's rights at a critical time, the National Woman's Party helped bring about woman suffrage as well as introduce the Equal Rights Amendment.

By Anne Perusek, SWE Director of Editorial and Publications

SEWALL-BELMONT HOUSE

Positioned in front of the White House, NWP members burned copies of President Wilson's speeches, challenging the inconsistency between his support for democracy overseas, but failure to embrace equality for women at home.

Slightly more than 100 years ago, March 3, 1913, was the eve of Woodrow Wilson's inauguration as 28th president of the United States. By no coincidence, it is also the date of one of the largest women's rights parades in the country. Sixty-five years and two to three generations earlier — in 1848 — the first known national women's rights convention had been held in Seneca Falls, New York.

By this point, trailblazers such as Elizabeth Cady Stanton and Susan B. Anthony had died. Progress on obtaining the right to vote was very slow. On March 3, 1913, between 5,000 and 8,000 supporters of woman suffrage marched down Pennsylvania Avenue, from the Capitol to the White House, demanding that women have the right to vote. Many of the onlookers harassed and physically attacked the marchers. They threw lit cigar butts, pushed and shoved the marchers, and tossed verbal insults. Despite having granted appropriate permits for the parade, the Washington, D.C., police force did nothing to protect the marchers, nothing to stop the attackers. At least 200 marchers were injured. Army troops had to be called in from Fort Myer to stop the violence.

The above transpired as Woodrow Wilson's inauguration train was arriving at Union Station. An estimated half-million people were witnessing the parade or participating in the violence against the marchers, rather than greeting the new president. The next day, the inauguration took place, and by then the woman suffragists had gained considerable publicity and sympathy. As a result of the public outcry, there was an investigation into the Washington, D.C., police force that led to the expulsion of its chief.

PROVIDING CONTEXT

The above story is just one of many from the long struggle for women's rights in the United States. That it is not well known underscores the importance of expanding our knowledge and understanding of history, and speaks to the need to "write women back into history," as the National Women's History Project

SEWALL-BELMONT HOUSE

Alice Paul, founder of the National Woman's Party, defined much of the strategy in the final years running up to the passage of the 19th Amendment, granting women the right to vote. Of the struggle, she was quoted in the March 5, 1919, issue of *The New York Globe*: "When men are denied justice, they go to war. This is our war, only we are fighting it with banners instead of guns."

SEWALL-BELMONT HOUSE

The Sewall-Belmont House and Museum is the oldest structure on Capitol Hill, now a premier women's history site. Located at 144 Constitution Avenue, N.E., Washington, D.C., the museum is open for tours on Fridays and Saturdays at 11 a.m., 1 p.m., and 3 p.m. For more information, please visit http://www.sewallbelmont.org/

has proclaimed. In fact, this year marks the 35th anniversary of the women's history movement.

A significant part of the chronicle of women's rights is preserved in Washington, D.C., in the Sewall-Belmont House and Museum located on Capitol Hill. A handsome brick structure that dates back to 1799, the building became home to the National Woman's Party (NWP), whose leaders organized the March 3, 1913, parade and eventually broke away from the long-standing and more conservative woman suffrage organization. The NWP is credited with infusing new energy in the drive to woman suffrage, as well as the Equal Rights Amendment (ERA). The Sewall-Belmont House served as the party's headquarters during the years it worked on the ERA.

The key figure in establishing the NWP and devising tactics such as the March 3 parade was Alice Paul. She had spent time in England, supporting suffragist activities there and becoming friends with the Pankhurst family — militant activists whose strategy was to "hold the party in power responsible." Adopting a similar approach in the United States, Paul and her cohorts led many more suffragist parades, speaking tours, and demonstrations in front of the White House, as well as other attention-grabbing activities. Members of the NWP were arrested and imprisoned, where they went on hunger strikes and were force-fed.

The party also established its own newspaper, *The Suffragist*, which documented their activities and included illustrations by political cartoonist Nina Allender.

A FIRST STEP

After many long years of struggle, the 19th Amendment granted women the right to vote. It passed the U.S. Senate and House of Representatives in May-June 1919 and was signed into law Aug. 26, 1920. Paul and the NWP viewed this as only one important step in the march toward full equality. At the NWP convention the following February, members began a campaign to ensure full equality for women in the United States and throughout the world.

In July 1923, Alice Paul presented a draft of the ERA. It was the 75th anniversary of the 1848 Seneca Falls Convention — the first national convention on women's rights. Less than six months later, in December 1923, Sen. Charles Curtis (Kan.) and Rep. Daniel Anthony (Kan.) introduced the amendment in Congress for the first time. Nearly 50 years later, it was finally approved by the Senate on March 22, 1972, and sent to individual states for ratification. To become law, ratification by 38 states was required. When the deadline of June 30, 1982, expired, the amendment was three states short. It was defeated by a well-organized and well-funded campaign that appealed to fears that women would no longer be "feminine," etc. While the language had been modernized, at its roots the opposition to the ERA was not much different from the initial opposition to woman suffrage. Some of the arguments against the ERA included that it would disrupt the relationship between men and women as understood in some interpretations of the Bible, as well as prevent husbands from supporting their wives. The ERA is yet to be passed, though currently there is momentum to reintroduce it.

WOMEN'S HISTORY MONTH

On March 1, 2015, President Obama issued a proclamation recognizing Women's History Month, International Women's Day (March 8), and the numer-

NATIONAL ARCHIVES

Delegations from Wisconsin and Oregon prepare to enter the lineup for the March 3, 1913, parade, held on the event of President Woodrow Wilson's inauguration.

SEWALL-BELMONT HOUSE

Cartoonist Nina Allender's illustrations were an integral part of *The Suffragist*. Upon the passage of the 19th Amendment in 1920, her rendering of "Victory" appeared in the newspaper.

ous contributions made by women (see page 10D). As the 44th president of the United States, his proclamation was in keeping with recent U.S. presidents and previous terms of his presidency. These proclamations should be understood as more than polite sentiments — they are a recent development on the American scene in response to grassroots efforts by women's history advocates.

As we honor women who paved the way, it's important to keep in mind that less than 100 years ago, women did not have the right to vote or to consider any of life's possibilities — from education and career to decisions regarding marriage; whether to marry or not; whether to have many children or to limit the size of one's family through birth control — all aspects of modern life taken for granted today. And while women now enjoy these rights, we still fall short of having the protections under law that the ERA would have guaranteed. If Alice Paul were alive today, it's certain that she would say there is still much work to be done. ■

A PROCLAMATION
BY THE PRESIDENT OF THE UNITED STATES OF AMERICA

Throughout history, extraordinary women have fought tirelessly to broaden our democracy's reach and help perfect our Union. Through protest and activism, generations of women have appealed to the values at the heart of our Nation and fought to give meaning to the idea that we are all created equal. As today's women and girls reach for new heights, they stand on the shoulders of all those who have come before and carry forward their legacy of proud achievement. This month, we celebrate countless pioneering women and the victories they won, and we continue our work to build a society where our daughters have the same possibilities as our sons.

Courageous women have called not only for the absence of oppression, but for the presence of opportunity. They have demonstrated for justice, but also for jobs — ones that promise equal pay for equal work. And they have marched for the right to vote not just so their voices would be heard, but so they could have a seat at the head of the table. With grit and resolve, they have fought to overcome discrimination and shatter glass ceilings, and after decades of slow, steady, and determined progress, they have widened the circle of opportunity for women and girls across our country.

Today, more women are their family's main breadwinner than ever before. Women are nearly half of our Nation's workers, and they are increasingly among the most skilled. At the same time, more than 60 percent of women with children under the age of 5 participate in the labor force. This increasing participation of women in our workforce has bolstered our economy and strengthened our families, and it has demonstrated that the policies that benefit women and working families benefit all of us.

But not all of the rules that govern our workplaces have caught up with this reality, and today, too many of the opportunities that our mothers and grandmothers fought for are going unrealized. That is why I am committed to tearing down the barriers to full and equal participation in our economy and society that still exist for too many women. All women deserve equal pay for equal work and a living wage; the Congress needs to raise the minimum wage and pass a law that ensures a woman is paid the same as a man for doing the same work. I continue to call for increased workplace flexibility and access to paid leave — including paid sick leave — so that hardworking Americans do not have to choose between being productive employees and responsible family members. And I have proposed a plan that would make quality child care available to every middle-class and low-income family in America with young children. These are not only women's issues — they are family issues and national economic priorities.

We know that when women succeed, America succeeds. The strength of our economy rests on whether we make it possible for every citizen to contribute to our growth and prosperity. As we honor the many patriots who have shaped not only the destinies of other women, but also the direction of our history, let us resolve to build on their efforts in our own time. As a Nation, we must join our voices with the chorus of history and push forward with unyielding faith to forge a more equal society for all our daughters and granddaughters — one where a woman's potential is limited only by the size of her dreams and the power of her imagination.

NOW, THEREFORE, I, BARACK OBAMA, President of the United States of America, by virtue of the authority vested in me by the Constitution and the laws of the United States, do hereby proclaim March 2015 as Women's History Month. I call upon all Americans to observe this month and to celebrate International Women's Day on March 8, 2015, with appropriate programs, ceremonies, and activities. I also invite all Americans to visit www.WomensHistoryMonth.gov to learn more about the generations of women who have left enduring imprints on our history.

IN WITNESS WHEREOF, I have hereunto set my hand this twenty-seventh day of February, in the year of our Lord two thousand fifteen, and of the Independence of the United States of America the two hundred and thirty-ninth.

BARACK OBAMA

CONGRATULATIONS TO SWE ON 65 YEARS OF REACHING NEW HEIGHTS.

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Happy Pi (π) Day!

Each year, Pi Day is observed on March 14. This year's alignment with the calendar brings a once-a-century treat to enthusiasts across the globe.

By Deb O'Bannon, Ph.D., P.E., F.SWE, SWE Editorial Board

March 14 marks Pi Day, an unofficial holiday that commemorates the mathematical constant pi. This year, the occasion is garnering particular interest, as the date — 3.14.15 — corresponds to the first five digits of pi, something that happens only once every 100 years. Adding to the curiosity, at 9:26:53 a.m. and p.m., both the date and time will follow the sequence of the first 10 digits of pi: 3.141592653. Next year, thanks to rounding, the phenomenon will repeat itself on 3.14.16.

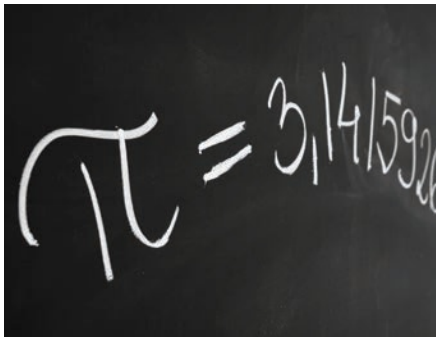
Celebrations of Pi Day are planned by a number of organizations, including Tau Beta Pi. We quantitative types can take a few minutes to muse upon pi's storied past and importance to all disciplines of engineering. And, of course, there are lighthearted treatments of pi across the Web. For example, a pleasant piano treatment of pi titled "Digits of Pi(ano)" can be found at https://www.youtube.com/watch?v=U5aGojkCexo and another, "Pi(ano) Song," at http://www.piday.org/2010/piano-song/.

The United States is one of the few countries that express the date as MM-DD-YY, which enables the digits of pi to appear in our calendars. Among the countries whose calendars align with pi are Belize, Canada, Micronesia, Kenya, and the Philippines.

Historically, mathematicians have pursued the calculation of pi from the time we have records. The Babylonians used pi≈25/8 in 1900 B.C.E. Archimedes proved 223/71 < pi < 22/7 in 300 B.C.E. (accuracy within 0.04%). A Chinese mathematician, Zu Chongzhi, computed pi to seven decimal places in the fifth century C.E.

A breakthrough that resulted in the Madhava-Leibniz series computed pi to 11 decimal places in the 14th century C.E. An amateur British mathematician, William Shanks, computed pi correctly to 527 decimal places by hand in 1873, working on it every morning before lunch over 20 years!

The advent of modern computing rocketed the significant digits of pi most recently in 2013 to 12,100,000,000,000 as calculated by Shigeru Kondo — a Japanese systems engineer. He holds the Guinness record with American Alexander Yee. Kondo completed the calculations at home with a homemade computer. As you might imagine, completing this 371-day computation was not without some close calls (including one with a hair dryer). ■



Deb O'Bannon, Ph.D., P.E., F.SWE, is a professor of civil engineering at the University of Missouri-Kansas City and immediate past-chair of the SWE Magazine *editorial board.*

If you'd like to try your hand at a calculation to celebrate Pi Day, here are a few levels of accuracy:

Three decimal places

$$\sqrt{2}+\sqrt{3}$$

Four decimal places

$$\sqrt[3]{31}$$

Five decimal places

$$\frac{7^7}{4^9}$$

Seven decimal places

$$\frac{355}{113}$$

30 decimal places

$$\frac{\ln\left(5280^3\left(236674+30303\sqrt{61}\right)^3+744\right)}{\sqrt{427}}$$

ENJOY!

BACK TO TABLE OF CONTENTS

AFRL

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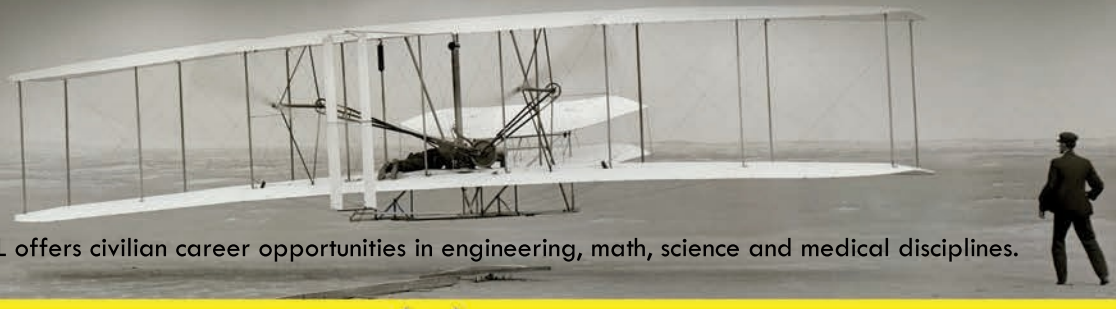

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New Faces of Engineering, College Edition

The New Faces of Engineering, College Edition is a program of DiscoverE: Engineers Week that recognizes third-, fourth-, and fifth-year engineering students for their academic achievements and their commitment to the engineering profession. This year, SWE selected four finalists, one of whom will be named in April as the Society's representative for the program.

How do you describe your field of study to a third-grader?

Lam: Engineers use their combined knowledge of science and math concepts to help them solve problems for you, me, and our community. As mechanical engineers, we work with a lot of the objects you see moving, such as vehicles (land, air, or sea) or robots, as well as complicated systems that help control the heating and cooling for your rooms or processes that manufacture your toys, electronics, and more! Mechanical engineers can design the products, create the process of making the products, test them — they make things you use every day happen!

Schwartz: Have you ever wondered why lights work without fire? Or how a car can move without someone pushing it? Going to school for electrical engineering has taught me how and why these things can happen. Knowledge is power. The more you know, the more you can do. Essentially, I am learning real, magic powers. Do you want magic powers? Well, the more you know, the more powers you will have!

Williams: My job is to make things fly. I really like anything that goes in the sky, whether that's rockets, airplanes, spaceships, helicopters, or anything else. Some people say, "Oh, it's not rocket science," but my job literally is rocket science, and that's awesome! I use math, science, and problem-solving skills to turn an idea into something real. Engineering involves design, experiments, teamwork, and most importantly, learning. Every day I learn something new, and I never get bored. Plus, I get to play with jet engines. How cool is that?

Kimberly Lam

School
New Jersey Institute of Technology
Third year
Major: mechanical engineering

SWE Highlights
Region E collegiate communications editor
Section president
Section secretary
Workshop co-presenter, Region E conference

Brittany Schwartz

School
University of Wisconsin-Milwaukee
Third year
Major: electrical engineering

SWE Highlights
Section president
Section outreach coordinator
Section junior SWE advisor

Winick: Engineering is the application of creativity. The job of an engineer is to look at a problem, come up with an answer, and then make that answer happen. Engineers bring together everything they have learned to be able to solve today's problems. It involves lots of teamwork, communication, and thinking and is extremely rewarding.

What gets you excited about your future as an engineer?

Lam: There will always be problems for an engineer to solve. Personally, I love a good challenge and don't like being bored or to do the same rhyme and rhythm as my job. I know for a fact that, as an engineer, I'll never be bored and will always have a new challenge. My high school engineering teacher and idol

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was a mechanical engineer who worked in a variety of subfields: engine design, medical products, even making the castings for Slim Jims. I wish to follow in his path by taking on eclectic challenges and exciting work. Furthermore, I am excited to be an engineer who also happens to be female. My goal is to be a positive role model to young girls and to show that engineering isn't just a career for men — it's just as exciting and relevant to everyone!

Schwartz: One of the problems we face today is the efficient utilization of renewable energy sources, be it solar, wind, or geothermal. In completing my degree, I plan to become involved in an effort to innovate and find a solution to our energy problem. One sector in the field that has a lot of promise is battery optimization. The ability to store our renewable energy when it is readily available for times when it is not abundant would allow us to start cutting the cords of fossil-fuel-based energy supplies. Not only would this allow the U.S. to achieve energy independence, but it would also greatly reduce the environmental impact we have and provide a guide for other countries to follow. This domestic and global problem drives me in my studies and is my intention in pursing a degree in electrical engineering.

Williams: What gets me excited about my future as an engineer is the idea of endless possibilities. I don't really know where my career is going to go, and I think that's great. It's a great time to be a young engineer, because there is so much to do, so many things to discover, and so many problems to solve. I am excited to be part of the solution to the world's biggest problems.

Winick: I am excited for how many options I have ahead of me. The fact that engineering can be applied to so many areas excited me. I cannot wait to get out in the field and start making a difference in people's lives. Engineering is a field of problem solving and creativity, and I cannot wait for the chance to apply both of those skills. ■

Ruth Williams

School
West Virginia University
Fourth year
Major: aerospace engineering and mechanical engineering

SWE Highlights
Section president
Section treasurer
Region G conference committee
Region G collegiate communications editor
Runner-up, Region G Advancing Leader award

Erin Winick

School
University of Florida
Third year
Major: mechanical engineering

SWE Highlights
Section president
Section recording secretary
Section historian
Program development grants committee
SWE Future Leader

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Policy Aims and the Federal Budget

Funding basic research and development is key to innovation as well as gender equity in science, technology, engineering, and math.

By Sandra Guy, SWE Contributor

President Barack Obama's proposal to undo automatic spending cuts, known as the sequester, faces a combative standoff with Congress. SWE members concerned about funding for STEM, basic research, and scientific initiatives will have to keep a close eye on the 2016 federal budget debates.

Yvonne Rodriguez, Ph.D., public policy liaison for SWE and the Association for Women in Science (AWIS), said a key category to watch is funding for basic research. "In order for the United States to continue its economic leadership and to be a world leader in innovation, we have to fund basic research and development (R&D), not only for academic institutions, but for industry," Dr. Rodriguez said.

The ability to keep basic research fully funded will help women, too, because it can provide greater opportunities to further female engineers' and researchers' work, rather than continue the current dilemma of women scrambling to grab scarce resources, she said. To illustrate, Dr. Rodriguez noted research showing that projects headed by men won greater time on the Hubble Space Telescope than those led by females, and that female-led research teams also obtained less access on other observatories than did those headed by men. With greater time available on observatories, the hope is that both men and women gain equal and more viable access, she said.

Congress is expected to get to work quickly on the president's 150-page, $4 trillion spending proposal. Budget experts on Capitol Hill say they expect both the U.S. House and Senate to pass budget resolutions by mid-April, according to news media reports.

Of relevance to SWE

The Obama plan would support a variety of programs of interest to SWE members. It would:

- ***Fund STEM programs in grades K-12*** aimed at attracting students from nontraditional and underrepresented groups to science, technology, engineering, and mathematics coursework. The budget would invest more than $3 billion — an increase of 3.6 percent over 2015 enacted levels — to improve and expand STEM learning, under the auspices of the Federal STEM Education Five-Year Strategic Plan. The budget also proposes a $125 million program letting high schools design student-centered learning curricula with an emphasis on attracting girls and other underrepresented groups into STEM fields.

- ***Increase funding for research by 5.5 percent*** and ignore the sequestration cap on spending. The budget proposes a 5 percent increase for the National Science Foundation; an almost $1 billion increase for the National Institutes of Health, to a total of $31.3 billion; and an 11 percent spending jump for Department of Agriculture research.

- ***Provide a 31 percent increase in funding for the Department of Education's Office for Civil Rights,*** which enforces Title IX rules that require colleges to investigate and resolve complaints of sexual misconduct. If approved, the office could hire 210 new full-time staff members, increasing its ranks from 544 to 754. That's important because more than 90 investigations remain open. From 2010 to 2014, cases ranged in length from 298 days to 325 days, according to budget analyses.

- ***Continue commitment to world-class basic research*** by dedicating $67 billion for basic and applied research, a $2 billion (3 percent) increase from 2015 enacted levels.

Boosting scientific capacity

Obama called the 3 percent increase proposal for basic and applied research a measured effort to boost America's scientific capacity after years of tight budgets. Even greater increases would be preferable, said John P. Holdren, Ph.D., director of the White House Office of Science and Technology Policy. But the proposal "reflects the reality that we continue to have to govern in an era of very tough choices," he said.

Under the plan, the National Institutes of Health would receive $31.3 billion. The NIH, the largest single provider of research money to American universities, has seen its budget shrink by nearly 25 percent since 2003, when adjusted for inflation.

Outlays for the conduct of R&D would represent 3.5 percent of all federal spending in FY 2016, continuing a long-run decline, and 12.4 percent of discretionary outlays, which is in line with historical norms, according to the American Association for the Advancement of Science (AAAS).

Matt Hourihan, director of the R&D budget and policy program at AAAS, said both Republicans and Democrats tend to keep research funding level year-to-year because they understand the need to invest in science and technology to tackle the world's biggest challenges.

"We have a global energy challenge, any number of health and life-sciences challenges such as the Ebola outbreak, and the National Science Foundation has proposed an initiative to deal with global food, water, and energy systems," Hourihan said. "In fact, there are few issues you can point to in which science and technology wouldn't have an impact," he said.

The budget would invest $215 million to launch the Precision Medicine Initiative (PMI) — a move toward tailored

treatments. The PMI would create a large-scale national volunteer research group to help people better understand health and disease, speed development of more effective approaches to cancer treatment, and support effective regulatory, privacy, and security standards in precision medicine.

The budget aims to support R&D most likely to create the foundations for the industries and jobs of the future, including robotics, cyberphysical systems, big data, the Materials Genome Initiative, the National Nanotechnology Initiative, and engineering biology.

It also would accelerate the administration's Lab-to-Market Initiative with increased funding for the NSF "Innovation Corps" and more dollars for the National Institute of Standards and Technology to strengthen interagency lab-to-market efforts.

Energy, climate change, security

The budget proposes $7.4 billion for clean energy technology programs governmentwide to accelerate the transition to a clean energy economy and position the United States as the world leader in the energy industries of the 21st century. In the U.S. Department of Energy, the budget seeks $2.7 billion for the Office of Energy Efficiency and Renewable Energy to accelerate R&D, build on ongoing successes, and increase the use of critical clean energy technologies. The budget also includes $325 million for the Advanced Research Projects Agency–Energy, a program that seeks to fund transformative energy research.

Related to homegrown clean energy are the following:

- ***Taking action on climate change.*** The 13-agency U.S. Global Change Research Program (USGCRP) coordinates federal research to improve the country's ability to understand, assess, predict, and respond to the human-induced and natural processes of global change. The budget proposes $2.7 billion for USGCRP, whose outcomes support the administration's Climate Action Plan.

- ***Making America a magnet for jobs.*** The budget calls for supporting the development and scaling of new advanced manufacturing technologies, helping smaller manufacturers adopt new technologies to increase their competitiveness, and accelerating the transfer of new technologies from federal labs to industry. The budget would provide $2.4 billion for federal R&D directly supporting advanced manufacturing at the NSF, the Department of Defense, the Department of Energy, the Department of Commerce, and other agencies. The budget would fund a national network of 45 manufacturing innovation institutes aimed at making the United States a global leader in advanced manufacturing technology.

- ***Allowing NASA to continue to develop a mission to Jupiter's moon, Europa.*** In addition, the funding would create the Orion crew vehicle, Space Launch System and Exploration Ground Systems aimed at sending astronauts beyond low-Earth orbit. The $18.5 billion budget proposal would be a half-billion-dollar increase from enacted 2015 levels.

The Space Launch System is a new heavy-lift rocket, capable of sending humans aboard Orion to deep-space destinations such as an asteroid and Mars. NASA has spent six years working on plans to send astronauts to Mars. The work is headquartered at the Kennedy Space Center, but also includes companies in 37 states, said NASA Administrator Charles Bolden when he spoke about the 2016 budget proposal.

Here on Earth, Bolden said the budget enables NASA engineers and scientists to continue to work to develop new composite materials to reduce the environmental impact of future airplanes and spacecraft, and pave the way for revolutionary new aircraft shapes and propulsion systems.

The ability to keep basic research fully funded will help women, too, because it can provide greater opportunities to further female engineers' and researchers' work, rather than continue the current dilemma of women scrambling to grab scarce resources.

- ***Investing in innovation for national security and to develop innovative security capabilities.*** The budget proposes $12.3 billion for the Department of Defense's Science and Technology program. It also maintains the DOD's role in fostering breakthrough approaches for discovering promising technologies with $3 billion for the Defense Advanced Research Projects Agency (DARPA).

When then-Defense Secretary Chuck Hagel announced a "Defense Innovation Initiative" on Nov. 15 at the Ronald Reagan Presidential Library in Simi Valley, California, he listed technologies such as robotics, unmanned systems, miniaturization, and 3-D printing as places to look for "game changing" technologies that would maintain military superiority, according to media reports.

