high-energy electrons found by radio telescopes in radio galaxies and quasars reach their extreme in pulsar magnetospheres.

Ginzburg is a generalist whose encyclopedic reading and depth permit coverage of a variety of such novel, specialized material. He uses order-of-magnitude (nearly dimensional) formulas, sufficient to provide quantitative estimates. He appreciates the experimenter's contribution. The book provides a model of how non-theorists can judge what realms of theory may be illuminated by work in a new range of photon and particle energy, how new technologies may be used to good effect.

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Light Scattering by Phonon–Polaritons

R. Claus, L. Merten, J. Brandmuller
237 pp. Springer-Verlag, New York, 1975. $29.70

For those of us who are neither too young nor too old (and who have been paying attention), polaritons have been a lively microlaboratory in which to learn physics, sharpen perceptions and gain sophistication. From the work of Kerson Huang, John J. Hopfield, and Ugo Fano in the 1950's we learned how the coupling of electromagnetic vibrations to crystalline excitations (either phonons or excitons) affects both the optical properties of the crystals and the behavior of the fundamental excitations themselves (the longitudinal–transverse frequency splitting, for example).

The coined term "polariton" stands for a wave of electric polarization shared between the electromagnetic field and the crystalline degrees of freedom. Although Huang demonstrated dispersion curves for phonon–polaritons in 1951, the existence of polaritons remained figmentary until they were observed directly as elementary excitations in their own right, in inelastic light-scattering spectroscopy, by Charles H. Henry and Hopfield in 1965. Thereafter the perception of polaritons' reality grew and their popularity spread to all corners of the earth, carried partly by the floodtide of laser-light-scattering spectroscopy and partly by the wonder of it all.

That the volume under review is entitled *Light Scattering by Phonon–Polaritons* is due to the fact that there is no other comparable way to study phonon–polaritons. Although some properties of polaritons are known from such indirect techniques as infrared reflectivity, to study them *in vivo*, as it were, one simply must penetrate the crystal as with light. Practitioners of the light-scattering art mapped out many beautiful polariton dispersion curves, and we came to regard these as *being* polaritons.

The study of these entities has helped us to understand other phenomena. Ferroelectricity, for example, is often associated with a "soft mode" exhibiting remarkable temperature sensitivity; its polariton does interesting tricks. Anharmonic phonon interactions have been fruitfully studied. Such marvels as frequency-dependent phonon damping and Fano interferences have been demonstrated with startling clarity and directness.

Polariton damping, however, brings a sticky end to the subject. When we contemplate the damping of such a composite excitation, we must keep clearly in sight the separate parts of which it is made, as well as the specific ways its parts are probed in an experiment. Representing the excitation as a point in complex frequency–wavevector space is inadequate and, in fact, thinking of it as a polariton no longer helps. I would therefore wish to augment my study of the living polaritons in this book by reading about dying polaritons in the response-function approach of A. S. Barker Jr and R. Loudon.

With this exception, I believe that the authors have given an excellent and complete account of the behavior of polaritons. They have included plenty of diagrams and formulas to make the ideas precise, but they have not neglected the philosophy that brings the ideas to life.

The book will be useful to students and practitioners of solid-state physics whose interests run to lattice dynamics and phonons, to light scattering or to electromagnetic propagation. Many of the ideas are, of course, generalizable to electromagnetic energy coupled to other excitations than phonons, so those interested in such diverse topics as plasmons and surface waves may also hope to find inspiration here.

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Detection and Spectrometry of Faint Light

J. Meaburn
270 pp. D. Reidel, Boston, 1976. $34.00

For the past 15 years John Meaburn has been designing spectrometers to analyze the visible and infrared emission from gaseous nebulae. In this fifty-sixth volume of the Astrophysics and Space Science Library he has set down a method for evaluating general types of spectrometers. His aim, as stated in the preface, is to "bridge the gap between the pure instrumental physicist and the user of detectors and spectrometers."

The monograph is organized into three general parts: introductory chapters on spectrometry, detectors, prism spectrometers and gratings; intermediate chapters describing various spectrometers, and a final chapter on signal-to-noise ratios as the principal criteria of merit. The introductory chapters are brief, tending more to definition of terms than explanation of principles. The intermediate chapters consist of an instrument-by-instrument analysis of the parameters needed to determine a potential factor of merit Z_{pot} for each spectrometer. The final chapter attempts to relate some of these parameters to the signal-to-noise ratio of a system.

The book is a rather complete catalog of individual instruments and combinations of instruments. Faced with the problem of choosing which instrument—a grating monochromator, a Michelson interferometer or a PEPSIOS or SISAM monochromator—to use in a particular experiment, one is likely to throw up his or her hands and use whatever is handy. With the method illustrated in the text, a rapid paper-and-pencil analysis of the Z_{pot} for the several spectrometer systems might be made without too much difficulty.

