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mentors

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Feature

19

Millie Dresselhaus is known as the "Queen of Carbon."

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11

14

Columns/ Departments

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Letter from the Editor

Magical Mentors

What exactly is a mentor? Is it someone who provides guidance, nurturing, or career advice? Can it be someone who may not even know you, but somehow has done something so extraordinary that it has had a profound impact on your life? The answer is, "Yes, to all of the above!"

Mentors tend to be called "role models" because they are individuals who set strong examples for others to follow. Sometimes role models are called "pioneers" because they may be the first to overcome a challenge, where others have failed. I tend to refer to these individuals as "warriors" rather than pioneers because most challenges do not involve just overcoming technical issues. Challenges come packaged with social and political barriers as well.

In this issue of *IEEE Women in Engineering Magazine*, we celebrate mentors and all those individuals who have dedicated their lives to sharing their experiences with others. Their efforts have helped change mind sets and open doors for generations of young people who have come after them.

Dr. Mildred Dresselhaus is our leading lady when it comes to role models and mentors. Dr. Dresselhaus, or Millie, as most of us know her, is the first female recipient of the IEEE Medal of Honor, an award that has been around for 90 years.

Many stories have been done on Millie, her career, her innovative technologies, and how she has been a strong advocate for women. However, upon meeting Millie at the IEEE Honors ceremony, I was struck by the fact that her legacy is also a family affair. Millie's daughter and granddaughters have also ventured into science and engineering, where each woman has taken ownership to craft her own unique career path. Millie didn't just inspire her own family to pursue the science, technology, engineering, and math (STEM) fields, she empowered them to be innovative and do it on their own terms. All of us at *IEEE Women in Engineering Magazine* celebrate Millie's lifetime of achievements and are honored to have been granted an interview with her and her family.

Karen Panetta

Good mentors recognize that "one size does not fit all" and that our entry points into the STEM fields vary greatly across the world. Some of the role models we interview in this issue show the different avenues to attract youth into STEM. Susan Schueller uses music and has found many innovative ways to make connections and create opportunities for others through her love of the arts.

Heather Dewey-Hagborg's bioart concept has attracted artists, STEM experts, journalists, educators, musicians, and many other types of individuals with little-to-no background in technology. Heather collected DNA from articles like chewing gum and hair and set out to determine from these diposed items if she could reverse engineer what the individual looked like from the DNA left behind. How does one go from being interested in art to becoming a technology, privacy, and DNA expert? Heather sets the stage for us and shares her incredible journey.

Finally, there are women out there who appear to be able to do it all and seem to have achieved the elusive "life balance." In our interview with Dr. Ellen Ferraro, we learn that life balance is really about making choices and being courageous enough to ask for what you need to make it all work synergistically. It is also centers on knowing that there are certain aspects of our lives that should not be sacrificed and not apologizing for holding true to your heart. Dr. Ferraro is the wonder woman most women aspire to be, and we thank her for her sharing her "best practices" for life with us.

Everyone of you is a mentor and a role model in your own way. You care enough to share your experiences, support your peers, and, most of all, you keep learning. Students may not believe that they are already role models, but younger students are watching you, even if you don't realize it. At times, the feats we achieve may seem small and trivial,

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but consider those same feats when you were new to the STEM fields. Who were you watching?

We celebrate all of our *IEEE Women in Engineering Magazine* "Women to Watch" and want all of our readers to share their stories with us. Every story is worth telling, and all of us are still learning, no matter how long we have been in the field.

So, to all of our readers, as our own IEEE WIE member Susan Schueller would say, "Ancora imparo," which means, "I am still learning." Let's keep learning together to continue the IEEE Women in Engineering legacy of mentorship to empower our peers, our community, our families, and, most of all, ourselves!

Karen A Panetta

—*Karen A. Panetta*
Editor-in-Chief
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IEEE women in engineering MAGAZINE

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Previous Page | Contents | Zoom in | Zoom out | Front Cover | Search Issue | Next Page

That One Spark

Dunie moves toward progress

When someone who has spent 30+ years of her career around defense and national intelligence, and who now sits on seven boards as either a director or an advisor, quotes a great piece of advice she was once given and has used to guide her career decisions, it is highly beneficial to listen. "Don't ever take a position as a token," Deborah Dunie recalls being advised by a friend's father. "You have to stand on your own two feet, otherwise you will never be happy."

Throughout her career, those words have meant that Dunie must be passionate about and qualified for an opportunity instead of taking it because it "seems like she should." This is advice she now passes down to her own mentees. "If you take a position as a token, meaning you don't have the innate qualifications for it, people will recognize that you don't deserve to be there," she warns. "Don't take a position as a token, and stay away from people who do so."

Following these words of wisdom does not mean that she has not taken risks with her own career. In fact, it's been quite exciting. Dunie has worked in the Amazon, wrote an executive order for a U.S. president, served as a company's first chief technology officer (CTO), and now finds herself in what she calls "semi-retirement" at the young age of 51, intending to go back into the workforce after her teenage daughters leave home for college.

In 1981, when Dunie herself left for college, she wasn't sure what she wanted to do but recognized that she wanted a career that could provide a living. "There was a family friend who had studied engineering and recommended I look into that, especially because my favorite class in high school was physics," she says. "It seemed like engineering would be a good base and, from that, I could go into pretty much any field." After earning a degree in electrical engineering from Tufts University in Massachusetts, Dunie moved back home to New Jersey and took a systems engineering role at ITT Avionics, where she had interned during the summers.

Dunie with her husband, Justin.

"ITT offered me a full-time job before I graduated, so that worked out really well," she shares. "As someone who does a lot of work with educational institutions now, I think it's very important for students to consider internships. You can go to school and you can learn a lot but that doesn't really qualify you to do anything other than learn, so getting on-the-job experience is key."

While at ITT, Dunie completed a master's degree in electrical engineering at Stevens Institute of Technology. "I had an invitation to study for my Ph.D. at Carnegie Mellon, but I bailed on that," she says, laughing. "After working and going to school at the same time, the idea of continuing as a student was just not appealing. I knew I needed to be passionate about the research topic to continue my studies and not just go for the title."

Instead, Dunie left ITT and moved to Washington, D.C.—where she had never been before—to work for a small firm consulting for the U.S. Navy. "It was deeply technical work but fun and interesting," she says. She soon received a call from a contact who asked her to talk to General Electric about an opportunity with GE Aerospace. "I worked in a number of different roles at GE and enjoyed being part of an exceptional rotational program with high potential for personal growth," she says.

When Martin Marietta purchased the division of GE where Dunie worked, she was no longer able to participate in GE's rotational program, so, after a few years, she left to join Raytheon (E-Systems at the time). There, she ran the research and development portfolio for Raytheon's Melpar Division and helped out with the integration of Raytheon and E-Systems when

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the former bought the latter. But when she again got a call from a friend asking her to entertain an opportunity at Oracle, Dunie jumped at the chance to learn a different side of industry.

"I didn't have a software background, so I thought it would be good to learn about that, and I thought working partially outside the intelligence sector would mean working with younger, more energetic folks," she shares. "But two weeks into the role, I got sucked right back into the intelligence vertical." Still, Dunie calls her six years at Oracle a "great run," during which she also got married and had her children.

Dunie enjoys sailing on her father's boat on the Long Island Sound.

An "Outside Insider"

Before the birth of her second daughter, Dunie received a call from the new National Imagery and Mapping Agency (NIMA), currently called the National GeoSpatial Intelligence Agency. NIMA was looking to collapse six government agencies into one and engaged Dunie, who calls herself an "outside insider," to run the integration. Having traveled three weeks of every month while at Oracle, Dunie says she "had this idea where, as a government employee, I could work eight hours a day and then go home to my husband and two babies." The role would be a substantial pay cut,

Dunie hiking in Yosemite National Park.

so she told herself she would just do it for a year.

"A year and a half later, I was on a diplomatic mission in the Amazon," laughs Dunie. "So clearly I was not working eight hours a day *and* I'd stayed past the one-year mark." But it was during that trip that she was recruited to her next role, working as the director of Plans and Analysis for the Deputy Under Secretary of Defense for Intelligence (USDI). The position was initially billed as part of the counterintelligence and security directorate, but when it became evident that Dunie had a stronger IT background than others in the office, she became the USDI representative to the Department of Defense chief information officer.

"I ended up being a liaison to the National Intelligence Community chief information officer, as something of a go-between for the IT priorities of national defense and national intelligence," she says. "With the country in the middle of a war, my days were really horribly consumed and quite taxing. The goal was to make sure the right intelligence got where it needed to be, because we were going to save lives."

During these years, Dunie says she worked on a number of different initiatives and even wrote an executive order for President George W. Bush.

Overcoming the Politics

On top of the work pressures, there were environmental ones as well. "I was in a system that was incredibly male dominated, and the politics in defense are intense," shares Dunie. "But I'm a strong-minded individual. If my colleagues first saw me as 'a woman,' I like to think that over the years they didn't focus on my being female because I knew what I was talking about. I wasn't afraid to speak up and be a dominant force." As an example, she recalls how colleagues would joke with her about wanting men around the office to open doors for her and, instead of quieting the gender stereotypes, she would respond that she absolutely expected men to do so, as she appreciates gentlemen.

Ultimately, having been in engineering school with mostly men prepared her for the low number of women in her workplace. Still, Dunie calls on her favorite piece of advice to add that gender didn't really matter because she was in a position where she knew she could truly add value. "I had the benefit of having worked in both industry and government, so that gave me a unique perspective to intertwine the two," she says. "If I learned nothing else at the Pentagon—and I learned a lot at the Pentagon—it was to look at things from different angles and consider as well the second- and third-degree impacts of the decisions you make. Across the board there should be diversity of perspective, and that's really critical."

Across the board there should be diversity of perspective, and that's really critical.

In 2006, Dunie got a call asking if she'd talk to the team at CACI, a professional services and information technology firm led by Dr. Jack London. "Dr. London is an icon in the defense community but I didn't know a lot about the company, and I wasn't sure what they wanted to talk to me about," she explains. "If they were going to ask me to do business development, I was going to say 'no thank you'."

Instead, Dr. London asked her to be CACI's first CTO. "I told him I would only do it if I had a real seat at the table," says Dunie. Assured that her voice would be heard, she took the role, serving as CTO during the eight years CACI grew from a US$1 billion firm to four times that size.

Jumping on Board

Toward the end of 2014, Dunie recognized that she was getting burnt out and knew she wanted to spend more time with her family before her daughters left for college. "I wasn't looking to retire outright," she says. "But I wanted to do something different that also offered some flexibility." When the chance to sit on a board of directors presented itself, Dunie thought it would be just the thing to re-energize her.

In early 2015, she was appointed to the board of SAIC, a US$4.4-billion publicly traded information solutions and services company in the federal sector market. "When transitioning from a job to a board, the role is fundamentally different," explains Dunie. "Now you represent the shareholder and you're not supposed to be engaged with day-to-day management of these entities. But I know too much about this industry and it's clearly a sector I care about, so it's challenging for me." Mid-year, she was appointed to the board of Alliant Energy Corporation, a publicly traded company that provides regulated electric and natural gas service to communities across Iowa, Wisconsin, and Minnesota. Dunie describes this appointment as "like being a kid in a candy shop" because it's a different industry with its own technologies and a lot for her to learn.

She also sits on the board of advisors at three engineering schools and works with two startup companies. She's passionate about making opportunities accessible to anyone trying to advance his or her life. "It's critical that people

have the opportunity to excel in areas that they may not originally know much about," explains Dunie. "Sometimes it just takes that one spark, like the excellent physics teacher I had in high school."