Key goal of R&D investment

When Obama presented the budget, he noted that one goal of R&D investment is to create jobs with livable wages that strengthen the middle class and to move the country closer to sustainable-energy independence.

"To compete in the 21st century economy and make America a magnet for job creation and opportunity, we need to invest in American innovation, strengthening our manufacturing base, keeping our nation at the forefront of technological advancement, and leading in the development of clean energy alternatives and the promotion of energy efficiency while moving toward energy security through safe and responsible domestic energy production," he said. ■

Compelling Encouragement for Women Engineers

With numerous awards ranging from the SWE Achievement Award in 1977, to the 2014 Presidential Medal of Freedom, and most recently, becoming the first woman to receive the IEEE Medal of Honor, Mildred Dresselhaus, Ph.D., has encouraging insights for women engineers. Adding to the credibility of her counsel is her flourishing career as a pioneer of nanoscience, accomplished while raising a close-knit family that now includes five grandchildren. This professor of physics and electrical engineering and emerita Institute Professor at MIT is a woman engineer who has "been there, done that, and felt that."

By Charlotte Thomas, SWE Contributor

While many women engineers are successful in their careers, statistics indicate that close to 40 percent drop out of engineering, according to Nadya Fouad, Ph.D., Distinguished Professor of Educational Psychology at the University of Wisconsin, Milwaukee, who presented these numbers at last summer's American Psychological Association convention. Mildred Dresselhaus, Ph.D., persisted in her career at a time when the retention of women in STEM received much less attention than today, and she encountered many trials that women today don't face.

Discouragement becomes advocacy

The Presidential Medal of Freedom acknowledges Dr. Dresselhaus as "one of the most prominent physicists, materials scientists, and electrical engineers of her generation," yet she, too, has faced discouragement in her career. "When I got my degree in 1958, it was pretty lonely," she said, noting that women at that time represented only 2 percent of the physics students. Nevertheless, Dr. Dresselhaus was not deterred, and her long-term response to these obstacles was to become a well-known advocate for women in science and engineering. In 1973, she received a Carnegie Foundation grant to study the traditional male-dominated field of physics, which propelled her advocacy into the spotlight. She went on to become the Abby Rockefeller Mauzé chair at MIT, which provides an endowment to support the scholarship of women in science and engineering. "I've also been involved with SWE since the 1960s," she stated, noting that she speaks to groups on campus and that as a SWE Achievement Award recipient, she has been a lifetime member since 1977.

PAUL HENNESSY

Mildred Dresselhaus, Ph.D., was one of 19 people to receive the 2014 Presidential Medal of Freedom, which is presented to individuals who have made especially meritorious contributions to the security or national interests of the United States, to world peace, or to cultural or other significant public or private endeavors. The White House called Dr. Dresselhaus "one of the most prominent physicists, materials scientists, and electrical engineers of her generation."

Growing career and family

Aside from her many prominent awards, Dr. Dresselhaus met the demands of her career, raised four children with her husband, and dealt with the obstacles facing women in science and engineering, all of which offer inspiration for today's women engineers. Beginning at MIT in 1967 as a visiting professor for a year, she was hired full time to teach physics to engineering students and went on to develop a course around that subject. She developed a new model for the electronic structure of graphite and was the first to use lasers for the magneto-optics experiments. Today she is called the "queen of carbon" by her peers.

Maintaining a successful family life and career presented her with many challenges, but she continually drew strength from the powerful support of others, beginning in her childhood and early education. "What helped me is that historically, from my very early years my inspiration almost always came from women in some form," recalled Dr. Dresselhaus, speaking first of her mother, who did not have a professional career herself but encouraged her daughter to be a good student. Dr. Dresselhaus went on to Hunter College High School on Manhattan's Upper East Side, which she described as "highly intelligent, intellectual, fast moving, and very selective." It was there that she had her first real exposure to science and math.

Inspiration from powerful influencers

Though Dr. Dresselhaus originally planned to become an elementary schoolteacher, she was deeply inspired by Rosalyn S. Yalow, Ph.D., a teacher at Hunter who later became one of the first

BARBARA LITWACK

Having completed a postdoctoral fellowship, Mildred Dresselhaus, Ph.D., began her career at MIT Lincoln Laboratory. While there, she changed her research focus from superconductivity to magneto-optics. The series of experiments she conducted went on to produce a fundamental understanding of the electronic structure of semimetals, particularly graphite.

MIT

In addition to her numerous awards and research on carbon science and carbon nanostructures, as well as a full spectrum of topics in condensed matter and materials physics, plus co-authoring more than 1,400 publications, and holding five U.S. patents, Mildred Dresselhaus, Ph.D., enjoys playing chamber music on the violin and viola.

female medical physicists and received a 1977 Nobel laureate for her work. "She had similar kinds of problems as I would face," noted Dr. Dresselhaus. "We intersected and she encouraged me to go seriously into science, not teaching." During the years to follow, Dr. Yalow kept in contact with Dr. Dresselhaus, attending her lectures when possible and keeping current with her progress.

Another powerful influence Dr. Dresselhaus cited was Abby Rockefeller Mauzé, who funded female professors at MIT in subjects in which women were underrepresented. Dr. Dresselhaus described her as a "champion of women's lib and for women making their own decisions. She funded a sitting professorship for women in science and engineering. I was an early beneficiary. These fields are important for society and women weren't there." Because of that professorship, Dr. Dresselhaus said that "the faucet was opened" to her career progression, and it provided the encouragement she needed to move on. "I arrived in a wonderful academic environment with many opportunities that wouldn't have opened otherwise. I'm still here after 55 years," she said.

Some sage advice

Given her personal history of overcoming barriers with optimism and the encouragement of notable women, Dr. Dresselhaus is in a position to offer sage advice for women engineers today. She does so with a sense of humor. Responding to a question about how to continue positive change and progress for women engineers, she offered, "As more of us come into the profession, guys get more used to us." Her solution to facing controversy and opposition as a woman in science and engineering is, "Anytime you go into a new area and do something different, you're sure to have controversy. That's a given." As the first to exploit the thermoelectric effect at the nanoscale, for example, Dr. Dresselhaus faced some strong opposition. Her perspective — that controversy is part of the process of doing something different — can be a powerful antidote to discouragement.

It's no surprise that she hasn't backed away from difficult assignments over the course of her career. "I'll work on it and come up with something," was her response when asked to "make submarines quiet," a field she described as "stagnant for 30 years" when the problem was handed to her. Her observation was that it was an active field that had stopped functioning for some reason. People had run out of ideas, but her response was, "If you wait a few years, science moves forward and there are new ideas on the table."

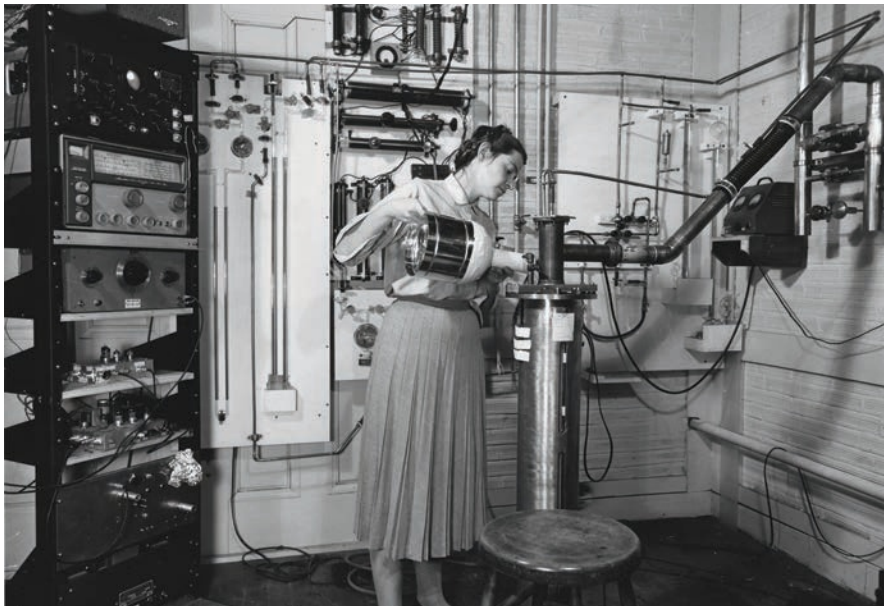
Though Dr. Dresselhaus has turned a deaf ear to negativity throughout her career, she has some thoughts about standing up against discrimination. That she really liked what she was doing was key to not letting gender bias prevent her from accomplishments. "Engineering and science are great careers for women, and once you solve a problem, that makes it more gender neutral," she advised. "One's interest level is the most important factor that will overcome barriers. Yes, you can find discrimination if you look for it. But if you decide you won't pay a lot of attention to it, it becomes less of an issue."

"One's interest level is the most important factor that will overcome barriers. Yes, you can find discrimination if you look for it. But if you decide you won't pay a lot of attention to it, it becomes less of an issue." — Mildred Dresselhaus, Ph.D.

She also looks beyond the immediate

ED QUINN

MIT



ABOVE: As noted in a Dec. 15, 2014, MIT EECS article, Mildred Dresselhaus, Ph.D., spoke about her long career and her research interests. "Throughout my career, I have been interested in finding out how the unique properties of new materials beyond silicon could contribute to electronics." BELOW: Soon after earning her Ph.D. at the University of Chicago in 1958, Dr. Dresselhaus attended Cornell University to study superconductivity with an NSF-sponsored postdoctoral fellowship.

circumstances to the reality that there is a tremendous need for talented people with the ability to solve problems. If a woman has the talent and skills, that's the most important factor. "That is the basis of where I come from," Dr. Dresselhaus explained. "If you are working in a field where what you do counts, it's more important than what you look like. That is what gives women the motivation to keep going." Yes, women are dropping out of engineering studies and careers. Yes, the image of an engineer today is still a male, but as she points out, the ultimate criteria in the end is looking for or being the best person to do the job. "The work atmosphere gets better every year because the need for skills goes up," she concluded. Though Dr. Dresselhaus has demonstrated throughout her career that she can push back, not all women can or want to. Her answer is to set goals and have an idea what you want to accomplish. "I enjoy my work. Having a passion is true of most of the people I know, doing something we like to do even though it might not be easy."

The power of mentoring

Mentoring other women became a passion for Dr. Dresselhaus and promoting opportunities for women in science and engineering is still a priority in her career. "I spent more time mentoring others than being mentored," she advised. Since then, Dr. Dresselhaus has mentored and encouraged countless students both through time spent with them personally and the hundreds of others who come to mentoring sessions when she speaks at university campuses.

Here, too, she offers perceptive advice based on her years of experience. "It isn't the number of hours you mentor, but what you say and do," she said, pointing out that when she takes on a student she makes sure the interaction between them is beneficial to the student, and realizes that she benefits as well. "At times I'll hear someone in academia saying, 'I have someone working for me.'" That's not how she sees the mentoring relationship. "I say the person is working with me. We benefit from each other," she noted, referring to how she still learns from the younger people around her. "They know many things I don't, so I can learn from them. I have experience they don't have. It's a give and take, not just me doing things for them. We discover things together."

"Engineering and science are great careers for women, and once you solve a problem, that makes it more gender neutral."

— Mildred Dresselhaus, Ph.D.

Her enthusiasm and ongoing fascination with science have kept Dr. Dresselhaus from retiring. Here again, her sense of humor and positive outlook have kept her happily working seven days a week. "I'm not ready to retire. I'm still interested in what I'm doing and still enjoying science," she said. ■

BACK TO TABLE OF CONTENTS

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"A Large and Powerful Organization..."

Reflections on SWE's 65th Anniversary

As anniversaries often do, SWE's 65th presents an opportune moment to reflect on our past and our present, as well as to peer into the future.

By Betsy Homsher, SWE Editorial Board

In the summer of 1950, soon after female students and working engineers gathered in New Jersey to form the Society of Women Engineers, first president Beatrice Hicks proclaimed: "I am convinced we are going to grow into a large and powerful organization."[1]

And so we have. From its original 60 or so founders, 65 years later SWE now boasts more than 32,700 members. Younger generations of students and professionals continue to join the organization for the same reasons the founders established it: "to foster a favorable attitude in industry toward women engineers ... to contribute to their professional advancement ... to encourage young women with suitable aptitudes and interests to enter the engineering profession ... and to guide them in their educational programs."[2]

A CONSISTENT FOCUS

It is striking that while in many ways, we live and work in a very different world than the founders, the Society's mission has changed very little over the past 65 years. Its consistent focus on meeting the needs of women engineers, and students who aspire to become professional engineers, has provided a durable framework for the Society's growth. On an individual level, women — then and now — find in the Society a group of like-minded peers who share the same goals: the desire to pursue professional careers that allow them to become their best selves, as employees, citizens, and family members. In 2015, as in 1950, SWE members are smart, educated, talented, and self-determined persons who make important contributions — at work, in our communities, and at home.

At the same time that SWE's mission has remained constant — despite astounding social, cultural, and perhaps most importantly, technological changes — so has its approach to fulfilling that mission. At this writing, the student section at my university is preparing to host 30 high school girls for two days of hands-on engineering activities that will demonstrate what engineers do and how to prepare for the profession. It's a time-honored tradition at Kettering University; this annual precollege program has endured for nearly 20 years.

Similar SWE-sponsored events took place throughout the country on Feb. 26 to "Introduce a Girl to Engineering," a part of DiscoverE festivities. The roots of these activities can be traced to SWE's earliest days, when members tirelessly sought many opportunities to introduce girls to engineering and encourage them to pursue the education necessary to become professionals.

From the beginning, SWE members have visited schools, given lectures and presentations, served as mentors, and raised money to fund scholarships for girls. Today, SWE sections host these kinds of events all over the country, all the time. And they continue to make a difference. One example: In 2014, the Society awarded more than $700,000 in college scholarships to more than 230 students. Many of our professional members were once SWE scholarship recipients. Collegiate members rely upon these scholarships to pursue their ambitions: a college degree in a field that holds the promise of lifelong intellectual challenges, opportunities to excel professionally, and achieve personal prosperity.

Last September, the Society experienced an unprecedented surge in donations following an episode of the HBO program "Last Week Tonight." In a report questioning the Miss America Organization's claims of being the world's largest provider of scholarships for women, the show's host, John Oliver, used statistics provided by SWE and asked viewers to donate to the Society.

IN TUNE WITH THE GLOBAL PULSE

SWE's resilience can also be attributed to its abiding attention to the national and global pulse. Historians who have used the Society's archives — housed at the Walter P. Reuther Library at Wayne State University in Detroit — have found abundant evidence of SWE's ability to retain its focus on advancing women in engineering while adapting to changing conditions and circumstances in the U.S. Two recent books, *Girls Coming to Tech! A History of American Engineering Education,* by Amy Bix,

ABOVE: The Society made the most of Cold War concerns regarding the Soviet Union's technological and scientific capabilities to illustrate the importance of and need for more women engineers. This illustration was furnished by SWE and appeared in the September 1963 issue of *Mechanical Engineering*. PREVIOUS PAGE: This poster from the Pittsburgh Section captures the flavor of the 1950's effort to raise awareness that women could be engineers, and the Society's ongoing focus on outreach to the next generation, which has continued in full force over the decades.

Bella Abzug, feminist advocate, New York congresswoman, and founding member of the National Organization for Women, was the keynote speaker at the 1979 Society of Women Engineers convention, as it was called at that time, held in San Francisco. She was the most high-profile leader of the women's movement to be invited to speak at a SWE event.

Ph.D., and *Searching for Scientific Womanpower,* by Laura Micheletti Puaca, Ph.D., demonstrate SWE's important role over the decades. Dr. Puaca identified SWE's staying power within the concept of "scientific womanpower." The Society adopted the rhetoric of national security when perceived threats surfaced during the Korean War, just as SWE was founded. The Society deployed the rhetoric throughout the nearly 50-year period of the Cold War, which continued to breathe life into its arguments for women's participation in engineering. For most of those years, no one called the campaign a diversity strategy, but that's what it amounted to, if one largely benefiting white women.[1]

Today, members include women (and men) of all racial and ethnic backgrounds, working in a broad spectrum of specializations in industry, government, and higher education. What was once an all-volunteer organization now boasts international headquarters in Chicago with a paid staff. These women and men assist members in more than 400 student and professional sections throughout the country, and beyond.

On almost any given day, somewhere in the world, SWE sections and affiliates host educational events for girls, networking and professional development opportunities for professionals, outreach to industry, or advocacy efforts. A comprehensive list of all these activities, by and for women engineers, would fill this edition of *SWE Magazine,* and many more. For more than a decade, *SWE Magazine* has produced a "Yearbook," typically in the Fall issue, to capture highlights of these activities.

SWE's annual conferences now attract more than 8,000 attendees and feature an unparalleled career fair attended by many of the world's largest employers of engineers, who compete to hire members. These employers partner with SWE because they know the smart and talented members will become exemplary employees. In short, SWE has become "a large and powerful organization."

SWE's membership growth has extended its impact to thousands more girls and women who aspire to careers in engineering, who wish to advance women's participation in the field, and who achieve their dreams, at least in part, through their engagement with the organization. Many of us have experienced the joy of knowing that our encounters with smart girls have opened their eyes to a career in engineering and the fascinating places it can take them. It is, perhaps, our most important work. Beatrice Hicks and the other founding members certainly thought so.

Over the years, in these pages, SWE has celebrated headliners with awards and citations. Now, "Women Engineers You Should Know," a new feature in this publication (see page 28), celebrates the achievements of lesser-known engineers who carry out SWE's mission with less fanfare but arguably no less significance, particularly when considered on a human scale.

TACKLING POLICY ISSUES

Since its beginning, SWE's efforts on behalf of women and girls, as well as opportunities for them in the profession, have garnered the attention of industry, government, and academic leaders. While these efforts haven't always achieved the desired result, as when the Society learned it had been overlooked for participation in President John F. Kennedy's 1961 Commission on the Status of Women, SWE has nevertheless persevered, undeterred.

It has tackled contentious issues, such as the Equal Rights Amendment when,

USAF Lt. Colonel (Ret.) Arminta J. Harness, SWE president from 1976-1978, delegate-at-large, at the National Women's Conference. U.S. President Jimmy Carter appointed her to this role in 1977.

in the 1970s, supporters and opponents within the organization sparred over what position the Society should take. SWE ultimately endorsed the ERA. Although the amendment failed, SWE nonetheless located itself at the center of a national discussion.

More recently, the Society's structure includes a government relations and public policy committee, which hosts a congressional outreach day on Capitol Hill each spring. The event, which is designed to increase awareness of the need for and the importance of increased diversity and inclusion in the science, technology, engineering, and mathematics (STEM) work force, draws the attention of both Democratic and Republican senators and representatives, as well as a variety of attendees from many government offices — including the National Science Foundation; the Senate Subcommittee on Research and Science Education; the House Committee on Science, Space and Technology; and the Department of Education's Office for Civil Rights.

In the fall of 2014, SWE and the Association for Women in Science (AWIS) announced a partnership to advocate on behalf of women in STEM fields. These two organizations represent 50,000 members; a force no one can overlook, at least not without peril.

21ST CENTURY SWE

If only Beatrice Hicks could see us now. When she told people in the 1930s that she wanted to become an engineer, teachers and classmates quickly proclaimed it was no place for a woman. She, and the founders of SWE, persevered to achieve their personal ambitions and to ensure a younger generation could, too. The Society continues that work. Today, we take for granted women's access to college degrees and professional opportunities in engineering. And we have every right to do so. At the same time, it's all too easy to think our experience is and has been normative. That's not the case, as scholars such as Dr. Puaca and others have demonstrated.[2] SWE founders, and many members since then, have encountered obstacles — large and small — in their paths. While a career in engineering is now one of the most lucrative a woman can achieve, salary disparities persist. So do implicit and explicit biases, along with discriminatory behaviors and practices, in classroom and laboratories and in workplaces. Industry and government have invested millions of dollars in diversity initiatives, yet women account for only 10 percent of the engineering work force. Female enrollment in engineering degree programs has remained stagnant for years. Our work is not done.

The future is bright, however. During this year's Super Bowl, one national advertiser ran a commercial that demonstrated persistent stereotypes that discourage girls from pursuing their interest in STEM fields. President Barack Obama established the White House Council on Women and Girls, a national effort to increase the participation of women and girls in STEM fields. In popular media, the *Huffington Post* established its Girls in STEM Mentorship Program to provide aspiring engineers and scientists mentors who promote and support what SWE has long advocated: the full participation of women in these fields. These efforts, and many more, are a win-win — for women and girls, for the benefit of society overall, and for SWE.

Sixty-five years ago, SWE founders created an organization that bestowed an impressive legacy: an enduring organization that continues to fulfill its original mission while persistently expanding its reach and legitimacy. Today, we can say with pride and certainty that SWE is truly "a large and powerful organization." Our challenge now is to sustain that strength and vitality so that 65 years from now, another generation of members will celebrate us. ■

Betsy Homsher is vice president for student life and dean of students at Kettering University in Flint, Michigan, where she established the Office of Women Student Affairs in 2002. She is a member of the SWE Magazine *editorial board and serves as the faculty advisor to Kettering University's SWE collegiate section.*

References:

1. *Laura Micheletti Puaca,* Searching for Scientific Womanpower: Technocratic Feminism and the Politics of National Security, 1940-1980. *University of North Carolina Press, 2014, pp. 65-84.*
2. *Society of Women Engineers, Certificate of Incorporation, Feb. 13, 1952, Box 1, Folder 4, Society of Women Engineers Archives. Quoted in Puaca, p. 57.*

SWE at sixty-five:

women engineers you should know

The Society of Women Engineers' 65th anniversary is a fitting occasion to celebrate the contributions of women who have carried out SWE's mission with less visibility than their more famous sisters, but whose work is no less important. With little fanfare, women engineers make significant contributions every day and lead interesting and fulfilling lives, giving to their profession and communities. Quite often, those who are behind the scenes, out of the limelight, make real change in the workplace and in our communities. It is our intention to recognize such women and make their efforts better known.

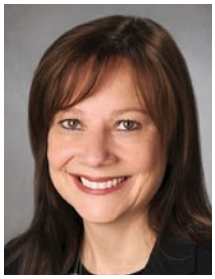
Casting a wide net, *SWE Magazine* staff and editorial board sought contemporary and historic women whose lives have embodied the Society's mission to: "stimulate women to achieve full potential in careers as engineers and leaders, expand the image of the engineering profession as a positive force in improving the quality of life, and demonstrate the value of diversity." Through a variety of means ranging from social media discussions to archival research, we examined the stories of many women who have made a difference in these critical areas. If you follow SWE's social media, you might recognize some of our categories, as they were announced in these venues as part of our search.

Determining a final list was a daunting challenge, and our selections are in no way meant to be definitive. While some names you may recognize, very few are "household names," familiar to most people. From a variety of perspectives, in different environments and moments in time, these women represent "ordinary" women doing "extraordinary" things. In saluting them, we are saluting all the women, known and unknown, past and present, who have advanced our mission.

By Anne Perusek, Director of Editorial and Publications

Conversation over dinner with a fascinating companion is one of life's simplest and most satisfying pleasures. If you could have dinner with any woman engineer, living or dead, who would she be?

Mary Barra



Named CEO of General Motors in January 2014, Mary Barra is the first woman to head one of the "Big Three" automobile companies in the United States. She is also a member of the GM board of directors. An electrical engineer, Barra earned her B.S. from Kettering University, and began her tenure at GM in 1980 as a co-op student. She later earned an MBA from Stanford University, and held a number of positions within GM, including plant manager of Detroit-Hamtramck Assembly, and vice president of global manufacturing engineering, before moving to her current position.

Lillian Moller Gilbreth, Ph.D.

Sometimes referred to as the "first lady of engineering," Lillian Moller Gilbreth, Ph.D., was the first honorary member of SWE. Dr. Gilbreth and her husband developed motion studies to increase the efficiency of industrial workers, and co-authored a number of books on the subject. She used the techniques derived from the studies to design appliances and equipment to make housework easier, particularly for the disabled. The Society's first scholarship was named in her honor, and has been granted annually since 1958. Also known as the mother in the book and film, *Cheaper by the Dozen,* Dr. Gilbreth taught for many years at Purdue University. She died in 1973 at age 93.

Kate Gleason

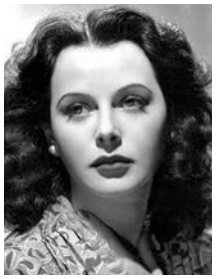
In 1884, Kate Gleason was the first woman admitted to study engineering at Cornell University in Ithaca, New York. Her family owned Gleason Works, a gear factory in Rochester, and she was frequently required on-site to problem solve and ensure smooth operations, conflicting with her class schedule and forcing her to leave Cornell. Returning home, she completed her education at the Mechanics Institute, later renamed Rochester Institute of Technology. She and her father designed a machine that produced beveled gears quickly and inexpensively, and she became treasurer as well as sales representative for Gleason Works. The first woman president of a U.S. bank, she was also a leader in developing low-income, standardized housing. In 1998, RIT renamed the engineering school in her honor, the Kate Gleason School of Engineering.

Beatrice Hicks, P.E.

Inspired by the Empire State Building and the George Washington Bridge, Bea Hicks, P.E., told her engineer father that she, too, would become an engineer. She earned degrees in chemical engineering, electrical engineering, and physics. Hicks was the first woman engineer employed by Western Electric

Company. She pioneered in the theoretical study, analysis, development, and manufacture of sensing devices; patented a molecular density scanner; and developed an industry model for quality control procedures. In 1950, Hicks was chosen as the first president of the Society of Women Engineers. Five years later, in 1955, she became president of the firm founded by her father, Newark Controls Inc., which designed and manufactured environmental sensing equipment, much of which was used in the NASA space program. Hicks received honorary doctorates in engineering from Rensselaer Polytechnic Institute, Stevens Institute of Technology, and Worcester Polytechnic Institute, and an Honorary Doctor of Science degree from Hobart and William Smith Colleges. Her many awards included the SWE Achievement Award in 1963 and election to the National Academy of Engineering in 1978. She was inducted into the National Women's Hall of Fame in 2001, and honored by the New Jersey Inventors Hall of Fame in 2013.

