WOMEN AHEAD of Their Time

Given annually since 1952, the Achievement Award is the Society's highest honor, often preceding recognition from the wider technical community and identifying innovative women at the forefront of their disciplines. This spring, two of SWE's past Achievement Award recipients each received another honor recognizing their stellar accomplishments. When Yvonne Brill won the John Fritz Medal in April, she became only the second woman to receive what is considered engineering's most prestigious award. In March, the National Science Board named Mildred Dresselhaus, Ph.D., the 2009 recipient of its Vannevar Bush Award.

BY MEREDITH HOLMES, SWE CONTRIBUTOR

SWE ARCHIVES/WAYNE STATE UNIVERSITY

In April 2009, Yvonne Brill, a pioneering rocket propulsion engineer, won engineering's most prestigious award, the John Fritz Medal. She is only the second woman to receive this award since it was established in 1902.

Brill earned her B.Sc. in mathematics from the University of Manitoba, Canada, and her M.S. in chemistry from the University of Southern California. She began her career in the aircraft industry in 1945, and when her employer, Douglas Aircraft, was awarded the Project RAND contract, Brill became a research analyst in the missiles division.

Of this post-war era, she said, "Rockets and space were new, relatively unknown fields when I joined Project Rand in 1946." Brill was the only woman engineer working in rocket propulsion systems at the time. She was on a team of five scientists who defined rocket propellant performance, derived high-temperature thermodynamics properties for rocket exhaust, and published one of the earliest reports on the subject.

"Our first task in performance calculations at RAND was to extend the thermodynamic tables for exhaust gas species to 5,000 kelvin. The National Bureau of Standards [NBS] tables only went to 3,000 kelvin then. These calculations were very labor-intensive in the days before computers and somewhat boring after a while," she said. "I dealt with this by changing jobs." Later, when the NBS officially extended its thermodynamic tables, the results did not differ from the calculations done by Brill's team.

In 1949, Brill went to Marquardt, a small engineering company, to work on advanced ramjet fuels. Brill was the first woman the company had ever hired for a technical job, and the first with a chemistry, rather than an engineering, background. Again, Brill arrived just as the company was entering new scientific territory. "Compressible flow theory and high-speed flows were only coming into vogue then ... ," Brill said. "I was on equal footing with the engineers, because they hadn't taken these courses as undergraduates, either." Brill found she enjoyed engineering. "I designed the igniter for a supersonic ramjet missile known as Project Rigel, and got to pack the propellant charge for the igniter. The missile flight test was successful!"

In 1966, Brill joined RCA Astro Electronics as a senior engineer in propulsion systems. She was the only propulsion engineer on the staff. She had never worked on satellites before this, but had a dozen years of experimen-

> "Don't get discouraged by your undergraduate coursework. Getting the degree is the hardest part. Doing engineering is fun."
> –Yvonne Brill, 1986 Achievement Award recipient

tal and analytical experience on rocket engines, both liquid and solid rockets. She collaborated with colleagues from previous jobs and in rocket science. "They gave me great support when I needed someone with detailed propulsion knowledge to test my new ideas," she said.

While at RCA, Brill invented and patented the electrothermal hydrazine thruster (EHT). This propulsion system keeps a satellite in a fixed, geosynchronous orbit longer than other systems and with a larger payload, an innovation that has saved commercial satellite owners millions of dollars. Brill also found management at RCA to be supportive. "The EHT did not exist when I proposed it. I wrote a patent disclosure in 1967, and RCA pursued the disclosure to a U.S. patent, which was granted in 1972. The patent is in my name, assigned to the RCA Corporation." To date, more than 200 of these thrusters have been flown on spacecraft built by RCA, GE, Lockheed Martin, and Motorola (Iridium).