When it comes to helping others find their spark, she is fascinated by what truly motivates someone. "One thing I always tell my mentees is not to run away from a job, but to move toward something. Make a change because there is something else you want to do, not because you need to leave a current situation." Some of the greatest joy she finds is watching people realize their potential and to help motivate them to enhance their lives personally and professionally.

With her recent change into semiretirement, Dunie is moving toward the pursuit of work-life balance that, she says, may not truly exist. "Having a healthy partnership with my husband has been essential. He provides a support infrastructure that allows me to travel and pursue my interests and hobbies, such as gardening and hiking," says Dunie. "There is a give-and-take on priorities every day, but balance is a good pursuit."

Though, she adds, "Life is short. At the end of the day people should also try to have more fun."

—Leslie Prives

Achievable Work-Life Balance

Ferraro shares lessons learned

Many of us want a better work-life balance, but we can have high expectations of what this balance looks like. The balance we are all after seems to include discovering the secret way to do all things easily and with aplomb. In our perfectly imagined, perfectly balanced worlds, we work, parent, and take care of aging parents without a hiccup. Our laundry never sits in piles on the couch, and we never miss a conference, whether it be IEEE or a parent-teacher get together. This is what we want, us overachievers: perfection.

Ellen Ferraro, director of Systems Engineering at Raytheon Integrated Defense Systems, knows that reality doesn't look like that. Maintaining a balance between your work life and your personal life is challenging, and, as the word *maintaining* would suggest, requires constant rejiggering. Achieving work-life balance requires that you be the chief executive officer of your own life—setting forth a strategic vision and then making informed decisions that allow you to deliver that vision.

Ferraro spent many years working part time, and people often ask her if she regrets that decision. "I don't know where I would be if I hadn't worked part time," Ferraro admits. "Would I be vice

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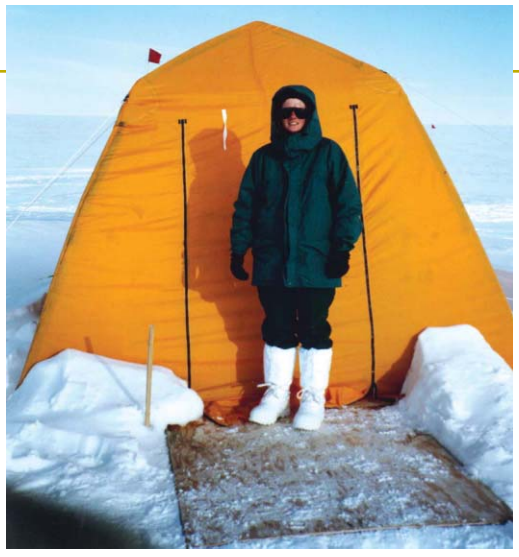

As the recipient of a NASA fellowship, Ferraro used radar sensors to study the Greenland ice sheet.

president, be a higher labor grade, or be higher paid? I don't know. I can't live parallel lives. But what I can say is that I am very happy where I am. I feel I made the right decisions for me, my family, and my career. That is what you have to do."

What exactly does this look like in practice? Ferraro shares the following five "lessons learned" from her own experiences as a working mother of two children.

Keep a Written List of Priorities and Use it to Guide Decisions

We can all sit down with a cup of coffee and jot down our priorities. That is the easy part. The challenge is continuously using this list to guide our decisions. First, we must develop the habit. Second, it takes strength (maybe even guts) to pass up an opportunity or say no to a colleague.

As our own managers, we must make the difficult calls. Just as we would at work, we can employ compromise and creativity but sometimes we do have to say no. And once we do, we must stand confident that we have made the best decision for our situation. Part of the complication is that our priorities are fluid, constantly requiring re-evaluation.

"My priorities coming out of graduate school were to work hard at my career and, when not doing that, to have fun," Ferraro says. "It was great. I traveled with my husband, enjoyed leisure time, and focused on my career. Those were my priorities. Then I had my daughters." As a mother of young children, work, she says, was still up there, but not at the top of the list.

Work would take another step back when her mother became ill. "One of my new priorities became making sure that I could help my father care for her, that I was able to visit her on a regular basis and relieve him so that he could take a break," she adds.

A double drop in priority like this can be frightening, as you worry about how this change will impact job performance. For any major change in your priorities, one of your first stops should be your manager's office. "Be open," Ferraro advises. "If you are open with your manager about your situation and the facts within, then you will be much more successful than if you try to hide it and manage everything on your own."

Managers want to help you be successful, she adds. "If they know what you are trying to balance, they will try to help you."

Know Your Options

Telecommuting, part-time work, work sharing, and family leave—Ferraro has taken advantage of all of these situations during her career. She took six months leave with the birth of each of her two daughters, and then, when she returned to work, she came back part time in various schedules—first a few hours, then 20, 30, and finally full time.

Raytheon was very flexible. But what if your company is not? "You can be the one who drives for change and points to best practices outside of the company," she says. "Forge the path. I am sure there will be many after you who will be happy that you asked the question."

One way to avoid being in this situation altogether is to seek out the right company. When job-hunting, investigate the flexible work policies of your employer. "You may not need it right now, but to know it's an option and available later is key," Ferraro adds.

Ask About Culture

Ferraro remembers an evening when she was at Raytheon and had to leave to pick up her daughters. She was talking

Ferraro (right) sits with her daughters and her mentor Dr. Eli Brookner (left) at the IEEE Radar Conference. Ferraro's husband Paul is in the next row.

with her manager and "starting to break into a sweat," worried that she would not make it to her daughters' school on time. But her manager noticed. "How about we walk to your car together? Grab your stuff," he said.

She was working at one of Raytheon's largest facilities. With more than 4,000 employees, the walk to the car would take 15 min. "By the time we got to my car, we had finished our conversation," Ferraro says. "I made it to pick up my kids on time. My manager got the information he needed. To me that means we had the right culture here. He didn't hold it against me at all for having to leave."

Raytheon's culture rewards employees for results as opposed to how many hours they are in the office. This is why Ferraro has stayed with the company and has been so happy there. "[Raytheon] allows you to take advantage of the policies and still perform," she says.

To find an environment like this requires either luck or legwork. It can be difficult to pinpoint a company's culture. As the interview process progresses, culture-related questions can and should become a part of the conversation.

Don't Go at It Alone

Ellen recommends that you have three mentors: a technical, a career and a work/life-balance mentor. For a technical mentor, you may want an engineer. A career mentor will be someone in the position that you hope to achieve, perhaps a technical subject matter expert or a vice president. Pick someone further along in his/her career than you are to help with work-life balance.

"You can call on them like a board of directors that you go to with questions along the way," Ferraro adds. If you have done an effective job in choosing your mentors, you can expect that the three will often be willing to put on different hats and help you in any way they can.

Years ago, Ferraro's technical mentor, Dr. Eli Brookner, was the technical chair and she was the chair of the plenary session at the IEEE Radar Conference. Ferraro's husband, a vice president at Raytheon, happened to be an invited keynote speaker. As luck would have it, the kids had a half day. Ferraro told Brookner that either she or her husband wouldn't be able to be there, but he put on his work-life mentor hat and came up with a better plan. "Bring the kids," he said to her.

"That never occurred to me," she admits. Ferraro's young daughters "marched right up and sat in the front row and listened attentively to the presentation."

Take Care of Yourself

Eat right, exercise, and sleep. Sometimes these are the first things to to be sacrificed as we rush through our days. But Ferraro likens it to the airplane safety instructions—"You must help yourself before assisting others," she says.

And while you're at it, lay off the working mother guilt and the what-ifs, she adds. In May, an article in *The New York Times,* "Mounting Evidence of Advantages for Children of Working Mothers," broke the results of research that showed economic, educational, and social benefits for children of working mothers. According to the study, the sons of working mothers grow up more willing to share domestic duties such as child rearing and housework. Daughters of working mothers have more years of education, better rates of management positions, and higher incomes.

Despite those long-term benefits, in the day-to-day moments you can still feel that you are never quite doing well enough at any one thing. "I really think that we are harder on ourselves than we should be," Ferraro says. "We need to set more reasonable expectations for ourselves. If you feel that you are doing everything that you can, then you probably are. You are doing a better job than you think."

This reminds her of a story. "Someone once told me, 'Stop driving to work beating yourself up for the fact that you're not at home, and stop beating yourself up on the way home because you're not at work.' I have since used that drive time to instead reflect and transition in a positive way. It's a change in mind set," she explains.

—Katianne Williams

Stranger Visions

Creating realistic 3-D portraits

Heather Dewey-Hagborg was sitting in a therapy session staring at a picture on the wall when she noticed a crack in the glass, and in the crack, a single hair. As an artist and a scientist, her work often begins with questions, ponderings that may be scientific, philosophical, or political. She is fascinated—often obsessed—with the contemporary world around her, with wanting to bring to light that which we cannot see.

When Dewey-Hagborg saw the hair, she was already grappling with the idea of privacy and using art as a way to explore the omniscient potential of media, technology, and science in our digital age. She had a particular interest in electronic surveillance. In 2008, she had worked on a billboard art installation—the question "Who owns you?" against a white background, in a font similar to the Google logo.

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Dewey-Hagborg has turned her interest to the world of bioart.

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For the Stranger Visions project, Dewey-Hagborg collected cigarette butts, hair, and chewing gum from public spaces.

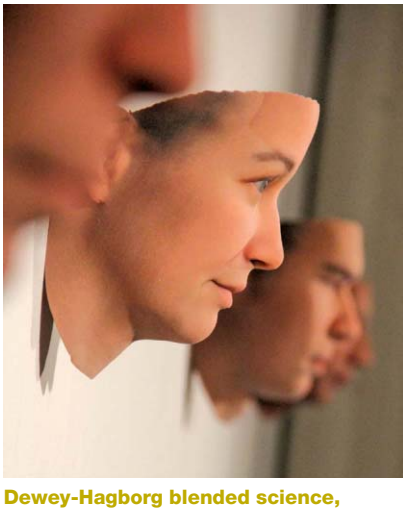
"Even if it wasn't the government observing us, then certainly companies were, and they were turning it into profit for themselves," Dewey-Hagborg says. But no one, she realized, was talking about genetic surveillance—the body, the bread-crumb trail we leave behind.

She began to imagine the person who had left the hair and noticed the detritus that we all walk by every day, small personal items discarded by people, the potential assault on our privacy. Dewey-Hagborg wanted to find a way to make that vulnerability visible in an art project. From DNA analysis of collected forensic samples, she was interested in creating realistic three-dimensional (3-D) portraits. Was this even possible? And if it was possible, what were the broader implications of doing so? That is how Stranger Visions was born.

DIY Biotech

Dewey-Hagborg knew she wanted to turn her eye to the world of bioart, but the tools seemed out of reach. If biotechnology was generally inaccessible to the masses, she was fortunate to be in an area where that was changing—Brooklyn, New York.

In 2009, molecular biologist Ellen Jorgensen and her partners had opened a community biotech lab called Genspace. Genspace is part of the do-it-yourself (DIY) bio movement, which aims to make biotechnology open to everyone under the concept that with diversity comes innovation. In Jorgensen's 2012 TED talk ("Biohacking—You Can Do It Too") she likened her vision for personal biotech to the personal computer.



Dewey-Hagborg blended science, technology, and art to create realistic 3-D facial sculptures based on the DNA of the forensic samples.

There was a time, she reminded the audience, when people wondered why the would need a computer.

Dewey-Hagborg enrolled in Genspace's Biohacker Crash Course. Among other things, students would learn how to extract DNA and then how to amplify that DNA, essentially making enough copies—hundreds of thousands—to make it usable. Just as Jorgensen had envisioned, the class turned out to be made up of all sorts of people; there were artists, journalists, amateurs and hobbyists, teachers, scientists, musicians, industry types, most with very little background in technology.

