tion of differences in the depth of surface-state annealing in silicon wafers: Wafers with few defects showed the annealing effect 50–100 μm beyond the irradiated region, whereas in wafers with a high level of structural damage (such as those that were heavily implanted) the annealing effect was confined to the irradiated region.

Each chapter contains many illustrations and a bibliography. This book augments the texts already published and will find a place on many a professional's bookcase. I recommend it.

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Lasers, Spectroscopy and New Ideas: A Tribute to Arthur L. Schawlow

William M. Yen and Marc D. Levenson
Springer-Verlag, New York, 1987. 337 pp. $45.00 hc ISBN 0-387-18296-9

This book allows the reader to enjoy, at least remotely, the experience of physics research with Art Schawlow. Its 19 short articles, whose authors all have been students of Art's at Stanford University over the past 25 years, cover the three primary areas to which Schawlow has richly contributed—lasers, spectroscopy and "new ideas." Each article includes reminiscences of Art's humor, his excellent physics intuition and, most importantly, the immense joy and enthusiasm he brings to his research, teaching and lectures. It is interesting that many physics concepts can be more clearly grasped and understood with the informal writing styles used in this book.

As one might expect, the style and scientific content of the brief articles in this volume vary widely. Some are detailed and will serve as excellent references and reviews. Examples are the three articles on solid-state spectroscopy, by Roger M. Macfarlane ("Optical Spectral Linewidths in Solids"), Satoru Sugano ("Spectroscopy of Solid-State Laser Materials") and George F. Imbusch and William M. Yen ("Ruby Solid-State Spectroscopy: Serendipitous Servant"). Sugano discusses the early history of the laser. This is an ideal time to look back at the development of the laser, one of the major advances of this century, but I was disappointed that Schawlow's early laser research and that of his collaborators is not covered in this book. There is an interesting anecdote from the first session at a conference on lasers in June 1959: Schawlow suggested that the laser would most likely be used as an oscillator and so should be named "Light Oscillation by Stimulated Emission of Radiation"—or LOSER. I would love to have heard more about this early period from the laser pioneers. Several histories of this period will soon be available [see the article by Joan Bromberg in PHYSICS TODAY, October 1988, page 26], and some important figures, such as Charles Townes in his remarks in his 1986 Beckman lecture at the University of Illinois, have already begun to recount their versions.

The first section of this book on lasers and laser spectroscopic techniques includes a contribution from Theodor Hänsch that describes the beautiful work on Doppler-free precision spectroscopy and the original ideas on laser cooling. Today cooling of atoms well below 10 μK has been attained, a breakthrough that can be directly traced to the Stanford group. Of course, it was the brilliant research in spectroscopy for which Schawlow received the Nobel Prize in 1981. The book includes a song written for Art's 65th birthday and a picture of the Stanford group taken the day the Nobel Prize was announced.

Again, the joy of physics research is the book's primary focus. But it also manages to convey Schawlow's deep humanity, scientific achievements and broad influences on physics through his graduate students in a thoroughly enjoyable, though random, manner.

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Exercises in Astronomy

Edited by Josip Kleczek
Reidel (Kluwer), Boston, 1987. 339 pp. $64.00 hc ISBN 90-277-2409-1; $19.50 pb ISBN 90-277-2423-7

In all fields legends abound, and a laboratory book by Marcel G. J. Minnaert has been an astronomical legend. Since its publication in 1969, following 25 years of development at Utrecht University in the Netherlands, Minnaert's *Practical Work in Elementary Astronomy* has been widely respected. Just as Minnaert's *Nature of Light and Color in the Open Air* (Dover, New York, [1948]) led many people to a new appreciation of the sky, Minnaert's laboratory book provided a wide range of interesting experiments to astronomy students on all levels.

Josip Kleczek, a Czech astronomer who is coordinator for the International Astronomical Union of the International Schools for Young Astronomers, has edited a new edition of Minnaert's laboratory book. He has retained Minnaert's organization, with its split between "The Planetary System" and "The Stars," as well as 20 of Minnaert's 34 planetary exercises and 33 of 40 stellar exercises. To these, he has added 2 planetary and 19 stellar exercises, credited to astronomers from countries around the world, including the US, Belgium, Australia, the UK, Brazil, France and Czechoslovakia. As in Minnaert's original, the exercises are labeled "S" for observations carried out on the real sky and "L" for laboratory exercises carried out indoors. The ideal is to start work on a given night outdoors, and then continue indoors, though weather will rarely permit this ideal to be met.

Astronomical observing often is disparate from the astrophysics taught in class, because it is easier to observe the locations of objects in the sky than to analyze their radiation. Many of the exercises in this book aim at combining theory and observation. In the first two of six exercises contributed by David A. Allen (Anglo-Australian Observatory), for example, one learns about blackbody radiation—as theoretical a concept as there is. The first is a straightforward plotting exercise leading to Wien's displacement law. The second concerns infrared photometry—Allen's specialty. The third exercise is about interstellar reddening. Allen's three other exercises consider studies of the atomic spectral transitions known as forbidden lines and show how to calculate abundances. Because such calculations make use of recombination coefficients, statistical weights and collision strengths, some sophistication is called for on the student's part. Surely the lengthy exercise on magnetohydrodynamics entitled "Practice with MHD," by Donat G. Wentzel (University of Maryland), is accessible only to students with advanced physics experience. For such students, however, it is an unparalled opportunity to learn about an important field.

Some of the exercises are quite up to date. Jean Surdej (University of Liège, Belgium) even provides one about gravitational lenses. But the bulk of the exercises are unaltered since the first edition, so the references have dated. Too, the telescope described in the opening pages of the technical notes is not of a type likely to be in current use. Nor are computers or even calculators put to explicit