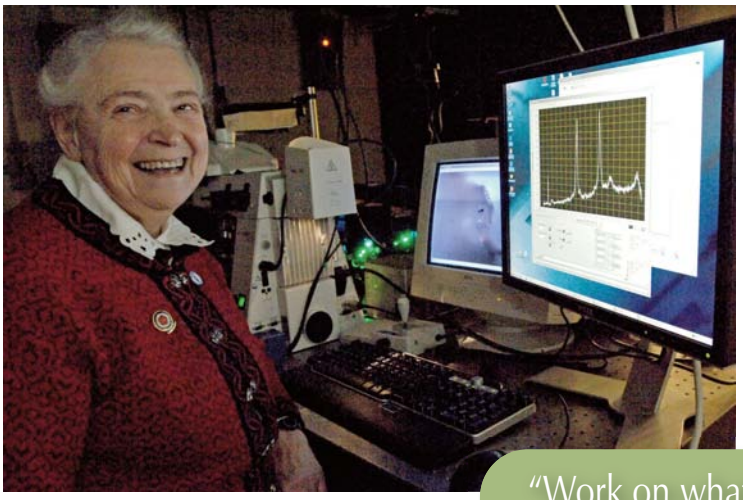
Brill has always been active in encouraging women to become engineers, and especially to enter the aeronautical, aerospace, and biomedical fields. She established the Brill Family Scholarship, which, through SWE, awards $1,000 to a woman engineering student every year.

Brill is candid about work/life balance for women engineers, observing, "To say the least, if you have a career and children, it is hard to achieve a good work/life balance." Brill and her husband, a research chemist, have three children. Brill returned to work when the youngest was 2 years old. She said, "The most important support came from my husband's understanding of the challenges of a career. He had no objections to my working late or sometimes on weekends to do the jobs I was assigned. He approached his job in the same way."

Brill consults on satellite technology and space propulsion systems and has provided technical support on commercial communications satellites to many companies in the United States and abroad. She is a member of the National Research Council Space Studies Board, the National Academy of Engineering, the Women in Technology International Hall of Fame, and an Honorary Fellow of the American Institute of Aeronautics and Astronautics. Brill has received many awards and honors, including the SWE Resnik Challenger Medal, the IEEE Judith A. Resnik Award, and the NASA Distinguished Public Service Medal.

Mildred Dresselhaus, Ph.D., a leading expert in carbon science and an MIT Institute Professor, is the 2009 recipient of the National Science Board's Vannevar Bush Award. She was honored for "public service in science and engineering, advocacy for increasing opportunities for women in science," and for "extraordinary contributions in the field of condensed-matter physics and nanoscience." Her studies of carbon science, thermoelectricity, and physics at the nanometer scale have led to many other scientific discoveries.

MIT



"Work on what's interesting and exciting to you, and don't worry about what everybody thinks. Time will tell whether or not you're right."
–Mildred S. Dresselhaus, Ph.D., 1977 Achievement Award recipient

Dr. Dresselhaus has spent her entire professional academic career at MIT, teaching and doing research, always working in emerging areas of science and engineering. While an undergraduate at Hunter College, she received a Fulbright Fellowship (1951-52) to attend the Cavendish Laboratory at Cambridge University. She received her M.S. from Radcliffe College in 1953 and her Ph.D. from the University of Chicago in 1958, then spent two years working on superconductivity at Cornell as an NSF post-doctoral fellow.

For seven years, Dr. Dresselhaus was on the staff of the MIT Lincoln Laboratory in the Solid State Physics Division, where she did research in magneto-optics that led to a new understanding of the electronic structure of semimetals. "My first job was great; I could do almost anything I wanted — except for anything I knew about," she said. "They weren't interested in superconductivity, so I began to learn about magneto-optics, about which I knew nothing." Dr. Dresselhaus thrives on working at the edge of the familiar, pointing out that when fields mature, all the interesting discoveries have been made, and

The John Fritz Medal and Vannevar Bush Award

The John Fritz Medal is widely regarded as the highest honor one can receive in the engineering profession. Established in 1902 by the American Association of Engineering Societies, the annual award recognizes "scientific or industrial achievement in any field of pure or applied science." Visit www.aaes.org for more information.

Each year since 1980, the National Science Board has presented the Vannevar Bush Award to an individual who has made "substantial contributions to the welfare of the nation through public service activities in science, technology, and public policy." For more details, please visit www.nsf.gov/nsb.