She started the course wondering if this project in her head could be accomplished, and it only took one class to realize that it might be, at least to some extent. She spoke with Jorgensen, then pitched her idea before the board, and soon she was working in the lab under the board's mentorship.

Snips

Dewey-Hagborg gathered samples—cigarettes, hair, chewing gum—from the streets of Brooklyn and set out to determine how their owners may have looked. Coming up with a genetic profile deals with identifying "snips" on the DNA—well, SNPs. Single-nucleotide polymorphisms (SNPs) are, in essence, copying errors, which also means that they are what distinguishes us genetically from everyone else on the planet.

When a cell divides to make two new cells, it makes copies of its DNA to pass along. But what if a mistake is made when copying, much like a typo? These typos change the recipe, and may, depending on where they occur on the strand, influence not just appearance but possibly health (or nothing at all). The new cell has a particular set of SNPs in it, and those become part of you. When you create new life, you pass some of those SNPs along in your DNA.

Dewey-Hagborg had to find a method to identify the SNPs that would clue her in to her subject's physical characteristics. For a few hundred dollars you can send a saliva sample to an online personal genetics and profiling service

The 3-D portraits were displayed alongside boxes containing the original finds.

and receive in return a microarray of hundreds of thousands of SNPs, but for Dewey-Hagborg to get similar results from forensic samples it would be prohibitively expensive. Besides, she didn't need hundreds of thousands of SNPs. She continued in the do-it-yourself vein, selecting roughly 40 SNPs and analyzing them in the lab herself using a process called polymerase chain reaction (PCR). PCR is a technique that amplifies a few copies of DNA across several thousands of degrees of magnitude. It is based on the natural process of DNA replication even though it occurs in a lab. This "molecular photocopying" is fast and inexpensive. These results were then sent to Genewiz for sequencing, and genetic blueprints were returned to Dewey-Hagborg in the form of a text file full of codes.

Creative Process

When she was not in the lab, Dewey-Hagborg was at her computer working on two pieces of software. First, she used the BioPython library to develop a data interpretation program to read in the coded text file and output a list of genetic traits like ancestry, gender, hair curl, and eye color. Next, she appropriated an open source MATLAB 3-D modeling program from Babel, Switzerland, called MorphFace, in essence turning a 3-D facial recognition program into a 3-D facial generator that could morph a face based on her input parameters.

Although the owners of the samples are anonymous, it is clear that the final 3-D models are not meant to be exact. They are art and science blended, "this whole swath of stuff that is being amalgamated in the creation of these portraits," she says. Some parameters were invented. For example, with no way to determine age, Dewey-Hagborg parameterized each model to be roughly 30 years old, which is close to her own age. She played with other parameters, generating five or six potential portraits for each sample, and ultimately chose the one that she found most aesthetically pleasing for printing. After each life-size sculpture was produced on a color printer, Dewey-Hagborg finished the models by hand, adding features like freckles, which are the one thing she found very hard to incorporate into the modeling process.

Her life was taken over by media requests and e-mails that ran the gamut from hate mail questioning the ethics of her art to people hoping to send her their DNA.

A Media Whirlwind

The Wall Street Journal showed up at a work-in-progress show at the Clocktower Gallery in New York, and Dewey-Hagborg suddenly found herself and Stranger Visions on the front page of the "Metro" section of the newspaper. From there it got crazy. "And that," she says, "is where it ended up stopping in a way."

The media whirlwind managed to freeze everything in time to what Dewey-Hagborg calls "a snapshot of a much more ambitious project," but the project took on a second life as media representation and public intervention.

She had to deal with the sudden fame. As Dewey-Hagborg continued to work on her Ph.D. project, her life was taken over by media requests and e-mails that ran the gamut from hate mail questioning the ethics of her art to people hoping to send her their DNA.

But much good came from the situation. Dewey-Hagborg traveled, held exhibitions, and, perhaps most importantly, talked with different audiences.

She mingled with techies at events like SXSW and TEDxVienna, with artists at museums and art schools and with policy makers in Washington, D.C. Through having these conversations, she was able to question her work in different contexts and from different points of view. Her work—including the examination of what she was able to do and what she was unable to do as a biohacker—called attention to this developing practice, giving the public, she says, "the opportunity to anticipate and speculate upon a direction before it becomes widespread."

This whirlwind, Dewey-Hagborg says, was unexpected and great. "The whole intent at the beginning was to bring the surveillance issue to light, to take something invisible and make it visible," she says. Stranger Visions accomplished that. She has diverse groups talking about the ethical, social, and moral implications of biotechnology, bringing to bear exactly what Ellen Jorgensen hoped for when creating Genspace.

—Katianne Williams

Sharing Brain Work with Girls

It's a good time to get into the biomedical fields

Olga Imas is an associate professor of biomedical engineering at the Milwaukee School of Engineering (MSOE) in the Electrical Engineering and Computer Science Department. She came to the United States at age 16 with her family from the former Soviet Union in the early 1990s. Due to family circumstances, they came at a time when many others did and settled in the city where they had family in Milwaukee, Wisconsin.

Olga Imas

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Her family was very technically oriented. "In my family, if it's not math, then it's science or medicine or engineering," Imas says. "I never questioned that one day I would enter a science-related field as well. So, when it was time to start college and choose a career, it was a natural decision to for me to go into engineering. I visited many nearby universities while I was in high school, and MSOE really stood out with its outstanding engineering programs."

[Teaching] was always something I enjoyed and never thought of as work but rather as a sharing of knowledge and experience.

Imas started at MSOE in computer engineering but switched to biomedical engineering within the first year because she found the field fascinating and impactful. She appreciated that the biomedical field offers many opportunities to work on the cutting-edge of medical science, developing state-of-the-art technology for diagnosis, monitoring, and treatment of diseases. She graduated in 1999 with her undergraduate degree and completed her Ph.D. degree in biomedical engineering and functional imaging at Marquette University and the Medical College of Wisconsin in 2004.

Making Professional Transitions

Her Ph.D. research centered on brain function, electrophysiology, and the science of anesthesiology. Through the application of advanced signal processing methodologies to electroencephalogram signals, she studied the mechanisms by which general anesthetics produce unconsciousness. Imas then completed a three-year postdoctoral fellowship at the Medical College of Wisconsin, continuing in the same research field. Her research culminated in more than 20 peer-reviewed abstract and full-length publications.

Upon completion of the postdoctoral fellowship, she joined the GE Healthcare Computed Tomography and Positron Emission Tomography department as a software product development specialist in the field of neurology. Imas says she left GE Healthcare because she had always enjoyed teaching over the years—during her post doc, teaching classes at Marquette part time, and while at GE Healthcare, as an adjunct professor at MSOE.

"Teaching was natural for me," Imas explains. "It was always something I enjoyed and never thought of as work but rather as a sharing of knowledge and experience. I thought that eventually I wanted to do it full time. And so when the opportunity to join MSOE presented itself, I took it. It was a great feeling coming back to MSOE as a professor and giving back to the university that had contributed so much to my successes. It was also a good decision for my family, giving me more time and flexibility to spend time with my two daughters and my husband."

She rejoined MSOE as a full-time faculty member in 2009 and has her own consulting company iBioTekk, assisting medical device startups in the development of advanced digital signal and image processing algorithms and data analysis of various biological signals.

Outreach with IEEE/WIE

Imas participates in many different outreach efforts, like spearheading the science, technology, engineering, and math (STEM) workshop for high school girls at the 2015 IEEE USA Annual Meeting, chairing the IEEE Women in Engineering (WIE) Section in Milwaukee since 2010 (except for 2011–2012), and being involved with many other MSOE/IEEE events. She invites IEEE Members to attend the presentations of MSOE senior design projects in a professional setting and holds poster competitions, career fairs, and career panels. She also serves on the organization committee that plans the annual Great Lakes Biomedical

Conference, which focuses on student professional and technical education.

Imas joined the IEEE as a Student Member and was involved in the Engineering in Medicine and Biology Society and other professional and honor societies. When she returned to MSOE as an associate professor, she rejoined IEEE again in 2010 and became a chair of a WIE Affinity Group in Milwaukee.

She is also a coleader of the GE Girls program, a week-long, tuition-free camp at MSOE and GE Healthcare for middle school girls who are interested in exploring STEM fields. The program is a collaborative effort between GE Healthcare, the GE Healthcare Women's Network, and MSOE.

Imas enjoys involving girls in her interest area. "Programs for girls are a great way to introduce girls to STEM disciplines, to let them discover what their natural talents are, to let them see that engineering and science are exciting and impactful, and that they can be just as successful in these fields as boys," she explains.

Imas says it's good to explore and compare different majors, but if someone is interested in biomedical engineering, definitely pursue it. Now, it's the fastest growing engineering field. "It's a great mix of technology and medicine, which is fascinating," she says. "There is a wide range of career opportunities in this field."

—Debbie Sniderman

Music To Her Ears

Schueller stays in tune with her skills

The expression "music to my ears" suggests that the benefit and enjoyment of music comes from listening to its sound. But for IEEE Senior Member Susan Schueller, the act of creating music has brought joy, particularly because it serves as a natural extension of her work in engineering. "Music obviously has a science behind it, in sound waves," she explains. "But playing music is also a great way to sharpen your skills. Learning how to read music is good for memory, and coordinating with your fellow musicians is a wonderful exercise in teamwork. Both of those relate very well to engineering, as does the fact that when playing music, you're multitasking."

Schueller, who plays flute, piccolo, and cello, is a software engineer in the Boston, Massachusetts, area, with a B.S. degree in computer science and an M.S. degree in information technology, both from the University of Massachusetts at Lowell. In between the two degrees, she has three decades of career experience across both start-ups and large firms, such as Hewlett-Packard and Raytheon. She also "multitasks" as a student and is currently pursuing a doctorate of science degree in cybersecurity from Capitol Technology University.

Schueller maintains her music as both a creative outlet and a way to connect with like-minded individuals.

"Enrolling in the doctorate program was motivated by all of the issues going on in cybersecurity right now," explains Schueller. "Having the background and career experience I have as a software engineer gives me the technical expertise to better understand cybersecurity risks and propose solutions."

Melding with Music

Schueller discovered her interest in math and science in middle school, which is also when she started playing music. Though she took flute lessons and played through high school, she set the instrument aside for 20 years once she became busy with college, marriage, and her career. "In 2001, I decided I was going to fit music back into my life again," says Schueller. "I bought a new flute, joined a community band, and have been involved with several community organizations ever since, as my music skills came back."

This turned out to be fortuitous a couple of years later when, having been laid off from one of her software jobs, Schueller learned of a job tuning and repairing pipe organs in Andover, Massachusetts. "That job was a wonderful blend of both my music and engineering interests," recalls Schueller. "Not only was I learning the music that pipe organs make, but I also used my problem-solving skills to do electrical wire and other small parts technical repairs." Since that time, she has also done some flute repair work, which she describes as a fun way to understand the mechanics of how flutes work to produce music.

Though she wound up going back to work full time, Schueller maintains her music as both a creative outlet and a way to connect with like-minded individuals. "There are a lot of engineers who are musicians and musicians who are engineers that I can relate to," she says. She is currently the principal flute in the Lexington Bicentennial Band and plays in other musical ensembles throughout the greater Boston area on various instruments. In 2005, Schueller enrolled in cello lessons because she had always been fascinated by string instruments. "The flute plays really high notes, and I wanted to learn something with low notes, and then I absolutely fell in love with cello, so I've stayed with it," she explains.

Music has also offered opportunities for Schueller to give back to the community, through volunteer efforts such as the Boston Symphony Orchestra's Instrument Playground, where children get to try different musical instruments in a hands-on environment. And in 2010, a shared music teacher provided Schueller with an introduction to a freshman in high school who was in need of an inspiring mentor. "This has meant a lot to me," shares Schueller. "We would meet up to practice and then perform together at concerts for all four years she was in high school. At her high school graduation, I was invited to sit in her seat and play her instrument for her while she walked across the stage."

