Mildred Dresselhaus works in her office at MIT in November 2006.

PHOTO: MICHELINE PELLETIER/GAMMA-RAPHO/GETTY IMAGES

SCIENCE LIVES

All hail the Queen of Carbon

A new biography solidifies the legacy of a pioneering and prolific nanoscientist

By **Vijaysree Venkatraman**

"Dr. Mildred S. Dresselhaus, of Lincoln Laboratory, who has achieved prominence as a solid-state physicist, has been appointed Abby Rockefeller Mauzé Visiting Professor at the Massachusetts Institute of Technology," read a small news item in the *Boston Globe* on 8 October 1967. The appointment was for a single year, but it was still notable because it was the first time MIT's electrical engineering department had hired a female professor. Before that year was out, the department would offer Dresselhaus a full professorship with tenure.

In *Carbon Queen*, the first full-length biography of the history-making scientist, science writer Maia Weinstock traces Dresselhaus's exceptional career, which included foundational research on various forms of carbon that has enabled other scientists and engineers to make tremendous advances with nanoscale structures "on the order of one-hundred-thousandth the width of a human hair." Such materials—which include cylindrical nanotubes, iconic buckyballs, and two-dimensional graphene—have applications in energy storage, medical research, and quantum computers.

Carbon Queen: The Remarkable Life of Nanoscience Pioneer Mildred Dresselhaus
Maia Weinstock
MIT Press, 2022. 320 pp.

It all began with graphite—the familiar "lead" of pencils, which is neither a metal nor a semiconductor but, nevertheless, conducts electricity. Dresselhaus's investigations into the electronic structure of graphite contradicted the theorized energy level spacing within the material's valence and conduction bands and led to a standout publication in 1968, her first year at MIT (*1*). In her six-decade-long career, she would publish ~1700 peer-reviewed articles as well as eight books on the fundamental properties of carbon, earning her the moniker "Queen of Carbon," a title she apparently hated at first but later embraced.

Weinstock writes evocatively of Dresselhaus's improbable journey from a tough neighborhood in New York City in the 1940s to a world-renowned research institution. In the Depression era, we learn, her family struggled to make ends meet. Fortunately, the musically talented "Millie"—as she was widely known—won free lessons at the Greenwich House Music School. There, she learned of a nearby school for girls, where, after passing the difficult entrance examination, she excelled in mathematics and science. Later, at Hunter College, Dresselhaus was preparing to become a math teacher until Rosalyn Yalow, who would go on to win the Nobel Prize in Physiology or Medicine in 1977 and briefly taught nuclear physics at Hunter, insisted that her protégé apply to graduate school.

At the University of Chicago, where Millie completed her graduate studies and briefly enjoyed the informal mentorship of Nobelist Enrico Fermi, she met and married postdoc Gene Dresselhaus, a rising star in theoretical physics. Gene would become his wife's lifelong cheerleader and collaborator (he introduced her to graphite), and together they raised four children. He celebrated his wife's accomplishments, but Millie regretted the fact that she got far more credit than her husband for work they had done together, notes Weinstock.

Only the Nobel Prize, which was awarded to other researchers for discovering buckyballs and carbon nanotubes, respectively, eluded Millie. "In both cases, they had ideas I missed, and they did great work," she told the *New York Times*.

Keenly aware that a philanthropic grant made it possible for her to enter academia, Dresselhaus used her prominence to further the same vision. Not content with being a distant role model, she regularly met with young women on campus and sought to increase their numbers in technical courses. Her research into the undergraduate admissions process revealed that "it was harder for women to get into MIT than for men," and over the years she made useful recommendations to level the playing field for women in science at MIT and elsewhere.

In *Carbon Queen*, Weinstock has pieced together Dresselhaus's story using decades of profiles, print interviews, oral histories conducted with the scientist herself, and new interviews with her contemporaries. Using lively metaphors, she makes complex scientific concepts accessible, comparing, for instance, the bandgap—which determines whether a material can conduct electricity—to a bouncer at a popular nightclub. Readers are also left with vivid images of the woman herself, as a child on her way to music school; as a high-spirited teen, sneaking friends into the Hayden Planetarium; and finally as a trailblazing scientist who, politely but always with great effect, gave the academy hell for its dismal track record with women. ■

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REFERENCES AND NOTES

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