Hedy Lamarr



While her fame as a movie star and World War II pinup eclipsed her technical contributions, toward the end of her life Hedy Lamarr began to receive the recognition she deserved for inventing spread spectrum technology. After puzzling over the best method for launching radio-controlled missiles, she and Hollywood composer George Antheil jointly filed a patent for a "secret communications system," which was granted on Aug. 11, 1942. The significance of the patent became apparent later, with the inventions of the transistor and computer chips. Lamarr's method is still in use today by cell networks, Bluetooth devices, and Wi-Fi. In 1998, the Electronic Frontier Foundation recognized her contribution to wireless communication with a special award for "blazing a new trail on the electronic frontier."

Ada Byron Lovelace

Computer science pioneer Ada Byron Lovelace was the daughter of the famed poet Lord Byron. Educated by private tutors, Lovelace demonstrated strong math and science abilities and was fascinated by her friend Charles Babbage's ideas for the "analytical engine," which laid the foundation for modern computers. In 1842, she translated a short article by Italian mathematician Luigi Menabrea describing the analytical engine. Asked by Babbage to expand it, based on her notes and understanding of the machine, she wrote an article, "Sketch of the Analytical Engine, with Notes from the Translator," that was more than three times the length of the original and included several early computer programs, plus commentary on potential uses of the machine. She is known as the founder of scientific computing.

Marissa Mayer

After spending more than 10 years leading the development of Google's most successful products, Marissa Mayer was appointed CEO of Yahoo in 2012, at age 37. Born in Wisconsin and the daughter of an engineer father and artist mother, Mayer went on to graduate with honors from Stanford with a B.S. in 1997 and an M.S. in computer science in 1999. For both degrees, her specialization was artificial intelligence. She built travel-recommendation software that advised users in natural-sounding human language for her undergraduate thesis. In 2009, the Illinois Institute of Technology granted Mayer an honorary doctorate degree in recognition of her work in the field of search.

Wanda Munn, F.SWE

As a single mom, Wanda Munn decided to return to school rather than remain a secretary in a nuclear engineering department. Earning her B.S. in nuclear engineering in 1977, Munn spent the

next 18 years focused on systems design, construction, and operation of the Fast Flux Test Facility for Westinghouse, Hanford. She also received an MBA from the University of Washington in 1982. She has served as an elected council member for the city of Richland, Washington. In 1977, Munn was honored with the McCall Life Pattern Award for women in reentry. In addition, she received the SWE Distinguished New Engineer Award in 1984, and the American Nuclear Society National Public Communications Award in 1988. Munn was named the Tri-Cities Engineer of the Year in 1993, and in 1998 was inducted into the Society of Women Engineers College of Fellows.

Judith Resnik, Ph.D.

An active SWE member, Judith A. Resnik, Ph.D., was a NASA mission specialist aboard the ill-fated space shuttle Challenger, which broke apart 73 seconds after liftoff on Jan. 28, 1986. Dr. Resnik grew up in Akron, Ohio, and graduated as class valedictorian, scoring a perfect 800 on her college boards. She attended Carnegie Mellon University, earning a B.S. in electrical engineering, followed by graduate school at the University of Maryland, where she earned her master's and Ph.D. Prior to her 1978 selection by NASA as an astronaut candidate, Dr. Resnik was a biochemical engineer at the National Institutes of Health, and a senior systems engineer at Xerox. A gifted pianist, her hobby was gourmet cooking.

Emily Roebling

When Emily Roebling's engineer husband became seriously ill, she took over as project manager for one of the 19th century's greatest engineering accom-

plishments — the construction of the Brooklyn Bridge. From 1872-1883, she oversaw the daily construction of the bridge. Not only did she manage the technical aspects, but she also negotiated through a maze of politics, labor difficulties, and threats to halt the project. She received a good deal of positive press at the time, but her contributions were later forgotten. During the 1983 centennial celebrations for the bridge, her work came to light, and there are now two plaques on the bridge honoring her.

It is easy to overlook important work that is taking place around us, or the human-interest story unfolding in a colleague's life. With this in mind, who are some of the women engineers we should know?

Yvonne Brill, F.SWE

With a long and contributive aerospace career that began in the 1940s and spanned the early years of jet and rocket engines and the development of satellites, through the Space Race, the space shuttle, and beyond, SWE Fellow Yvonne Brill was a trailblazer, inventor, and inspiration. In 1967, she invented the hydrazine/hydrazine resistojet propulsion system, which was developed to the hydrazine resistojet thruster, becoming an industry standard. Her employers included RCA, NASA, and the International Maritime Satellite Organization. She consulted on satellite technology and space propulsion systems until the final months of her life. Brill served on the NASA Aerospace Safety Advisory Panel, reporting to NASA and the U.S. Congress. Among the numerous major awards Brill received were: the John Fritz Medal, the National Medal of Technology and Innovation, the SWE Achievement Award, the Resnik Challenger Medal, and NASA's Distinguished Public Service Medal. Despite the demands of career and family life, Brill supported other women engineers and engineering students. She died in March 2013.

Yvonne Y. Clark, P.E., F.SWE

A mechanical engineer and engineering professor, Yvonne Y. Clark, P.E.,

F.SWE, was SWE's first African-American member, joining the Society in its early years. She graduated from Howard University in 1951 with a B.S. in mechanical engineering, the first woman to do so. In 1972, she became the first woman to earn a master's in engineering management from Vanderbilt University. She began her career in industry, later joining the faculty at Tennessee State University and receiving SWE's Distinguished Engineering Educator Award in 1998. Clark was at the center of a pivotal moment in SWE history when she attended the 1957 SWE national convention (as they were called) in Houston. When Clark was prohibited from staying at the convention hotel, or attending the convention, SWE confronted civil rights and segregation with a principled stance, threatening to move the convention elsewhere. The hotel softened its position, but SWE determined to never hold a convention south of the Mason-Dixon line until the passage of the Civil Rights Act. Years later, when the convention was again held in Houston, Clark received an apology from the mayor for her treatment in 1957, and a welcome to the city.

Lois L. Cooper, P.E.

SWE Fellow Lois Cooper, P.E., had an accomplished career with Caltrans — previously known as the California Department of Transportation — that included oversight of many large highway projects and the design of the first bikeway in the district.

Born Lois Louise Saunders in 1931 in Vicksburg, Mississippi, she was the first member of her family to graduate from high school and college. She attended Tougaloo College; Los Angeles City College; and Los Angeles State University, now California State University, Los Angeles, majoring in math and completing her degree in 1954. Cooper took night classes in surveying at the University of Southern California, and in engineering at Los Angeles State. Not only did Cooper pass the P.E. exam on her first try, but in doing so, she also became the first African-American woman in the state of California to do so. Instrumental in promoting engineering as a career to minority youth, the Lois Cooper Scholars program at the University of Wisconsin-Platteville has recently been established in her memory to increase the number of distinguished underrepresented STEM graduates from UW-Platteville.

Rachel Hutter, P.E.

Combining two seemingly distinct interests — engineering and theater — SWE member Rachel Hutter, P.E., has built an intriguing career with Disney. Hutter graduated from Michigan State University with a B.S. in electrical engineering and a minor in theater. She joined Disney in 1997 as part of the Imagineer-

ing® team that built Animal Kingdom®, fulfilling her childhood dream to work for Disney. In 2005, Hutter received SWE's Emerging Leader Award for Quality and in 2006, she was named Engineer of the Year among all the central Florida engineering societies. Married, a mother, and involved in her community, Hutter exemplifies a well-rounded life.

F. Suzanne Jenniches, F.SWE

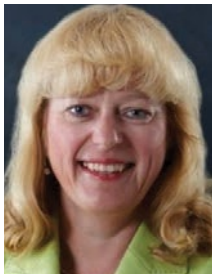
F. Suzanne Jenniches has the rare distinction of receiving the Society's Achievement Award (2000); of having served as SWE president (fiscal year 1989); induction into the Society's College of Fellows in 1993; and receiving the Distinguished New Engineer Award in 1983. Starting her career as a high school biology teacher, Jenniches was the only woman to take evening classes in engineering at Johns Hopkins in the 1970s. She retired as vice president and general manager of Northrop Grumman Electronic System sector's Government Systems Division in 2010, following an accomplished career with significant contributions and service to the profession. Not long after her retirement, Northrop Grumman endowed in perpetuity the SWE award that Jenniches created: the Suzanne Jenniches Upward Mobility Award. Jenniches established the award to recognize women who rise to significant positions in engineering and technical management.

Ellen Ochoa, Ph.D.

Ellen Ochoa, Ph.D., deputy director of NASA's Johnson Space Center, entered graduate school the same year the space shuttle flew for the first time — an event that sparked a lifelong passion for research in space. She became the first Hispanic woman to go to space when

she served on a nine-day mission aboard the shuttle Discovery in 1993. A veteran of four space flights, Dr. Ochoa has logged nearly 1,000 hours. She led two shuttle missions dedicated to research, and as the space program moved into the International Space Station era, participated in two missions that were part of the assembly of the space station. On the ground, she helped to determine how astronauts would train for, and operate, an international space station. Prior to her career as an astronaut, Dr. Ochoa was a research engineer and a co-inventor on three patents for an optical inspection system.

Ruthann Omer, P.E.



As a young civil engineer, Ruth Ann Omer, P.E., assumed duties as president of Gateway Engineers, following in the footsteps of her father, who co-founded the firm and was stepping back. Amassing more than 20 years of municipal engineering experience, with a background in the construction and inspection arena, Omer manages the engineering activities for seven municipalities located in Southwestern Pennsylvania. She is president and a member of the firm's board of directors. A life member of the Society, she served on the SWE board of directors in the 1990s, and as SWE president in fiscal year 1995.

Betty Preece, F.SWE

The first woman to receive a degree in electrical engineering from the University of Kentucky, Betty Preece was also an organizing member of the Society of Women Engineers. Preece provided six decades of service to the Society, and was recognized with the SWE Distinguished Service Award, at the 2007 annual conference. A SWE Fellow, she served

more than 11 years on the *SWE Magazine* editorial board, as well as in many other positions. She accomplished a number of "firsts," including the first woman engineer for the Eastern Test Range, now part of Patrick Air Force Base. She earned an M.S. in science education from the Florida Institute of Technology, where she later taught and started the first SWE collegiate section, serving as counselor from 1976 until shortly before her death in 2009. Passionate about working with young women and encouraging them to find careers in engineering and science, Preece supported outreach efforts and presented at national and international conferences.

Margaret Pritchard, P.E., F.SWE

A member of SWE for more than 55 years, Margaret "Pritch" Pritchard, P.E., F.SWE, has served the Society in numerous capacities, including archives committee chair and as Region J director, and various Society and regional roles. She was involved in the planning and execution of the first International Conference of Women Engineers and Scientists, which SWE hosted in 1964 in New York, and enthusiastically attended subsequent ICWES meetings across the globe. For many years Pritchard was an international consultant with her own firm, specializing in wastewater treatment, pollution control, and energy conservation. Instrumental in establishing SWE's "Over the Hill" tradition at the annual conference, she rarely missed a gathering.

Karen Ramsey-Idem, Ph.D.

An engineering director for Cummins Inc., Karen Ramsey-Idem, Ph.D., is responsible for global technical resources management. Her current

projects include the expansion of a technical center in India, the construction of a new technical center in China, and fully leveraging the global capabilities and capacity for technical work across Cummins Business Units. Dr. Ramsey-Idem joined Cummins in 1997, and holds a B.S., M.S., and a Ph.D. in mechanical engineering from Tennessee Technological University; and "Specialist to Strategist" and "Directing Innovation" certificates from Smith College. A SWE member, she represents Cummins Inc. on the SWE Corporate Partnership Council (CPC). She represents the SWE CPC on the SWE conference advisory board, and is a member of the SWE CPC International Advisory Council. She resides in Cookeville, Tennessee, with her husband and the youngest of their three children.

Betty Shanahan, CAE, F.SWE

Former executive director and CEO of the Society of Women Engineers, Betty Shanahan is a SWE Fellow and member of the Chicago Regional Section. Shanahan stepped down from her role as executive director at the end of 2013, after serving 11 years and leading the Society to significant growth, most notably increasing the size and scope of the annual conference; expanding SWE's efforts globally; and establishing the Society as a key resource and driver of public policy concerning women in science, technology, engineering, and math, and STEM education. During her tenure, the Society received the Turner Prize in recognition of SWE's contributions toward a more diverse industry and technical community. Over the course of her more than 35-year career, Shanahan was the only female engineer who worked on the Eagle minicomputer design project at Data General, and contributed to the design of the first parallel processing computer. She received an honorary doctorate from the University of Connecticut, and the Claud R. Erickson Distinguished Alumni Award from Michigan State University.

Marge Taber, Ph.D.

Retired professor of electrical engineering technology at Purdue University, Marge Taber, Ph.D., served as the SWE collegiate section faculty advisor. Diagnosed with cancer, even after 56 radiation treatments and cancer reoccurrences, Dr. Taber never gave up hope. She began her career as a development engineer, and after six years left industry to get in on the ground floor of the development of an electrical-electronic engineering technology program at a community college. She continued as an educator and never looked back. In 1987, she was recognized by SWE as the year's Distinguished Engineering Educator.

Making positive change can require moving beyond preconceived notions, sometimes ignoring protocol and expectations. Which women engineers have succeeded by breaking the rules?

Grace Murray Hopper, Ph.D.

The co-author of COBOL and a pioneering computer scientist, Rear Admiral Grace Murray Hopper, Ph.D., broke new ground. Known as "Amazing Grace," she taught at Vassar College and received her Ph.D. in mathematics from Yale in 1934. During World War II, she joined the U.S. Navy WAVES. Throughout her long career, she was involved in naval affairs and in improving computer technology. Several famous quotes are attributed to her, including, "If it's a good idea, go ahead and do it. It's much easier to apologize than it is to get permission," sometimes expressed as, "It is often easier to beg for forgiveness than to ask for permission." Known for keeping a clock that ran backward, she explained, "Humans are allergic to change. They love to say, 'We've always done it this way.' I try to fight that. That's why I have a clock on my wall that runs counterclockwise."

Naomi McAfee, F.SWE

A pioneer in the field of reliability and quality engineering, SWE Fellow Naomi McAfee received her B.S. in physics from Western Kentucky University in 1956. The first woman to hold a supervisory engineer position at Westinghouse Defense and Electronic Systems Center in Baltimore, she headed the group responsible for developing the television

camera system used on Skylab. McAfee held several offices in SWE, including the Society presidency during 1972-74. Title IX was passed during McAfee's tenure, male membership was approved, and the Equal Rights Amendment was being debated. A vocal supporter of the ERA, she implored attendees at the 1978 Student Conference and SWE Convention, "With time running out for passage of the ERA, it is incomprehensible that we could either ignore or neglect equality." A self-professed rabble-rouser, she noted in her oral history interview, part of the SWE

Pioneers Oral History Project:

"Now, there is always a conservative group, and there's always a liberal group, and there's always somebody like me who's a radical. The radicals go out and shake the trees and the liberals come along and really make things happen."

Libby Williams Taylor

After graduating with a B.S. in chemical engineering from Carnegie Mellon University, Libby Williams Taylor participated in a yearlong German-American exchange program that included an internship at a German brewery, where she researched yeast. Returning to the United States, she could not find comparable work, but kept the hope that someday she could work in a brewery. Several years later, with her husband's support, she left the family and went back to Germany for a six-month master brewery program. Completing the program, she realized that the time to make the career switch was truly at hand. She returned to the United States and took a position with Dogfish Head Brewery. She reports that women brewers are a minority, much like women in engineering, though there are four women brewers in her company. While different from her work as a chemical engineer, the background in chemicals has proven most helpful. ■

The Founders

Gathering at the Cooper Union's Green Engineering Camp on a spring weekend, the following women founded the Society of Women Engineers on May 27, 1950, known as Founders' Day:

Nancy Armstrong
Carol Piker Bauer
Ellen Bird
Mary Blade
Jane Borgstede
Ruth Bowden
Sophia Voskerchian Boyajian
Kay Broughton
Ann Bzik
Helen Greenwald Cademy
Lois E. Chew
Rita Daunais
Catherine A. Dolan
Elsie Eaves
Marjorie Martin Eby
Hilda C. Edgecomb
Judith Epstein
Mary Field
Jane Becker Fischer
Miriam Gerla
Alma Kuppinger Forman
Evelyn R. Vernick Fowler
Cecilie Froehlich
Mary Jackson Giovanoni
Roslyn Keller Gitlin
Eleanor Greiner
Ann Gunsolus
Jane Gunsolus
Beatrice Hicks
Grace M. Hopper
Elizabeth Jay
Evelyn Jetter
Jane F. Brennan Kane
Ruth Kern
Irene Kusmiss
Hermane Milenbach Lamondola
Ruby Singleton Langford
Rheta Kudroff Latt
Stella Lawrence
Catherine Levanis
Doris M. McNulty
Marilyn H. Medwin
Tina Mellila
Phyllis Evans Miller
Julia Morris
Lillian G. Murad
Joan O' Brien
Marion Ottavanger
Elizabeth Pearce
Mary Purvis
Elizabeth Reiman
Marie Reith
Phyllis Diamond Rose
Frima Schoolman
Aileen Fong Shane
Audrey Hurst Thayer
Janet Tillotson
Dorothy Fisher Trauberman
Joyce Trotte
Margaret Walker
Edith Winter

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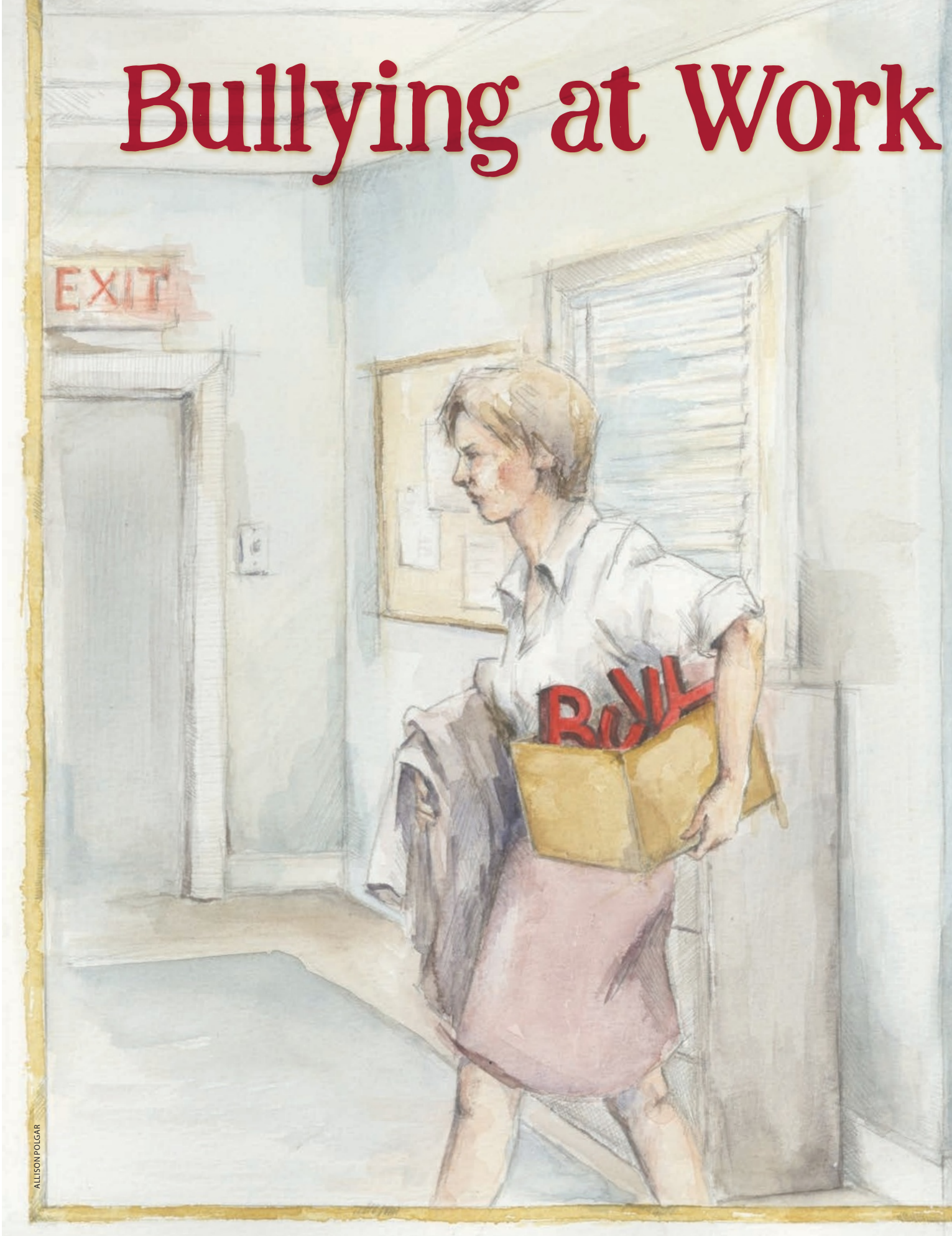
Bullying at Work



ALLISON POLGAR

Evolving Toward Zero Tolerance

A line of 25 first-graders follows a teacher down the hall toward the cafeteria. A hurried head count sends her running back to find a missing student. In a darkened classroom, a 6-year-old victim of bullying huddles in a corner, hands clenched in fists, face pressed against the cinder-block wall. Adult targets of workplace bullies know just how this child feels.

By Seabright McCabe, SWE Contributor

Most of us can recall the fear, stress, and hurt of being bullied as children — on a playground, in a classroom, or on a neighborhood street. Though bullying behavior has been observed as early as preschool, it often doesn't remain in childhood. Bullies grow up, go to college, get jobs, and carry their behaviors into the workplace and onto social media. Their victims suffer in a multitude of ways, not the least of which is the memory of early scars. Mary Fitzpatrick, Ph.D., director of diversity research and initiatives at the University of Wisconsin-Madison College of Engineering, said, "When you re-experience something that you experienced as a kid, you instantly feel like that kid again. You forget that you have more power than you realize."

Bullying at any age has two things in common: The bully feels or is rewarded for the behavior, and the victim has very little, if any, recourse. In schools, it can almost seem to be a rite of passage. In the workplace, bullies and co-workers may shrug off the behavior, implying, "That's how it is here, so just deal with it."

Many factors might make a person a target, physically or psychologically, including the simple fact that one's sex may represent only a small fraction of a profession's work force. Dr. Fitzpatrick noted, "When a person is unique from the mainstream in an organization, they're more likely to be a target — which neatly describes women in engineering."

Bullies without borders

In western industrialized societies, bullying and its effects are pervasive (see sidebar). Many European countries refer to it as "mobbing," implying group-on-individual behavior. In Japan, the word for bully is *ijimekko*, and in Italy, *il dominatore*. The connotation is the same across languages: abuse of power.

"We don't see big differences in bullying behavior between cultures and countries," Ellen Pinkos Cobb, J.D., senior regulatory and legal analyst for The Isosceles Group, said, referencing industrialized societies. "In Israel the communication style may be more direct, where in Japan it may be more passive, but the abusive conduct is generally the same. Whether it's yelling and shouting, exclusion, withholding resources needed to do a job, or impossibly heavy work demands, all of these tactics are common across the world."

Bullying may also spike during economic downturns, as budget cuts, outsourcing that overloads remaining employees, and the perception of job insecurity promote high-pressure, aggressive, and politically ruthless work environments. According to a Zogby poll commissioned by the Workplace Bullying Institute (WBI) in January 2014, 27 percent of 1,000 U.S. workers surveyed had been the target of bullying; an additional 21 percent had witnessed an incident or incidents of bullying in the workplace.

Are you a target?

Bullies seek out talented subordinates, using their power against those who have less of it. The behavior is always repeated, directed against those who are technically and socially skilled, autonomous, ethical, empathetic, and who are apt to avoid confrontation. In short, the same qualities that attract both colleagues and customers are also what attract bullies, who seek to eliminate perceived threats to their position through undermining or aggression.

But identifying potential bullies and their targets through personality traits is only one way of examining the problem — one that leaves out important demographic, societal, and environmental factors, and other conditions that may

contribute to bullying behavior.

"For example, there has been little research about cultural competency around understanding what the intersection of race, gender, ability, and body type might be with bullying, and these are areas that vocational psychologists explore quite a bit," Dr. Fitzpatrick said.

Part of the reason for this oversight has to do with where the bulk of research on bullying originates. Dr. Fitzpatrick, who is also a vocational psychologist, explained. "Bullying has been primarily investigated by industrial organizational psychologists, who have a different lens on the workplace. Their research is typically about the performance of the organization, so it's commissioned by and aligned with management," she said. "Vocational psychologists are more likely to be advocates for the employee and more likely to work directly with individuals in terms of career counseling roles. They're more inclined to understand the interpersonal impacts on the individual.

"For companies, the simple solution is to try to figure out the likelihood that a candidate will be bullied and avoid hiring them, to make the problem go away by doing a better job of determining fit beforehand," she continued. "But that's a problem — first, it's discriminatory, and second, the research on predicting who's likely to be a target is equivocal. Third, it's probably not going to work because it's practically human nature that someone will eventually become a scapegoat."

Mean girls in the workplace: fact or fiction?

"I really never had an engineering job where I didn't witness or experience bullying behavior," a woman engineer who asked to remain anonymous said. "In my first job, there were two other women in my unit, and I found out there was a tremendous amount of gossip going around about me. Terribly negative, mocking of my clothes, my hair, the way I spoke in meetings. The only way I found out about it was accidentally seeing an email. If I hadn't, I would never have known, because to my face, there was friendliness."