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Schueller proudly reports that her mentee, who plans to major in music education at college, was also accepted into the school's wind symphony. "It's a fantastic feeling to think about how my mentoring has made a difference in someone else's life," she says. As an added bonus, Schueller has a photograph of both women in their graduation gowns, since she graduated with her master's degree in 2014 as well.

Reaching Out

While mentoring through music was a new role for Schueller in 2010, she has been doing outreach on behalf of science, technology, engineering, and math (STEM) organizations for over a decade. Back when she was working for iRobot, Schueller's manager recommended her for a role representing the company to the Society of Women Engineers. The position involved coordinating meetings and events and doing some outreach to college students. "I found that I really enjoyed giving talks and demonstrations on engineering and that led me to attend more conferences and seek out opportunities to do more of that work," says Schueller. This was around the time that the movement to develop STEM interest among young girls became stronger, and so Schueller was part of a community of women trying to do similar promotion.

"I think it's really important to be a role model for the next generation," she continues, adding that she is considering teaching once her doctorate degree is completed. "Having been in the field for so many years, it's important to pass that torch. Sometimes there are girls who are interested in engineering and it might seem a bit intimidating to them, but maybe seeing other women get the word out that engineering is exciting shows them that they have support out there and encourages them to keep pursuing that passion."

More than the destination, it has really been the joy of the pursuit that has driven Schueller thus far, whether that be through the expansion of her engineering and technical career, a reinvigoration of her love of music, or the search for opportunities to connect and give back. Crediting her husband, Richard, with inspiring her, Schueller explains that he was a physicist who loved astronomy and was active in STEM outreach as well. "He was constantly making connections and creating opportunities and many of those have benefitted me," she says. Though he passed away in June, she says she's working to further his legacy and continue the good work he did throughout a decades-long career.

What she learned from him, and from her own experiences, is that there's no need to be restricted to any one type of learning. "I've worked in several different areas: government and military, health care, commercial, robotics, and others," she says, advising others to consider all possibilities. "Don't feel restricted by what someone says you might be good at, but go for what you are interested in. Connect with others, find a good mentor, and seek advice from someone who's been there for encouragement and ideas."

To remind herself of that mantra, Schueller wears a bracelet inscribed with the saying, "ancora imparo." The quote, which translates to "I am still learning," is attributed to Michelangelo when he was creating art well into his 80s. It's a lyrical phrase for an engineer who has become an integral part of Boston's music community. And that may just be the start. Says Schueller, "I look at the bracelet and think of how life is full of so many wonderful learning opportunities and that they would be great to explore through engineering."

—Leslie Prives

BY KATIANNE WILLIAMS

A Career Fit for a "Queen"

DRESSELHAUS SERVES AS A MENTOR TO MANY

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Previous Page | Contents | Zoom in | Zoom out | Front Cover | Search Issue | Next Page

Millie Dresselhaus may be known as the "Queen of Carbon," but she's quite modest about the title. When she hears the moniker, she chuckles. "I got that name quite a number of years ago in Sweden," she recalls. "A man from India, who had been making his whole career in Sweden, this country with royalty, gave me this name when introducing me at a seminar at his university, and the press went with it."

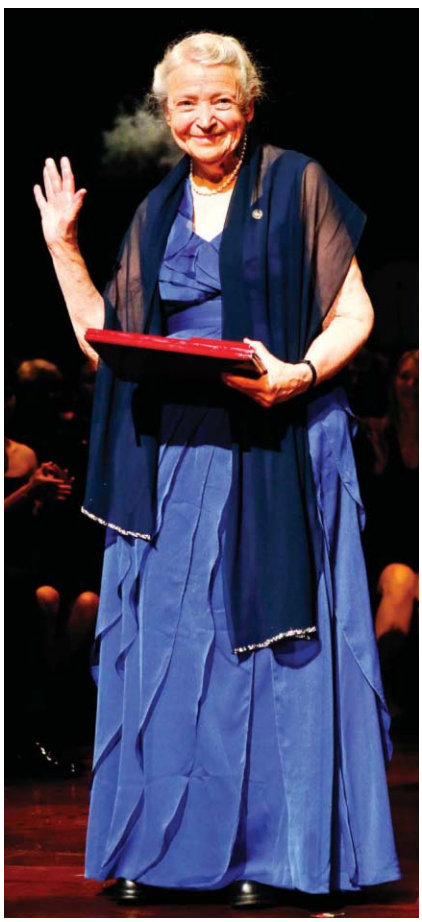
For a while, the name went away, but now, with the 85-year-old's decades of quiet achievement being so widely recognized, the name has returned—"resuscitated," as she says. Over the last five years, Dresselhaus has been awarded the Presidential Medal of Freedom, the Kavli Prize in Nanoscience, and the Enrico Fermi Award from the U.S. Department of Energy. Most recently, she became the first woman to receive the IEEE Medal of Honor since its inception a century ago.

All of this has been quite the journey. Dresselhaus grew up in the Bronx, New York, as the child of impoverished Polish immigrants who hoped she would be a schoolteacher. After college, she forged a path for herself at a time when it was difficult to get faculty to take women seriously. Later, she was a working mother who raised four children with her husband, Gene Dresselhaus. Through it all, Dresselhaus had a penchant for seeking out—even making—opportunities, including learning everything she could from the key mentors in her life.

Today, Dresselhaus who started teaching in both the electrical engineering and physics departments at the Massachusetts Institute of Technology (MIT) in the 1960s, is a mentor to many. She provides opportunities to the many women who have followed her into science, technology, engineering, and math, including her own daughter and granddaughters. Looking back on her own childhood, she knows that money, not interest, was almost the deciding factor in her career, and she does not want this to happen to others.

Not only does Dresselhaus pay college tuition for her grandchildren so that they may follow their interests, but she has a broader way of investing in the future as well. From her own experience, she knows that fellowship money and support can have a big impact in fields that don't have many women, so when Dresselhaus won the Kavli Prize, she gave the million-dollar purse back to MIT. She established the Mildred S. Dresselhaus Fund, a way to help young faculty, particularly women, start their careers.

"We have to see how that works out," she says about the fund. "I am hoping it will enable things to happen that wouldn't happen otherwise."



Dresselhaus used the full award from the Kavli Prize in Nanoscience to establish the Mildred S. Dresselhaus Fund at MIT.

Humble Beginnings

Dresselhaus was born in 1930. Her parents were Polish immigrants, and the family lived in the Bronx. The early schools were awful academically, with many teachers spending much of their time disciplining children as opposed to teaching.

"At age 75, I said I was going to retire," Dresselhaus says. "But it's ten years later, and I haven't done that yet."

Dresselhaus's older brother was a musical prodigy, earning himself a scholarship to the Greenwich Village Music School. A few years later, a young Dresselhaus, just four or five years old, also received a violin scholarship, although she downplays it with her characteristic modesty. "I just went along for the ride, and the teachers thought I might be gifted too," she says.

Dresselhaus was gifted enough, and today she still loves the violin. But what also happened was that Dresselhaus's brother swung open a door for her that went way beyond music. The parents at the music school knew about many educational opportunities beyond the Bronx, and one of these was Hunter High School.

At the time, Hunter High School was an all-girls school. "An exceptional place, highly motivating," Dresselhaus calls it. Hunter High School and Hunter College stood together on a single city block, their shared focus was to prepare young women to become school teachers. "Gifted students from the college came walking ten feet, and they were in the high school," Dresselhaus says. "Effortless. I thought, well, that's what I'm going to do."

It's not that her family discouraged her, she says, but they just didn't know anything about science. What they understood was teaching, which they believed was a respected career that would provide Dresselhaus with security and opportunity.

Nobel Prize-Winning Mentors

It didn't take long before teachers were telling Dresselhaus that she was in the wrong field. "I could teach science, of course, if I wanted to, but they thought I should spend more of my time finding what science I was good at."

One of these teachers was a young scientist named Rosalyn Yalow. Yalow had graduated from Hunter College magna cum laude with a B.A. degree in physics and chemistry, and she earned her Ph.D. degree in nuclear physics at the University of Illinois. She very much wanted a nuclear-physics-based research position, but no university would take a chance on a young Jewish woman. She took the job at Hunter.

This was the early 1940s, the middle of World War II. The Manhattan Project was underway. Around this time, under the football stands at Stagg Field out at the University of Chicago, Enrico Fermi and his team of scientists were working on creating the first controlled nuclear chain reaction, Chicago Pile-1.

Yalow would only teach at Hunter for one semester before moving on to a physicist job at the Bronx Veterans Hospital, which Dresselhaus calls "about the lowest level job that you might think of." But it was there that Yalow discovered something very important. "She was a physics person trying to work with biology, not like today, where we have the field of biophysics," Dresselhaus explains. Working with Dr. Solomon A. Berson they discovered the radioimmunoassay (RIA), a precise way to measure insulin and hormones in the blood. This discovery would break open the field of medical physics and usher in a new era in endocrinology.

Dresselhaus's mentor would become the second woman to win the Nobel Prize in Medicine. "Nevertheless, when I gave the most minor talk, when she knew I was doing anything whatsoever, Rosalyn would show up," Dresselhaus says.

From her own experience, she knows that fellowship money and support can have a big impact in fields that don't have many women, so when Dresselhaus won the Kavli Prize, she gave the million-dollar purse back to MIT.

With Yalow's encouragement, Dresselhaus went on to earn her master's degree from Radcliffe, but her time there was not particularly productive or even comfortable, and she eagerly headed off to the University of Chicago for a Ph.D. program. It was the mid-1950s, and Enrico Fermi was still there. At the University

of Chicago, Dresselhaus got to know him very well, taking his classes and often walking to campus with him in the early morning hours during what would be the last year of Fermi's life.

"He was a person who could work in every field of physics at the very cutting edge," she recalls. "That gave me the idea that I'd better try to do something like that too. As a graduate student, I spent a lot of time in the chemistry department, here and there, trying to learn a lot of things." Prof. Clyde Hutchison was very helpful during that time.

Dresselhaus embraced Fermi's way of questioning and teaching. In Fermi's lecture hall, you did not take notes; you listened. He would provide the notes beforehand and wanted students to focus so that they could make connections. He encouraged questions and interests in all fields. He wanted students to follow the trail of "what-ifs," the surprising thoughts that might pop into one's head as he or she absorbed the lectures.

In 1955, Dresselhaus began working with superconductivity for her Ph.D. degree. Remarkably, when she needed the materials for her experiments, she raided the war surplus supplies left over from Chicago Pile, still under the university's football stands, and repurposed the materials, creating microwave equipment and superconducting wire.

While in Chicago, she met a fellow physicist named Gene Dresselhaus. They married in 1958 and moved to Ithaca, New York, where Gene had an entry-level faculty position and Dresselhaus used her National Science Foundation (NSF) postdoctoral grant at Cornell. These years would prove to be scientifically disappointing. Her postdoc, in her words, was nonproductive. "I wasn't sure that what I was doing was important. No one was interested in me at all. I had the NSF postdoc, so it's not that I wasn't supported financially. I was kind of a freebie but nobody wanted me. It's kind of surprising," she says after a pause, all of these years later still somewhat mystified that her gender alone could ever have been so problematic.

At the University of Chicago, Dresselhaus got to know him very well, taking his classes and often walking to campus with him in the early morning hours during what would be the last year of Fermi's life.

