overcrowded with footnotes, which stifle the effect that a continuous narrative might have given. On the other hand, there are numerous flashes of insight into the significance of an act or the character of an actor that suddenly light up the situation and almost justify the rather drab setting without which they would not stand out so clearly. But the interest is maintained throughout, and the reader feels that he has been admitted not to a drama of the imagination but to events that actually happened.

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Applications of Spinor Invariants in Atomic Physics. H. C. Brinkman. North Holland, Amsterdam; Interscience, New York, 1956. 72 pp. $3.25.

This slim monograph is intended to introduce the physicist to spinor invariants and their use in atomic physics. The development of these methods was initiated by H. A. Kramers, to whose memory the book is dedicated. Spinors and their invariants are introduced into atomic physics systematically, not only to treat the electron spin but for all quantities that might otherwise be represented as spinors, vectors, or tensors. That this is possible is well known. All of these quantities have transformation laws that are representations of the three-dimensional orthogonal group or, in relativistic theories, of the four-dimensional Lorentz group. They may be obtained from the representation by spinors as multiple Kronecker products. In less technical language, a vector is equivalent to a set of quantities bearing two spinor indices, and so on. Accordingly, the possibility of formulating all the more important results of invariance-theoretical considerations in spectroscopy by means of spinors and their invariants is beyond doubt. Whether it is desirable, as a means of unifying a variety of different results and considerations, is largely a matter of taste.

The book is divided into three major parts: the first deals with the formal relations between three-dimensional rotations in a real space and two-dimensional unitary transformations in a complex space; the second is devoted to the construction of wave functions for systems containing N spinning electrons; and the third deals with some more detailed calculations, including spin-orbit interaction and intensities of spectral lines.

The presentation is on the whole clear and straightforward. In my opinion the presentation of the foundations would have gained much if it were less formal. As it is, the introduction of spinors appears contrived and artificial. A reader who is already familiar with spinor theory will have little difficulty in this respect, but he does not require the wealth of mathematical detail offered in the first part. Aside from this criticism, the author should be commended for building the theory step by step, treating, for instance, the scalar (nonrelativistic) electron before introducing the Pauli electron. Whether the omission of Dirac's relativistic theory can be justified is another question.

Because of the somewhat historical nature of the subject matter, including the restriction to nonrelativistic atomic physics, it is questionable whether a monograph was the ideal form of publication for this article. Articles of similar scope are frequently published in such journals as the *Reviews of Modern Physics*, whose subscription price for a year is only slightly higher than the price of this book.

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Nuclear Radiation Detectors. J. Sharpe. Methuen, London; Wiley, New York, 1955. 179 pp. $2.50.

This little volume is one in the well-known series of Methuen's Monographs on Physical Subjects. It covers virtually the entire field of nuclear radiation detectors in 180 small pages. There are six chapters containing the following material: Chapter I, introduction, is a brief qualitative description of the basic processes involved in detection. Chapter II is more specific and more quantitative and describes the interaction of neutrons, gamma rays, and charged particles with matter. A short section of this chapter discusses Cerenkov radiation. Chapter III, on detection media, is a larger chapter describing phosphors and scintillating crystals, secondary emitters, crystal conduction counters, and gaseous ionization media.

The efficiency of detectors is covered in Chapter IV. This material includes solid angle considerations, window absorption, electron yields from the walls of Geiger counters, and so forth, and a section on mean level detectors (as distinguished from detectors counting individual events) and dosage measurements. Chapter V is concerned with the scintillation counter. In this chapter, one finds a brief discussion of the photomultiplier, an unexpectedly large section on alpha-particle scintillation counters, some discussion of the uses of scintillation counters as electron and gamma-ray energy spectrometers, and a cursory account of fast-and-slow-neutron scintillation counters.

Chapter VI is the last and largest chapter and is concerned with gaseous ionization devices, such as ionization chambers and counters, proportional counters, Geiger counters, Geiger-Müller counters and their various properties. One can see from the rather ample list of topics discussed by Sharpe that, on space considerations alone, a thorough handling of each subject would be impossible. Yet the detail presented is quite surprising, and in many respects the work is written with authority. The author is obviously well grounded in many of the various fields he chooses to describe.

The diagrams and other drawings are well chosen; the tables are quite informative and up to date. Mathematical expressions appear to have been selected with attention to their basic importance. I am much impressed by the last chapter on gaseous ionization detectors.

There are a few minor matters that I noticed which may need a little comment. The general method of growing NaI(Tl) crystals uses the Bridgman method rather than the Kyropolous method (p. 121). The decay constant of ZnS-Ag has been reported by Koontz to be faster than the 3×10^{-6} sec given on page 126. The Sternheimer reference (33), on page 36, to energy loss of electrons has been rendered obsolete by a later Sternheimer reference (*Phys. Rev.* **91**, 256 [1953]).

All in all, I heartily recommend this little volume to veterans of the field as well as to beginners. If a concise book on nuclear-radiation detectors is needed, then this book is *it*. It is to be hoped that Sharpe may someday be willing to expand the material into a full-length venture.

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Protoplasmatologia. Handbuch der Protoplasmaforschung. vol. VIII, *Active Transport through Animal Cell Membranes.* Paul G. Lefevre. Springer, Vienna, 1955. 123 pp. Illus. $9.

In the branch of cellular physiology that deals with "permeability," the notion of "active transport" has gained considerable ground during the past few decades. In his discussion of this development, the author places emphasis on the lines of investigations that have to do more or less directly with the activity of cells in the translocation of substances through the cell surfaces and avoids including other physiological processes that conceivably might fall under the heading of the volume but would necessitate ad-

dition of an enormous body of literature. Concerning the delimitation of the term *active transport,* it is held that any transfer process may appropriately be considered if the role of the cells appears to be more complex than merely offering a selective resistance to diffusion. The transports discussed are in general either between the interior and the exterior of the cells, or through layers of cells from one side to the other.