Decades later, this former mechanical engineer feels her stomach churn at the memory. "It was so disturbing to find out this was going on. Just like any girl in high school, when you think you have a group of friends and then realize that 'no, you don't.' It was devastating."

Of the 31 percent of women engineering students who complete their degrees, 38 percent either never enter the field or leave it after a few years. Two of the reasons they cite most are "incivility" and "undermining in the workplace." Interestingly, incivility and undermining are bullying tactics that women are more likely to use than men and, unfortunately, woman-on-woman (WOW) bullying does occur in engineering.

According to the WBI, 60 percent of all workplace bullies are men and 40 percent are women. In a sense, men are equal opportunity bullies, targeting women about 46 percent of the time, other men, 54 percent. Significantly, the WBI reports 40 percent of women who exhibit bullying behavior at work target other women 71 percent of the time.

"It's an alarming statistic that so many women choose female targets. The fact is that we're all socialized to the idea of masculine superiority and women are not immune to that," Dr. Fitzpatrick said. "The research shows that women bully at roughly the same rate as men, so there's no gender bias. Men and women use different approaches, and this is also true of girls and boys in schools. Women tend to use things we might put into the category of incivility, like not inviting someone to a meeting, or gossiping.

"I'm sorry to say that because it sounds like a stereotype," she continued. "Men tend to use more aggressive approaches like calling someone out in a meeting, where women will do things behind the scenes, in the social environment. I don't know that I can explain why a woman would bully another woman. I'd like to know."

Why do victims of WOW bullying, or any bullying for that matter, tolerate it? Gary Namie, Ph.D., a social psychologist and recognized authority on workplace bullying, offered insights on the WBI website: "Feminist writers claim that women grow up accustomed to having their personal boundaries invaded and thus learn to treat other women that same way. A girl's opinions are treated as irrelevant by the father compared to her brother's. A girl's ambitions are tamped down, expectations made more 'realistic,' dreams treated as impossible. This is denial of her very psychological integrity, a discounting of her humanity. If this is how she is raised, she grows accustomed to being treated rudely or denigrated as not deserving equal status with others. So, when bullied at work, the immediate reaction is rarely outrage and righteous indignation that a fool would dare lie so readily or be so unapologetically cruel. It is more likely a timid turning away, starting immediately to blame herself, buying into the lies (as if some 'kernel of truth' is buried in all the manure), and spiraling into a psychologically compromised state."

Plenty of women don't engage in or tolerate bullying. In her dissertation

"Women who support other women in the workplace are more likely to achieve at high levels. They are more likely to advance, and they are more likely to stay in engineering. That's a very hopeful result."

– Mary Fitzpatrick, Ph.D., director of diversity research and initiatives at the University of Wisconsin-Madison College of Engineering

research, Dr. Fitzpatrick arrived at a significant new finding on the attitudes of women engineers. "Women who support other women in the workplace are more likely to achieve at high levels than those who don't," she said. "They are more likely to advance, and they are more likely to stay in engineering. That's a very hopeful result."

Her research offers proof that the tactic of women bullying and not supporting other women in the engineering workplace is not a positive tactic for career advancement. "You're more likely to advance if you do help," Dr. Fitzpatrick emphasized. "That's not cause and effect; it's correlation. Supportive women tend to already be at higher levels where they have more power. They're able to leverage that power. They're also more likely to be committed to the career."

Could workplace bullying be the new sexual harassment?

Up until the mid-1980s, women who suffered sexual harassment in the workplace rarely objected because it was perceived as part of the job and the language to describe and confront it did not exist. They sought instead to avoid, deflect, or defuse situations, fearing retaliation, further attacks, or even job loss. Today's victims of workplace bullying often remain silent for similar reasons, but around the world, legal recourse for employees has been building.

Cobb's book, *Bullying, Violence, Harassment, Discrimination and Stress: Emerging Workplace Health and Safety Issues*, is in its second edition (a third is being prepared) and tracks legal developments in antibullying legislation around the world. Workplace protections are on the books in Sweden, France, Norway, Denmark, the Netherlands, and Finland, among other countries. "They all place responsibility on the employer to ensure a safe workplace, not just physically but psychologically, which is often interpreted as requiring protection from bullying," Cobb said.

Protections for U.S. workers lag far behind. "Businesses resist legislation because it gives more power to employees, and because of the belief it may open the floodgates to lawsuits," Cobb said. "Think about how sexual harassment was once unregulated. There was no system for defining whether it was real or imagined. It still happens since the laws were passed, but it happens less often because it's punishable. Proposed antibullying legislation, known as the Healthy Workplace Bill, sets a high threshold for proving bullying."

Another reason Europe leads the way in antibullying legislation is that the European Union is a bit more pro-employee. "The underlying European antibullying laws consider the dignity of the individual as a basis for saying, 'You can't just harass someone with impunity,'" Cobb added.

At the WE14 conference in Los Angeles, a panel discussion concerning workplace bullying was met with a standing-room-only audience of women engineers. Each person interviewed for this story remarked, "That doesn't surprise me at all." The need to address the problem of bullies in the workplace is loud and clear, though strategies for combating it through clear policies, as was the case with sexual harassment, are slow to develop.

While those gears turn, victims of bullying are urged to keep meticulous and secure (not kept at work) written records of abuse; to seek outside vocational, career, or mental health counseling; to strengthen social networks; and to take steps to ensure physical health and work/life balance. Further pushback against workplace bullying will come from many directions, and more comprehensive research, better laws, and enforceable company policies may yet combine to turn the tide. ■

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High Costs for Employees and Employers

The Workplace Bullying Institute (WBI) defines bullying as a repeated pattern of verbal or physical abuse used to intimidate, threaten, humiliate, and prevent others from succeeding. It takes many forms: whispers over a cubicle wall, anonymous attacks on Facebook, or morning meetings that turn into an ambush. The range of bullying tactics, from subtle undermining to nightmare scenarios, can be broad and damaging to personal and professional well-being.

The consequences of bullying are far-reaching. Physical and mental stress can spill out of the work situation into the home. Health impacts include insomnia, panic attacks, depression, hypertension, weight loss or gain, and an increased risk of substance abuse, even suicide. Continual stress can lead to immune system suppression, making an individual more vulnerable to disease — and that's just for the victims.

"Workers who witness bullying can have a stronger urge to quit than those who experience it firsthand," Ellen Pinkos Cobb, J.D., said, referring to a 2012 report by the Sauder School of Business at the University of British Columbia in Vancouver. "Bullying deeply affects workplace morale, leading to higher absenteeism, poor performance, and lower productivity, not just for the individual but for the whole work force.

"Workplace bullying is an internal occurrence, undertaken by managers and/or co-workers, and it has the opposite effect of violence inflicted by sources external to the company, like a robbery, for instance," Cobb continued. "When something like that happens, people tend to band together. Workplace bullying fractures morale from inside the organization. I've seen people bullied and yelled at, and it's really disturbing to be a bystander. You don't know what to do."

What many people do is quit, or just wish they could. Consequences to the bottom line of companies are huge, with the Workplace Bullying Project Team at Griffith University in Australia estimating the financial cost of bullying to businesses at between $6 billion and $13 billion per year.

Women in Engineering: A Review of the 2014 Literature

SWE's assessment of the most significant research found in the past year's social science literature on women engineers and women in STEM disciplines.

By Peter Meiksins, Ph.D., Cleveland State University
Kacey Beddoes, Ph.D., Oregon State University
Peggy Layne, P.E., F.SWE, Virginia Tech
Maureen McCusker, Virginia Tech
Elsa Camargo, Virginia Tech
Katie Boyd, Virginia Tech

Interest in the underrepresentation of women in engineering and other STEM disciplines continued unabated in 2014. In addition to a large amount of scholarly and professional interest in the issue, broader public attention was drawn to it by discussion of America's competitive status in STEM fields — questioning whether the U.S. is falling behind, and if recruiting more women is the solution — and by an op-ed in *The New York Times* in which researchers Wendy Williams, Ph.D., and Stephen Ceci, Ph.D., made the controversial claim that sexism and discrimination were *not* significant factors explaining the low numbers of women in academic science. Our review of the literature covered well over 100 publications, including books, major reports, and journal articles in publications representing a half dozen or more disciplines. We searched for articles by examining major research databases and more than 70 journals that publish articles on gender and engineering. As always, the studies varied tremendously in quality and rigor; they also varied in their methodological approach, from complex statistical analyses of large data sets to interpretive studies of qualitative data.

The literature we reviewed continues to explore familiar explanations of why there are relatively few women in engineering. Some studies focus on early childhood socialization and children's experiences in the K-12 educational system, arguing that STEM in general and engineering in particular are perceived by children as male fields, so girls either are not attracted to them or are actively discouraged from entering them. Others focus on what happens to young women who display an aptitude for math, science, and engineering when they enter university. The focus here is on whether engineering programs are supportive of female students, whether engineering curricula respond to the kinds of issues in which female students are likely to be interested, as well as on understanding why young women with strong math and science skills opt for majors other than engineering. Finally, the literature continues to recognize that engineering graduates do not always thrive or remain in the field after they enter the workplace. Studies of both academic and nonacademic settings in which female engineers and scientists work continue to investigate potential obstacles to female engineers' career progress and factors that may explain why some female engineers "opt out."

It has become fairly common to argue that the explanation for the low numbers of women in engineering lies in *all* of these areas and that there is no single cause of gender imbalance in technical fields. However, an interesting aspect of this year's literature is the increasingly lively debate over the question of whether gender bias and discrimination characterize contemporary engineering workplaces. Are these factors keeping women out and/or holding them back when they gain admission, *or,* as some observers now hold, are women simply choosing not to enter the field, despite real progress in eliminating bias and discrimination? If gender bias and discrimination have been reduced or even eliminated, should the focus of analysis shift to the choices women make earlier in life about whether or not to enter technical fields in the first place? And, if the key is to understand women's choices, are those choices simply a matter of individual preferences or are they constrained by gendered realities that make certain choices more likely than others? Given the prominence afforded these questions, particularly by Williams and Ceci's *New York Times* op-ed piece, we have paid particular attention, in this year's literature review, to contributions that bear on the issues of bias and the nature of women's choices.

A historical overview

One of the most substantial publications we reviewed this year provides us with the opportunity to look at female underrepresentation in engineering in historical context. Amy Sue Bix's (2014) *Girls Coming to Tech! A History of American Engineering Education for Women* surveys the experiences of female engineering students at elite institutions from the late 1800s to the 21st century. Based on extensive use of

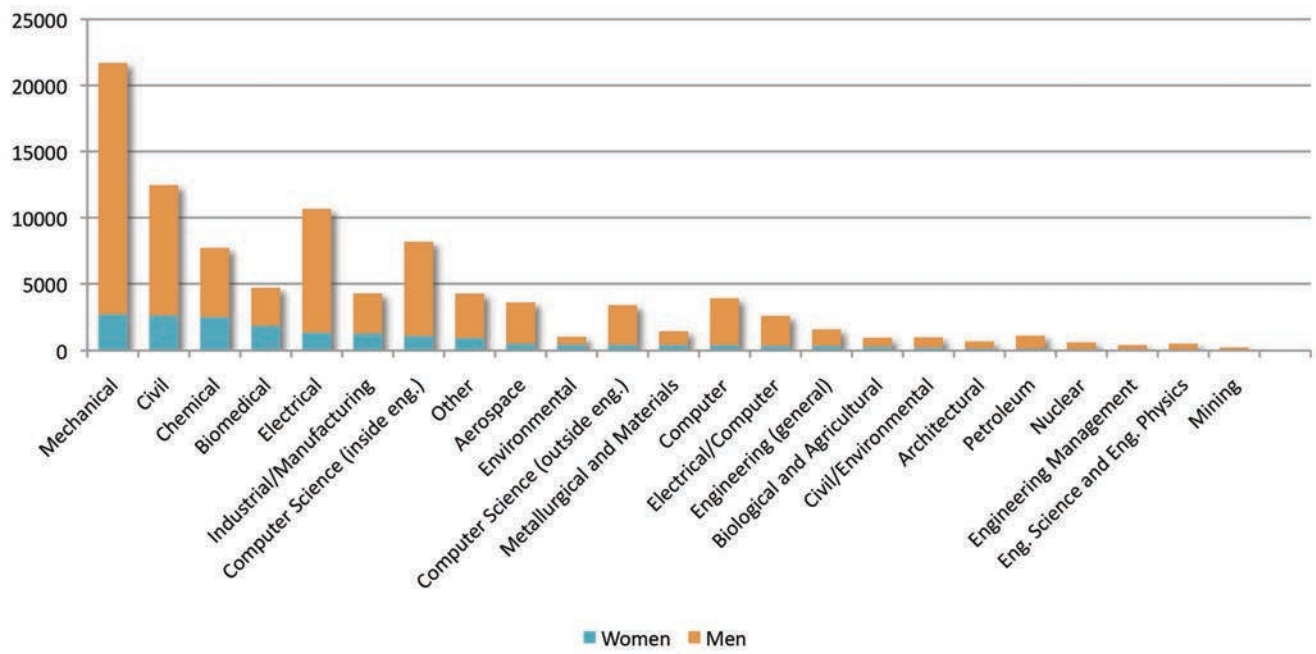
archival materials, including the SWE archives, *Girls Coming to Tech* tells the story of how women gained entry to engineering, with focused case studies of Georgia Tech, Cal Tech, and MIT making up a substantial portion of the book. A full-length review appeared in an earlier issue of *SWE Magazine* (the 2014 Conference issue), but a quick summary here will serve to introduce some of the important questions about the contemporary situation.

Bix describes the powerful forces that have served to exclude women from engineering over the past 100-plus years. She demonstrates that women in engineering colleges often encountered conscious, deliberate efforts to keep them out as well as an unwelcoming or even hostile culture that made it difficult to feel as if they belonged and to get the help that they, like their male counterparts, needed. Various forms of harassment, from sexist jokes to stereotypical comments on women's bodies to more serious forms of sexual misbehavior, also plagued female engineering students well into the 21st century. Bix is equally persuasive, however, in arguing that it was often unstated, implicit biases and unrecognized gendered processes and structures that blocked women's entry or discouraged their progress. Thus, factors ranging from the absence of equal facilities for women (e.g., restrooms), to often unstated and unacknowledged perceptions of women's inferiority, to linguistic practices ("girls" come to tech) that diminished women combined to make it difficult for them to thrive in engineering programs. She stresses the importance and consequences of conscious efforts to change attitudes and to break down the barriers that had traditionally kept women out of engineering.

In the end, the story Bix tells is one of incomplete progress. She documents the fact that the open questioning of the propriety of women's entry into engineering has more or less died away as women have found a place in the field. SWE is singled out for praise as one of the organizations that has played a key role in effecting this change. At the same time, she notes the persistence of stereotypical beliefs about women's abilities as engineers and scientists (she comments, for example, on Harvard President Lawrence Summers' infamous comments in 2005 on women's math abilities). In addition, she notes that observers have expressed concern that women's progress may have plateaued; even if explicit biases may have weakened, many of the implicit beliefs and structural realities that kept women out in the past continue to be in place today. As the *SWE* reviewer put it:

"Her rich and nuanced study reminds us of how far women have come, as well as how much work remains if American engineering educators hope to cultivate the potential of all who seek its rewards" (Homsher 2014:61).

Bix's historical review, then, leaves us with the question of why, despite concerted effort to increase the numbers of women in engineering, and some measurable progress in reducing conscious resistance to that effort, women remain a minority in the engineering profession.



Source: Yoder, Engineering by the Numbers, American Society for Engineering Education, 2014

Girls' aptitude vs. interest vs. socialization?

One possible answer to the question of why girls are less likely to be interested in engineering lies in childhood. For whatever reason, girls are less likely than boys to express an interest in engineering, so are less likely to identify it as a career choice and to take the preparatory steps necessary to entering the field. Traditionally, this was attributed to girls' lesser ability in the fields critical to engineering success: math and science. Educators and parents did not encourage girls to pursue engineering, and even girls themselves were not attracted to engineering because of the belief that girls lacked the skills needed to become an engineer.

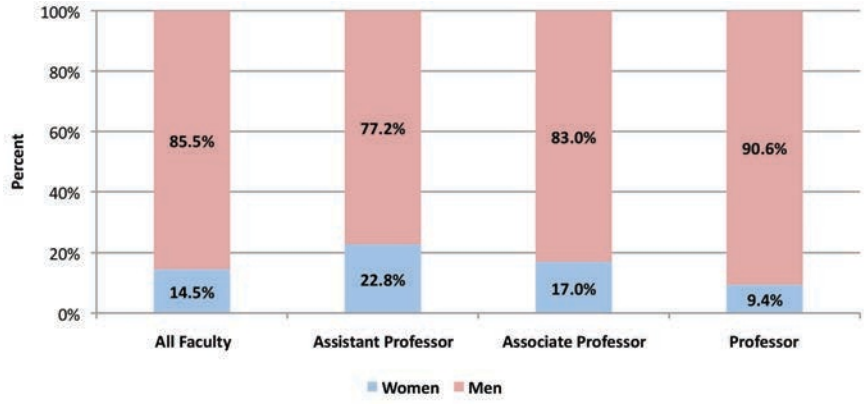
Evidence has accumulated that this lesser ability is more myth than reality (for a brief summary, see Valla and Ceci 2014). But, the *belief* that girls lack math and science ability persists. Saucerman and Vasquez (2014) published a useful review of the literature on psychological barriers to women's participation in STEM, emphasizing what they argue is girls' and women's lifelong exposure to overt and subtle messages that make them feel that their absence from STEM fields is the result of lack of ability. They note, for example, that most teachers with math anxiety are female, and that teachers transmit math anxiety to students, so girls continue to be its primary victim. Similarly, teachers continue to attribute the math success of boys (but not girls) to innate ability, while media continue to portray STEM professionals as men. They note the existence of research indicating that men actually have more egalitarian views of women's ability in science and math than do women, perhaps reflecting the continued effects of the subtle messages to which women are exposed throughout the life course.

Scholarly attention also has turned to a different explanation of the relatively small numbers of girls expressing an interest in STEM careers. Maybe it is not a matter of perceived ability but rather that girls aren't attracted to engineering because they lack knowledge about a field that is widely stereotyped as male and which is seen to be involved with activities in which girls typically are not interested.

Several of the studies we reviewed this year focused on this explanation for female underrepresentation in engineering and what can be done about it. Hammack and High (2014) report on a study of 68 sixth- and seventh-grade girls in the Southwest who participated in an after-school mentoring program about engineering. Prior to the program, girls viewed engineers as people who "fixed things and built stuff." Participation in the program resulted in their viewing engineers as creative problem solvers who improve the world. Hirsch et al.'s (2014) study of 141 fourth- and fifth-graders also found that an enrichment program shifted students' perception of engineers (this was true for both boys and girls in their study). Interestingly, they found that girls in a girls-only enrichment group were more likely to show an increased sense of self-efficacy and to depict engineers as female, something few children of either sex did prior to the enrichment program. Each of these studies points to children's perceptions of engineering as male, and to the fact that that perception can be changed. A note of caution is introduced, however, by Robinson and Pérez-Quiñones (2014), whose study of 19 middle-school minority girls found that participation in a program on human-computer interaction changed the girls' perception of the discipline, but had little effect on their interest in pursuing a career in computer science.

One common intervention designed to combat the gender typing of engineering and STEM disciplines overall is mentoring. Underlying this approach is the idea that girls are less likely to be attracted to engineering and related fields because they see relatively few females in these occupations and have little contact with women who could serve as models. Two studies we reviewed, however, raise questions about this approach. Draus et al. (2014) surveyed 695 women in informational technology, who reported that they did not see a great deal of usefulness in mentoring; 57 percent said that mentoring had little or no effect on their decision to go into IT. Bamberger (2014) reports on a study of Israeli ninth-grade girls whose school was visited by 12 highly educated female scientists and engineers from one of the country's leading high-tech companies. Sixty girls participated in the visit, while a group of 30 did not. This intervention actually backfired, as the girls who participated in the visit had a more negative view of women in STEM and were less likely to express an interest in STEM careers afterward, while the control group showed no change. Bamberger speculates that the participants in the visit were frightened by the scientists and engineers,

Engineering Faculty by Rank and Gender, 2013



Source: Yoder, Engineering by the Numbers, American Society for Engineering Education, 2014

who used terms and concepts the girls found foreign and incomprehensible.

Valla and Ceci (2014), in a brief but provocative research note, point to another possible explanation for the fact that relatively few young women are attracted to careers in engineering and related fields. They raise questions about the ongoing focus on math ability in analyses of female underrepresentation in STEM, arguing that whether women have strong math ability tells only one part of what one needs to know to explain their occupational choice. The authors cite other research indicating that career choices are shaped by interests, not just aptitudes. Moreover, they note that women who score high on math ability *also* tend to score high on verbal ability, something that is less true for men. As a result, talented women have abilities in multiple areas, and may opt to enter fields in which verbal, rather than math, skills are central, whereas men who are good at math are more limited to what the authors describe as "narrow," math-centered activities. Valla and Ceci argue for a "breadth-based model" of women's underrepresentation in STEM, suggesting, in effect, that women choose not to enter these fields, rather than being excluded from them. This complements their contention, to be discussed below, that women are not treated unequally in science but are choosing NOT to enter math-based STEM fields, largely because of their choice to devote time to family and child-rearing activities.

Valla and Ceci raise an interesting question about whether talented young women are "voting with their feet" in avoiding science. However, the authors take for granted the definition of certain career paths (including engineering) as "narrow." Their argument is that boys who are only good at math are drawn to engineering and computer science because these fields demand those skills exclusively. But, as the National Academy of Engineering's Engineer of 2020 report and ABET's 2000 reconfiguring of accreditation criteria for engineering programs advocate, engineering actually requires a variety of professional as well as technical skills.

Solving the Equation: AAUW Report Makes Recommendations for Change

On March 26, the American Association of University Women (AAUW) will release a report summarizing the latest research on women in engineering and computing. Funded in part by the National Science Foundation, the report highlights compelling recent findings and makes recommendations for increasing the representation of women in engineering and computing.

Solving the Equation: The Variables for Women's Success in Engineering and Computing features the latest data on girls' achievement in subjects related to engineering and computing, how few women are working in these fields, and what can be done.

Solving the Equation synthesizes the research on the underrepresentation of women in the technical work force from multiple disciplines and makes evidence-based recommendations for change. The goal is to synthesize and publicize what is known about the situation of women in these fields and to spark the attention of journalists, decision makers, and the public so as to encourage change.

In a second, future phase of the project, AAUW will publish an agenda for future research on the underrepresentation of women in engineering and computing. To form the future research agenda, AAUW will convene a working meeting of prominent researchers in the field. The resulting research agenda will identify questions that are yet to be answered and promising directions for future inquiry. The agenda will be widely disseminated to interested stakeholders.

The research report will be available for free download at www.aauw.org/what-we-do/research/.

Valian (2014) raises precisely this question in a commentary on previously published studies on the use of occupational interest inventories. Valian argues that "gender schemas" (stereotypes) are built into these scales and that sex differences in interests are changeable and sensitive to environmental cues (such as changes in which women are represented in fields formerly dominated by men). Women's interest in math and science fields will increase if they have a feeling of belonging and an expectation of success, so that Valian concludes that "if we change the environment of math and science, we will change women's interest in math and science" (229). Perhaps, then, if engineering and math became (or were perceived as) less "narrow," they might attract more of the more broadly talented women Valla and Ceci describe.

What happens in university?

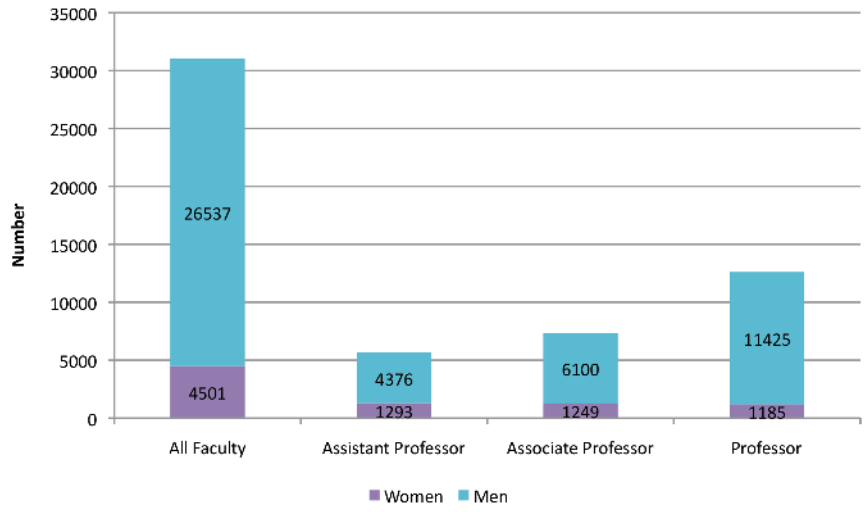
Many young people make their decision about a college major well before they enter the post-secondary system. But, many of them also change their minds, often multiple times, while others complete high school without a clear sense as to what their intended major is. Thus, explanations for the underrepresentation of women in engineering need to look not just at what happens before college, but also what recruitment practices and messages are used to attract engineering students. Moreover, since at least some students leave engineering before completing their degrees, and because there has been considerable talk about the "leaky pipeline" for female engineering students, it is also important to consider how engineering programs endeavor to retain students, particularly female students.

These issues were central to a number of the publications we reviewed this year. Holloway et al. (2014) considered the question of whether admissions criteria are contributing to women's underrepresentation in engineering. They analyzed admissions data from the 2006-2010 cohorts at a Midwestern public university for applicants to the college of engineering. They found that there was gender bias in the admissions process and that it was built into the criteria and policy in use. The university responded by changing its admissions practices; this involved

both reorganizing the admissions office and changing the criteria. Some of the changes included reducing emphasis on math scores on standardized tests and increasing the focus on other cognitive factors such as verbal or written test scores, and on noncognitive factors such as leadership and academic motivation. Holloway et al. report that these changes were effective in eliminating gender bias in the admissions process at this university.

