Remembering Millie

By George W. Crabtree

Millie Dresselhaus remains an enduring force in science and society. Her unexpected death in February 2017 prompted immediate recognition and admiration of her life and the impact she has had. As we adjust to living without Millie, we appreciate her influence even more deeply now. She was an icon for many virtues—science, women, truth, and service, among others. She represented these things so well and so naturally that many of us took them for granted; of course Millie would advance the frontier of carbon, champion women in science, stand for honesty and trust, lead the DOE Office of Science, the American Physical Society, the American Association for the Advancement of Science, the Board of the American Institute of Physics, and co-chair the Decadal Study of Condensed Matter and Material Physics. She was uniquely tireless, thoughtful, and attentive all at the same time.

Millie was a standout in science. Although she published more than a thousand papers, many landmarks in their fields, her first papers were not so highly cited. Like all of us, she had to learn how to write. Somehow, this is a comforting thought—even the best have to start as beginners.

Her interest in carbon started in the early 1960s, with work on the electronic structure of semiconductors, semi-metals, and graphite. She recognized that intercalation into graphite offered a new window on the interplay between electronic and atomic structure, an example of advanced nanoscience before the concept or the word was popular. Her review articles became classics in the field, finding trends across intercalants and stages of intercalation.

The discovery of fullerenes and nanotubes took the subject to a new high, and Millie was among the first to ask the penetrating questions and formulate the compelling answers in this burgeoning field. Her thought experiment of rolling up a single sheet of carbon with the rolling axis oriented in various directions in the carbon plane allowed for the diversity of nanotubes—zigzag, armchair, and chiral—to be easily categorized and analyzed. Her insight proved prophetic with the explosion of work on graphene, a natural extension of her thinking to explain the special importance of the edge structure in determining electronic behavior. Millie was the founding mother of carbon science, always at the forefront and the first to understand the proliferation of new discoveries.

One of Millie's more recent interests was energy, recognizing, as usual, well before the community at large, how important this subject would be. She chaired the first Basic Research Needs Workshop sponsored by the US Department of Energy–Basic Energy Sciences (DOE-BES) in 2003, on the hydrogen economy, which opened a new dimension in the basic science of hydrogen. Her leadership informed not only the impact of the workshop, but also the format and best practices for the approximately 20 subsequent workshops on energy and grand challenge science (workshops based on the most important and promising basic science challenges to pursue in the next decade, independent of energy).

One of Millie's most amazing features was the simplicity and elegance of her thinking. This applied not only to science but also to human dynamics. She was an icon for women in science, having experienced gender bias directly in her career.

But this did not discourage her; on the contrary, it energized her. She thought deeply about the often unconscious origins of gender bias and how culturally ingrained it had become in science and society. In the 1970s, she began organizing meetings on gender bias in science, counseling women on dealing with it, and raising the consciousness of men who often encouraged it, sometimes unconsciously, in their own behavior. Her work elevated awareness of gender bias in science to a new level. Millie had a characteristically deep and simple sense of the issue: "what makes the workplace good for women makes it good for everyone." This elegant insight captures Millie's essence.

Although Millie was a model and an inspiration for others, she had her own line of distinguished mentors and heroes. The then future Nobel laureate Rosalyn Yalow encouraged Millie to pursue physics instead of teaching, and the brilliant Enrico Fermi mentored her doctoral studies at the University of Chicago. Millie held Arthur von Hippel in high regard for his concept of science as an interdisciplinary enterprise, a feature that MRS deeply embraces with its emphasis on materials across science and applications and through the endowment of its highest honor, the Von Hippel Award. Young scientists of both genders especially loved Millie. She was a major force in creating the next generation of scientists, having supervised more than 60 doctoral students. She once confided to friends that she spent every Sunday writing recommendation letters for her younger colleagues.

I remember sitting at a table with Millie exchanging stories of music. She played classical violin in a chamber music group at MIT for many years. Consistent with her natural talent, she could sight-read music. Her daughter, also a musician, would often stop by Millie's house with sheet music and a request: "Mom, would you play this piece, I want to hear how it sounds." This story illustrates her prodigious talent, her joy of music and family, and an unceasing willingness to give to others.

Millie loved to travel. She was once on a panel at the National Academy of Sciences in Washington, DC. She magically appeared 15 minutes before the starting time, greeting everyone in her warm and calm way, saying that she had just gotten off an overnight plane from Japan. This seemed quite natural to her, as if everyone did this all the time. She gave, in her usual way, a beautifully structured and measured talk, without notes or slides, which captivated all of us. On another occasion, she was serving on a committee in Golden, Col., in the middle of winter. A snowstorm canceled her flight to Asia immediately following the meeting and she worked diligently on the phone to rebook. Suddenly she looked up with a smile and said, "They always take good care of me. I have a million miles on that airline." "Which airline?" I asked. "Oh, two or three of them," she answered.

Millie's role as a scientific icon was celebrated recently in a famous GE commercial,* filmed in the fall of 2016 and broadcast in 2017, asking the question "What if we treated great female scientists like they were stars?" Millie was the object of the commercial, with young girls getting Millie dolls for their birthday, newscasters talking about Millie sightings, and Millie's visage depicted in wall-sized murals. No one could personify this concept better than Millie—the quintessential female scientist who combined intellectual brilliance and accomplishment with personal and human caring. She stands for all the good qualities we treasure in scientists and people. She followed her own path, used her own elegant insights as a guide through the natural and human worlds, and represented the community at its best. Her loss leaves an enormous hole in the fabric of science and society, though her memory endures as an inspiration and an aspiration. We remember, with pleasure and satisfaction, the path she pioneered and the values she espoused for us all.

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Please note that MIT is planning an event to be held at MIT on Sunday, November 26, 2017—Celebrating Our Millie: The Legacy and Impact of Mildred Dresselhaus. Additional events honoring her memory are being planned for the 2017 MRS Fall Meeting in Boston, November 26–December 1.

*www.youtube.com/watch?v=sQ6_fOX7ITQ

A Geology Lesson

By Judy Grahn

Here, the sea strains to climb up on the land
and the wind blows dust in a single direction.
The trees bend themselves all one way
and volcanoes explode often.
Why is this? Many years back
a woman of strong purpose
passed through this section
and everything else tried to follow.