trative examples. The developments treated are clearly written and fairly easy to follow, although absorbing new concepts is always a fairly slow process; knowledge of at least a number of the basic ideas in abstract algebra is advisable for anyone wishing to go through the whole book.

The translation into English is better than that of most translated mathematical works which I have encountered. The typographical errors noted were obviously such and could easily be corrected by the reader.

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Mathematics

Elements of General Topology. D. Bushaw. Wiley, New York, 1963. viii + 166 pp. Illus. $6.95.

It is refreshing to discover a book which, in some 150 pages, transmits and unifies so many aspects of a basic branch of mathematics as does Bushaw's *Elements of General Topology*. The book is suitable for use in a one-semester course and the author's stated prerequisites of some knowledge of set theory and 3 years of sound undergraduate mathematics are realistic. After a leisurely, instructive, historical account, a well-motivated approach to a topology via axioms for open sets is followed by equivalent axiomatizations via neighborhoods, closed sets, closure, and later, subbases, bases, and neighborhood bases. Chapter 3, a brief treatment of continuity and homeomorphism, is followed by a discussion of subspace, product, quotient, and metric topologies (and later, uniformities), nicely unified by the observation that all are induced in a natural way by a function and a given topology (uniformity). T_4-separation and connectedness are discussed in chapter 5, along with equivalence in metric spaces and implications in general of Frechet, sequential, and covering compactness. A very clear proof of Tychonoff's product theorem is given. Bourbaki's influence, mentioned by the author, is evident. The concept of filters, rarely found in English texts, is clearly expounded and used in the chapters on uniform spaces and their completion (the last two chapters).

Bushaw has succeeded well in adhering to basic concepts with minimum distraction. His knack for choosing useful forms of effective results makes for easy reading and neat proofs. Involved proofs occur only in the last 20 pages, and many well-chosen examples and more than 200 graded exercises are spaced strategically throughout. Appendices include basic set theory, a bibliography, and hints or answers for some exercises. A minimum of errors—perhaps a dozen typographical, a couple of wrong formulas, and but one glaring error in an example (the latter on page 30) —and clear but informally stated definitions contribute to the readability of this text.

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Intermediate Textbook

Thermal Physics. Philip M. Morse. Benjamin, New York, revised edition, 1964. xiv + 455 pp. Illus. $10.50.

This book comprises the text materials used by Philip M. Morse in the course in thermodynamics and statistical mechanics which is required of senior physics majors at Massachusetts Institute of Technology. Those who are familiar with the preliminary edition published in 1962 will find this regular edition somewhat enlarged by the addition of a few topics, rewritten and improved in clarity, but essentially unchanged in choice of subject matter and order of presentation.

In *Thermal Physics* Morse undertakes to present, in three separate sections, ordered discussions of thermodynamics, kinetic theory, and statistical mechanics. No one can deal with all of these subjects in 400 pages, and the success of a text like this will depend on the degree of agreement between the author's preferences and those of the instructor and students who use the book.

Morse's preferences are clearly theoretical, and he places emphasis, in both text and problems, on ideas and algebraic development. There is virtually no discussion of experiments or experimental procedures bearing on the ideas, and actual data appear irregularly and in many cases approximately. Those who enjoy (or require) careful attention to the hard facts of experiment will find Morse's treatments disappointing; those who prefer horseback estimates in getting a feel for theory will be pleased.

The first third of the book is given to a conventional treatment of classical thermodynamics along historical lines. The discussion is concise, but Morse manages to include reasonable reference to the third law and a long section on helium II. It is pleasant to see attention paid to systems having more than two independent variables. But for a book oriented toward theory, some of the discussion is weak. There are, for example, no sharp definitions of such basic ideas as heat and internal energy. The treatment of the second law is based on Clausius and Kelvin, with no hint that modern alternatives exist for good reasons. Even within the Clausius-Kelvin limits, there is only casual discussion of the problem of approximating an arbitrary cycle by a set of Carnot cycles. The algebraic manipulations are done by the common elementary procedures (all too frequently opaque to students), without the simplicity and gain in conciseness available through the use of Jacobians. These are common characteristics of texts in thermodynamics; but they are not necessary in even a short treatment, and they mar a book newly written in the 1960's.

The second section, about 90 pages, discusses kinetic theory, chiefly of gases, but with some discussion of magnetic materials. It provides a very useful opportunity to introduce ideas of probability, phase space, distribution functions, and the like in the context of the rather specific kinetic theory model.

After a bow to classical statistical mechanics (Liouville's theorem), Morse develops a modern treatment of statistical mechanics by postulating the connection between entropy and the distribution function. This is then illustrated in a short chapter on the microcanonical ensemble and in extended discussions of the canonical ensemble, with applications to the theories of specific heat (including the Debye theory), the properties of gases, and paramagnetic materials. The grand canonical ensemble is introduced and is used to treat Einstein-Bose and Fermi-Dirac as well as Maxwell-Boltzmann systems. Tastes in statistical mechanics are individual, but Morse's choice of basic approach is defensible, and his treatment of it is excellent. Only the optional last chapter disturbs me; the student who has studied quantum mechanics will find little that is new, while the student who has not will find the discussion too concise to be instructive.