Ultimately, professional benefit came from her time in Ithaca. "At the end, Gene and I were both offered research positions at the MIT Lincoln Laboratory, and I was told I could work on anything except [the things] I knew something about," she says. "That turned out to be the best advice I could have received. It's good to change your field totally a few times in your career because it enriches what you do. If you learn a number of things, it is much better than knowing one thing."

During this time, there was exciting news: Dresselhaus was expecting a child. She and Gene welcomed their daughter Marianne in 1959. As a child, Marianne was "technically gifted," and "the real engineer, always fixing things," according to Dresselhaus. Soon, the young family would head east to Cambridge, Massachusetts, where Gene and Dresselhaus began their jobs at MIT's Lincoln Labs. Here, Dresselhaus's work with carbon would begin.

Queen of Carbon

In 2014, U.S. President Barack Obama welcomed Dresselhaus back to the White House, where she had become quite the regular. She had been a previous guest after receiving the 2012 Kavli Prize in Nanoscience and again when she received the 2012 Enrico Fermi Award. She had also been a guest of U.S President George H.W. Bush when she received the National Medal of Science in 1990.

This time, President Obama awarded Dresselhaus with the nation's highest honor, the Presidential Medal of Freedom, and he spoke with the audience about her impact: "Her influence is all around

Dresselhaus has paved the way for future generations of women in STEM, including those in her own family.

us—in the cars we drive, the energy we generate, the electronic devices that power our lives." All because of her work with carbon.

Through different crystal structures, carbon makes up both the hardest and the softest natural materials known—diamond and graphite. Carbon atoms link nicely to each other, forming strong chains called polymers, and carbon easily bonds with other atoms, forming lattices. Millions of carbon compounds have been discovered.

And still, decades ago, hardly anyone was interested in carbon except for Dresselhaus. Everyone else was studying semiconductors, but Dresselhaus saw promise in the small effective masses of carbon materials and carbon's widely spaced energy levels for electrons.

Everyone else was studying semiconductors, but Dresselhaus saw promise in the small effective masses of carbon materials and carbon's widely spaced energy levels for electrons.

While in Cambridge, she would give birth to three more children, all boys, and it turned out that this research niche she had carved out, almost free of competition and demand, suited motherhood very well. Dresselhaus continued to be the same scrappy, pragmatic scientist who had at one time built her own equipment from a heap of war surplus supplies. She knew that the MIT Magnet Lab had the facilities to generate fields to knock electrons up or down a level with a small amount of energy, the perfect stage for experiments in studying the electronic structure of semimetals. She was especially interested in graphite.

Graphite is built in flaky layers, and, while the layers easily break apart, the graphite within each layer is very strong. Dresselhaus studied the properties of graphite by inserting other molecules between the layers, essentially separating the layers by a small gap in distance and by a small energy gap that provided much information about electronic and optical properties that could be probed by varying the magnetic field.

Dresselhaus sits among the books and papers in her office at MIT.

New-Age Nanotech

It's generally accepted that the idea of nanotechnology began back in 1959 with the talk given by physicist Richard Feynman, "There's Plenty of Room at the Bottom," although the term *nanotechnology* would not be coined for another decade, and practice wouldn't really catch up with theory until the 1980s when two inventors at IBM Zurich would invent the first scanning tunneling microscope that could "see" individual atoms. This new age of nanotechnology has brought about the ability to make strong and lightweight materials with applications across chemistry, biology, physics, engineering, and materials science.

Still, Dresselhaus has worked with nanotechnology for decades. Back in the 1960s and 1970s, "People were thinking about how to do nano, they just didn't have the technology," she says. "The ideas, the environment, wasn't really there. I'm not the only person who was working on nano. Some of us discovered each other many years later." Her early work with graphite laid the groundwork for this new era of carbon nanotechnology, particularly with graphene and carbon nanotubes, and she has spent the last decades leading the way in researching these very rich research areas.

Carbon nanotubes are more or less like they sound—hollow tubes made out of carbon with a diameter in the nanometers. They are in the fullerene family, like the buckyball, and are incredibly strong, good conductors, and can be either single- or multiwalled. Graphene is a sheet of graphite that has a thickness of a single atom. It is strong within this plane, perhaps the strongest material in the world, yet it is flexible, ultralight, and conducts electricity better than copper. We don't know exactly where graphene and carbon nanotubes will lead us, but unbreakable touchscreens, water filters that make salt water drinkable, nanoscale drug delivery, and radioactive contaminant removal are a few of the many new technologies.

A Bright Future

Dresselhaus has been an inspiration to generations of young scientists, and she does not want to give this up. She still goes to MIT every day. "At age 75, I said I was going to retire," Dresselhaus says. "But it's ten years later and I haven't done that yet." She did reach a compromise with the university. She no longer accepts anything more than a token salary for her work since, to her, work is a vacation.

Over the years, MIT has been a family affair. Along with working with her husband, two of Dresselhaus's children attended MIT, including her only daughter Marianne, who had shown such aptitude for mechanics as a child. Today, Marianne's daughter Leora is a Ph.D. candidate at MIT.

Marianne double-majored in nuclear engineering and mechanical engineering ("Not to be like her mother," Dresselhaus says). It was the 1970s, and she was interested in the growing field of nuclear engineering. She may have liked to have had a little distance from her parents, but MIT offered exactly what she was looking for, and so Marianne went to MIT. She met her husband there, a fellow MIT student and a computer science major. They shared knowledge, and Marianne became very effective with computers. They moved to California shortly after. Marianne occasionally travels with Dresselhaus, which her mother enjoys very much.

It's Wednesday, which means that granddaughter Leora stopped by Dresselhaus's office for lunch. Her research focus is terahertz spectroscopy, specifically the vibrational properties of solids ("studying explosives," as Dresselhaus tells it). Leora measures the effects of shock waves in materials with ultrafast optical techniques. "She's starting into a new research area," Dresselhaus explains. "She has the courage to pioneer something new. I'm not surprised that she's doing her own thing."

Lunch is nothing fancy—no trips to the heart of Kendall Square. "We just quietly come to my office for a sandwich, and we talk about what we're doing and whatever we're thinking about," Dresselhaus says. "This has been going on for some years now."

The relationship has meant a lot to Dresselhaus, whose granddaughter spent her childhood on the opposite coast. "She grew up in California. I saw her when I visited, but how often can I visit? It's been nice having her close by, and she's been a big help to me. Family things come up, and I discuss many things with her. It's really nice to have somebody young and active and doing things."

Dresselhaus no longer accepts anything more than a token salary for her work since work, to her, is a vacation.

For Leora, the Ph.D. landscape is much different. According to the National Center for Science and Engineering Statistics, in 1958, fewer than 3% of doctoral degrees in the physical sciences and fewer than 1% in engineering were awarded to women. By 2006, those numbers had risen to 29% and 20%, respectively.

Leora is not the only granddaughter in the sciences. Granddaughter Elizabeth is an undergraduate at the University of Pennsylvania (UPenn), and her wide swath of scientific interests seems to mimic her grandmother's. "When she started, she didn't know what major," Dresselhaus says. "She thought chemistry, then electrical engineering, then physics." Today, she has settled on a double major. Elizabeth was named a Vagelos Fellow at UPenn, where, in the same spirit as her grandmother, she has given much of her fellowship money away.

Not everyone in the family is a techie. Leora's sister is the literary one, inheriting Dresselhaus's traits of questioning, imagining, and asking "what if" in a totally different direction—fiction. She runs a hotel on the border of California and Nevada, which Dresselhaus says provides her with much material for her stories.

Leaving a Legacy

In 2013, the inaugural recipient of the Mildred S. Dresselhaus Fund was scientist Polina Anikeeva. "I think of Millie as one of my greatest role models," Anikeeva explains. "As a part of my Ph.D. thesis committee, she has not only helped shape my dissertation but also read every page—and fixed grammatical mistakes. Her dedication to science and mentoring is unparalleled."

When Anikeeva received the award, she thought that Dresselhaus knew, but Dresselhaus who hadn't wanted to bias the selection committee's decision, was as surprised as the award's recipient. "I remember walking into her office for a joint picture, and she looked over and smiled, saying, 'Oh, it's you—that makes sense'," Anikeeva recalls.

Anikeeva's research lies at the interface of materials science and neuroscience, and she is working with her students to develop optoelectronic and magnetic materials and devices. These materials and devices monitor and modulate neural activity and development in the brain, spinal cord, and peripheral nervous system.

"The award allowed me to take scientific risks and work on ideas that are a little more obscure and challenging, and hence difficult to fund through traditional routes," Anikeeva says, showing that the fellowship is working as Dresselhaus envisioned.

—Katianne Williams is a freelance writer specializing in the technology field.

Previous Page | Contents | Zoom in | Zoom out | Front Cover | Search Issue | Next Page

Career Advisor

Career Transitions

Don't underestimate the power of preparation

Maybe you're fresh out of college, or maybe you've been home raising a family for two (or ten) years. It's possible that you were let go after a merger or you've decided you would like more impactful work. Whatever the reason, here you are beginning a job search—that formidable maze of networking and interviewing.

If so, regardless of your spot on the career ladder, you will want to hear what Joan Lampert has to say. Lampert has helped people navigate all manners of transitions. In fact, she calls herself her own first client. After a career that spanned Hay McBer, Ernst & Young, and Wm. M. Mercer, Lampert took her psychology and M.B.A. degrees and struck out on her own to figure out what she really wanted to do with her life, which turned out to be helping other people figure out what to do with theirs. That was eight years ago. Today, Lampert's company, Joan Lampert Career Transitions, helps people find meaningful careers at companies that best suit them.

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Lampert has a warm sense of humor and a friendly and approachable demeanor. She's like an old friend, a great comfort to someone embarking on a job search that will never be all roses. In fact, there is little like a job search for its ability to make one turn a critical eye on one's self during the same time at which one must appear most confident.

Joan Lampert

What can you do? Like a Boy Scout, be prepared, Lampert says. Don't underestimate the value in researching, rehearsing, and organizing. And for when things start to go awry—say your memory fails you and your mind goes blank—being prepared means you will have also a back-up plan, a soft mat on which to land.

Lampert's advice does not start regarding networking or the interview but with the elevator statement—that small but powerful package that will become your go-to in all types of situations.

The Elevator Statement

Lampert's advice does not start regarding networking or the interview but with the *elevator statement*—that small but powerful package that will become your go-to in all types of situations. Entrepreneurs pitching products to investors have elevator statements, and, likewise, the elevator statement is your chance to sell yourself. It is the opener, the ice breaker. It involves making a flawless, information-packed introduction to that person who could be the gateway to your new job.

Spend time crafting this statement and commit it to memory so that it is on the tip of your tongue whenever you need it. Whether you are at a conference, a party, a meeting, lunch, or an interview, you will never again have to flounder when you hear the words, "So tell me about yourself."

"When asked that, I might be tempted to start by saying I grew up in Brooklyn," Lampert says with a laugh, "but that's not very helpful in an interview."

If not your life story, then what exactly does belong in your elevator statement? According to Lampert, the elevator statement is a rehearsed summary of who you are and—more importantly—what you can do for the company. This sounds easy enough, but she puts so much emphasis on the pitch because many people botch it so badly. "You should speak in terms of what you're adding to the firm, not the other way around," she says. For an engineer, this might mean emphasizing your strengths in teamwork, collaboration, and project management.

"Let me give you an example." Lampert explains, putting on her candidate voice. "Hi. I'm Joan Lampert, an electrical engineer who project-manages teams developing systems and products for appliances. My colleagues say I am unique because I focus intently on key details while keeping the big picture in mind. I am also known for keeping the

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team productive and staffed by people who know how to collaborate."

Practice makes perfect. "Test it on friends and family so that when you are out in the world you have something to say that makes you identifiable and memorable," Joan advises.

