of the fourth class of women admitted to Yale. There she decided to major in physics and became one of the first two women to do so.

Pollack's time at Yale sounds like a nightmare; she endured eating disorders, anxiety attacks, and a constant fear of failing. She describes never feeling like she was doing well and never receiving any encouragement from professors or fellow students. Yet multiple signs indicated that she was doing remarkably well. For example, several teachers invited her to work with them on independent research projects. She graduated from Yale *summa cum laude*. A reader could be excused for wondering about the cause of her lack of confidence, her inability to read the signs of success, and her constant self-doubt.

During her senior year, Pollack began to take writing courses, in which her experience was totally different. Her classes included other women, and teachers and fellow students were encouraging and supportive. Based on that experience Pollack abandoned her ambition to go to graduate school in physics and become an astrophysicist. She's not very clear on the reasons for her decision; I suspect she herself still doesn't know. In any case, she has become a successful, award-winning writer and teaches writing at the University of Michigan.

In the second part of the book, Pollack goes back to Liberty High School and Yale and interviews her high school and college teachers. At her high school, she finds encouraging changes—the physics instructor is female and the advanced class includes three girls. But one of the math teachers tells her that "guys are more hard-wired to build things."

At Yale, Pollack finds a similar mixture of exciting changes and more of the same. The physics department chair is Meg Urry, a woman who, in addition to having a distinguished career in astrophysics, has made significant contributions to the cause of women in physics. Pollack gets to know a group of girls who "don't give a crap," who take pleasure in their ability to do math and physics, and who are not crippled by self-consciousness as she was. And yet, in numerous ways, nothing has changed; many a girl still worries that "if she's perceived to be a feminist, the boys won't ask her out."

In the third and last part of the book, Pollack moves beyond her own personal experience to review much of the literature and offer alternative reasons why women in physics are so rare and why they so often drop out. Her preferred explanation is that "female science majors need far more encouragement than men, even as their instructors perceive any need for praise as a sign that the student lacks the seriousness or commitment to succeed in research."

Pollack is an engaging writer with an eye for an apt anecdote. Her personal story should convince skeptics that the culture of physics makes it difficult for women—even talented and enthusiastic women—to persist and succeed. On the back of the book, former Harvard University president Lawrence Summers is quoted as saying, "I certainly understand many aspects of the issue better for reading Pollack's work." I sincerely hope that others will feel the same, that they will find her discussion of being "the only woman in the room" compelling, and that they will be inspired to think differently about women in physics.

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Searching for the Oldest Stars

Ancient Relics from the Early Universe

Anna Frebel

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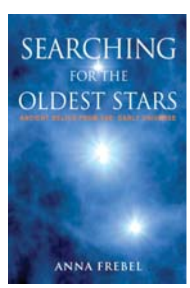
"Metal-poor stars are a girl's best friend! Who still needs diamonds?" Those final two sentences of Anna Frebel's *Searching for the Oldest Stars: Ancient Relics from the Early Universe* express the author's love of and passion for stellar archaeology, the quest to constrain the origin of elements through archaeological "digs" of the night sky. Throughout her book, Frebel conveys her enthusiasm in the way she interweaves a story of the cosmic origin of elements with a personal account of scientific discovery and methodology that gives readers a glimpse into the life and thrills of a modern-day astronomer.



All elements, except for hydrogen, helium, and lithium, have their origin in the interiors of stars: The iron in our blood, the calcium in our bones, and the carbon, nitrogen, and oxygen that make up the amino acids that are crucial for life itself—all were created in the interior furnaces of stars and then released by stellar explosions. As Carl Sagan put it in *The Cosmic Connection: An Extraterrestrial Perspective* (Doubleday, 1973), "We are made of star-stuff." Although Frebel gives a detailed description of how various elements are synthesized in stellar interiors, she neglects to provide a physical description of primordial nucleosynthesis. It would have been fitting, in particular, to include an explanation of why elements heavier than lithium cannot have formed during the first three minutes after the Big Bang.

As one of the world's leading researchers in the field of stellar archaeology, Frebel uses large telescopes to take spectra of stars and to search for the most metal-poor stars—that is, stars poorest in elements heavier than helium. Absorption lines in those spectra are the fingerprints that reveal the stars' elemental makeup, and they take central stage in a captivating detective story of how the first stars formed only a few million years after the Big Bang.

Metal abundances in the universe build up over time, as more and more stars shed the elemental yields from which newer generations of stars form. As a consequence, metal-poor stars are also old. The astrophysicist's hunt for the most metal-poor stars is thus much like the archaeologist's hunt for the oldest forms of life. Frebel discovered several of the most metal-poor stars known, some of which have metal abundances, relative to hydrogen, that are less than 1/250 000 of that in the Sun. Such stars are cosmic fossils that may well have been enriched by the ejecta of only a single supernova; thus they provide important insight regarding the elemental yields of the first population of exploding stars in the universe.

A unique aspect of *Searching for the Oldest Stars* is that each chapter is intended to stand alone, so the chapters need not be read in any particular order. Some chapters outline the detailed physical processes by which stars form and evolve. Others tell enthralling stories, such as the author's account of the Australian bushfires that destroyed the Mount Stromlo Observatory in 2003 or her description of what it is like to spend weeks on end on a remote mountaintop observing the night skies. Readers of PHYSICS TODAY should have no problem with the physical concepts that feature in the chapters describing the various nucleosynthetic burning stages in a star's life or the neutron-capture processes that are responsible for the synthesis of elements heavier than iron. But readers less versed in basic physics and astronomy will find those chapters challenging and may find themselves flipping among chapters to weave a comprehensive picture.

Frebel's delightful blend of science and personal stories has plenty to offer for readers ranging from nonscientists to professional astronomers. In addition, by highlighting the important role of women astronomers in the development of stellar spectroscopy, Frebel clearly strives to motivate and inspire future generations of female scientists. Laden with passion and excitement, *Searching for the Oldest Stars* accomplishes what it sets out to do—engage readers and provide insights into stellar archaeology and the motivations that propel scientists in their quest to answer fundamental questions.

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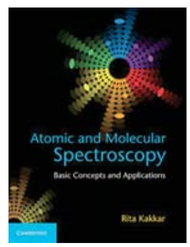
Atomic and Molecular Spectroscopy

Basic Concepts and Applications

Rita Kakkar

Cambridge U. Press, 2015. $75.00 (415 pp.).
ISBN 978-1-107-06388-4



In her preface to *Atomic and Molecular Spectroscopy: Basic Concepts and Applications*, Rita Kakkar writes that the book is primarily intended for graduate and advanced undergraduate students who have already taken a course in quantum mechanics and know how to apply elementary molecular point-group representation theory. Her text covers the basics of light–matter interactions; electronic spectroscopy of atoms; and rotational, vibrational, and electronic spectroscopies of diatomic and small polyatomic molecules. Raman spectroscopy, vibrational and rotational, receives its own chapter. That separation is common, but I prefer to integrate Raman with other absorption and emission spectroscopies. The book does not consider magnetic resonance spectroscopies or even the influence of nuclear moments on spectra.

The most attractive features of *Atomic and Molecular Spectroscopy* are that each chapter has many fully worked-out problems and each concludes with numerous exercises; the book includes 257 exercises in total. Mathematical derivations are presented in great detail, so even the weakest students should be able to follow them.

The cost of those features, however, is that the book treats most topics at a lower level of