Morse's book has many virtues: it is clear within reason, its physics is good and solid, and best of all it conveys a flavor of unity that must represent the author's own comprehension of thermal phenomena. The sense of unity is surprising in a book oriented to theory, since thermodynamics and statistical mechanics are basically quite different subjects whose marriage in a single course is a study in contrasts. But instructors and students who share a singlemindedness similar to Morse's, and a preference for theory, will find *Thermal Physics* the basis of a successful intermediate course. Even those who would wish for more attention to experiment and a more eclectic treatment could read and teach the book with profit. And perhaps in a future edition Morse could add data and references (at least) to make his book more versatile without sacrificing its unity.

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Wanted: Amateur Sleuths

Meteorites. Fritz Heide. Translated from the second German edition (Berlin, 1957) by Edward Anders and Eugene R. DuFresne. University of Chicago Press, Chicago, 1964. x + 144 pp. Illus. $6.50.

This little book is so simple, lively, and clear that many laymen can read and enjoy it. In his preface, the translator, Edward Anders, mentions that F. A. Paneth, in his very favorable review of the original book, said that he was opposed to a translation because "It can be assumed that most scientifically minded people, especially students at universities, know at least a little German." Anders, with the assistance of Eugene DeFresne, has now translated the book. Although it is debatable how much German scientifically minded people and students at universities know, it is not debatable that Fritz Heide's book is an excellent introduction to the subject of meteorites.

Meteorites are chunks of material that fall to the earth from outer space. The subject kindles interest easily. Heide's book, having only 131 small pages and being so easily readable, is the ideal first book on the subject. There is little danger that this book will extinguish anyone's interest. My biggest complaint is that the $6.50 price tag for the clothbound edition puts it out of the range of many high school students and even libraries. There is, however, a $1.95 paperback edition.

Although scientists have studied meteorites for 150 years, nonscientists have studied them much longer. Until recently, the number of laymen interested in meteorites greatly exceeded the number of professional meteoriticists. With the advent of the space age, meteorite research in the United States has accelerated tremendously, but the ratio of interested laymen to meteoriticists appears to be decreasing. In contrast with other branches of science, the ratio of laymen to scientists interested in meteorites is of vital importance to the subject itself, since the science of meteorites depends almost completely on laymen to collect samples. The amount of meteoritic material available for research is diminishing, although the need for such material is growing. The laboratory studies of these interesting objects, made with the modern tools of science, use increasing amounts of material, and most experimental findings stimulate more research. Since the number of falls from the sky cannot be increased, the collection efficiency must somehow be improved. The obvious way is to increase the number of collectors by interesting more laymen in meteorites. Heide, in his last paragraph, presents this ticklish situation in a somewhat different vein:

> In contrast to many other branches of natural science, the science of meteorites is in the enviable position of being able to invite large groups of the public with an interest in natural science to active participation, instead of merely passive reception of research findings. We have seen of what great importance is the entire complex of phenomena associated with the fall of a meteorite. Even limited and apparently insignificant observations by laymen can, if sufficiently numerous and made with sufficient accuracy, provide the basis for far-reaching and important conclusions. The author will be most pleased if he has succeeded in arousing interest and the desire to participate actively in our sciences in at least some of the readers of this little book.

Heide's book consists of three chapters. The first describes the phenomena associated with the fall of a meteorite—the displays of light and sound that accompany the deceleration in the atmosphere, the impact with the ground, and the craters. He also tells how one recognizes meteorites. Practically every page contains a photograph or a figure. The sections on the hazards connected with the fall and on historical facts are particularly entertaining. I did not know that a number of monks were hit by meteorites during the Middle Ages, nor that one killed a dog in Nakhla, Egypt, and another a colt in New Concord, Ohio. I also did not realize that Thomas Jefferson had put himself on record with the remark that it was easier to believe that a Yankee professor would lie than that stones would fall from heaven. The author also quotes other 18th-century scientists, including Lavoisier, on the absurdity of stones falling from heaven. His discussion of the first scientific book on meteorites, published in 1794, by the German physicist Chaladni, *On the Origin of the Iron Masses found by Pallus and others Similar to It, and on Some Natural Phenomena Related to Them,* stimulates my interest in the history of science.

The second chapter describes the meteorite matter itself—the sizes, surface features, and shapes and the chemical and mineral compositions. Here, too, photographs and figures on every page illuminate the text. Meteoriticists are astronomers, physicists, chemists, metallurgists, geologists, and biologists, none of whom often pays much attention to the specialist with a different background from his own. Heide is a professor of mineralogy and petrography at the University of Jena, but he emphasizes other studies more than mineralogy. This is remarkable and may be one reason why the book is so simple and clear.

The third chapter, on the ages and origin, is not so lively as the rest of the book. The attempt to cover uranium-helium ages, potassium-argon ages, and cosmic-ray exposure ages in four pages, which also contain two long tables, is not so successful as the rest of the book.

Because of the topic's relation to our space program, I would have expected a rash of American books on meteorites, but only two have appeared during the past 2 years—Brian Mason's *Meteorites* (Wiley, New York, 1962) and this translation. Both are needed. Heide's book stimulates the interest; Mason's book provides the vehicle by which people can easily go more deeply into the subject.

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