Despite the author's attempt in his final chapter to relate the parameters so carefully listed in the earlier chapters to the signal-to-noise ratios, much of the effort is abandoned in favor of an analysis that could have been carried forward without most of the material in the preceding chapters. Granted, as the author asserts, that factors listed in the intermediate chapters are related to the signal-to-noise ratios "in a very complex and often variable way," there is no indication of what importance the author puts on Z_{pot} relative to these ratios as calculated in the three illustrative problems in the final chapter.

Meaburn makes a modest attempt to explain the workings of the various instruments, but the sheer number of devices considered and the use of figures from original papers do not allow a pedagogical approach. One cannot understand many of the fine points unless one has read some of the basic references to spectrometers given in the text. The book needed the hand of a good copy editor—a lack of commas makes the text frustrating to read. Most readers, however, will use this as a reference, dipping in where needed and ignoring the rest.

The detection of faint light, mentioned in the title and covered in Chapter 2, is a brief review of most commonly used visible-light detectors and a description of

several electronographic tubes, photoelectrically intensified photographic plates. Perhaps because improvements in dynamic range have been so recent, the new silicon-intensified targets or their combination with image intensifiers are only briefly mentioned.

Since there is a good deal of emphasis here on the spectrometry of extended sources (starfields, nebulae), this text may also be useful to those performing remote sensing or spectroscopy on microscopic samples, as well as to astronomers. Many spectroscopists outside astronomy, however, may find it difficult to find or adapt any novel approaches to their field. A discussion of the merits of the "state of the art" of spectrometers was left out intentionally.

When it comes right down to it, Meaburn asserts in the final paragraph: "In practice there is often no good substitute for building several closely competitive devices for a particular problem, and trying them in the prevailing conditions before deciding which is best. More often than not the spectral information obtained in this way proves to be complementary, each device giving somewhat different insight into the nature of the source . . . ."

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Aristotle, Ptolemy and Copernicus (l. to r.) exchange views in an imaginary debate depicted on the frontispiece of Galileo's dialog, published in 1632, on the Ptolemaic and Copernican models.

Matter in Motion: The Spirit and Evolution of Physics

E. S. Abers, C. F. Kennel
412 pp. Allyn and Bacon, Boston, 1977. $11.95

Over the last decade, the one-semester introductory (and usually also terminal) physics course for non-science majors has become firmly established at a wide variety of colleges and universities, for it caters to an audience that might otherwise get no exposure to physics at all.

One of the more salutary features of this course is its stubborn refusal to settle down to a single fixed curriculum. Boiling down the standard full-year course is clearly impossible, so that the textbook author is left a free field. The number of available formats is, to first order, equal to the number of titles in print.

A course of this sort has two obvious goals. The first is to provide the scientific literacy essential to a citizen of a technically advanced society that wishes to remain democratic. The second is to dispel the widely held misapprehension that science consists of little more than a vast collection of uncontestable facts meticulously gathered and catalogued by individuals distinguished primarily by their ability to repress their emotions completely. Unfortunately, most introductory science courses only serve to reinforce this impression. Combating it is particularly urgent when the clientele consists of individuals pointed toward graduate study in disciplines now caught up in a pell-mell rush to adopt rankly empirical methods, a trend defended by the claim that "this is how the hard sciences succeeded." Where but in physics, with its history of great intuitive leaps from a few scattered clues, can this message best be delivered?

Unfortunately, it is nearly impossible to do justice to both goals in a single term, and Ernest Abers and Charles Kennel make no such vain attempt. Instead, they land entirely in the second camp.

Most books that choose this route extend the history of physics beyond the Galileo-to-Faraday span of so many traditional courses. Many extend primarily into the modern era, but this book goes in the other direction.

In the hands of Abers and Kennel, Greek and medieval science finally get their day in court. The achievements of the ancients in astronomy were striking, and the physics built on those achievements by Aristotle and Eudoxus provided Galileo with a firm base as well as something to rebel against. While Galileo's persecutors may have quoted scripture against him, the skeptical Greeks regarded the absence of observable stellar parallax as a more telling blow against the heliocentric theory of Aristarchus. And Ptolemy emerges as an almost-modern positivist, fully conscious of the arbitrary nature of his "Fourier analysis" of planetary motion. In the medieval era, Nicholas Oresme and the Merton College school both realized the necessity of dealing with non-uniform motion, but they were stymied by a mathematics that scarcely extended beyond arithmetic and geometry.

The astronomy is strong and detailed, and most instructors, at least, will take pleasure in teaching the closest modern equivalent to the actual calculations performed by the ancients and Kepler (whether students will be equally entranced remains to be seen). The mathematical presentation moves at a measured pace, with ample textual motivation and numerical examples that often precede the derivation of general formulas. Some of the mathematics is relegated to short appendices at the end of each chapter, allowing the instructor some freedom to tailor the level to the audience.

In this book Newton's laws at last emerge in the context from which they actually arose, which was astronomy rather than the pulleys and inclined planes of conventional texts. Indeed, meticulous historical fidelity is the trademark of the book.

Abers and Kennel then move to geometric and physical optics, magnetism and electricity (again, historical fidelity dictates treating magnetism first). Here the authors unfortunately abandon their well-conceived mathematical approach for a more qualitative treatment.

The mathematics returns in a final