The report deals entirely with actual experimental results in animal systems. These are compartmentalized in six sections, which deal with the transfer of inorganic cations, inorganic anions, sugars and related compounds, amino acids, fatty acids, and water. The sections are individually arranged in terms of the type and the function of the cell or tissue involved.

Throughout the volume emphasis is placed on such generalities or specificities as the investigations may reveal in comparable activities of different biological systems. It then becomes evident that there are differences, somewhat erratic in nature, in the operations of even closely related transport systems, in different types of cells, or in different organisms. This attests to the impossibility of drawing, at the present stage of information, any significant generalizations regarding the characteristics of these processes or regarding the nature of the basic patterns in the structure and functional mechanics of the active transport phenomena. Perhaps the most noteworthy result brought to light is the observation that relatively few cell types exist that exhibit an entirely passive diffusion pattern. It rather appears that the typical healthy animal cell is engaged actively in the transfer of the bulk of the net material through the membrane of the cortical layer. In the course of the cell's ordinary activities, the transfer does not simply result from movement along activity gradients through pores or through the substance of the membrane.

There are 19 tables, 31 figures (graphs), and a bibliography comprising 565 full citations.

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Thermal Power from Nuclear Reactors. A Stanley Thompson and Oliver E. Rodgers. Wiley, New York; Chapman & Hall, London, 1956. 229 pp. Illus. $7.25.

The title might lead one to believe that this book deals mostly with heat transfer and power generation, but this is not the case. Actually, it would be more descriptive to call this book an introduction to reactor engineering, if this title had not previously been pre-empted by earlier textbooks. The first two-thirds of the book are devoted to reactor physics and reactor calculations and only the last third to heat generation and removal.

The textbook is suitable for a senior in the average engineering school. The authors presuppose a working knowledge of differential and integral calculus and of nuclear physics at the level covered in Lapp and Andrews' book. The approach to the reactor equations is somewhat pragmatic in that a number of the relations are presented as revealed knowledge or simply deduced. This really is not a drawback for the reader who needs only a working knowledge of the equations and a "feel" for relative magnitudes. If at a later date the student wishes to go more deeply into some phase of reactor design, he will find that Thompson and Rodgers' book has given him an excellent perspective.

The book opens with a very brief review of the nuclear physics directly applicable to the subject under consideration and an equally short discussion of neutron ballistics. It is perhaps unfortunate that the authors discuss elastic scattering in terms of a force field repulsion instead of at once introducing the concept of the compound nucleus, since the latter picture is much more suitable for any discussion of resonance scattering.

Following is a long chapter on reactor equations and computation of critical masses. The discussion is applicable mainly to enriched, thermal reactors. The section on numerical methods for critical reactors is valuable, and the material has not, to my knowledge, appeared in other textbooks. This chapter could have been strengthened by a discussion of the resonance integral; reactors of low enrichment are becoming more and more important as power producers. Chapters on kinetics and shielding complete the sections devoted purely to reactor physics.

Reactor materials and thermal stresses are the subjects of the next two chapters. The latter is particularly valuable and, unfortunately, is omitted from most textbooks on reactor engineering. Conventional chapters on heat transfer and thermal power cycles conclude the book.

The text contains no descriptions of reactors themselves, no discussion of reactor chemistry or chemical technology, and no problems for students to solve. The last is a handicap for class use. Nevertheless, I believe that this is the best textbook now on the market for use with a one-semester, senior course in reactor engineering. My opinion is based on past experience in teaching several elementary reactor engineering courses. On the other hand, it would be difficult to stretch the material in this book to cover two semesters, and an additional textbook is indicated if the course is to run a full school year.

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Comparative Endocrinology of Vertebrates. pt. II, *The Hormonal Control of Water and Salt-Electrolyte Metabolism in Vertebrates.* Proceedings of a conference held at the department of zoology, University of Liverpool, 12–16 July 1954. Memoirs of the Society for Endocrinology No. 5. I. Chester Jones and P. Eckstein, Eds. Cambridge University Press, Cambridge, England, 1956. 124 pp. Illus. $4.75.

Hormones circulate, not only in rats and men, but also in frogs and fishes. Hormones were first recognized to influence dramatic phenomena like sex characteristics; now they are admitted to show their powers continuously in the control of permeability and salt-lethality. The endocrinologists who came to the conference that this volume reports thinking that too little material would be available on nonmammals went away feeling that insufficient review had been given to extant knowledge in all vertebrate classes. The papers printed here followed in the same week of 1954 those on the comparative physiology of reproduction and sex hormones that were published last year as memoir No. 4.

Each of seven biologists presented a comprehensive and well-documented review. Two dealt with fishes (Fontaine, D. C. W. Smith), two with amphibians (Sawyer, Capraro), one with tissue electrolyte exchanges in general (Conway), and two with formal comparisons among classes (Heller, Chester Jones). Extensive and pointed discussions followed each review.

Muscles and skins of frogs historically furnished the clearest evidences of "active" processes in water and electrolyte exchanges. Endocrine glands of cattle furnished most of the hormones to be tested. Mixing the two, recent investigators obtained the basic facts about the hormonal regulations of exchanges as known today. Water and sodium intake through frog skin (both intact and isolated) is largely governed by neurohypophysial hormone concentrations. Excretion of the same substances through frog kidneys is modified by the same agents. Faster intake goes with slower output, which illustrates an integration of controls. Speculations reported here largely center on the kinds of forces that operate in frog skin; these speculations are richly balanced with facts cited.