KRISTINA JOHNSON, PH.D.:
Academic, Entrepreneur, Energy Policymaker

It's appropriate that Dr. Kristina Johnson's speech, on the occasion of receiving SWE's Achievement Award, contains references to light. She is an electrical engineer with expertise in liquid crystal, electro-optics, and smart pixel arrays. As with so many other Achievement Award recipients, SWE's recognition in 2004 was a harbinger of other accolades in engineering, academe, business, and public life. Dr. Johnson holds 129 U.S. and foreign patents, co-founded several start-up companies, and has published more than 140 articles. In 2008, she won the John Fritz Medal, engineering's most prestigious award, the first woman to join scientific luminaries like Alexander Graham Bell (1907), Thomas Edison (1908), Alfred Nobel (1910), and Guglielmo Marconi (1923).

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Dr. Johnson was nominated in March by President Obama and confirmed in May by the U.S. Senate as Under Secretary for Energy in the U.S. Department of Energy. She oversees energy efficiency and coordinates clean and renewable energy research and commercialization — one of the Obama administration's top priorities.

Although Dr. Johnson's father and grandfather were both engineers, it didn't occur to her to pursue engineering until she won first prize from the Society of Women Engineers at a Colorado state high school science fair. Pursue it she did, earning her B.S., M.S., and Ph.D. in electrical engineering at Stanford.

In 1985, Dr. Johnson joined the electrical engineering faculty at the University of Colorado, Boulder, rising quickly from assistant professor to director of a National Science Foundation Engineering Center. In 1999 Dr. Johnson went to Duke University, to be dean of the Pratt School of Engineering. Long an advocate of cross-disciplinary research, she helped set up the Fitzpatrick Center for Interdisciplinary Engineering, Medicine, and Applied Sciences at Duke. Under her leadership, the school's endowment, student body, faculty, and research expenditures grew significantly.

In 2007, Dr. Johnson was appointed provost of Johns Hopkins University, the largest research university in the country. She was the first woman to hold that position.

there are few opportunities for significant findings. "After a while, I realized I wanted to do something different. Carbon science interested me at the time. It seemed so far out — only three people in the world were working on it, and I was one of them."

Like Yvonne Brill, Dr. Dresselhaus was able to take advantage of a surge of support for scientific research in the U.S. in the 1950s and 1960s. "Before the launch of Sputnik in 1957, there weren't many career opportunities in science, and even fewer for women," she said. "After Sputnik, there began to be many more jobs."

Dr. Dresselhaus was at the leading edge of women's entry into academic science and engineering. When she got her Ph.D., very few women in the United States held doctorates, and when she joined the MIT faculty in 1968, women made up just 4 percent of the undergraduate student body, and women faculty numbered about 10. Dr. Dresselhaus took a practical view of her pioneer status: "A lot of people weren't ready for a woman with a Ph.D. I didn't impose myself on people who weren't ready for me," she said. Attitudes that might have stopped some, never interfered with her plans. "I just kept on working on what interested me. If I had a good idea, I pursued it, and then people were eager to work with me. In the end, it's what you do that counts."

Dr. Dresselhaus was the first tenured woman professor in MIT's School of Engineering. She is currently professor of physics and electrical engineering, and since 1985, has been Institute Professor at MIT, the highest academic position at the university.

In the early 1960s, when women students were a tiny minority in MIT classrooms, Dr. Dresselhaus held mentoring sessions in her office and coached women students in networking to combat both social and academic isolation. In 1973 she received a Carnegie Foundation grant to encourage women to study traditionally male-dominated disciplines. That same year she was appointed to MIT's Abby Rockefeller Mauze chair, which promoted scientific scholarship by women.

Marc Kastner, Ph.D., dean of MIT's School of Science, described Dr. Dresselhaus as an "exceptional physicist, classroom teacher, and mentor of young scientists ... now being recognized for her great public service." As Dr. Dresselhaus pointed out, service is part of the ethos of academic life at MIT: "... Ever since I've been here ... we've been strongly influenced by service, not only to MIT, but to the whole country ... ." She was president of the American Physical Society and of the American Association for the Advancement of Science, and treasurer of the National Academy of Sciences. She directed the Office of Science at the U.S. Department of Energy from 2000 to 2001 and chaired the Governing Board of the American Institute of Physics from 2003 to 2008.

Dr. Dresselhaus' career has been varied. She has followed her interests and her desire to make discoveries. But she acknowledges that the political climate or the availability of funding also influence the course of a career. She advised, "If there is something you really want to do, and at first you don't succeed, wait a few years and try again. Things change. Just think how attitudes about global warming have changed in 10 years." ■