Several studies we reviewed discussed the question of whether engineering is, or could be, presented in ways that respond to female students' interests. Lehr, Finger, and Christine (2014) conducted online surveys with first-year engineering students at a polytechnic state university in California and report the relatively familiar finding that efforts to recruit female students to engineering may be more successful if they convey different messages about what it means to be an engineer (e.g., make a difference) and/or if they occur in different settings (e.g., English classes). Klotz et al. (2014) report on a large survey conducted as part of the larger "Sustainability and Gender in Engineering Survey" of college students in introductory English classes. They found that, in general, sustainability was a theme that could attract both male and female students to engineering. However, there were differences between male and female engineering students — men were more likely to be interested in energy, while women were more interested in addressing issues of disease and poverty. Findings such as this add support to the argument that engineering may need to present itself differently to women than to men.

Cech's (2014) findings from a study of more than 300 engineering students at four New England schools, however, raise questions about whether an emphasis on issues such as sustainability, health, or poverty is actually at the heart of engineering students' sense of self. She reports that engineering students display a culture of "disengagement" and did not put public welfare consideration at the forefront of their professional identity. Moreover, she finds that students' commitment to public welfare concerns decreased over time, as she interviewed students as first-year students, then again as seniors. Thus, it may be that students lose their interest in these issues fairly quickly, so that basing engineering recruiting materials on their centrality may not make sense. Or, it may be that students who *are* interested in these issues will find it difficult to thrive in a student culture dominated by a very different set of concerns, resulting in high attrition rates and levels of dissatisfaction.



Source: Yoder, Engineering by the Numbers, American Society for Engineering Education, 2014

Brawner, Orr, and Ohland (2014) draw attention to another aspect of recruitment: When does it occur? While most engineering graduates begin their college careers in engineering, a minority does not. The authors' analysis of data from the Multiple Institution Database for Investigating Engineering Longitudinal Development shows that students who shift into engineering from other math and science disciplines are more likely to be female (the difference is not huge, but still significant). Thus, it may be that paying more attention to recruiting students from other majors will prove to be an effective way of increasing the numbers of women in the discipline, an idea that would be consistent with the argument that there is no single pipeline into the profession. Lattuca et al. (2014) note that engineering students in community colleges are unusually likely to be minority students, first-generation college students, and non-native English speakers. Looking outside the traditional high school recruitment pipeline may be a way to increase the diversity of engineering programs in other ways as well.

Once women declare an interest in engineering or STEM disciplines, do they stay? If they stay, what contributes to their retention? Gayles and Ampaw (2014) analyzed secondary data on 1,488 female STEM majors at four-year institutions in the U.S. between 1996 and 2001. They found that regular interaction with faculty was an important predictor of completion, particularly for women. So was being a full-time student. Surprisingly, however, good social experiences were *not* predictive of completion (although women students noted negative aspects of their social experiences); and, GPA was a weaker predictor of completion for women than for men, implying that some successful female students leave STEM disciplines despite high grades.

Several studies (Raelin et al. 2014; Flores et al. 2014) point to feelings of

self-efficacy as a particularly important predictor of degree completion for women in engineering and STEM more generally, which echoes research we have reported in previous years. Raelin et al. add that contextual support is very important in encouraging women to stay in school and complete STEM degrees. Miller et al.'s study of 286 engineering students at two predominantly white and two HBCUs notes that female students mentioned seeking help from other female students as an important strategy for coping with the challenges of their minority status.

Imran, Nasor, and Hayati (2014) describe an interesting case study showing how admissions criteria and curricular design can influence the retention of engineering students. They studied two groups of undergraduate electrical engineering students, one composed of students admitted *before* changes to admissions and curricular requirements, one composed of students admitted *after* those changes were in place. The changes included reducing the total number of hours required, curricular redesign to ensure a smoother transition from junior to senior years, and enhancements to the program designed to encourage interest and engagement. The authors report that the changes significantly increased retention for students in general, and for female students specifically; the percentage of women in the second study group was also larger than in the first group, perhaps because of changed admissions rules, perhaps because of more effective retention.

The workplace: a gender-biased academy?

The argument that academic departments are not welcoming to female scientists and engineers and that women encounter a hostile, chilly, even sexist climate when they enter academic science has been central to the literature on women in STEM disciplines. Part of the rationale for the existence of programs like the National Science Foundation's ADVANCE is the perceived need to take positive steps to counteract the effects of both conscious and unconscious gender bias in the academy. Not everyone agrees that this is still a problem, however, as this year's literature review made clear. In a major monograph-length article, Ceci et al. (2014) summarize their own and others' research challenging the view that a major cause of the underrepresentation of women in academic science is gender discrimination in these disciplines. The monograph reviews the research underlying the op-ed they published this year in *The New York Times* (Williams and Ceci 2014). They contend that the most recent evidence shows that women who enter academic science disciplines fare at least as well as their male counterparts. In math-intensive fields where women are underrepresented, they find that female candidates are at least as likely to be invited to interview for tenure-track positions. Similarly, they find that manuscript and grant funding are now gender neutral, with female authors and principal investigators experiencing similar acceptance and funding rates as their male counterparts.

In their scholarly monograph, Ceci et al. argue that, instead of focusing on discrimination against women who enter academic science, researchers seeking to explain the underrepresentation of women in science should focus on precollege factors and the likelihood that women will major in math-intensive STEM disciplines. Their review of the current research does not support the view that early sex differences in spatial and mathematical reasoning are biological; indeed, they find evidence that sex differences in math ability, even at the high end (the right tail) from which most STEM academics are drawn, can and have changed over time and vary across cultures. They also note that gender differences in attitudes and expectations about math-intensive careers appear very early in children's development and lead to a lower percentage of women choosing to major in math-intensive STEM disciplines. The clear implication of their argument is that interventions designed to increase female participation in academic science should target young children, not adults, and focus on influencing girls' attitudes to careers and STEM majors that involve advanced mathematics.

Ceci and Williams' arguments have been sharply criticized by others. Rebuttals, particularly "Sexism in Academic Science: Analysis of *The New York Times* Op-Ed" (2014), contend that Ceci and Williams make selective use of data, don't acknowledge evidence of sexism in science, and focus on individual-level data, rather than the structural characteristics of academic departments and institutions. Particular criticism is leveled at their analysis of the evidence regarding the allegedly equal treatment received by female academics in publication and tenure and promotion decisions. Ceci and Williams acknowledge that female assistant professors are less "productive" scholars, but see this as evidence not of sexism, but of choices women make to prioritize family and child-rearing over academic work. From their point of view, if women publish less and are, therefore, less likely to be granted tenure and promotion, it is *not* because they are women but because they are less successful within the gender-blind competition that is scientific work.

Critics note, however, that this normalizes a highly gendered reality in which women (and not men) are expected to and expect to have primary responsibility for child-rearing and in which definitions of scientific success assume an "ideal worker" who can devote all or most of his (or her) time to scientific work. From the critics' point of view, then, science is organized in a way that is gendered and that favors the experiences and realities of men over those of most women (unless those women are willing to "act like men"). Ceci and Williams are charged with ignoring this aspect of the social organization of gender in STEM.

Several studies we reviewed emphasized the gendered reality of academic engineering and science and challenged the view, propounded by Ceci and Williams, that academic science is now gender neutral. Beddoes and Pawley (2014), for example, interviewed 19 STEM faculty (four of whom were

2014 Outstanding Women in Engineering

By Kacey Beddoes, Peggy Layne, and Maureen McCusker

While the following achievements are worth celebrating, they should also be considered in light of new research this year on biases in award systems. Mason, Marchetti, Bailey, and Baum (2014) found that women academics receive proportionally fewer awards than male professors. Based on historical institutional data from a large technical university, they found that between 1964 and 2012, 19.8 percent of university awards were given to women, and between 2007 and 2012, women received 12.1 percent of awards, but were approximately 30.5 percent of the faculty population. The authors identified challenges to creating less-biased award systems, including unclear criteria, the use of student evaluations, and the use of letters of recommendation, all of which have been shown to perpetuate gender biases detrimental to women. In order to minimize biases in award systems, the authors recommend giving committees the tools they need to avoid perpetuating biases: establishing clear and explicit evaluation criteria, and then critically evaluating that criteria; holding decision makers accountable; being transparent and systematically tracking progress; and legitimizing female leaders in order to establish a basis for positive ratings.

An earlier study funded by the National Science Foundation's ADVANCE program and led by the Association for Women in Science

American Society for Engineering Education (ASEE) Awards

National and Society Award Recipients

Donald E. Marlowe Award
Jean W. Zu, Ph.D., P.Eng., University of Toronto

Fred Merryfield Design Award
Maria C. Yang, Ph.D., Massachusetts Institute of Technology

Sharon A. Keillor Award for Women in Engineering Education
Susan McCahan, Ph.D., P.Eng., University of Toronto

DuPont Minorities in Engineering Award (Formerly Vincent Bendix Award)
Stephanie Luster-Teasley, Ph.D., North Carolina A&T State University

William Elgin Wickenden Award
Glenda S. Stump, Ph.D., Massachusetts Institute of Technology
Michelene T.H. Chi, Ph.D., Arizona State University

Curtis W. McGraw Research Award
Ellis Meng, Ph.D., University of Southern California

ASEE Section Awards

Outstanding Teaching Award
North Central: Mary C. Verstraete, Ph.D., The University of Akron

Outstanding Campus Representative Award
Midwest: Christi Luks, Ph.D., The University of Tulsa

Outstanding Service Award
Illinois-Indiana: Joanne Lax, Purdue University

Outstanding Community College Educator Award
Pacific Southwest: M. Elizabeth Rozell, Bakersfield College

Outstanding Mid-Career Teaching Award
Southeast: Priya Goeser, Ph.D., Armstrong Atlantic State University

2014 ASEE Fellow Member Honorees
Laura Bottomley, Ph.D., North Carolina State University
Rebecca Brent, Education Designs Inc.
Christine M. Cunningham, Ph.D., Texas A&M University
Patricia Hall, Ph.D., The University of Tulsa
Kim LaScola Needy, Ph.D., P.E., University of Arkansas
Mary A. Sadowski, Ph.D., Purdue University
Ann Saterbak, Ph.D., Rice University
Noel N. Schulz, Ph.D., Kansas State University

ASEE Professional and Technical Division Awards

Biomedical Engineering Division

Theo C. Pilkington Outstanding Educator Award
Rena Bizios, Ph.D., The University of Texas at San Antonio

Biomedical Engineering Teaching Award
Renata Ramos, Ph.D., Rice University

Civil Engineering Division

George K. Wadlin Distinguished Service Award
Kristen L. Sanford Bernhardt, Ph.D., P.E., Carnegie Mellon University

College/Industry Partnerships Division 2013

CIEC Best Session Award: Presenter
Lori Glover, Massachusetts Institute of Technology

CIEC Best Presenter Award
JoZell Johnson, Intel Corporation

CIEC Best Moderator Award
Letha Hammon, DuPont

Cooperative and Experimental Education Division

Lou Takacs Award
Kimberly Demko, GE Aviation

Alvah K. Borman Award
Louise T. Carrese, Rochester Institute of Technology

Educational Research and Methods Division

Distinguished Service Award
Daria Kotys-Schwartz, Ph.D., University of Colorado Boulder

Engineering and Libraries Division

Homer I. Bernhardt Distinguished Service Award
Amy Van Epps, Ph.D., Purdue University Libraries

K-12 and Pre-College Division

Meritorious Service Award
Elizabeth Parry, North Carolina State University

Women in Engineering Division

Mara H. Wasburn Apprentice Educator Grant
Jan DeWaters, Ph.D., P.E., Clarkson University
Mary Katherine Watson, The Citadel

Women in Engineering ProActive Network (WEPAN) Awards

University Change Agent Award
Cordelia Ontiveros, Ph.D., California State Polytechnic University, Pomona

President's Award
Mary Anderson-Rowland, Ph.D., Arizona State University
Brenda Hart, University of Louisville

Distinguished Service Award
Beth Holloway, Ph.D., Purdue University

Founders Award
Tricia Berry, The University of Texas at Austin

Betty Vetter Award for Research
Amy Sue Bix, Ph.D., Iowa State University

The National Academy of Engineering

New Female Members
M. Katherine Banks, Ph.D., P.E., Texas A&M University, College Station
Virginia S.T. Ciminelli, Ph.D., Universidade Federal de Minas Gerais, Brazil
Katherine Whittaker Ferrara, Ph.D., University of California, Davis
Maria Flytzani-Stephanopoulos, Ph.D., Tufts University
Naomi Halas, Ph.D., D.Sc., Rice University
Geraldine Knatz, Ph.D., University of Southern California
Ellen M. Pawlikowski, Ph.D., U.S. Air Force, LA AFB
Indira Vasanti Samarasekera, Ph.D., University of Alberta, Canada
Jennifer Rexford, Ph.D., Princeton University
Stacey I. Zones, Ph.D., Chevron Energy Technology Co.

(Lincoln, Pincus, Koster, and Leboy, 2012) examined data on scholarly recognitions from 13 scientific disciplinary societies, and similarly found that while the number of awards and prizes going to women has increased in the past two decades, men still receive a disproportionate number of these recognitions. This analysis showed that while increasing numbers of women in the nomination pools for the awards studied did increase their likelihood of receiving the awards, women were still more likely to be recognized for teaching and service than for their scholarly activities. Men were more likely to win scholarly awards than women, regardless of the proportions of men and women in the nomination pool. Recommendations to address this underrepresentation include increasing the number of women on awards committees, educating awards committees about the impact of implicit bias on evaluation, reviewing awards criteria for biased language, and providing explicit guidance on issues to be addressed in letters of recommendation.

For fuller discussion, please see:

Lincoln, A.E., S. Pincus, J.B. Koster, and P.S. Leboy (2012). "The Matilda Effect in Science: Awards and Prizes in the US, 1990s and 2000s." *Social Studies of Science.* 42: 307-320.

Mason, S.P., C.E. Marchetti, M.B. Bailey, and S.A. Baum (2014). "Faculty Awards at a Large Private Institution: An Indicator of Evolving University Values?" In *121st ASEE Annual Conference and Exposition.*

Society of Women Engineers (SWE) Awards

Achievement Award
Frances Mazze Hurwitz, Ph.D., NASA Glenn Research Center

Suzanne Jenniches Upward Mobility Award Endowed by Northrop Grumman Corporation
Janeen Judah, Chevron

Distinguished Engineering Educator
Karen A. Thole, Ph.D., The Pennsylvania State University

Global Leadership Award
Rita Bowser, Westinghouse Electric Company
Anne Coté, Kimberly-Clark Corporation
Suzanne R. Davidson, The Boeing Company

Prism Award
Cindy Hoover, Spirit AeroSystems Inc.
Emily L. Howard, Ph.D., The Boeing Company
Carol J. Weber, Caterpillar Inc.

Emerging Leader
Angela Ahmad, Exelon Corporation (BGE)
Jennifer A. Brooks, Caterpillar Inc.
Kristi Christensen, Deere & Company
Dianna Genton, Huntington Ingalls Industries
Zohra Hemani, Northrop Grumman Corporation
Laura M. Major, The Charles Stark Draper Laboratory Inc.
Jessica McElman, Naval Surface Warfare Center, Carderock Division
Tara L. Rossman, Caterpillar Inc.
Patricia Walker, Medtronic Inc.
Erika Williams, John Deere

SWE Distinguished New Engineer
Carrie Ballester, Lockheed Martin Corporation
Cybill Boss, P.E., URS Corporation
Britta Jost, Caterpillar Inc.
Stacy Lueneburg, Continental Automotive Systems
Lisa M. Rimpf, The Babcock & Wilcox Company
Stephanie R. Salas-Snyder, Intel Corporation
Jessica Teachworth, Lockheed Martin Corporation
Erin M. Wakefield, Intel Corporation
Abigail Wendt, P.E., Magellan Midstream Partners L.P.
Lauren Wolf, The Boeing Company

Fellow Grade
Alma Martinez Fallon, Newport News Shipbuilding
Betty Irish, Comfort Systems USA Southwest
Diana Lyn Joch, Northrop Grumman Corporation
Silvia Karlsson, P.E., General Motors
Helen O. Patricia, Kennametal Inc.
Catherine Pieronek, University of Notre Dame

Distinguished Service Award
Naomi Brill, F.SWE
Stacey Bright Culver, The Babcock & Wilcox Company

Outstanding Faculty Advisor
Kristine K. Craven, Ph.D., Tennessee Technological University

Outstanding SWE Counselor
Jennifer May Vilbig, Vilbig & Associates

Outstanding Collegiate Member
Kaitlyn J. Bunker, Ph.D., Michigan Technological University
Samantha Knoll, University of Illinois at Urbana-Champaign
Ritu Raman, University of Illinois at Urbana-Champaign
Tabitha Voytek, Carnegie Mellon University
Grace Guin, The University of Alabama
Mary Ashley Liu, The University of Texas at Austin
Alexandra Romine, The University of Alabama
Samantha Scharles, Milwaukee School of Engineering
Erin Westerby, Bradley University
Nicole Woon, The University of Pennsylvania

The Anita Borg Institute for Women and Technology Awards

Women of Vision Innovation Award
Tal Rabin, Ph.D., IBM T.J. Watson Research Center

Women of Vision Social Impact Award
Kathrin Winkler, EMC Corporation

Women of Vision Leadership Award
Maria Klawe, Ph.D., Harvey Mudd College

Intel Science Talent Search Awards

Natalie Ng, California, fifth place
Zarin Ibnat Rahman, South Dakota, seventh place

National Society of Black Engineers (NSBE) Awards

Graduate Student of the Year
Whitney B. Gaskins, University of Cincinnati

Entrepreneur of the Year
Sabiha Quraishi, Masha Manufacturing

Pre-College Initiative Director of the Year
Paige Lewter, Southern Maryland NSBE Jr. Chapter

Pre-College Initiative Student of the Year (Female)
Paige Cheatham, San Antonio City Wide NSBE Jr. Chapter

Outstanding Woman in Technology
Tonya Noble, The Boeing Company

Professional Member of the Year (Female)
Angelena Edwards, Central Jersey Professional Chapter

Society of Hispanic Professional Engineers (SHPE) Awards

Diversity Award
Keila Martinez-Camacho, IBM

Educator of the Year, K-12
Melissa Villegas-Drake, Pan American Charter School

Promising Engineer Award
Carla Sayan, Raytheon

SHPE Star of Today Award
Stephanie M. Martin, Ph.D., Kimberly-Clark Corporation

Student Role Model, Graduate Award
Andrea Sanchez, Ph.D., University of South Florida

Women Engineering Deans

By Peggy Layne, P.E., F.SWE

Cammy R. Abernathy, Ph.D.	University of Florida
Linda Abriola, Ph.D.	Tufts University
Emily L. Allen, Ph.D.	California State University, Los Angeles
Neslihan Alp, Ph.D., P.E.	The University of Tennessee at Chattanooga
Nada Marie Anid, Ph.D.	New York Institute of Technology
Nadine N. Aubry, Ph.D.	Northeastern University
M. Katherine Banks, Ph.D., P.E.	Texas A&M University
Gilda A. Barabino, Ph.D.	City College of the City University of New York
Stacy G. Birmingham, Ph.D.	Grove City College
Barbara D. Boyan, Ph.D.	Virginia Commonwealth University
Mary C. Boyce, Ph.D.	Columbia University
Tina Choe, Ph.D.	Loyola Marymount University
Candis S. Claiborn, Ph.D.	Washington State University
Robin Coger, Ph.D.	North Carolina A&T State University
Teresa A. Dahlberg, Ph.D.	The Cooper Union
Natacha DePaola, Ph.D.	Illinois Institute of Technology
Persis S. Drell, Ph.D.	Stanford University
Doreen Edwards, Ph.D.	New York State College of Ceramics at Alfred University
Julie R. Ellis, Ph.D., P.E.	Western Kentucky University
Elizabeth A. Eschenbach, Ph.D.	Humboldt State University
Lorraine N. Fleming, Ph.D., P.E.	Howard University
Liesl Folks, Ph.D.	University at Buffalo, The State University of New York
Christine E. Hailey, Ph.D., P.E.	Utah State University
Jane S. Halonen, Ph.D.	University of West Florida
Leah H. Jamieson, Ph.D.	Purdue University
Sharon A. Jones, Ph.D., P.E.	University of Portland
Zella Kahn-Jetter, Ph.D., P.E.	Saint Martin's University
Maria V. Kalevitch, Ph.D.	Robert Morris University
Anette M. Karlsson, Ph.D.	Cleveland State University
Debra Larson, Ph.D., P.E.	California Polytechnic State University, San Luis Obispo
Denise M. Martinez, Ph.D.	Tarleton State University
Charla Miertschin, Ph.D.	Winona State University
Amy J. Moll, Ph.D.	Boise State University
Lynne A. Molter, Sc.D.	Swarthmore College
Mitzi Montoya, Ph.D.	Arizona State University, Polytechnic campus
Cherry Murray, Ph.D.	Harvard University
Elizabeth Jane Orwin, Ph.D.	Harvey Mudd College
Sarah A. Rajala, Ph.D.	Iowa State University
Kristina M. Ropella, Ph.D.	Marquette University
Julia M. Ross, Ph.D.	University of Maryland, Baltimore County
Anca L. Sala, Ph.D.	Baker College
Elaine P. Scott, Ph.D.	University of Washington, Bothell
Melodie Selby, P.E.	Walla Walla University
T. Kyle Vanderlick, Ph.D.	Yale University
Susan E. Voss, Ph.D.	Smith College
Terese Wignot, Ph.D.	Wilkes University
Sharon L. Wood, Ph.D., P.E.	The University of Texas at Austin
J.K. Yates, Ph.D.	Ferris State University

Source: American Society for Engineering Education

men) at a Midwestern public research university between 2009 and 2011. The participants in this study all note that there are significant conflicts between being a female faculty member and having children and a family. Within the university, views similar to Ceci and Williams' prevail: These conflicts, while acknowledged, are generally regarded as a matter of individual choice, not of inherent, structural conflicts between prevailing models of family life and work. The respondents identified this as a primary reason for the underrepresentation of women in academic STEM departments and expressed the view that jobs in industry were actually more accommodating.

Cherkowski and Bosetti (2014) in a study of female faculty in all academic disciplines reported that academic women feel pressure to "do it all," to observe academic publication norms but also to be excellent mothers, a kind of pressure not experienced by their male counterparts. Finally, Cech and Blair-Loy (2014) surveyed 506 STEM faculty members at a research-intensive university regarding their perceptions of the consequences of taking advantage of the university's "family-friendly" policies. They found that faculty believed that using the work/life policy would have negative consequences for their careers because of the perception that parents have lower worker commitment. Like Beddoes and Pawley's respondents, these academics were more likely to want to leave for industry, where family-friendly accommodations were perceived as more widely accepted. Cech and Blair-Loy found no difference between mothers and fathers in their attitudes toward family-friendly policies. Because it is women, far more than men, however, who take the primary role in child care and other care work, the effects of these perceptions are experienced primarily by female faculty.

Other research we reviewed points to evidence of continued biased or discriminatory practices in academic science, questioning Ceci and Williams' view that academic STEM departments have become gender neutral. For example,

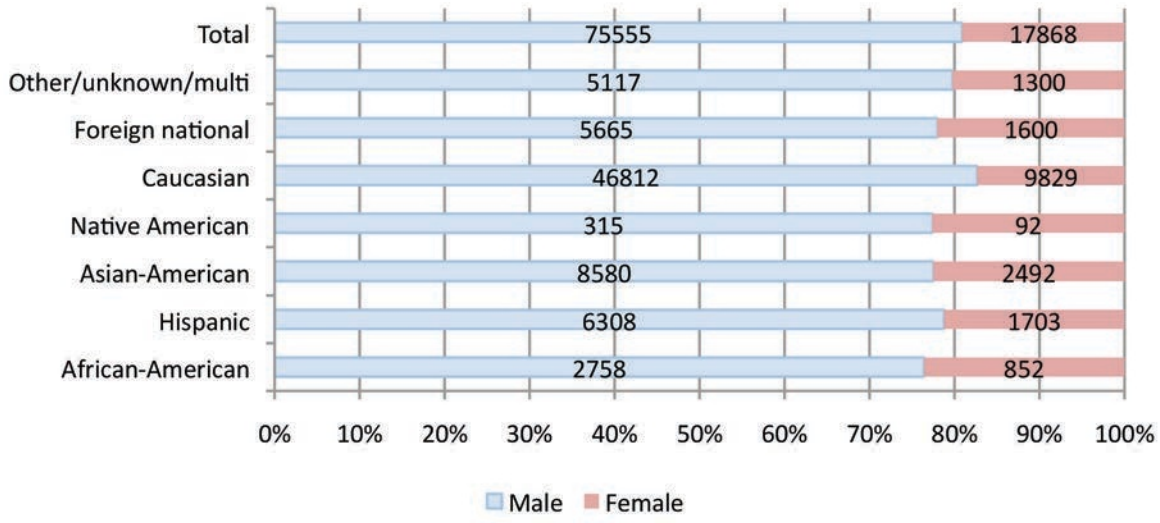
Milkman, Akinola, and Chugh (2014) report on an interesting experimental study examining whether bias persists in graduate education. They conducted an "audit study" involving more than 6,500 professors at top U.S. research universities; faculty were contacted via e-mail by prospective graduate students whose names signaled their gender and race/ethnicity (male/female, Caucasian/African-American/Hispanic/Chinese/Indian). The e-mails asked faculty to meet with prospective graduate students about possible research opportunities prior to applying to the doctoral programs in which they taught. The authors hypothesized that faculty would be less responsive to female and minority applicants, and that the pattern of discrimination would be stronger in fields in which women and minorities were underrepresented because faculty would be less accustomed to female and minority colleagues; and in which pay was higher because these fields tend to be dominated by white males.

