tackled the structure of the tobacco mosaic virus, a subject more challenging than DNA. In his 1982 Nobel lecture, Aaron Klug—her closest collaborator and friend—acknowledged her contribution to his own work on molecular structure.

Maddox brings out one fact not generally known: *The Double Helix* was originally scheduled to be published by Harvard University Press. The outcry from eminent scientists and from Franklin's family was so intense that Harvard's board of overseers asked the press to drop the book. Atheneum later published it.

Maddox's mastery of historical detail gives us a definitive portrait of this warm and brilliant scientist and represents the science in an accurate and approachable way.

True Genius: The Life and Science of John Bardeen, the Only Winner of Two Nobel Prizes in Physics

Lillian Hoddeson
and Vicki Daitch
Joseph Henry Press, Washington, DC, 2002. $27.95 (367 pp.). ISBN 0-309-08408-3

Although many outstanding scientists are known for their outgoing dynamic personalities, John Bardeen, one of the most creative scientists of the 20th century, was a modest and quiet man. Yet he received two Nobel prizes in physics—one for the transistor (which revolutionized computers and communications) and one for the theory of superconductivity (one of the fundamental theoretical advances in recent times). *True Genius* gives an insightful and warm account of the scientific and personal life of this remarkable man.

Bardeen was the son of the dean of the University of Wisconsin–Madison Medical School. An outstanding student, he skipped from third to seventh grade. He majored in electrical engineering at the University of Wisconsin–Madison, where he took John Van Vleck's course on quantum mechanics—the first of its kind in the US. He then joined the research laboratory of Gulf Oil Co in Pittsburgh, where he worked on electromagnetic prospecting. The authors follow his career to Princeton, where he did his PhD thesis on many-body effects on metal surfaces. After a postdoctoral fellowship at Harvard, Bardeen joined the faculty of the University of Minnesota. There, he began his interest in superconductivity. Following Fritz London's ideas, he was convinced that there was an energy gap in the electronic spectrum that led to the expulsion of magnetic field.

After World War II, Bardeen joined Bell Laboratories in Murray Hill, New Jersey, where he worked on developing a semiconducting triode to replace the vacuum tube device, particularly in switching circuits. In a series of experimental and theoretical advances, Bardeen and Walter Brattain found that by placing two fine contacts at close spacing on a surface below which was a holelike semiconductor, they could achieve a 100-fold triode gain. As documented in the book, William Shockley, who led the group, thought he should receive the major credit for the discovery, because of an earlier suggestion of his (which proved to be incorrect). Shockley later developed the junction transistor, and the group shared the 1955 Nobel Prize in Physics.

In 1950, Bardeen moved to the University of Illinois, Urbana–Champaign, where he was able to pursue his interests in basic research. He founded a semiconductor laboratory and a theory group. Returning to his old interest in superconductivity, he brought together Leon Cooper (a postdoc with field-theory training) and me (as a graduate student). To attack the problem, Cooper found that two electrons above a frozen Fermi sea bind for all coupling strengths, which shows that the normal state is unstable. I found the wavefunction of the many-pair problem from which Bardeen proved there was an energy gap. Over a two-week period we were able to show that many of the theory's predictions were in agreement with experiment, with unique effects of the pairing correlations being observed.

True Genius relates how Bardeen taught his students to decompose a complex problem into simple pieces that preserve the physics. He was highly successful in using simple mathematics to analyze complicated problems: Stating the grand formalism often gets in the way of fundamental simple effects.

The book contains a collection of wonderful stories of how genius and humility can be combined to produce remarkable results. Having made a hole-in-one on the golf course, Bardeen was asked which was better: a Nobel Prize or a hole-in-one. He replied that he guessed two Nobel prizes were better.

I recommend this book as a joyous read.

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Journey from the Center of the Sun

Jack B. Zirker
Princeton U. Press, Princeton, N.J., 2002. $29.95. (302 pp.). ISBN 0-691-05781-8

Journey from the Center of the Sun is written with the experience, perspective, and insight of one who has spent decades in solar physics. Its author, Jack Zirker, graduated in 1996 to astronomer emeritus with the National Solar Observatory at Sacramento Peak, New Mexico. During his career, he contributed to solar physics as observer, experimentalist, theorist, and observatory director. In his own words, "[I] wrote this book because I wanted to share some of my pleasure in the subject. . . . I wanted to try to explain how the Sun works, the physical principles that govern its behavior, the many things we have learned since Sputnik, and the long list of things we still don't understand to our satisfaction." In these objectives he has been abundantly successful.

Solar physics is challenging and provocative because so much observational detail is available and so much remains to be puzzled out. The nearness of the Sun, with its generous photon, particle, and magnetized plasma fluxes, enables discovery of physical details inaccessible from any other astrophysical source. As a magnetically variable star, the Sun yields extravagant observational phenomena that need to be understood and explained from first principles. As Zirker says, "the more information one has, the more complex the phenomenon seems to become." The very core of the Sun is observable in neutrinos; the interior down to about 0.1 of the solar radius is studied with exquisite precision by helioseismology. Above the photosphere layer (where radiation can escape), the real fun begins: One can observe radiation from gamma-ray to kilometer wavelengths. Outside the magnetosphere of Earth, in situ measurements directly probe the solar wind, solar cosmic rays (energetic charged particles from flares and interplanetary shocks), and magnetized clouds.