The Truth About Networking

If the idea of networking fills you with dread, you are not alone. People often seem to think that they are not good at it, as if there was a class that we all missed. Networking is nothing more than carrying on a conversation and, contrary to what many believe, it does not require as much unabashed self-aggrandizing as you would think. In fact, Lampert advises, "Don't talk all about yourself. I won't like you after hearing about you, you, you, and I won't want to help you."

It's not always easy to carry on a conversation with someone you just met; it can feel stilted. The key, Lampert says, is becoming proficient at asking other people about themselves. This means having a library of questions from which to draw upon—and practicing enough to be comfortable asking them.

A good starting point is, "What do you do?" Beyond that, Lampert suggests a few follow-ups. How long have you been there? What's the company like? I'm thinking of working in that field—do you have any advice for me? I'd like to find out more about that—do you know someone I could talk to?

"Carry on a reciprocal conversation that allows you to determine if the person is a good link for you and if they might know other people who will be helpful in your job search," she adds. "Just never let one of your questions be 'Do you know of any jobs?' It won't work. The truth is the person probably doesn't know you well enough to be ready to recommend you to anybody."

You may believe that networking is an ability you are either born with or not, that it is the domain of extroverted, salesperson-type personalities. That can make the idea of working on it seem fruitless, but it's not. While some are naturally gifted at the art of small talk, we can all improve with practice.

And you must practice. Networking is worth it. It is the best way to find a job, especially as you move up to more senior positions in your career. Lampert puts it this way: "The entire world is on the Internet. If you see something that looks good, there are a thousand other people applying for that same position." She also shares this surprising bit of information: the connection that will land you a job is usually not a first-degree connection but someone you met through someone else.

"It's very helpful if you can tell anecdotes about what you did so that it comes alive.

Networking isn't just small talk. One of the most important networking steps takes place after you meet someone. The sometimes-forgotten step is that you need to keep the dialog going. "This keeps you at the front of their line, and they know they're in the front of your mind, which is very flattering," Lampert explains. "Say that you see an article referencing something you talked about—then send it along."

To stay organized, Lampert recommends tracking the information on a spreadsheet. Her own spreadsheet has columns for recording with whom she talked, when, their contact information, what they talked about, how they were introduced, and further actions, such as "call in the Spring" or "Send book."

Finally, networking today isn't all face-to-face conversations. There are many engineering-specific social networking sites that will allow you to build connections from the comfort of your own couch. Lampert points to an ArenaSolutions.com blog post that lists some of these options—you can post questions on Quora, share videos and blogs on The Engineering Exchange, and share or find information on Engineers Looking for Stuff. Of course, the biggest professional networking site remains LinkedIn.

Acing the Interview

The excitement over successful networking may quickly be supplanted by a fear of what comes next. Interviews today aim to probe your inner psyche to predict how you might act in certain situations. The questions posed in this sort of situational interviewing, often called *behavioral event interviewing*, often start with "Tell me about a time..."—as in, "Tell me about a time you argued with your manager and how you settled it" or "Tell me about the hardest problem you ever solved and how you went about solving it."

As you prepare, a quick online search will provide you with more sample questions than you could possibly need. Many of these questions are variations on the same themes. In engineering, demonstrating success in project work and collaboration will be particularly important.

Lampert recommends framing your answers as stories. "It's very helpful if you can tell anecdotes about what you did so that it comes alive. 'I wrote the biggest essay ever on carbon technology' becomes 'I worked with a super scientist. He didn't write well, but I did, and so I got to translate what he said into a paper that we published together.'"

"People are anxious in interviews—that is to be expected," she continues. "Feel free to ask, 'Am I answering your question?' and, if you find yourself going blank, buy yourself a little time by having a transition statement in your back pocket such as, 'Excuse me, I was just thinking about an answer. Let me get back to what we were talking about.'"

Interviewing can throw some other curveballs. If finding yourself on camera gives you hives, then prep for a video conference by hopping online and practicing with a friend until the terror is gone. Practice looking at the screen and providing clear, crisp answers. On the day of the real deal, dress up as if you were going to an office. Take no shortcuts. "You don't want anyone to see you in your pajama bottoms in case you forget and start to

walk around the room," Lampert says with a laugh.

Finally, make researching your interviewers and the company an important part of your prep work. Look up your interviewers, and don't be afraid to connect with them by saying something like, "I see we went to the same school." Learn about the company so that you can ask relevant questions as the interview draws to a close. Joan recommends a few general questions for your arsenal.

- What's your biggest challenge as an organization?
- Where do you see the company going in five years?
- What characterizes a successful engineer here?
- How will I know I am successful after a year?
- How do you measure performance?

Of course, there are topics of which to steer clear, such as salary and work hours. The main rule of thumb is to avoid asking anything that smacks of "What's in it for me?"

Make researching your interviewers and the company an important part of your prep work.

Trust Yourself

Lampert is in the business of helping people find jobs that they love. While you may just be happy to have been offered a job, you still need to evaluate the company. Otherwise, not too far down the road, you may find yourself looking again.

Before accepting any offer, spend time reflecting on your experience. Did you like the people you talked to and are you excited about working with them? Is the culture a good fit? Can you support the company's vision or product?

Lampert suggests asking yourself where you have been happiest in the past, whether it was in college or at a particular job. "What are the environments and kinds of people that make you comfortable?" she says. "That's what you go for."

—Katianne Willliams

The First-Ever All-Girls Robotics Competition

Organizer says, "Come and play"

With the goal of seeing robotics teams comprising 50% of women by 2020, the Robotics Education and Competition Foundation hosted the first-ever all-girls Robotics Championship in Southern California in March 2015. Nancy McIntyre organized and created this showcase event, and she works tirelessly to encourage more participation by girls on VEX Robotics teams around the world.

Foundation Supports Robotics for All

The Robotics Education and Competition Foundation hosts more than 12,000 robotics teams in over 30 countries at the elementary, middle, high school, and college levels. They provide free curricula, available online mapped to national standards, and certification exams for students who demonstrate proficiency in pre-engineering and robotics.

McIntyre's role involves training teachers and offering certification programs, as well as working with students and providing scholarships for both boys and girls, all over the world. She helps support more than 1,000 teams in California at 100 robotics events in 15 leagues and works with her counterparts in other states to roll out similar programs.

The foundation hosts coed robotics education for kids of many ages—the VEX IQ Challenge for elementary school and lower middle school and the VEX Robotics Competition for upper middle school and high school. Every year there's a robotics competition along with state and world championships, where teams meet and play against one another following that year's rules. For 2016, the VEX Robotics Competition game is "Nothing But Net," where 2-on-2 robots must work together to score a softball-sized ball into a goal located high above the playing field. In 2015, there were 850 teams at the world championship, where the next year's game is revealed. There were some all-girls teams there, but it's designed for everyone around the world.

"We invite the girls to come play. This way, they don't know they're learning," McIntyre explains. "If we've done our job well, we're sneaking the learning in. When it looks like work, we scare people away. We want students to have as much fun as possible doing this."

Having been in charge of award-winning student robotics teams herself for more than a dozen of her 23 years teaching, McIntyre wanted her students to be engaged with the math and computer-aided design (CAD) because they thought it was fun and would make them a better team. "They didn't realize it would make them better people," McIntyre adds.

Girls compete at the 2015 VEX Robotics World Championship in Louisville, Kentucky.

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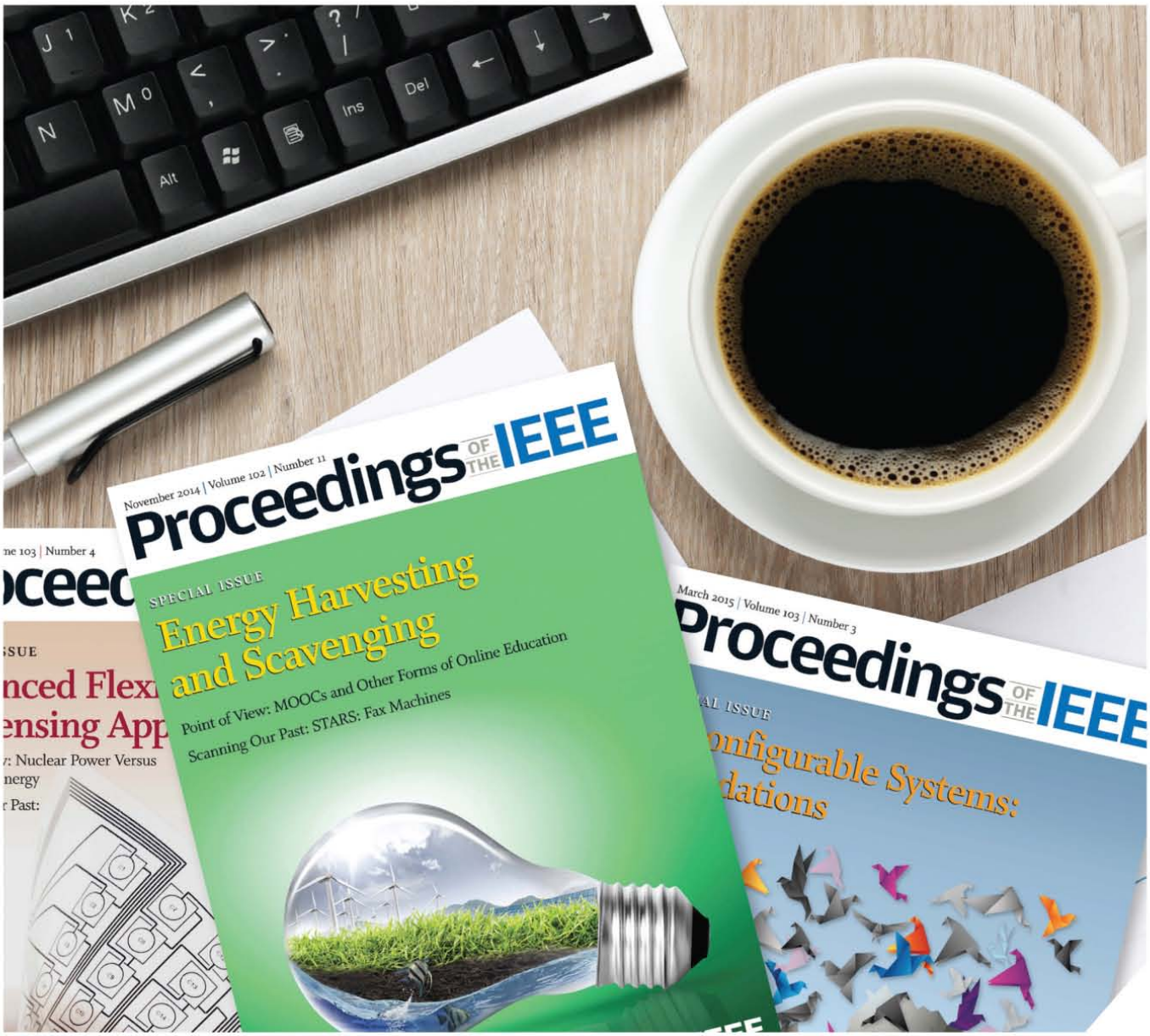

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The girls on the 24 teams and female engineer and teacher volunteers at the 2015 VEX Robotics All-Girls Showcase.

Today, more students are prepared to work in robotics industries, including drones that can be preprogrammed to fly missions to particular areas. But McIntyre says there are applications for robots that may draw more girls, who go about solving problems differently from boys. They may be more interested in robots that assist people, like in the health-care industry—like the da Vinci surgical robot or exoskeleton robotic devices that help people walk or stand up from a wheelchair and allow for movement—than the drones and other robots that serve the context of military combat.

"We don't train enough engineers, whether girls or boys, to be able to do everything they need to do. It's great that girls want to go into these fields. There are industry needs, lots of scholarships, and a plethora of jobs when they are ready," McIntyre says.

