decreased, certain lattice vibrational modes decrease in frequency either to zero (second-order phase transition) or to a small value (first-order phase transition) so that the crystal becomes unstable and transforms to a lower symmetry structure. Although the microscopic details responsible for the "softening" of the modes in different crystals may still be debatable, the existence of "soft modes" is firmly established. This idea has given a firm fundamental basis for the understanding of displacive transitions in ferroelectrics as well as many other structured phase transitions.

The authors of this large book, a theorist and an experimentalist who have both contributed extensively to the literature, utilize this soft-mode concept as the underlying theme. The resulting book is written with good understanding of the field and excellent summaries of many topics will be found. As stated in the preface, "the present book covers a wide range of topics right through from basic theory at the fundamental level all the way to devices," and it does it well. Any researcher or interested party will be able to find chapters or sections that will broaden their understanding or connect previously published work in a useful and thoughtful manner.

The soft-mode theme allows M. E. Lines and A. M. Glass to present the various topics in a reasonably unified way and to concentrate on archtypical systems. For example, the chapter on oxygen octahedra materials covers the ferroelectric and antiferroelectric perovskites, $LiNbO_3$ types, and the ferroelectrics with the tungsten-bronze structures. The soft-mode concept enables the connections between these materials to be emphasized and at the same time, the differences to be brought out.

The book has extensive chapters on the thermodynamics, statistical mechanics and microscopic theories of the phase transitions, as well as the other topics one would expect in a book on this subject. Additional chapters are devoted to other physics areas in which ferroelectric materials have proved to be particularly interesting, including the non-linear optics field. Ferroelectric materials have some of the largest non-linear coefficients and thus have proved to be useful, for example, as frequency doublers and modulators.

On the other hand, if your interest is in ferroelectrics in the form of thin films, ceramics or glasses, a look at the table of contents or the index will point you to pages where the work in these areas are well reviewed with a good range of references to the original literature. This should make the book useful to those scientists who might be interested in the possible application of ferroelectrics. In fact, the last 60 pages treat specific applications of ferroelectrics such as their use as pyroelectric detectors, memory or display elements, and electro-optic modulators.

I should think solid-state physicists in general would enjoy thumbing through this welcome addition covering such a wide range of topics. The book may open new vistas for many such people. The dedicated specialists in the ferroelectric field will certainly enjoy reading this book.

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The Physical Principles of Diagnostic Radiology

P. Sprawls Jr
365 pp. University Park, Baltimore, 1977.
$24.50

An increasingly popular diversion for physics professors is to simplify their subject enough so that it can be absorbed by a nonspecialist. Witness the proliferation of "Physics for Music Majors" or "Physics for People Who Hate Science" courses on many campuses. The difficult task undertaken by Perry Sprawls in this book is to create a "Physics for Radiologists." To appreciate the magnitude of this undertaking, at least as Sprawls perceives it, we need only observe his starting point. He assumes no previous knowledge of physics and virtually none in mathematics. Indeed, he includes an appendix that painstakingly explains the most elementary algebraic manipulations, things like determining the value of Y when given the relation $Y = X/WZ$ and values for X, W, and Z. He dispenses with elementary physics, from a definition of energy through a discussion of electrons and the structure of matter, in two short chapters covering a dozen pages each. He also gives the whole field of electronics equally short shrift.

From such humble beginnings, Sprawls proceeds to cover, or at least touch on, the whole gamut of physical principles important in diagnostic radiology. The topics include production of x rays, interaction of x rays with matter, radiographic image formation, scattered radiation, film characteristics, image blur and resolution, fluorescent screens, image intensifiers and fluoroscopy, tomography, image noise, patient dose and ultrasound. (The latter topic may seem anomalous, but ultrasonic imaging is an important diagnostic tool in most radiology departments today.)

By and large, the choice of topics is excellent, the level of presentation is appropriate to the intended audience (radiological residents and technologists), the illustrations are profuse and well done, and the exposition is clear. The book, however, has one major flaw. In his zeal to simplify complicated subjects, Sprawls has often glossed over important points and has allowed some serious errors to creep in.