Zirker sets out to deal with it all, and does an admirable job. He fits the many pieces together in an eminently satisfying manner. The book is free of mathematics but replete with illuminating cartoon illustrations and minigraphs, which, with only a couple of exceptions, are well integrated into the text. The typography is attractive and readable, with plenty of room in the margin for notes. In this era of brilliantly colored pictures on glossy paper, it was a surprise to open the book and find that, except for an 8-page insert of color plates, all illustrations are in gray scale. Surprisingly few figures suffer from lack of color, and for some of those, the color plates suffice to fill in the missing information. No doubt the use of grayscale figures helped to reduce the cost of the book, and that seems a good tradeoff now that a plethora of beautiful solar illustrations is readily available on the Internet.

It seems to me that this book has two audiences. The great lucidity of explanation and lack of mathematics commend it to the educated lay audience, to undergraduates, and to beginning graduate students. Zirker presents concisely and clearly such basic concepts as thermodynamic equilibrium and the Maxwell–Boltzmann distribution. A daunting challenge to the beginning student (or to anyone seriously interested in solar phenomena) is to master the wealth of significant observational detail and the jargon used by the solar community to describe it. I know of no other source that makes learning this language so pleasant.

The book's second natural audience is senior astronomers, like me, who have been so occupied with their own niche as to lose track of the great sweep of scientific advance. For them, the book is a pleasant and delightful way to catch up on the field. Zirker names names and comments on personalities (all positively) who have contributed seminally to the science he describes. It is fun to meet old friends as well as new science here. Historical background provides a perspective of how one discovery leads to the next question.

The book is not without its first-edition warts. A few figure references are in error, Ne becomes He in figure 12.3, and some typos creep in. Unfortunately, Zirker tends to use acronyms without spelling them out. This no doubt accounts for the inexcusable use of ISIS for Japan's Institute of Space and Astronautical Science, the institution that brought us the very successful Yohkoh mission for the study of high-energy solar physics.

At such a reasonable price, *Journey from the Center of the Sun* should be purchased and read by anyone with an interest in solar astrophysics. One might give it as a gift, as I have done here at Montana State, to every entering graduate student in solar astronomy. I can think of no better toehold in this fascinating but challenging field.

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Stellar Physics

G. S. Bisnovatyi-Kogan
(translated from Russian
by A. Y. Blinov and M. Romanova)
Volume 2: Stellar Evolution and Stability
Springer-Verlag, New York, 2002. $89.95 (381 pp.).
ISBN 3-540-66987-6

Sometimes just the right combination of events allows a scientific field to advance particularly rapidly. People are most familiar with how quantum mechanics arose in the first part of the 20th century, but models of stellar structure and evolution arose similarly at midcentury. In about 1955, only fairly elementary, semianalytic stellar models existed. By about 1970, stellar models offered a relatively detailed knowledge of the structure and evolution of stars, from the beginning of the slow-time-scale nuclear fusion of hydrogen into helium, through the processing of other elements, until (often) something dramatic happens in stellar evolution.

Major catalysts for this knowledge jump were the development of computers for widespread academic use and the corresponding development of numerical methods. The Henyey technique (as it is known in stellar astrophysics) was a noteworthy numerical method for solving implicit finite-difference equations. This technique allows the full equations of stellar structure to be solved with reasonable physical models for the equation of state and nuclear processing.

Of course, such a dramatic pace of advancement could not continue indefinitely. By the early 1970s, much of the broad scope of stellar evolution was reasonably well known. Attention then turned to more detailed issues, many of which remain only partially solved. By the 1980s, the focus of astronomy and astrophysics had moved to other new and exciting areas. Stellar-evolution research did not cease, but many problems of stellar structure (such as the solar neutrino problem) steadfastly refused to be solved. In the late 1980s and into the 1990s, stellar structure experienced something of a renaissance, prompted in part by three factors. First, astronomers observed the supernova SN1987A, and were helped by knowledge about that star before it exploded. Second, measurements of many oscillation periods of the Sun provided a finely tuned diagnostic of the solar structure. Third, astrophysicists realized that stellar composition undergoes considerably more slow-time-scale movement within the star than had been thought. Such efforts to understand stellar structure and evolution continue.

The advances of the past decade present a problem for this volume of *Stellar Physics*, which was published in Russian in 1989. In the current English version, Gennadii S. Bisnovatyi-Kogan has included a fair amount of material from the past decade but seems to have focused on updating the areas already covered rather than on adding new topics. As the preface states, the author has tailored his presentation to his own many and varied professional interests, including supernovae, the formation of accretion disks, and stellar stability. Although that practice is acceptable, it means a number of topics that should have been included in a general-purpose text have been left out. For example, there is little discussion of solar-oscillation theory, virtually nothing on how the solar-oscillation results have changed the astrophysical picture of the Sun, and not much on the mechanisms for transport of the chemical composition inside stars or on the motivation for such transport.

Although the omissions may make the book unsuitable for a graduate-level text on stellar evolution, the work has many strong points. For one, the author includes detailed discussions of the final stages of stellar evolution, which take up approximately half the book. He also offers in-depth results from Soviet and Russian research. Bisnovatyi-Kogan's discussion of astrophysicists' inability to produce supernova models that account for basic observations nicely summarizes the state of the art. The book's tables present many detailed results that can help validate current research models for situations in which the basic input physics—such as radiative opacities and nuclear energy generation—has not changed very much.

Although the translation is not always grammatically precise, it is clear. However, I found the system of references disruptive to my reading: The text cites references only by number, so I had to turn to the citation index in the back to find the authors and papers. Also, although the numbered reference list is putatively alphabetical, the actual order is only partially so. Such minor reservations aside, I heartily recommend the book for researchers in the field.

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