The First Time

In the summer of 2014, McIntyre found a donor and local sponsors to start all-girls teams and the first-ever all-girls VEX Robotics Workshop as a showcase event in California. They played the previous season's challenge, Skyrise, and no boys were allowed so that the girls could see that they could do everything the boys could accomplish. McIntyre says securing grant money and starting teams for the event was a way for more girls to become involved in how the foundation operates.

The funding for the all-girls event specified that they had to be sure that boys weren't building the robots, so McIntyre targeted all-girls schools and Girl Scout troops and welcomed other all-girls teams from coed schools that found their own funding to join in the events.

McIntyre ran a series of stories on the foundation's Facebook page for girls who were already involved in the program. She worked with women engineers in the community to develop mentoring opportunities for teams that needed assistance, and she ran follow-up workshop sessions on programming and their online challenges.

McIntyre says there are applications for robots that may draw more girls, who go about solving problems differently from boys.

The event was staffed by all-women volunteers—engineers, scientists, teachers, and college engineering students were referees, judges, and scorekeepers, and the girls were able to spend time with them hearing how they got started and their stories during lunch and a planned ice cream social. They also were able to talk about what they thought of the competitions and where their interest in the program could take them through college and beyond.

Continuing the Momentum

"As more girls get involved with the hands-on jobs and give more input to the strategy, CAD, math computations, and doing the programming, interest grows," McIntyre explains. "Some of those coed schools are now sending all-girl teams in addition to their regular teams too."

It was such a big success that McIntyre was asked to repeat and expand the Southern California project for the following school year. In 2015, there were 100 girls who made up 24 teams. In April 2016, there were 36 teams. McIntyre will have help from a national

Upcoming WIE Events

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WIE Summit Pune
23-24 September 2016; Pune, India

WIE Detroit Summit
07 October 2016; Detroit, MI

WIE Atlanta Summit 3-4
November 2016; Atlanta, GA

Women in Computing Summit
November 2016; Kerala, India

WIE Summit USA East
1-2 December 2016; Boston, MA

WIE Conference on Electrical and Computer Engineering
December 2016; Bangladesh

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sponsor and other colleagues to run things, and she is working with her foundation counterparts to hold workshops in other states.

"We are trying to roll this out across the United States and anywhere else there is interest," she says. "One friend in England who works for a missile company has had a hard time getting girls into their apprenticeship program, which is the way engineers enter their system. They found a woman engineer at the company who was interested, created a team, and brought the team to come play. It was so great that they are doing it again."

"Mentoring girls and young women does make a difference when they see someone who looks like them."

Another of McIntyre's colleagues, who is a retired professor in South Korea, will send two all-girls teams to play in 2016 in the memory of his mother who was the first western-trained female doctor in Korea. Other countries want to participate including one all-girls team from Puerto Rico that has played in the VEX competitions for years. They will also join in a trip to California if they don't qualify for the World Championships this season. Even though this showcase is not a state, national, or world qualifying event, and there are no rewards other than ice cream and trophies, there has been plenty of interest in showing up and having an amazing time, McIntyre says.

For anyone who is interested in shaping the next generation of engineers, McIntyre recommends volunteering. "Mentoring girls and young women does make a difference when they see someone who looks like them," she says. "Take on a team or come for one day. Be a judge, a referee—any way you participate, the girls will have a high level of respect, which can really help during a rough week. The girls really want to follow and walk in your footsteps. There are so many women who have struggled for a long time—seeing that their path may be easier because of where you have been is really worthwhile!"

—Debbie Sniderman

IEEE and HKN—Perfect Together

A closer look at the Honor Society of IEEE

IEEE-Eta Kappa Nu (IEEE-HKN) is the honor society of IEEE. Eta Kappa Nu (HKN) was founded in 1904 on the campus of the University of Illinois, Urbana-Champaign. The vision of the founders was to create an organization to both recognize the scholastic success of students and to help electrical engineering graduates find employment and support in their careers. The guiding principles remain the same—the invitation to join HKN is an early recognition of success based on the scholarship, attitude, and character of its members.

IEEE and HKN officially merged in 2010, and we celebrate five years as IEEE-HKN. IEEE and HKN have a long history of cooperation—sponsor joint programs, shared memberships, and a commitment to advancing the engineering profession and offering educational opportunities.

To be invited to join, students (both undergraduate and graduate) must meet strict academic criteria and make a commitment to work with their school chapter. School chapters are established under rigorous guidelines and approved and chartered by the IEEE-HKN Board of Governors. To learn about the criteria for students and chapters, visit www.hkn.org.

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Professionals may also join IEEE-HKN, either by invitation of an established active school chapter or by sponsorship from an IEEE-HKN member, subject to approval by the Board of Governors and based on the candidate's meritorious work in an area that falls within one of IEEE's fields of interest.

All students inducted into IEEE-HKN become IEEE Members. All professionals inducted must be or become IEEE Members; both pay a one-time fee to IEEE-HKN. The designation is lifetime. Once you are inducted into IEEE-HKN (or HKN), you are always HKN.

IEEE-HKN has established 236 chapters around the world; currently 182 chapters are active. Eight of these chapters are outside Regions 1–6 and are the result of volunteer efforts to expand IEEE-HKN worldwide—one of the goals of the merger. Early indicators show that students joining IEEE-HKN have a higher membership retention rate. The merger of IEEE and HKN has created increased recognition among students and professionals.

IEEE-HKN chapters and IEEE Student Branches have the opportunity to work together on almost all projects, based on the structure that works best at their university. IEEE Sections and Regions are encouraged to work with their local IEEE-HKN chapters to foster the relationships between all parts of IEEE.

IEEE-HKN has a pilot project in place to work with IEEE Technical Activities Board Societies and all technical groups. If your group is interested in connecting with IEEE-HKN, you are encouraged to contact IEEE-HKN Director Nancy Ostin at info@hkn.org.

IEEE-HKN also produces *THE BRIDGE* magazine. Digitally published three times a year (February, May, and October), it is e-mailed to lifetime subscribers and current Members. It is also available as open content on the IEEE-HKN website, www.hkn.org. *THE BRIDGE* has been the official publication of HKN since 1909. Each issue features a technical theme, chapter news, a Society spotlight, Member profiles, and much more.

Remember, if you were ever inducted into HKN, you are always HKN. Currently, IEEE-HKN has contact information for 32,000 people; it is estimated that there have been over 200,000 people inducted. If your IEEE membership card or record does not reflect your HKN status, please contact us to verify and add IEEE-HKN to your profile (a Member cannot self-service this option). You can submit our alumni reconnect form at http://fs25.formsite.com/ieeevcep/form14/index.html.

To learn more about IEEE-HKN, visit www.hkn.org. If you have any

questions, please contact me at n.ostin@ieee.org.

IEEE and HKN truly are perfect together!

—*Nancy Ostin*

Ms. Fix-It

Keser goes all MacGyver on the competition

"Lights, camera,…problem solve?" That could be a reality soon, thanks to the 2015 Next MacGyver competition, held to find a new television show that would excite young women about engineering. The contest did not just pull its name from the television show of 30 years ago—which centered on a spy who used engineering intellect to solve problems—but was inspired by fan reaction to its premise. The competition website quotes *MacGyver* creator Lee Zlotoff, who said, "I literally could not tell you how many times people have come up to me and said, 'I became an engineer, or I went into the sciences because of *MacGyver*'."

Hoping to galvanize that same spirit, Zlotoff, the MacGyver Foundation, the University of Southern California (USC) Viterbi School of Engineering, and the National Academy of Engineering (NAE) sponsored the Next MacGyver competition, inviting entrants to propose television show ideas that feature female protagonists who use engineering and science in some way. Of 2,000 applicants, 12 finalists were selected and five winners were chosen to receive a cash prize and a pairing with a mentor team, who would then help each winner develop his or her idea until it was ready to be pitched to television executives.

One of these winners is IEEE's own Dr. Beth Keser, whose concept, *Rule 702*, stars engineer-turned-expert witness MiMi as she provides consultation on legal cases with engineering problems. "MiMi earned dual Ph.D.s, is an aerospace and computer science engineer, and is an expert in drone technology," explains Keser. "She started her own company right out of graduate school and once it got to be successful, she sold it to focus on developing a new innovation. The law firm that negotiated the buy-out of her startup asked her to be an expert witness on a case, which kick-started a career in expert witness testimony."

While the case ideas in each episode will be ripped from the headlines, Keser's inspiration for the concept pulls from her personal and professional life. "With regard to the show's format, I love procedurals like *Law & Order*, *Elementary*, and *The Mentalist*," she says. "The idea originated from professors and engineers in my industry who tell me that being an expert witness is tremendously rewarding. I thought it would be great if a woman was so good at what she does that law firms ask her to give expert witness testimony. In each episode, MiMi gets a new case and while preparing for each case, she finds herself at the center of a technical or scientific mystery. She uses her engineering skills to recreate puzzling scenarios or test solutions in real time, but when danger unfolds, MiMi's deep curiosity is her potential downfall, as she doggedly chases the truth blind to the risk."

Another similarity to reality is that MiMi doesn't do this all by herself. Keser

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A scene from *Rule 702*, Keser's winning show concept. (Image by Luke Freeborn.)

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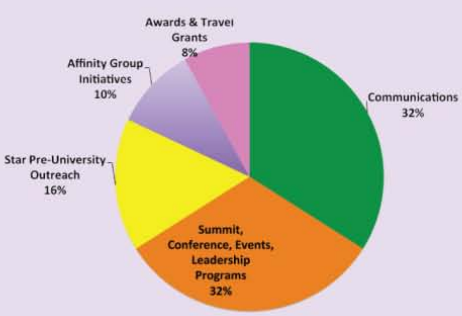

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Keser chairing the *"Own Your Professional Success—What You Should Do"* panel at 2015 ECTC.

says what she loves most about the show is MiMi's relationship with her friends, who are all female engineers. "MiMi calls on her network when she needs help with cases," describes Keser. "So we show unique paths one can take with an engineering degree, as well as women working together to solve problems. I wanted to demonstrate that female engineers could have camaraderie. That's what my experience was like in college and grad school, where all of my best friends were engineers."

The Hollywood Machine

Now engulfed in the world of television, Keser is experiencing a different type of teamwork. As one of five winners, she has been paired with Lori McCreary and Tracy Mercer of Revelations Entertainment, which is actor Morgan Freeman's production company and currently produces *Madam Secretary* on CBS. "I'm working now on a 10–15-page outline for the pilot script and have weekly meetings with the producers," shares Keser. "You would think they might be hard on you because they don't have a lot of time but instead, since they know I'm not a professional writer or someone who understands the Hollywood process, they explain everything. They have been so helpful, collaborative, and supportive."

That tone was set from the beginning of the competition, where Keser found even her fellow competitors to be friendly, not cutthroat. In July 2015, when the applicants had been narrowed down to the finalist stage, all 12 were put up in a Los Angeles hotel for three days for the pitch competition. During that time, they got to know each other, sharing experiences such as visiting a Hollywood-style green room and learning about the microphones they would wear during their pitches. Noting that show proposals ranged from science fiction to historical fiction to comedy, Keser says "there was an amazing cross section of ideas from both men and women." But her familiarity with the material was unmatched. "Most of the other finalists were writers, and some had engineering backgrounds, but there weren't any others currently practicing engineering," she adds.

Ultimately, when it came time for the actual presentations, Keser tuned out the competition to focus on her own pitch. "I wasn't paying attention to the other pitches and just tried to focus on practicing my own," she says. "My sister lives in L.A., so she was my cheerleader through the whole process. She would come back to me with feedback on the other competitors to help me out." And she had more cheerleaders watching from afar: Keser's husband and two daughters were on vacation in Connecticut during the competition but because it was live-streamed, her entire extended family was able to watch and offer support.