The results largely confirmed Milkman, Akinola, and Chugh's hypotheses, although there were interesting exceptions. Female and minority applicants did receive fewer responses, with Indian and Chinese students encountering particularly pronounced discrimination. For the most part, the pattern held across disciplinary areas, although there was no discrimination found in the health sciences and, in the fine arts, women and minorities were actually *favored*. Somewhat surprisingly, and contrary to what many other analyses would have predicted, the representation of women and minorities in the various disciplines was *not* a predictor of discrimination; the treatment of women and minorities was not better in disciplines with higher female and minority representation. There also was little evidence in this study that female students benefited from contacting female faculty, or that minority students benefited from contacting faculty in the same minority group, with the exception of the Chinese students. The study did find that discrimination was greater in disciplines in which faculty earn higher salaries. Faculty in public universities were less discriminatory than those in private universities; however, the ranking of the university was not a predictor of the level of faculty discrimination against female and minority candidates.

While this study is not exclusively focused on engineering or even STEM programs, it does provide evidence that engineering/STEM faculty continue to be affected by implicit biases that lead them to favor white male applicants to graduate school. As the authors of the study point out, the kind of discouragement a student receives from a nonresponse to the kind of request simulated in this study may lead them to not apply to a particular graduate program or to give up on their plans for graduate study altogether. This study revealed the importance of combating this kind of bias if the numbers of female faculty in STEM disciplines are to increase. Moreover, if the evidence found by this study proves to be correct, eliminating the effects of implicit bias is not simply a matter of increasing the numbers of female and minority faculty in academic departments, since the demographic composition of departments did not appear to affect the level of discrimination prospective students encountered. Instead, it would appear to be a matter of directly confronting the implicit biases of faculty of all kinds (male/female, majority/minority), a major component of many NSF-ADVANCE-funded projects over the years.

Joshi (2014) conducted online surveys

Engineering Bachelor's Degrees by Gender within Race/Ethnicity, 2013



Source: Yoder, Engineering by the Numbers, American Society for Engineering Education, 2013

with more than 400 participants in interdisciplinary research centers at a U.S. public university. The goal of the study was to see whether researchers judged men's and women's contributions differently. Results showed that recognition and utilization of the expertise of male and female scientists was contingent on the gender and gender identification of the actors assessing that expertise, the team's gender composition, and the degree of female faculty representation in the discipline in which the teams were embedded. Thus, men who strongly identified as male tended to evaluate women's contributions more negatively. Teams with more women were more likely to utilize the expertise of highly educated women. And in fields with more female representation, teams that had many women were found to be more productive.

Mason et al. (2014) found that women receive proportionally fewer awards than male professors. Based on historical institutional data from a large technical university, they found that between 1964 and 2012, 19.8 percent of university awards were given to women, and between 2007 and 2012, women received 12.1 percent of awards, but were approximately 30.5 percent of the faculty population. Challenges to creating less-biased award systems are identified, including unclear criteria, the use of student evaluations, and the use of letters of recommendation, all of which have been shown to perpetuate gender biases detrimental to women. The authors recommend methods for combating these clear indicators of remaining bias in academic science, including more explicit evaluation criteria, holding decision makers accountable, and legitimizing female leaders in order to establish a basis for positive ratings.

Finally, the argument that the workings of academic science have become increasingly fair, rational, and gender blind is called into question by research pointing to the ambiguity of tenure and promotion processes (Jones et al. 2014; Beddoes, Schimpf, and Pawley 2014). Intensive interviews with male and female faculty at a large public university in the Midwest revealed that faculty members described the tenure and promotion process as opaque, confusing, subjective, arbitrary, and blurry. Formal university and departmental policies, which spelled out ostensibly rational, measurable, and gender-neutral tenure and promotion criteria and processes, were seen as playing little or no role in defining the criteria for *actual* tenure and promotion decisions. Although the authors of these studies do not present direct evidence of the link between this "foggy climate" for tenure and promotion and gender inequality in STEM departments, they raise the question of whether gender bias may be at play if tenure and promotion decisions in academic science and engineering are governed by the subjective and ambiguous procedures they describe.

The question of whether academic science is still affected by sexist attitudes and practices is obviously critical to determining whether programs such as NSF-ADVANCE remain necessary. Clearly, those programs continue; our literature review turned up several descriptive accounts of ADVANCE programs on university campuses — e.g., Carpenter (2014) on Louisiana Tech and Wadia-Fascetti et al. (2014) on Northeastern. McClelland and Holland (2014) provide a particularly interesting examination of the role of departmental leadership in increasing gender diversity in STEM departments. They interviewed a group of 31 STEM chairs and deans, most of whom were male, and 11 of whom were in engineering. They noted that these leaders varied in terms of how much they saw it as their responsibility to effect change; those who were low on responsibility tended to play down the need for change and/or to see it as something that female faculty needed to be responsible for. More generally, McClelland and Holland reported that leaders of both kinds tended to ask men to make relatively small changes — be more sensitive, learn more about your female colleagues — while women were asked to make significant life or attitudinal changes to foster gender diversity.

Interestingly, we also reviewed a "feminist reflection" on NSF-ADVANCE by Morimoto and Zajicek (2014) that took a very different view from the one propounded by Ceci and Williams. The authors accept that academic sexism persists, but wonder whether NSF-ADVANCE programs are up to the task of effectively combating it. They ask whether it is reasonable to expect that a program developed within a major scientific institution can be expected to be the agent through which that institution itself is transformed. Their verdict is somewhat mixed. They criticize many ADVANCE programs for focusing on "individual-level" solutions that don't attempt to transform existing structures (e.g., mentoring or networking programs that seek to help individual women scientists do better within unchanged organizations). They also note that ADVANCE-funded efforts at organizational transformation can also, inadvertently, reproduce the status quo. For example, programs that seek to raise consciousness and change attitudes in academic departments often make women the consciousness raisers. Similarly, programs to encourage the development of family-friendly policies risk perpetuating traditional gender structures unless both men and women take advantage of those policies. Nevertheless, Morimoto and Zajicek hold out the hope that ADVANCE can be a truly transformative program. They add that it might be possible for programs such as ADVANCE to encourage openness to alternative models of scientific work and scientific success, models that do not construct the scientist as an "ideal worker" with unlimited time and a support structure at home and instead reward activities other than individual grant getting and publication, such as successful mentoring and fostering collaboration.

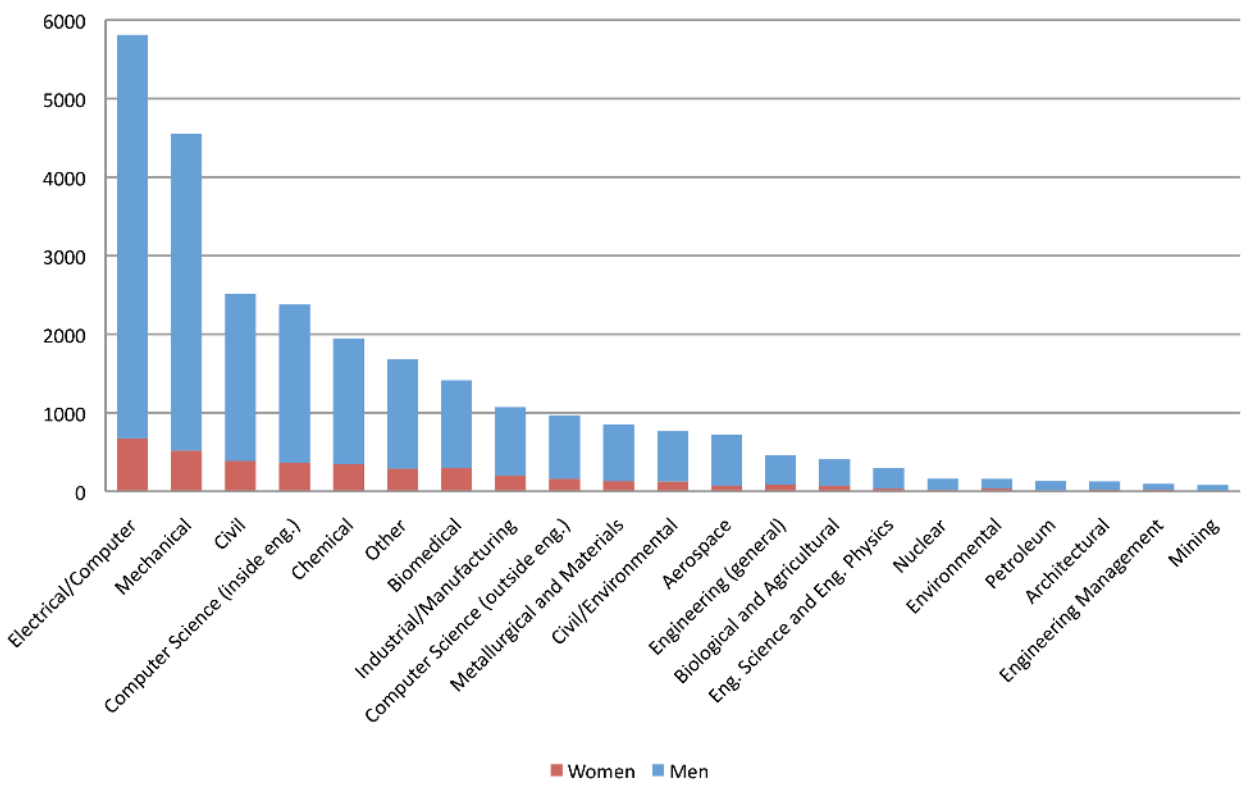
The workplace: gender bias in industry?

As has been the case for several years, relatively little research published this year focused on employed professional engineers outside the academy, and several of the studies we did find were about countries other than the United

States. We reviewed, for example, articles describing the disadvantages faced by female engineers in Portugal and their efforts to cope by trying to make their femininity "invisible" (Saavedra et al. 2014). Tacsir, Grazzi, and Castillo (2014) review the literature on women engineers in Latin America and report a familiar pattern of disadvantage and slow progress. There is a fairly obvious need to find ways to encourage more researchers to examine engineering employment and the experiences of female engineering graduates, especially since research published in previous years shows that many female engineering graduates do not go on to engineering jobs and that at least some women who do, eventually leave. There is an extensive literature on the experiences of women in professional and managerial occupations and the conflicts they encounter, but without focused studies on female engineers, we are forced to assume, without real evidence, that they are simply the same as women in other occupational roles.

We did review a few studies of working female engineers, most of which focused on the issue of bias and employer attitudes. Braun and Turner (2014) conducted a survey and a small, interview-based study with managers in STEM settings to examine their intention to engage in "women-friendly behaviors." Importantly, they found that what managers believed others expected them to do was not an important predictor of their willingness to engage in these behaviors, although this was the case for a subgroup of female managers. The managers were aware of the benefits attributed by advocates of promoting women, but also freely expressed reservations about female managers. Braun and Turner note that they were surprised by the openness with which managers talked about these reservations and acknowledge the existence of stereotypically negative views of women in these fields. The authors are encouraged, however, by the fact that managers' beliefs and past histories are important predictors of their willingness to behave in woman-friendly ways — those who did so previously continue to do so; those with more positive attitudes to women are more likely to do so. They also note that supportive organizational settings can help encourage managers to be woman friendly. The logical inference is that managers' practices can be made more woman friendly through efforts to promote attitudinal change, through hiring managers with positive attitudes toward women, and by creating the appropriate organizational climate.

Reuben, Sapienza, and Zingales (2014) point to a more discouraging reality — the persistence of stereotypical beliefs about women's ability in scientific fields. They conducted an



Source: Yoder, Engineering by the Numbers, American Society for Engineering Education, 2014

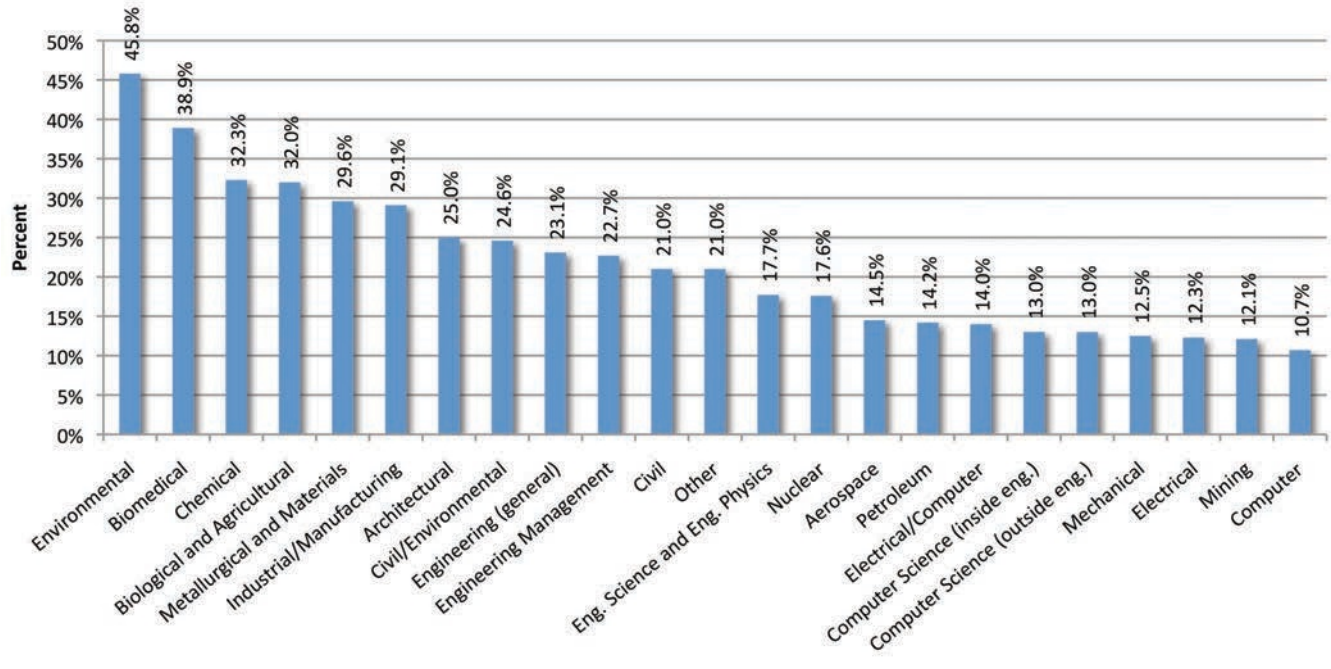
experimental study of 191 undergraduate students to examine their gender preference when it came to performing a math-based task. They found that both men and women prefer to hire men for such tasks. The discrimination is reduced when the candidate self-reports performance data, but the authors note that men are more likely to brag about their achievements, so that limits the degree to which bias is reduced. The authors see this experimental evidence as indicating that actual managers may be affected by the same stereotypical attitudes, which may, in turn, hinder women's careers in STEM disciplines.

In August, Nadya Fouad reported on the ongoing research project at the University of Wisconsin-Milwaukee focused on the retention of women engineers. Invited to address the American Psychological Association's annual meeting, her presentation, titled "Leaning in, But Getting Pushed Back (and Out)," received wide media coverage. It was picked up by national newspapers, radio, and online media, perhaps due to the tie-in with Sheryl Sandberg's book, *Lean In*, and concurrent media attention to the dearth of women in "tech." Fouad's research is based on a national survey of women engineers and has been discussed in previous literature reviews. Fouad's team concludes that workplace climate and lack of advancement opportunities drive women out of the profession. They are currently collecting additional data from both women and men engineers for the next stage of their study.

There was one major contribution to the literature on women in engineering workplaces this year: Bilimoria and Lord's (2014) edited volume on *Women in STEM Careers*. The collection includes research from the U.S., Europe, and Australia, examining women's work experiences, advancement, and leadership roles in STEM fields, both in industry and in the academy.

The most important contribution of the volume is to ask readers to pose a different question. Typically, we ask why women leave engineering — the metaphor of the leaky pipeline is clear evidence of this focus. Bilimoria and Lord suggest that we ask, instead, why women *stay*. The essays collected in the volume examine a variety of organizational initiatives that have been shown to make a positive difference for women's careers in STEM. In addition, the final section of the volume emphasizes the need to reframe organizational discourse and practice to create the conditions under which women will stay.

Among others, the essays in this section discuss the gendered character of definitions of success in STEM (which assume the ability to devote all of one's time to one's work), the ways in which care work and family responsibilities, while important to both male and female professionals, are not seen as an appropriate topic for discussion, and the need to make gender a more visible part of STEM curricula. Asking why women stay encourages us to examine the characteristics of the organization and the institution, not just the individual characteristics of the women who leave, thereby responding to the criticism that,



Source: Yoder, Engineering by the Numbers, American Society for Engineering Education, 2014

sometimes, efforts to promote gender equity focus too much on "changing the women."

Conclusion — closing the gap?

Readers of the literature on women in engineering and STEM are generally accustomed to the notion that these fields are a particularly extreme case; that they are quite unlikely to attract women and, while there has been progress, that progress has been slow, limited, and may have stalled. Economist Claudia Goldin (2014), however, constructs an argument that may give us reason to think that things may not be quite so bad, after all. In an important article addressing the residual pay gap between men and women in the United States, Goldin offers another lens through which to examine the status of women in engineering and STEM disciplines in general.

Goldin's concern is with the overall pay gap between men and women in the United States. She notes that average female pay has not yet caught up to average male pay, but the gap has narrowed significantly over recent decades. Goldin asks what would eliminate the last of the pay gap. She argues that the remaining pay gap is not the result of differences in human capital (e.g., education, skill) between men and women, nor can it be attributed to occupational differences (i.e., the concentration of women in different occupations than men). Instead, she argues that the remaining pay gap is primarily the result of the fact that, in certain occupations, value is placed on working long hours and on continuous employment. Women in these fields are more likely to seek to restrict their hours to accommodate family roles, or may interrupt their employment for childbirth and child-rearing, therefore suffering economic penalties and falling behind their male counterparts. Interestingly, Goldin finds that technology and science jobs are *more flexible*, and impose *fewer* economic penalties of this type on female employees.

Although Goldin's article doesn't specifically address the case of engineering, it delivers a good news/bad news report on STEM fields and, by extension, on engineering. In some occupational fields, reformers need to worry about both a pay gap and gender balance. Goldin's argument implies that the problem in STEM isn't a pay gap; it is primarily access — women who enter STEM fields do reasonably well economically, compared with men. They are better off relative to their male counterparts than are women in business. For various reasons, however, few women find their way into the field, so only small numbers of women benefit from this relative equity.

Goldin's analysis implies that finding ways to increase the numbers of women entering the field, rather than combating pay inequity in engineering, should be the focus of equity-oriented policy. It is also interesting to note that Goldin's analysis suggests that, at least in economic terms, the conditions for women in engineering appear to be relatively good. Given that, it would be important to look again at arguments suggesting that women leave engineering because they find it unwelcoming. Are women leaving engineering in unusually high numbers, or are we simply ignoring the reality that women are leaving other occupations, where conditions are less favorable, in even larger numbers? Subsequent research on women working in industry, particularly addressing the perspectives raised by Goldin, is needed to adequately shed light on these questions.

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Effective or Limited Strategy?

Over the years, the rhetoric of both national security and economic competitiveness has been used to argue gender equity in STEM. Two recent books dissect these approaches.

The most obvious reason to increase the numbers of women in engineering, and STEM fields more generally, is gender equity. However, proponents of gender integration in these fields have often turned to other arguments to try to persuade the reluctant. Two significant books published this year describe these arguments and point to the limitations of relying on them too heavily.

Laura Micheletti Puaca's *Searching for Scientific Womanpower: Technocratic Feminism and the Politics of National Security, 1940-1980* focuses on how advocates for women have used the rhetoric of national security to open doors for women in science and engineering from World War II through the Cold War. Puaca describes initiatives to recruit women into formerly male technical roles during World War II to "free men up" for the "more important" work of winning the war. Groups such as the American Association of University Women (AAUW) and the Society of Women Engineers made active use of Cold War fears to encourage women to pursue engineering and science (leveraging, for example, concerns about the Russian Sputnik launch).

During the 1970s and '80s, as second-wave feminism emerged, national security language faded into the background somewhat, and the language of rights and equity began to have more traction. But, as the Reagan era ushered in a more conservative political context and renewed concern about national security, women's organizations returned to the rhetoric of national security and economic competitiveness.

Puaca's book points to the continuity, and partial effectiveness, of this kind of rhetoric in persuading Americans that more women should be recruited to engineering and science. However, she also argues that it is limited in the end by the fact that it does not provide a critique of women's status in science and society.

A second book that raises related issues is *Falling Behind? Boom, Bust, and the Global Race for Scientific Talent,* by Michael Teitelbaum. The book is not focused on gender equity in STEM per se; rather, Teitelbaum's concern is the question of whether the United States is falling behind because there is a shortage of qualified STEM professionals in the United States. He notes that concern about America's competitiveness in STEM has been a recurring concern since World War II and documents five rounds of alarm in postwar American history.

According to his analysis, however, the available evidence provides little support for these concerns. In the most recent period, for example, concerns have been raised about American students' performance on tests of scientific and mathematical knowledge, about America's ability to compete with rising powers abroad, and about "shortages" of STEM professionals. Teitelbaum carefully calls these claims into question, noting that the top quartile of American students (from which STEM professionals are recruited) continue to do very well and that salaries in STEM fields have not risen as they should have if there truly were a shortage.

Previous alarms, often led by special interest groups, resulted in an overproduction of STEM graduates, resulting in periodic "busts" that actually made scientific and engineering careers less attractive. Teitelbaum notes how the rhetoric of STEM shortages and declining competitiveness has been used to argue for increasing the numbers of women in these fields: Women are portrayed as one of the great, untapped domestic sources of technical expertise. If Teitelbaum is right, however, that there is no shortage, and if he is right about the cycle of boom and bust in STEM fields since World War II, it is easy to see how exclusive reliance on this type of rhetoric can backfire when the next period of overproduction arrives and the resulting competition for scarce jobs intensifies.

These books raise important questions about what is the best strategy for advocates of gender integration in engineering and STEM. Should they argue that increasing the numbers of women in STEM will help solve problems unrelated to issues of gender? Or, should they take a more direct approach and make the case that gender equity *in itself* is the strongest argument for gender integration?

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Breaking Through the Glass Ceiling with Confidence, Courage, and Focus on Career

Based on her recent webinar, "DARE: Straight Talk on Confidence, Courage and Career," — presented on the SWE Advance portal — the author shares practical ideas and tips for achieving greater success in the workplace.

By Becky Blalock

Over the years, I have watched many talented people struggle to advance beyond middle management and upward through the glass ceiling. Women have particular trouble making the leap: While women hold more than half of the professional jobs in the United States, they make up only 34 percent of middle managers, 14 percent of executive officers, and a mere 4 percent of CEOs.

If you want to break through the glass ceiling and go to the next level, here are five key areas you must develop:

Learn to see the big picture

In middle management and below, the job is all about execution: delivering on the ideas and strategies that others have created. In the "C-suite," the job is about determining what work needs to be done, and then leading a team to make that work happen.

These entail very different skill sets. Doing well at execution requires specialization and focus. Doing well at the executive level demands a global understanding of the business environment and the tasks at hand.

So, if you want to make the transition to the executive level, you have to first start thinking beyond specialization and your immediate workload. Be open to developmental opportunities that may be unrelated to your current job, but that will give you wider knowledge and insights. Develop great relationships with individuals outside your department and company.

Read books, blogs, and newspapers to stay current on what's happening not only in your industry, but also in the business community at large. That way, when leadership opportunities arise, you'll already have an informed, strategic view of what needs to happen. Then you can…

Take the initiative

To show you have what it takes to be in charge, you have to be willing to take charge. Too many times I've seen people sit back and wait for someone to tell them what to do. If you want to be in the top jobs, don't wait to be asked. Figure out what needs to be done and then make it happen.

Find mentors and sponsors — and know the difference

Mentors are people who can coach you in areas where you don't have deep knowledge. They provide professional and personal support as you develop your career (and you, in turn, should reciprocate by providing similar support). They can be, but usually aren't, people in senior levels of management, as those individuals may not have the time or specific knowledge to mentor you effectively.

That's why sponsors are different from mentors, and in some ways even more critical to moving up the ladder. A sponsor is a senior-level leader, that is, someone who sits at the decision-making table, who is willing to advocate on your behalf. This is vital, because a senior team makes most of the decisions about the top jobs. If you do not have at least one cheerleader among this group, you are not going to get the top jobs.

Be willing to risk, and risk often

We all love to stay in our comfort zones. Stepping outside that zone brings the risk of failure. But it is new experiences that provide the most opportunity for personal and professional growth, and anyone looking to reach the next level must push herself to take risks and be *un*comfortable on a regular basis.

To make risk taking easier, adjusting your attitude toward failure is key. Failure happens all the time and it should not scare us. It teaches us what doesn't work so we can be more successful on the next try. We can gain a certain amount of knowledge from books, but nothing replaces on-the-job experience for getting you ready for the next career stage. And yet too many people, myself included, have avoided wonderful opportunities because the fear of failure was too great.

To counteract the fear of failure, continuously nurture your abilities and self-confidence. The more confidence and expertise you have, the more you

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become like a bird that "trusts not the branch, but its own wings." Also, be sure to take the time to develop your personal networks, so that if you do stumble, you'll have plenty of supporters to help you get back up on your feet.

Develop your emotional intelligence

Finally, if you want to lead, you must have strong emotional intelligence. That's because the higher up the corporate ladder you climb, the less the job is about you, and the more it is about whom you surround yourself with and your ability to lead and motivate others. No one can know it all, so having others who think differently and possess skills you may not have become critical to being successful in senior management.

Executive-level leaders must have self-awareness and an ability to keep their emotions in check. They must listen before reacting. As Stephen Covey recommends, "Seek first to understand and then to be understood." Above all, executives must be ethical and behave in a way that inspires trust and respect in those who work with them. People want to work for someone with integrity, who cares about and invests in others.