The reader can find several examples of this problem in the discussion of image blur and resolution in chapter 15. Figure 18 alone illustrates two gross misconceptions. The first is that an object having a sinusoidal thickness variation would produce a sinusoidal exposure variation on the radiograph. The second is that an object consisting of a *single cycle* of a sinusoid can be used to get a direct measure of MTF—the modulation transfer function.

An additional error concerning MTF shows up in figure 5 of chapter 15 and in the associated text. In that figure he plots the MTF associated with "receptor blur" (apparently a gaussian) and that associated with the x-ray tube focal spot. The latter curve is evidently a sine function, since the author states that "*most* focal spots" have a rectangular profile. Sprawls makes a considerable point of the fact that the focal-spot MTF goes to zero at one point. Yet, inexplicably, he does not plot the curve beyond this zero point. He thus does not mention the interesting phenomenon of contrast reversal, clearly evident in figure 7 of chapter 16, and leads the student to believe that the system has no response at all for spatial frequencies beyond the first zero of the MTF.

A most egregious error of omission occurs in the section on computed tomography. The author states, correctly enough, that many systems use the procedure of back-projection. He does not point out, however, that back-projection alone is totally inadequate and that some spatial filtering operation is also required. Basically he has described a method of reconstruction known since about 1940, and not the exciting new method of computed tomography.

The discussion of ultrasonic beam intensity also leaves much to be desired. The author starts by introducing the "amplitude of the ultrasound pulse," which is undefined except to say that it is "related to the energy content or 'loudness' of the ultrasound pulse." A brief paragraph on intensity ends with the following totally misleading sentence: "Since the pulse rate is fixed in most systems the intensity of the beam is proportional to pulse amplitude when the amplitude is expressed in decibels." Sprawls nowhere explains the simple notion that intensity is proportional to the square of the amplitude.

I could cite several other examples of oversimplification or outright error. If, as the dust jacket proclaims, this was indeed the "only comprehensive textbook on the Physics of Diagnostic Radiology," we could ignore these problems. However the field has long had an excellent text, *The Physical Aspects of Diagnostic Radiology* by Michel Ter Pogossian (Harper and Row, 1967). Except for the inadequate discussions of computed tomography and ultrasound, it is difficult to see what is added to the literature by Sprawls's book.

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Celestial Masers

A. H. Cook
135 pp. Cambridge U.P., New York, 1977. $15.95

Maser radiation—microwave amplification by stimulated emission—was first detected from galactic sources in 1965. More than ten transitions of the molecules OH, H_2O, and SiO have now been found to be strong masers. Observations with very long baseline interferometry indicate that the individual masers are very small, approximately 10^{13}–10^{15} cm in diameter. This information, and the observed maser intensities, require very high brightness temperatures, around 10^{10}–10^{15} K, of the radiation. In the most spectacular source, the rate of energy output in a single H_2O line is equal to one-tenth that of the Sun. The maser phenomenon indicates departure from thermal equilibrium. How it arises in space presents an interesting question. Many of the observed masers are located in dense clouds where stars are formed, and a study of them may also help reveal the physical conditions and kinematics in those regions of star formation.

In *Celestial Masers* Alan H. Cook reviews the literature on masers. He gives an introduction on the structure and spectrum of the OH molecule, summarizes the observations on the intensities, sizes, polarization properties and time variations of the OH and H_2O masers, and gives an account of the published pump mechanisms. To illustrate the principle of amplification by stimulated emission, Cook considers a linear maser in detail and summarizes the results for cylindrical and spherical masers. The author has contributed to the literature on a study of an interesting property of the OH masers, which is that many of them are 100% circularly polarized. He discusses this property at length and explains it as due to a combined variation in both the magnetic field and velocity motion of the gas such that one Zeeman mode is preferentially amplified.

A major shortcoming of the book is that it draws mostly from literature published before 1974. In view of the considerable development in the field since, the book is out of date. Thus Cook does not discuss the interesting SiO masers, which arise from rotational translations in the first and second excited vibrational states. He does not incorporate or barely men-