As for the process moving forward, it's up to the producer-mentors to help each of the five winners take their scripts to meetings where they might get a deal for a pilot. Then, Keser would have to decide what she wants to do about her career. "To stay on the show, I'd likely take the role of a producer-writer," she explains. "But that would be a big decision because I have a full-time engineering job. I love being an engineer. I love living in San Diego, working for Qualcomm, and collaborating with my team. Wouldn't it be cool just to say I was the creator of a TV show?"

Practical Magic

That may be the practical side of Keser showing, which is partly how she wound up with her career in engineering in the first place. "I lived in an engineering town and all of my friends' fathers were engineers," says Keser of growing up in Rochester, New York (home to Kodak and Xerox). "I was a good student, but loved math and science in particular, and wanted a practical application of those fields." She opted to pursue a materials science and engineering degree at Cornell University, where she had the opportunity to do both undergraduate research and a co-op program at Motorola in Phoenix, Arizona.

Learning that she loved research, Keser went on to pursue a Ph.D. degree in the same field at the University of Illinois at Urbana-Champaign. "Again, I like to stay really practical, so I worked for a professor originally from IBM and did research on electronic packaging," says Keser. Awarded grants from Motorola, Keser returned to Phoenix after graduation and worked as a packaging engineer and manager for 12 years, staying on through the spin-off of Motorola's

semiconductor group into Freescale Semiconductor.

In 2009, Keser took a new opportunity with Qualcomm in San Diego. As a principal engineer in the company's Package Engineering department, she manages a team of five working to qualify products and develop fan-in and fan-out wafer-level packaging. "I like the teamwork," she shares. "I've had jobs where you're only responsible for yourself, but I really love getting people together to make decisions and chart the course of the technologies we work on, or to review data and decide together what conclusions we can draw."

While working, Keser has continued to publish papers, which is what led her to an eventual senior-level membership in IEEE. Originally publishing work as part of the IEEE Electronic Components and Technology Conference (ECTC), the flagship conference for the Components, Packaging and Manufacturing Technology (CPMT) Society of the IEEE, she joined the committee that reviews abstracts and papers for the conference in 2001. In 2009, Keser joined the executive committee that plans the conference, and then in 2012, she ran for the IEEE CPMT Board of Governors, to which she was just reelected last year. In 2014, she added the title of IEEE Women in Engineering liaison and, for 2015, she served as general chair of the ECTC. "We had the most attendees, exhibitors, sponsors, and students in our professional development classes than ever before," she says of the excitement surrounding the past year's conference. "It was just the best thing ever."

Keser's contributions have also resulted in her selection as an IEEE Distinguished Lecturer, one of only three women among the 30 selected lecturers in the CPMT Society. She currently has a few events lined up, at which she'll speak about fan-out wafer-level packaging technology.

Staying Enthusiastic

Whether lecturing, teaching a professional development course, managing a team of engineers, or serving as a female engineering role model, Keser recognizes an opportunity to share her experience and enthusiasm for engineering. "It's really important to me to not only get women into engineering but to keep them there," she says. "I've been in industry for 17 years and there aren't really many women with my experience still in the field."

That is why the objective of the Next MacGyver competition resonated with her so strongly and she wanted to participate. "USC and the NAE want to use entertainment as a forum to educate people about women in engineering, both to get them there and keep them there," she says. "One of the best ways to influence people's opinions is through entertainment. If young girls saw more women in the movies or on TV doing engineering, it would become natural instead of it being exotic or unusual."

Two of the young girls Keser is watching closely are her daughters, currently in second and sixth grade. "I would love for them to get their engineering degrees," she shares. "They do have an affinity for it, and I would like to nurture that because if they study engineering, I know they will have analytical minds. If they decide to do something different career-wise, that would be their decision."

Like MiMi and her friends, Keser knows many people who have been successful with engineering degrees, even though they ultimately go on to other fields. Nurturing an interest may not be too difficult with a show-business mother around though. "I think they learned a lot about engineering just having listened to me practice my 5-minute pitch over and over this summer," she laughs.

—Leslie Prives

At the 2015 ECTC (from left): Alan Huffman, RTI International, vice general chair of ECTC; Sam Karikalan, Broadcom Corporation, assistant program chair of ECTC; Matt Grob, executive vice president and chief technology officer of Qualcomm; Beth Keser, Qualcomm Technologies and general chair of ECTC; and Henning Braunisch, Intel Corporation, program chair of ECTC.

For Whom the Bell Tolls

Inventing success through creativity and analytical skills

Deanne Bell may have had an early vision of her future while still a young girl participating in creative problem-solving competitions. "I loved to build and tinker," she recalls. "We would build these whimsical creative contraptions at my house after school." Today, as a host of CNBC's television show *Make Me a Millionaire Inventor* and founder and CEO of Future Engineers, she advises budding inventors and engineers on how to bring their own creations to life.

"I've always been passionate about combining my creative and analytical

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Bell filming in front of a green screen.

skills to think about problems in an innovative way," says Bell. As kids, she and her friends were resourceful inventors on a piggy-bank budget. She describes how they would go to stores and find broken-down items to take apart or to hardware stores and browse for things they might want to use in their inventions.

Though Bell recognized she wanted to be an inventor, it wasn't until junior high school that she made the connection between inventing and a degree in engineering. Fast forward a few decades and that same connection has helped Bell find success on television, since stints on a few shows have enabled her to use her engineering knowledge to educate and excite a wide viewing audience, as well as mentor a group of aspiring inventors as they bring their ideas to fruition.

"I've learned that television can be a very powerful medium for communicating the excitement of science and engineering to a broad audience," explains Bell. "After my first experience on a prime time show, I think one of the most shocking things for me was realizing how large and diverse the television viewership can be. I had to learn how to communicate science in a way that's engaging to an audience that can range from 5 years old to 105, or from your peer who has a technical background to someone who has no knowledge of the subject matter at all." But, she adds, with that opportunity, "just think about how many more people we can inspire through media, especially girls."

Deanne Bell

For Bell, the inspiration began at home. She was introduced to engineering by her father, an electrical engineer. "When I was very young and learning to read, I would sit down and try to sound out complicated words in his IEEE magazines," shares Bell. She went on to get a degree in mechanical engineering from Washington University in St. Louis, Missouri. After college, Bell worked for Raytheon as a mechanical design engineer. "I worked on many projects that were in early-stage development which I really enjoyed," she says. "It was exciting to work on unproven technologies and to engineer systems that hadn't been built before."

Joining the Squad

Bell ended up leaving Raytheon to travel solo around Asia for a year, which is where she was when she saw a job posting for the host of *Design Squad*. After applying, feedback on her resume and photo was positive, but she had only two days to get from the Philippines to Boston if she wanted to audition. "I had a glass of wine that night with a German pig farmer and he convinced me that I should go," explains Bell. "The next day I got on a plane and flew to Boston. After a month of auditions, I landed my first hosting job."

In 2006, she began her TV career as cohost of *Design Squad*, in a role that involved mentoring young "engineers-in-training" and presenting technical content on the show. While in Boston, Bell also maintained a job as a senior application engineer at a 3-D CAD software startup called SpaceClaim.

When a call came to cohost a show on the Discovery channel, Bell left Boston for Los Angeles and has used L.A. as home base for her adventures ever since. Beginning with *Smash Lab*, which focused on the "science of destruction" and crashes, smashes, and explosions, Bell next appeared on DIY Network's *Money Hunters*, as part of a team that renovated homes on a budget. From there, she was part of the expert panel featured on National Geographic's *The Egyptian Job,* which explored theories as to how a pyramid may have been looted. Then, Bell was a cohost on ESPN's *Rise Up,* in which a team renovated high school athletic facilities.

On every show she's worked, her engineering skill set has been put to use in some way. For example, with *Make Me a Millionaire Inventor*, instead of focusing primarily on the pitch, the show demonstrates how engineering, product development, and solid business plans can turn someone's great invention from just an idea into a venture capitalist's next big investment. Bell loves that the process of getting from an idea to an investment. "I prefer shows that have a technical context, and I've always prioritized being real and rugged over getting swept up in the glamour of TV," she says. "When I started in television, I was doing my own hair and makeup in the desert at 5 a.m., using the windshield mirror of my car. A lot has changed since then, but whether the show was about exploding a plane for science or helping inventors pitch to multimillionaires, the reasons I do this job are the same: because I'm an engineer with a passion for tech."

A Learning Curve

And much like any profession, Bell points out that there is a learning curve to hosting. "I guess in my auditions I showed some glimmer of being able to communicate on TV but by no means was I an expert," she says. "I had to learn to be extremely confident in a few ways. First, that as a host, you don't need to be perfect on camera. You can be honest about your strengths and pitfalls because if you try to be something you're not, viewers will see right through it." Bell adds that she also had to build confidence in herself off-camera, because she wasn't prepared for everyone suddenly having an opinion of her and commenting on whether they loved or hated her. While the vast array of commentary took some getting used to, she notes that it also led to her realization that media engages audiences on and off-screen, which can be a powerful way to inspire and educate others about the excitement of engineering.

Bell with ASME and NASA representatives celebrating the 2015 Summit Award for the Future Engineers: 3-D Space Challenges. The Summit Award is the highest recognition under The Power of A Awards. (From left): Bob Sims, Niki Werkheiser, Deanne Bell, Noha El-Ghobashy, and Sue Skemp.

Looking to the Future

Galvanized by this understanding, Future Engineers, an open innovation challenge platform for students in kindergarten through high school, was born in 2014. For Bell, who has explored a passion for science, technology, engineering, and math (STEM) in industry when she first started out, currently in media and also in the education space where she has volunteered and done various speaking engagements, she envisioned a platform that pulled these three sectors together and included an outreach component to students.

"Future Engineers is really an invitation to kids to use their creativity and analytical skills to invent, like I liked to do when I was younger," says Bell. "Sometimes when engineering is being taught to younger students, people think they need fancy equipment, but really you just need a good challenge."

Prizes help too; supported by the American Society of Mechnaical Engineers (AMSE) Foundation and NASA among other partners, Future Engineers is able to award prizes ranging from a 3-D print on the International Space Station to a one-on-one meeting with an astronaut to Space Camp scholarships or an actual 3-D printer for the winner's school. These are in keeping with the theme of Future Engineers' initial 3-D Space Challenge series developed for the ASME Foundation, while future challenges with other partners across a wide variety of STEM topics are in the works.

Another offering from Future Engineers is the curation of educational content in ways that are engaging to students. "One of the things I've had to learn in hosting television is to communicate clearly and concisely," explains Bell. "So we create a lot of media at Future Engineers that is two minutes or less. It's not easy to, say, explain microgravity in a two-minute video, but that's what we strive to do." Bell notes that videos also aim to incorporate women in STEM to provide a boost in excitement for girls, but the challenges themselves are always created to appeal to both genders.

For budding entrepreneurs and future engineers, Bell advises that one should dive right in. "My adventurous, risk-taking mentality has been applicable to everything I've done," she says, but credits her engineering degree as well. "An engineering degree is fantastic because it's really a tool kit. You learn how to think and solve problems, and you can use those problem-solving skills to figure out how to take the next step toward whatever it is you want to do. In my case, I've taken a nontraditional path and had to mold my own career."

She also advises others, especially younger generations, to dream big. "Imagine the impossible, I always say," shares Bell. "This is true with your career, with a technology you're working on, and with anything you desire." For someone who never imagined being a television star, this mantra has certainly driven her to success. Or, perhaps her career is the invention her younger self always dreamed.

For more information, please visit www.deannebell.com and www.futureengineers.org

—Leslie Prives

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