Tips for a more confident you

My premise is that confidence is a learned skill. It's critical to develop your confidence in order to maximize your chances of success. We all want to stay in those zones where we feel safe, accepted, and valued, but unless you step outside your comfort zone, and attempt something that poses risk, you're never going to grow and reach your full potential. Take the confidence quiz at www.beckyblalock.com for self assesment and additional career tips. ■

Becky Blalock is the author of the bestselling book, Dare: Straight Talk on Confidence, Courage, and Career for Women in Charge . *She is a speaker, thought leader, and champion of skill and relationship building to achieve success in the workplace. During her 33-year career with Southern Company, Blalock held a variety of leadership positions before becoming senior vice president and chief information officer. She presented her webinar Feb. 26, and it is available for replay under the Learning section at swe.org.*

Three Ways to Stand out in Your Profession

Upcoming webinar presenter Dorie Clark explains how to demonstrate your value to others.

By Dorie Clark

We all know it's not enough to work hard and do your job well. That's necessary, but certainly not sufficient, for your professional success. Instead, you have to ensure the message is getting across to others about who you are and what you're capable of. That doesn't mean obnoxiously tooting your horn; instead, it's about getting clear on your value, and finding ways to demonstrate that to others. Here are three ways to make that happen.

Know your brand. Some people are turned off by the term "personal brand," assuming that it implies a finger-to-the-wind effort to determine what others want, and then pretending to be that. In reality, that couldn't be further from the truth. Instead, it's about understanding your own strengths, and then ensuring others grasp why those traits are so valuable to your organization. Yet sometimes it can be hard for us to appreciate our own assets. That's why, in my book *Reinventing You*, I suggest the "Three Word Exercise." It's quick and simple, but very illuminating. Over the course of a week, ask a half-dozen colleagues, "If you had only three words to describe me, what would they be?" You're going to see commonalities in their responses, and that will help you figure out what aspects of your brand are seen as most unique and important.

Build your team. Spare yourself from reinventing the wheel professionally. Instead, cultivate a "team of mentors" — peers, junior employees, or older colleagues — who can help guide you and provide advice on targeted topics. You don't need to wait for one perfect person to be your role model; instead, look to a variety of people who may have expertise in one or two areas you'd like to learn (Jenny is great at delegation, and Stephanie is a terrific networker). Learning from your colleagues will save you time and effort, because you'll avoid common mistakes — and you will develop a reputation as an "A" player, because if you don't know the answer to something, you'll know where to find it.

Share your expertise. No one, except your very closest colleagues, will know how good you are if you don't share your knowledge publicly. To cultivate a powerful reputation in your company and in your field, you need to spread your ideas. Fortunately, it's never been easier to do that. LinkedIn now allows anyone with an account to start blogging on their site — meaning that you can weigh in on industry trends or issues in your field, and your thoughts will be immediately visible to your connections (who will see it in their news feeds) and anyone interested in you enough to be perusing your profile. If blogging doesn't appeal, other forms of social media can also be valuable in building your expert reputation, whether it's curating a thoughtful Twitter feed that shows you keep up with the world of engineering, or perhaps creating helpful YouTube videos sharing your expertise.

The best form of career insurance is a strong personal brand. If you stand out as a thoughtful expert in your field, anyone would fight to have you on their team.

Dorie Clark is a marketing strategist and professional speaker who teaches at Duke University's Fuqua School of Business. She is the author of Reinventing You *and the forthcoming* Stand Out. *In addition to her March 26 SWE webinar, "Taking Control of Your Life," Clark will present "Stand Out: How to Be Recognized for Your Ideas" on April 28.*

Work/Life Balance for Women — Not Just for Moms Anymore

As our understanding of work/life integration evolves, it is important to take a more comprehensive view, considering the needs of employees in a multitude of circumstances, including the single woman, whose voice has largely been absent from such discussions.

By Mary C. Verstraete, Ph.D., SWE Editorial Board

What woman hasn't dreamed of going home after a long, stressful day at work to find the house spotless, the laundry clean and folded, and a nice dinner hot and ready as she walks through the door? For women who have caring, supportive partners, this may actually be more than a dream; it may be a reality. For those of us who are single and live alone, however, walking into a clean house with food on the table is something we typically only dream of.

The stereotype

Single women face a variety of issues that differ significantly from our married counterparts, or from women who are single mothers; yet we also face many of the same challenges. One of these challenges is the way that "work/life balance" has typically been construed. The stereotypical image this phrase brings to mind is of a woman in her power suit, hurrying from the office to pick up her dry cleaning and then swinging by the soccer field to watch her 6-year-old score her first goal. For women with partners, this may also include racing home to prepare a healthful meal, squeeze in a workout, and then possibly an evening conference call.

This stereotypical view omits the single woman, or man, also working hard to balance his or her life between work responsibilities and other commitments outside the office. Perhaps it is time to take a more realistic look at work/life integration that includes everyone who is facing the demands of a busy life.

Moms (and dads) are typically "forgiven" when they have to scurry out of the office early to attend a recital, or pick up their kids after school, or take someone to a doctor's appointment. However, leaving work early or coming in late in the morning in order to meet the furnace repair person or the cable installer is not always treated with similar understanding. Our furry children have needs as well, needs they never grow out of. However, furrowed eyebrows typically greet those who have to leave work early to "let the dog out." Everyone needs some flexibility to deal with their lives outside of the workplace.

The single woman's dilemma

Without children or a partner, single women are frequently called on to assist aging parents, ill family members and friends, or to take on additional responsibilities in other areas. For example, I have a close friend who is an accounting manager. She and five of her brothers live in the same area as their parents, but she is always the one who gets called upon to help since all of the brothers are married and have children.

The family does not feel it is the least bit unfair to demand more of her than her siblings. So not only is she balancing a very demanding and stressful job, her home, her community service commitments, a gym membership, and several pets, but she has to also be the primary caregiver for her parents whenever the situation demands.

A more enlightened view

It is important to adopt the view that everyone is struggling to find equilibrium between the demands of their careers and the demands and desires of their lives outside the office. Moreover, everyone's struggle to do so merits respect. ■

Mary C. Verstraete, Ph.D., associate professor and associate chair of the undergraduate program in biomedical engineering at The University of Akron, earned her B.S., M.S., and Ph.D. in engineering mechanics/biomechanics from Michigan State University. A member of the SWE Magazine *editorial board, she was named SWE's Distinguished Engineering Educator in 2007 and Outstanding Faculty Advisor in 2011.*

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Solving Problems Is a Matter of Course

With engineering as a basis, one's career and life can take many directions. This is one woman's story of moving from engineer to venture capitalist, followed by director of family ministries, interim CEO, and CEO — all the while maintaining a robust personal life.

By Jane Zimmer Daniels, Ph.D., F.SWE, SWE Editorial Board

Many engineers follow paths that lead away from pure engineering into something else. Some of the most common transitions are from engineering into management, entrepreneurship, sales, and teaching. Emily Maddox Liggett is a woman who created a trajectory that led her in some very interesting and unusual directions.

Liggett was not a child who always knew she wanted to be an engineer. As a matter of fact, she threw away an invitation to a summer engineering camp at Purdue University. Her father retrieved the invitation from the trash and suggested she apply. Following that experience, she realized that her love of mathematics and problem solving made her a good fit for engineering.

After earning a degree in chemical engineering from Purdue University, Liggett joined DuPont. The company had a practice of moving engineers around to experience a variety of positions, giving Liggett the opportunity to change jobs without changing companies. With DuPont she held roles in product development, manufacturing, feedstocks (the raw materials required for a product), technical support, and acquisition integration — usually in the area of polymers and carbon-based materials. From there, Liggett took a leave of absence from DuPont and headed to graduate school at Stanford University, where she earned a master's in manufacturing systems engineering and a master's in business administration. Liggett said she likes the technical rigor of engineering as well as some of the "softer" challenges of business and management. She went to graduate school to learn more, to experience a different part of the country, and to meet new people.

Following graduate school, Liggett joined a diversified materials company, Raychem, where she was again able to change her career focus while staying with the same company. While working at DuPont and Raychem, Liggett held positions as a process engineer, a research engineer, a tech support engineer, and a sales engineer before moving into sales management, operations management, and general management. She began her career with Raychem as an area sales manager, a position she held for four years. From there she became national sales and marketing manager, director of operations, director of worldwide marketing, division manager, and vice president. She remained in most of these positions for two years before moving on to the next opportunity. Liggett describes her favorite position as being general manager for Elo TouchSystems, a subsidiary of Raychem. Elo TouchSystems was the first company to come out with touch-screen technology.

Emily Maddox Liggett

"In addition to the wonderful technology challenges, we had to create a whole new market for them. While we see touch screens everywhere today, that was not the case 20 years ago. We put together a fabulous team and changed the way the world interacts with computers — which was very cool."

Up to that point, Liggett's career included positions that are common to a fair number of engineers. That all changed in 1999, however, when Tyco International acquired Raychem. Liggett led venture and resource investments in energy, environmental, and electronics areas for a newly formed corporate venture capital investment group. The group used the corporation's money to invest in start-ups that were strategic to one or more of Tyco's businesses. Liggett said that they primarily invested in electronics or health care businesses. She learned an important lesson from her venture capital investment experience: that it is quite difficult to predict which new technologies and management teams will be winners.

Liggett was not a child who always knew she wanted to be an engineer. As a matter of fact, she threw away an invitation to a summer engineering seminar (camp) at Purdue University.

A multidimensional life

Ligget carved out her career paths while juggling the roles of wife and mother. Married to her college sweetheart, Dave Liggett, she reflected, "We are happily married with four adult children, two of whom are engineers — another example of problem solving and teamwork."

"We are able to turn the tide and that is very energizing."

After several interim CEO positions, Liggett is currently working as the president and CEO of NovaTorque Inc. in Fremont, California, a position she has been in for six years.

Although it may not always have been intentional, Liggett's career evolved from clear strengths and preferences. She said, "I like to have some element of a new position that's something I know and am competent in (maybe it's the technology, the market, the functional area ... something) and then have something completely new that I need to learn and master — and question whether there is a better way to do it."

Although it may not always have been intentional, Liggett's career evolved from clear strengths and preferences.

Also of note, Liggett's career took two more unusual turns. First, she took a break from engineering to cover an important need in her church. There she served as director of family ministries until a long-term leader/pastor could be found. The experience took her administrative and problem-solving experience into a very new environment.

The second unusual, and intriguing, path in Liggett's career was to take several jobs as interim CEO. These positions typically required her to move into a business that was not doing well. An interim CEO is routinely charged with solving problems and finding ways to improve a difficult business situation. "I wasn't sure I would like it, or be any good at it," Liggett said. "My first interim CEO role was with Capstone Turbine, which makes fabulous microturbines. They were the first to market with these, so we also had the challenge of developing cutting-edge technology (with lots of surprises), as well as creating a market for a product that had not existed before."

Liggett had run an energy business for Raychem and also had experience developing markets for a new product at Elo TouchSystems, but there was a lot she didn't know. She was attracted to the work because, "I'm an engineer — I like to solve problems. I especially like to solve problems with other people, when everyone is different and brings unique points of view to the table." In some cases, she hasn't been able to bring a business to a successful place, which can be frustrating. Other times, Liggett said, "I like to have some element of a new position that's something I know and am competent in (maybe it's the technology, the market, the functional area ... something) and then have something completely new that I need to learn and master — and question whether there is a better way to do it."

Liggett said she has never felt that she left engineering. "I've always been with technology-based companies, where new product development, innovation, and excellent manufacturing processes were critical," she said. "My colleagues are typically engineers as well. I need my engineering background, where problem-solving skills and new ways to approach things are important." ■

Jane Zimmer Daniels, Ph.D., F.SWE, an independent consultant, retired from her position as program director for the Clare Boothe Luce Program and the Higher Education Program at the Henry Luce Foundation. She is the former director of the women in engineering program at Purdue University, and was a co-founder and founding president of the Women in Engineering ProActive Network (WEPAN).

UC BERKELEY

Fiona Doyle

New Graduate Division Dean

Following a campuswide search, Fiona Doyle, Ph.D., accepted the position of dean of the Graduate Division at the University of California, Berkeley. She brings an abundance of campus leadership experience to this position, as well as extensive administrative experience in her many roles in the College of Engineering.

Dr. Doyle began her career on the Berkeley campus as an assistant professor in the department of materials science and mineral engineering in 1983. Tenured in 1988, she has been the Donald H. McLaughlin Professor of Mineral Engineering since 1998. She has served in many leadership capacities, including as chair of the department of materials science and engineering, associate dean for academic affairs, acting dean of the College of Engineering, and as chair of the Berkeley Division of the academic senate. Dr. Doyle is executive associate dean of the College of Engineering and chief academic officer of the Berkeley Education Alliance for Research in Singapore, leading the Singapore-Berkeley Research Initiative for Sustainable Energy. Among other responsibilities in the College of Engineering, she oversees Engineering Student Services, which provides comprehensive support and advising to undergraduates. In addition, she serves as interim director of the new Jacobs Institute for Design Innovation.

SWE Past President Now CEO

The National Women's Hall of Fame appointed its current board president, Jill S. Tietjen, P.E., F.SWE, to the newly instituted position of chief executive officer. Tietjen was SWE president in 1991-1992 and is a Fellow and life member.

The National Women's Hall of Fame is the nation's oldest membership organization dedicated to recognizing and celebrating the achievements of great American women. It was created in 1969 in Seneca Falls, New York, the birthplace of the American women's rights movement, by a group of local women and men who believed that contributions of American women deserved a permanent home in the small village where the fight for women's rights began.

Jill Tietjen

Tietjen has a long affiliation with the hall, having attended every induction ceremony since 1994 and serving on its board of directors since 2009, most recently as its president. An electrical engineer by profession, Tietjen brings a depth of knowledge about women's history to the position through her years of service in the nonprofit arena and as the co-author of the best-selling and award-winning book *Her Story: A Timeline of the Women Who Changed America*. She currently blogs for the *Huffington Post,* speaks nationally on the contributions of women, and serves on the boards of Georgia Transmission Corporation of Tucker, Georgia, and Merrick & Company of Greenwood Village, Colorado.

Tietjen spent her career in the electric utility industry where she provided services in the areas of planning and fuels, served as an expert witness, and is currently an independent director on two corporate boards. She is passionate about informing the public about women's accomplishments. She has successfully nominated women into the National Women's Hall of Fame and has twice seen her nominees receive the National Medal of Technology and Innovation.

Enabling the Deaf to Hear

The National Academy of Engineering announced that the 2015 Fritz J. and Dolores H. Russ Prize was given to Ingeborg J. Hochmair-Desoyer, Ph.D.; Blake S. Wilson, Ph.D.; Graeme M. Clark, Ph.D.; Erwin Hochmair, D.Tech; and Michael M. Merzenich, Ph.D., "for engineering cochlear implants that enable the deaf to hear." The $500,000 biennial award recognizes a bioengineering achievement that significantly improves the human condition.

NATIONAL ACADEMY OF ENGINEERING

Ingeborg Hochmair-Desoyer

A cochlear implant (CI) is a small electronic device that provides a sense of sound to people with severe-to-profound sensorineural hearing loss. CIs comprise two parts: an externally worn audio processor, which picks up sound and codes it into signals, transmitted to the small, surgically implanted internal component. An electrode attached to the implant directly stimulates the auditory nerve and sends the signal to the brain, where it is interpreted as sound. The CI is the most-used neural prosthesis developed to date; more than 320,000 hearing-impaired people have received CIs in one or both ears.

Electrical engineers Drs. Ingeborg Hochmair-Desoyer and Erwin Hochmair began their work on CIs as a team in the mid-1970s. Building on existing knowledge of the physiology of the auditory system, their truly engineering-based approach led to the world's first microelectronic multichannel CI, considered the prototype of modern CIs. The first two devices were implanted in December 1977 and in March 1978. Open speech understanding without lip reading via a small body worn audio processor was achieved in 1980. The Hochmairs went on to found the hearing implant company MED-EL and have continued to bring cutting-edge hearing implant technologies to deaf and severely hearing-impaired people of all ages for the past 25 years.

New AIChE President

Cheryl Teich, Ph.D., reaction engineering expertise area leader in The Dow Chemical Company's Engineering Solutions Technology Center, was named 2014 American Institute of Chemical Engineers (AIChE) president-elect, becoming president in 2015. With more than

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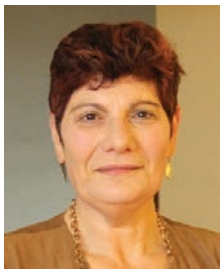


Cheryl Teich

45,000 members from more than 90 countries, Dr. Teich's election is a significant achievement in itself. She will not only lead this large international organization for the next three years, but she is also only the third woman to be elected to the position and the only woman from industry in a field in which women represent approximately just 18 percent of the practitioners.

"Chemical engineers are vitally important to solving world challenges of today. AIChE has a broad reach of members across academia, industry, government, geographies, age groups, experience, and gender who are working together to solve them," said Carol Williams, executive vice president of Dow's manufacturing and engineering, supply chain, and environmental, health and safety operations. "Cheryl brings leadership, commitment, and experience to the post, and she will be an excellent role model as she leads this organization forward. While I hope we soon get to a day when gender doesn't warrant a mention, I can honestly say that I am proud that our president-elect is not only a Dow colleague, but also a woman."

Dr. Teich is a founding member of AIChE's Process Development Division, a key organizer of the division's process development symposia, and has co-chaired and chaired AIChE national meetings. She was elected an AIChE fellow and a trustee of the AIChE Foundation.

Professor of the Year

Sheri Sheppard, Ph.D., professor of mechanical engineering at Stanford University, received the U.S. Professor of the Year Award sponsored by the Carnegie Foundation for the Advancement of Teaching and administered by the Council for Advancement and Support of Education. The award honors Dr. Sheppard's innovative approach to teaching undergraduate students in a hands-on, problem-solving way that transforms large classes into small group learning laboratories. This year's winners were chosen from a pool of nearly 400 nominees and selected by an independent panel of judges based on four criteria: impact on and involvement with undergraduate students; scholarly approach to teaching and learning; contributions to undergraduate education in the institution, community, and profession; and support from colleagues and current and former students.

STANFORD ENGINEERING

Sheri Sheppard

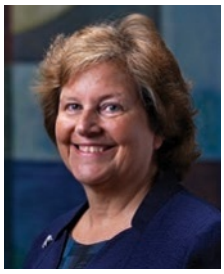
Dr. Sheppard, the Burton J. and Deedee McMurtry University Fellow in Undergraduate Education and professor of mechanical engineering, said she was humbled by the award. She thanked her many collaborators over the years, including those from the Stanford Center for Teaching and Learning, for helping her to create a learning-by-doing classroom environment that gives beginning engineers problem-solving experience. "Today's modern engineering work, more so than ever, is about being on teams, and so educators more and more are thinking about how to bring those team experiences into the classroom," Dr. Sheppard said in a video highlighting her work.

Harry J. Elam, Ph.D., Stanford's Freeman-Thornton Vice Provost for Undergraduate Education and the Olive H. Palmer Professor in Humanities, led the team of Stanford colleagues who nominated Dr. Sheppard. They cited her prior teaching research, including her leadership of a three-year study titled "Educating Engineers," which was carried out under the aegis of the Carnegie Foundation for the Advancement of Teaching.

Royal Academy of Engineering President Named

Professor Dame Ann Dowling, Ph.D., was named president of the Royal Academy of Engineering. Fellows of the academy elected Dr. Dowling as their first female president. Dr. Dowling succeeds Sir John Parker, who served as president for three years.

MICHA THEINER ROYAL ACADEMY OF ENGINEERING



Dame Ann Dowling

A world authority on combustion and acoustics, Dr. Dowling has been head of the department of engineering at the University of Cambridge since 2009. She became a Cambridge research fellow in 1977 and has remained at the university ever since, while also taking visiting research posts at the Massachusetts Institute of Technology in 1999 and Caltech in 2001. In 1993, she became the department of engineering's first female professor. In 2002, she was recognized in The Queen's Birthday Honours, receiving a CBE (Commander of the Most Excellent Order of the British Empire) for services to mechanical engineering, and again in 2007, in the New Year's Honours List, when she received a DBE (Dame Commander of the Most Excellent Order of the British Empire) for services to science. In 2011, she was awarded a UK Resource Centre Award for her "inspiration and leadership in academia and research."

Dr. Dowling started her career as a mathematician but always wanted to pursue applied mathematics and received her Ph.D. in engineering acoustics. Dr. Dowling led the Cambridge MIT Silent Aircraft project, which published its radical new design concept SAX-40 in 2006 with the aim of raising aircraft industry aspirations. She now leads research on efficient, low-emission combustion for aero and industrial gas turbines and low-noise vehicles, particularly aircrafts.

Her work in aeronautics and energy has been recognized by fellowships of the Royal Academy of Engineering and the Royal Society, as well as foreign associate membership of both the U.S. National Academy of Engineering and the French Academy of Sciences. ■

Executive Presence: The Missing Link Between Merit and Success

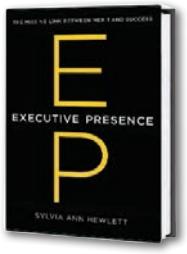
By Sylvia Ann Hewlett, Ph.D.
HarperBusiness
ISBN-10: 0062246895
ISBN-13: 978-0062246899

Review by Catherine Rocky, SWE Editorial Board

You know it when you see it — that individual who has it all together, who possesses a presence, and commands your attention. You wish someone would take you aside and explain how you can be that person, or better yet, a version of that person with your own style and voice, presenting your authentic self with strength, warmth, and confidence. As an engineer you may think you have what it takes technically, but are also aware that you have a few things to learn about how to "get it all together" — how to act, speak, and look.

SWE has offered many outstanding opportunities at annual conferences and regional and local events where speakers offer ideas for self-improvement and career advancement, especially into leadership positions. Oftentimes, speakers provide copies of their presentations, or generously offer tests that measure personal characteristics. Frequently, authors have signed and sold books, offering deeper insights to support their presentations — helpful to study and reflect upon after the event. I find such information useful to address my career-management goals and seek out the best self-help development materials, especially those to study on my own time.

Business author and economist Sylvia Ann Hewlett, Ph.D., has written a new, easy-to-read book, *Executive Presence*, that distills those components important to developing your personal brand. The author of numerous books and articles, Dr. Hewlett is the founder, president, and CEO of the Center for Talent Innovation in New York City. While many of us



may never have the opportunity to engage an executive coach, this book serves that role and is an invaluable resource to read and read again for wisdom and insights neither covered in engineering degree programs nor learned on the job. Although you may have the experience and ability to leverage your engineering degree into a leadership role, you may not possess the additional qualities required, or understand how to leverage them to your advantage.

In her definition and explanation of executive presence (EP), Dr. Hewlett asserts that it's that "it" factor that determines who advances in their careers. She states that "*it* is executive presence — and no man or woman attains a top job, lands an extraordinary deal, or develops a significant following without this heady combination of confidence, poise, and authenticity that convinces the rest of us we're in the presence of someone who's the real deal."

The concepts presented are valid for professionals at any stage of their careers, in any profession, and applicable for technical and management tracks. Although much of the information about "soft skills" has been covered in other books, *SWE Magazine* articles, and SWE presentations, Dr. Hewlett's book is based on current quantitative and qualitative research on what others look for when they evaluate EP, based on a national survey of approximately 4,000 college-educated professionals and 268 senior executives, along with 40 focus groups and interviews with business leaders.

Pillars of executive presence

Dr. Hewlett provides a detailed explanation of the concept, countless examples of why it is important to success in your career, and just about everything you need to know to evaluate your EP and develop those characteristics you were not necessarily born with. As engineers or STEM professionals who possess the analytical trait needed for leadership, we don't typically receive the education or coaching to fully develop the other needed traits, or how to leverage them for better assignments, jobs, titles, and pay.

Executive presence, as generally defined, is a measure of image, how you present yourself — not your performance. Dr. Hewlett explains that EP comprises three key components, what she calls "pillars," with differing degrees of importance as ranked by the 268 senior executives: how you act (gravitas — the core concept at 67 percent), how you speak (communication — 28 percent), and how you look (appearance — only 5 percent, but a "critical first filter" that is easily corrected). She further describes each component of EP in depth, supported by relatable anecdotes from survey participants and her personal experience, having lived and overcome obstacles in her career development.

She also addresses the tension between conformity and authenticity, the challenge of being feminine and authoritative, and the cultural prejudices faced by women and minorities.

In addition to the three key concepts, Dr. Hewlett presents valuable information on other factors critical to EP, including providing and receiving feedback, and the difference between a mentor and a sponsor. She also addresses the tension between conformity and authenticity, the challenge of being feminine and authoritative, and the cultural prejudices faced by women and minorities. Not only does she describe these issues in depth, but Dr. Hewlett also provides realistic suggestions for how to address them. She provides examples of well-known professional women and the difficulties and obstacles they have encountered.

As a reader, regardless of where you are in your career, you will benefit from this book and exploring how the concepts relate to your journey. As Dr. Hewlett states:

"Understanding EP and cracking its code will do wonders for your ability to achieve success and do what you want with your life."

If you are a student about to start your career, consider the information in this book as additional education that will benefit your professional life. If you are midseason in your career, there is much to gain from a course correction that could yield benefits and better opportunities. Those near the end of professional work life may find it interesting to reflect on the concepts discussed, think about your own experience, challenge your preconceptions as a manager or leader, and perhaps leverage your EP into a new venture as well as provide guidance and leadership to our younger SWE professionals. ■

Catherine Rocky is a national account manager with Terracon Consultants Inc. She holds a B.S. in geological engineering from South Dakota School of Mines and Technology. Rocky is past president of the Wichita Council of Engineering Societies. She is a member of the SWE Wichita Section and the SWE Magazine *editorial board.*

In Honor of Women's History Month

An iconic image from the SWE Archives

Katharine Stinson, left, was SWE's third president. She is shown with Joan Barriage examining a plane during the early 1950s — in appropriate business attire for the day, complete with heels and pearls. Stinson was the first female engineer hired by the Civil Aeronautics Administration, now the Federal Aviation Administration. During her 32 years working for the FAA, she was responsible for many engineering firsts.

WE EUROPE

The Annual Conference for Women Engineers

A GLOBAL EXCHANGE FOR CHANGE

[7-8 May, 2015] Amsterdam, Netherlands

$$H = z + \frac{p}{\rho g} + \frac{v^2}{2g} = h + \frac{v^2}{2g},$$

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Society of Women Engineers

Growth, Change, the Coming of Spring, and Turning 65

I can't help but feel energized as we move into spring. Between the activities taking place in SWE and the warmer weather, I am reminded of rebirth, growth, and change — themes we're all very familiar with. Being from Minnesota, where winter can be quite severe, the beginning of spring is deeply anticipated.

Themes of rebirth, growth, and change follow us through our careers, challenging and, perhaps, even sometimes discouraging us. Whether you're a collegian wanting to make the most of it during school, or a midcareer professional like me, thinking, "When should I take that next step in my career?," SWE can help you find your way. In fact, as we celebrate our 65th anniversary this year, we can look back over the decades to see numerous examples of how SWE has supported women in their efforts to build meaningful careers and satisfying lives. And we can partake in that self-actualization and growth, right where we are, individually and as an organization.

Be that voice

SWE is growing globally, creating partnerships with sister organizations and establishing affiliates worldwide. As we grow, I'm noticing that it doesn't matter where in the world we live — women engineers face the same challenges everywhere: disparaging classroom climates, a lack of role models, pervasive stereotypes, and a lack of "critical mass" of women in the work force. That's why it is so crucial for SWE members to step up, to be that voice for women engineers in our communities, and share the successes we've had in our lives.

Remember, no success is too small. Relating stories about the women who empowered you to pursue a career in engineering; or anecdotes about the women you've introduced to SWE who've grown into champions of their own careers; plus reflections on the professional growth you developed through SWE webinars and conferences — these are the stories that vividly demonstrate the powerful impact SWE has on the community. These are the personal successes we need to convey because they are encouraging and keep our momentum growing, and that growth is vital.

As we celebrate our 65th anniversary this year, we can look back over the decades to see numerous examples of how SWE has supported women in their efforts to build meaningful careers and satisfying lives.

In March we celebrate Women's History Month. This year, Eleanor Flexner is one of the nine women being honored by the National Women's History Project. Flexner was a historian, independent scholar, and a pioneer in women's studies. In the 1940s she began researching the 19th-century labor struggles of American women, but found few historians had touched the subject. Through her work, she brought to light what had been silent for decades. This quote from the preface of her book, *Century of Struggle,* struck me as profound and quite relevant, even in the year 2015:

"In the end all women and all men can only benefit from the more truthful and balanced image of women which will emerge from history where they are shown to have been actively involved in shaping their own destiny and that of the country."

There is much women can offer this profession, yet our efforts can be undermined by things seemingly beyond our control. Instead of worrying about what we can't control, let's instead focus on our individual and shared successes, on supporting one another, and on the diversity that strengthens and enriches us. Despite obstacles, we should take pride in our abilities to shape our destinies and achieve our dreams.

I recently read an article in *Scientific American* by Katherine Phillips, Ph.D., titled "How Diversity Makes Us Smarter." The article discusses how to prepare or challenge yourself if you know you are going to be working with people who aren't "like" you. Dr. Phillips explores how the conflict of different ideas and opinions can bring a "better you" to the table. She concluded the article with the following:

"This is how diversity works: by promoting hard work and creativity; by encouraging the consideration of alternatives even before any interpersonal interaction takes place. The pain associated with diversity can be thought of as the pain of exercise. You have to push yourself to grow your muscles. The pain, as the old saying goes, produces the gain. In just the same way, we need diversity — in teams, organizations, and society as a whole — if we are to change, grow, and innovate."

I encourage all of us to push ourselves to grow both personally and professionally to show the importance of diversity for the engineering profession, and for solving the problems our world is facing.

Happy SWE 65th!

Elizabeth Bierman

Elizabeth Bierman
FY15 President

BACK TO TABLE OF CONTENTS

Career Conversations

"Career Conversations" brings together a SWE collegiate member and a practicing woman engineer to chat about career, school, life, and whatever else is on their minds. In this case, the discussion focused on a past *SWE Magazine* article — "Global Collaborations Introduce Great Possibilities," which appeared in the Conference 2014 issue of *SWE Magazine* (http://www.nxtbook.com/nxtbooks/swe/conference14/#/26).

Patty Lopez, a platform applications engineer at Intel Corporation in Fort Collins, Colorado, spoke with Sruti Modekurty, a junior majoring in electrical and computer engineering at Carnegie Mellon University in Pittsburgh. Following are each participant's impressions.

Impressions
Patty Lopez

Sruti's perspective on this article was interesting. She found the sidebar "Indicators of Greater Need for Parity," which highlights the research of Indiana University Assistant Professor Cassidy Sugimoto, Ph.D., very enlightening, particularly where Dr. Sugimoto says lesser-developed countries engage in proportionally more collaboration. Sruti said that you don't know where your next idea will come from, and if you don't share knowledge and resources, how can we better humanity as a whole?

At Carnegie Mellon, Sruti engages with students from many different backgrounds, from countries across the globe. These diverse viewpoints allow her to think about other perspectives and ideas to solving problems that she would not have otherwise considered. Sruti has also met and kept in touch with some great women in computer science from different countries through programs such as the National Center for Women & Information Technology (NCWIT) and Square's College Code Camp. Even though Sruti doesn't travel abroad regularly, she looks for opportunities to obtain a new or different perspective. She said, "You can learn a lot from other cultures and locations — even if it is local to you and close to home."

The article mentioned that "some researchers see global cooperation's rise as a threat." When Sruti and I discussed this point, Sruti saw global cooperation posing very few threats. Aside from the inconvenience of working off hours to meet with people in various time zones, the most serious issue is the possibility that sensitive research could fall into the hands of the wrong people. Despite this, Sruti felt that the pros outweighed the cons, and having new knowledge is a win for everyone. The article's focus on global cooperation also indicates that the researchers were working on problems that apply to all of us, wherever we live. For example, if one country reduces carbon emissions, but another country increases emissions, it impacts all of us negatively, as we share a common future on the same planet. To solve pressing problems facing all of us, we should share research across borders.

I asked Sruti about the following statement:

"The real question is how to bring along the poor and those formerly excluded. We need to make global research more equitable and fair to bring the talents of women and those from developing countries into the system."

I am encouraged to see that future women engineers have such open minds, which will bring a great deal of creativity into the workplace.

Sruti had some thoughts on making global research more equitable and fair. The article mentioned an organization called Seeding Labs, and she liked the work they are doing to invest in researchers in developing countries. In support of Seeding Labs' efforts, Sruti pointed out that equipment in developed countries that is considered out of date, but still usable, can be given to developing countries for reuse. She also suggested establishing programs where people from developing countries could receive scholarships or funds set aside to travel to developed countries, and vice versa. These exchanges would allow participants to gain firsthand knowledge of the other person's research environment. Sruti also emphasized the importance of role models and sponsors, as they offer encouragement and examples of overcoming difficulties. Reflecting on a woman who did not have the advantage

of a sponsor, Sruti mentioned that she was outraged when she learned about Rosalind Franklin, Ph.D., who did not get full credit for her DNA discoveries.

Similarly, Sruti brought up the importance of increasing the number of patents submitted by women. Her first point was to build awareness earlier in women's careers so that the process of creating a patent or publishing an idea is known. Such knowledge early in one's career would be helpful. On the other hand, she wonders whether patents will be less valued going forward because of the open-source movement.

I was very happy to have the opportunity to speak with Sruti on this topic. Our discussion was refreshing, gave me insight into her world, and broadened my perspective. Sruti is a bright and articulate woman. I am encouraged to see that future women engineers have such open minds, which will bring a great deal of creativity into the workplace. It is gratifying both to know that my ongoing efforts to "give back" have made a difference and that Sruti also continues to give back. She is a role model for high school women through a summer camp she hosted, and was a runner-up for the NCWIT Aspirations Award in 2013.

Impressions
Sruti Modekurty

Because I haven't done as much research as Patty, I found her perspective on the global collaboration article to be very insightful. For example, Patty said she was impressed by the resourcefulness of the researchers and how the women used creativity and innovation to solve problems. They came up with solutions that were applicable worldwide — not just in developing countries, but in developed nations as well. Patty agreed with a major point of the article — that global collaborations are needed to solve problems. For instance, depletion of natural resources requires a global solution for the security of future generations.

Patty has experienced the benefits of global collaboration firsthand, having worked with a third-party team based in India; another partner team, also based in India; and customers in Japan, Singapore, and China. She supports customers worldwide, resolving technical issues so their systems are up and running quickly. Patty has worked globally to build community among technical women. She recruited technical women in India to organize the first Grace Hopper Celebration there and is a co-founder and the co-chair of Latinas in Computing.

Patty emphasized that working globally allows one to gain new perspectives. For instance, because the rate of recycling is very high in Europe, we can learn a lot about their efforts and approach. With more "international eyes" on a problem, solutions will be more effective, and the results will benefit more than just one country.

When we were discussing the issue about global cooperation as a possible threat, Patty pointed out that security and privacy are the areas with the greatest risk and downside. Despite any downsides, there are many benefits to global cooperation. To appreciate these, Patty suggested that we look at our own work through a different, more expansive lens. For instance, one should study topics that express and value a global perspective, that give voice to other experiences. Travel outside of your native country to broaden your horizons.

I asked Patty how we can help women to accomplish more. She told me about the initiatives Intel is driving, such as the She Will campaign, which will allow girls to raise their education levels and give them control of their futures. This is very important, because research shows that the more education a woman has, the later she will start her family. She will earn more over her lifetime, creating more financial stability.

To generate more patents by women, Patty suggested holding women-focused sessions to create awareness on the process. We could also follow the example of Elon Musk, who has made his Tesla patents public. Patty said, "You get more through collaboration than just one person protecting their own domain expertise." We could have team-focused "collaboratories" instead of focusing on the single awards. Teamwork is central to a global community, and we want to make the world a better place.

Patty suggested that we look at our own work through a different, more expansive lens. For instance, one should study topics that express and value a global perspective, that give voice to other experiences. Travel outside of your native country to broaden your horizons.

I am very happy to have met Patty. She is knowledgeable on this subject, citing all sorts of articles and research, and is a great role model. I loved hearing about her experiences, and what it is like in the workplace. Like so many women before her, Patty has blazed a path so the next generation of young women can fulfill their aspirations. ■

Reflections on Sally Ride's Legacy

The first American woman to fly in space, a children's science book author, co-founder of Sally Ride Science — the list goes on of the ways Sally Ride, Ph.D., inspired so many and interested young people in science, technology, engineering, math, and space. Now we can add being the first known LGBT (lesbian, gay, bisexual, transgender) astronaut to the list.

By Marcie Mathis, SWE Editorial Board

NASA

Sally Ride floats alongside Challenger's middeck airlock hatch.

When I learned Sally Ride, Ph.D., had a life partner of 27 years, I experienced a mix of feelings. Dr. Ride was very private about her personal life, something mentioned in everything I've read about her. When she married fellow astronaut Steve Hawley, Ph.D., she even kept that quiet for a while. As the first American woman in space, Dr. Ride was inundated with personal questions from the media. Given her nature and desire to keep the most fundamental parts of her life private, it makes sense that she would protect something so personal — and potentially newsworthy — as her relationship with her partner. She kept her illness private, too. It wasn't until her obituary, in a single sentence, that she publicly came out: "Dr. Ride is survived by her partner of 27 years, Tam O'Shaughnessy; her mother, Joyce; and her sister, Ms. Scott, who is known as Bear."

In some ways I wish she had not kept her life partner hidden, but at the same time, I can understand why she did. Times have changed, but for those of us who grew up during an era when being gay was not something people even talked about, being out at work could be a career disaster. In fact, it can be a little scary to be openly LGB or T even now, with all the changes in attitudes and legislation that have taken place. Add to that what likely would have been much intrusive publicity and exposure of her valued private life, keeping her relationship known to only a close circle seems pretty wise.

The difference of several decades

I recently watched "The Imitation Game," a film about Alan Turing, Ph.D.,

a British mathematician credited with creating the precursor to the modern computer, as well as leading the team that broke the German's Enigma code during World War II. He was later outed as being gay during a police investigation of a burglary at his home, and was arrested for it, because in that place and time — the United Kingdom in 1952 — being gay (or a "poof" in British lingo) was illegal. He lost his job and his security clearance. About a year after finishing what was basically chemical castration, in lieu of prison, he committed suicide (according to the coroner). What a tragic loss of a remarkable and brilliant man.

While I watched the film, I was struck with some of the parallels between him and Dr. Ride. They both were brilliant, both successful, both college professors, and both contributing in immeasurable ways to their nations. Yet, Dr. Turing was out (not by choice) and his contributions cut short just shy of his 42nd birthday. Dr. Ride was able to keep her relationship of 27 years private, and was able to continue contributing until her death at 61.

Dr. Ride's life and business partner, Tam O'Shaughnessy, Ph.D., was a keynote speaker at the Out to Innovate™ conference at Georgia Tech in November 2014. I was delighted to have the opportunity to hear her speak. She talked about Dr. Ride and mentioned how private she was, how she didn't like labels, and that their relationship was known only to a close circle of friends. Once Dr. Ride became sick and knew her time was short, however, they wanted to be more connected and officially became domestic partners. Of course, once the obituary was published and Dr. Ride was out, Dr. O'Shaughnessy was out, too.

Dr. O'Shaughnessy said that being out has changed her in fundamental ways and added, "I wish Sally could experience being openly gay with me; I have felt tremendous love and respect and acceptance across the country." Dr. O'Shaughnessy received a standing ovation that day for her keynote speech to about 400 folks. I felt empowered afterward, and am sure the young people in attendance were, too. I also felt tearful, though — Dr. O'Shaughnessy lost a life partner, and the world lost an amazing woman.

Even though Dr. Ride was not out while she was alive, she is still able to create enthusiasm in young LGBTQ+ folks for science, technology, math, and science. Her memory and her work live on through Sally Ride Science, the numerous books she co-authored, and with Dr. O'Shaughnessy. ■

Marcie Mathis graduated from the University of Washington with a bachelor's degree in electrical engineering. She has spent most of her engineering career as a civilian U.S. Navy employee and currently works at the Puget Sound Naval Shipyard and Intermediate Maintenance Facility in Bremerton, Washington. Mathis joined SWE in 1988 as a student and currently serves on the multicultural committee and as a member of the SWE Magazine *editorial board.*

It *Is* About Asking for the Raise

The long-standing gender gap in technology is finally being taken seriously in some companies, and by those with the power to change it. These efforts deserve our careful attention.

By Debra Kimberling, F.SWE, SWE Editorial Board

For women who have been in technology for any length of time, Microsoft CEO Satya Nadella's infamous edict concerning women and raises was nothing new. Nadella's words, "It's not really about asking for the raise, but knowing and having faith that the system will actually give you the right raises as you go along," provoked a firestorm due to the long-standing gender gap in technology wages.

A bit closer to home, a corporate executive quietly killed a training course titled "Negotiation Skills for Women" after learning that the attendees were taught how to ask for a raise. It was particularly frustrating because the executive had been a high-ranking and visible advocate for women in the company. His previous actions demonstrated strong support for women in the workplace, but perhaps women asking for pay raises was taking things too far. It seems quite telling that this particular training course has not been offered again. Eliminating this training is just one example I've observed of how differently women and men experience career advancement.

Perhaps Nadella is as strong an advocate for women as the executive who cancelled the negotiation training — that I do not know. But they both missed the basic fairness issue summarized succinctly in the maxim, "Justice delayed is justice denied." Any person, male or female, whose accomplishment is worthy of a pay raise or promotion and makes it known is perfectly justified in doing so. When the woman receives a disproportionate negative backlash, however, the antiquated company decorum that deems it unacceptable for women to request raises or promotions needs to change. Without public scrutiny, the impact of such unwritten rules remains hidden while quietly damaging the careers of many women.

Nadella has since apologized for his comments and now contends that he supports programs to close the gender gap. Two weeks after his highly visible public guffaw, he announced a rather radical change: Microsoft will roll out unconscious bias training to all of its employees. He now recommends, "If you think you deserve a raise, you should just ask."

Nadella is on the right track. There is a large and growing body of research in social psychology on unconscious bias. When it comes to diverse workplaces, the research shows that our gut instincts can lead to errors in people decisions. Unconscious bias affects not only how open and welcoming a workplace is, but also whom we choose to hire, promote, and mentor. It directly affects how much we choose to pay and to whom.

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Taking the problem seriously

Whether we like it or not, the high-tech world is still very much male dominated, but there is progress, and some companies are beginning to take the problem seriously. In May, Google became the first high-tech company to publically disclose its diversity statistics. Several companies have since followed suit. In September, Google released "Unconscious Bias @ Work," a training video with a vision to change the company's culture by educating all of its 49,000 employees regarding the prevalence and impact of unconscious bias.

The video offers recommendations to improve the company's culture, including: establish clear criteria for success; collect data; evaluate subtle messages we send; and hold everyone accountable. In 60 minutes, the video introduces a new vocabulary to effectively discuss bias. It also encourages collective decision making on whom to hire, promote, and reward with raises, and to justify those decisions based on merit, not gut instincts.

In an effort to eliminate promotion bias, Google sent an email to its entire work force to let women know it is OK to nominate themselves for a promotion. There is no reason to doubt Google's sincerity in trying to eliminate personal and institutional bias, which is, after all, in the company's best interest. We should all wish Google success, and we need to lobby more companies to do the same. Maybe one day, a woman not nominating herself for a pay raise and promotion she deserves would violate the company decorum. ■

SEAN EDDY

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Debra Kimberling, F.SWE, is the advocacy director for the SWE San Diego Section and a member of the SWE Magazine *editorial board. She frequently speaks on the social research to parents, educators, and the general public. She manages sales order risk decisions for Solar Turbines, a subsidiary of Caterpillar, in San Diego, where she works on gas turbine engines.*

SWE: Advocate for Diversity

As we celebrate Women's History Month and prepare for SWE's 65th anniversary, I feel a strong sense of pride in our mission and the Society's success in its role as a gender diversity advocate.

Our pioneer members understood the value they brought to the engineering profession — the value of diversity. They also understood it was important to educate academic institutions, employers, and the community at large about the importance of gender diversity in the engineering profession. Today, a key component of our mission remains "to demonstrate the value of diversity."

But how do we advocate for diversity, 65 years after that first meeting at Green Engineering Camp in New Jersey?

First, we focus on youth. SWE has a rich history of outreach programs for girls and young women. Our goal is to showcase engineering as a highly desirable career aspiration for women. Through hands-on activities and conversations with engineering students and working engineers, girls build their confidence and begin to see themselves as engineers. Whether at the section or region level or at the annual conference during "Invent It. Build It.," SWE members are connecting with young women and their parents. We know that especially early on, such positive interaction truly makes a difference.

We don't stop with our own events, however. It's important for our outreach partners to embrace gender diversity as well. One example of this relationship in action is our work with long-standing partner *FIRST*® Robotics. This year, together with Motorola Solutions Foundation, SWE provided minigrants to 44 *FIRST* teams. To qualify, teams needed to comprise at least 50 percent girls, and the team and all of their mentors/coaches needed to complete an online diversity/inclusivity training module developed by SWE. Not only will this program reach high school girls and nurture their innovation and engineering skills, but it will also reach their mentors/coaches and teammates through that training and demonstrate the power of diverse teams.

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The voice of women engineers

We engage in advocacy through our public policy efforts in Washington, D.C. Over the last nine years, we have formalized a means for Society members to ensure that the voice of women engineers is heard by legislators, government agencies, and the executive office. March 18-19, SWE will once again organize a congressional outreach day on Capitol Hill in Washington, D.C. The event, titled "Diversity and Inclusion Drives Innovation in STEM," will increase awareness of the need for and the importance of increased diversity and inclusion in the science, technology, engineering, and mathematics (STEM) work force. Participating SWE members will complete pre-visit training and attend a reception, in addition to having the opportunity to meet with their representatives or congressional staff. Through these activities we influence federal policies and funding decisions that support gender diversity in engineering.

We are pleased to present the most recent additions to our advocacy portfolio: diversity and inclusion tools and training for our members and partners. This fiscal year, we have rolled out a variety of tools that can be used by SWE members, sections, and regions, as well as by SWE's corporate and professional society partners. The knowledge cards are the first component, featuring provocative questions, summaries of current research, and intriguing data points to start conversations in the workplace and beyond. Each card revolves around a key aspect of identifying the unconscious biases prevalent in the engineering industry in North America. Accompanying facilitation guides make hosting a discussion easy and turnkey. The second component is a set of online training modules that can be accessed on the SWE Advance portal at swe.org. The online modules, released this month, focus on developing the individual as a lifelong learner and leader who is engaged in promoting and stewarding an inclusive culture. These thought-provoking resources are tools that will lead to meaningful change within organizations, helping them welcome diverse perspectives at every level.

By working together as advocates, we can make sure women feel welcomed, valued, and included in the engineering profession ... the kind of world our founders envisioned and advocated 65 years ago. Let's make them proud!

Karen Horting, CAE
Executive Director & CEO

Society of Women Engineers

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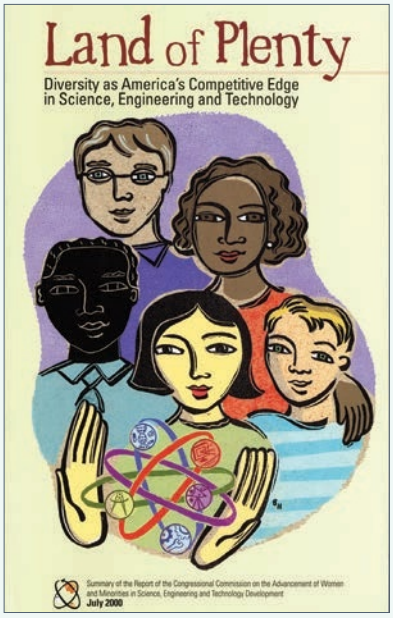
Capital Efforts on Capitol Hill

"If the laws or the policies are in place that more girls study science and math and engineering in K through 12, that advances our mission," explained Fellow life member and former executive director Betty Shanahan, CAE, in her 2014 SWE Grassroots Oral History Project interview. With the exception of SWE's outspoken support of the Equal Rights Amendment in the 1970s, the Society largely stayed out of political and public policy debates during its first 40 years. It decisively joined the public policy sphere in 1994, however, when it endorsed the Gender Equity in Education Act and when board member Patricia Eng, P.E., and Past President Suzanne Jenniches represented SWE on Capitol Hill during a hearing of the U.S. House of Representatives Committee on Science, Space, and Technology Subcommittee on Energy.

Since their testimony, SWE has continued to support public policy efforts, particularly in relation to Title IX and improving science, technology, engineering, and mathematics (STEM) education in schools. FY04 President Alma Martinez Fallon made public policy the keystone of her presidency, leading to a partnership with ASME in 2005, which enabled SWE to hire a public policy representative in Washington D.C. Today, SWE and the Association for Women in Science (AWIS) jointly fund a public policy liaison position, capitalizing on the synergy between SWE and AWIS members.

– Troy Eller English, SWE archivist



SWE and other STEM organizations provided input for the Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development (CAWMSET), established by Congress in 1998 to identify ways to recruit and retain women, underrepresented minorities, and persons with disabilities.

In 2009, Barbara Bogue, Ph.D., fourth from left, represented SWE in a hearing before the U.S. House Committee on Science and Technology and the Subcommittee on Research and Science Education. SWE co-sponsored its first congressional briefing during EWeek 2006.

SWE members and public policy representative Melissa Carl spoke to their legislators about Title IX's application to STEM fields during Congressional Visits Day in 2009. SWE sent its first contingent to the event the previous year.

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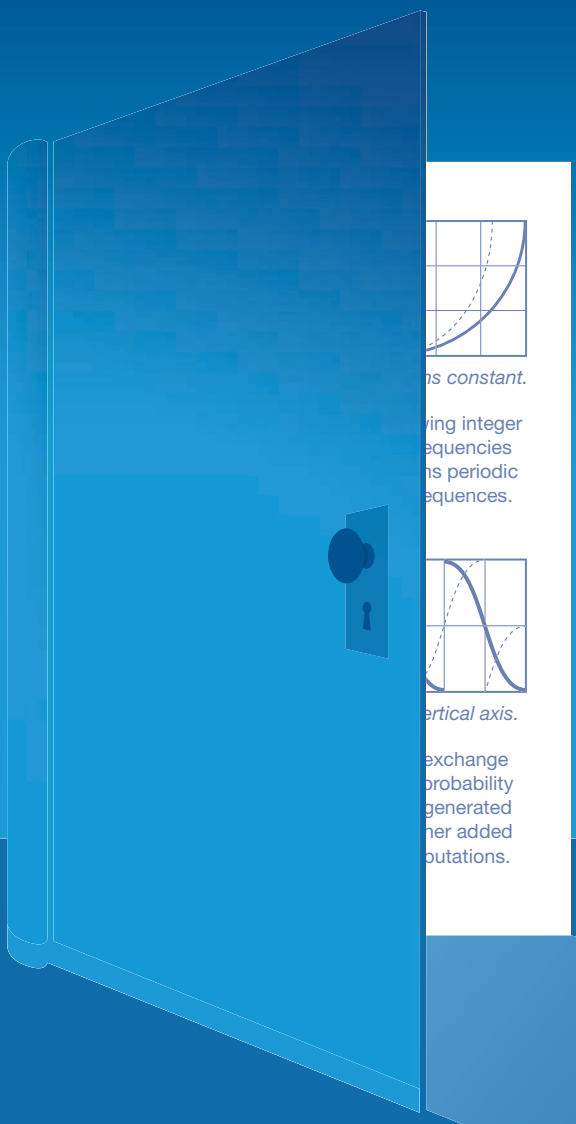

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