analyzed in the supplementary notes.

This book achieves a very broad coverage of subject matter in a limited space by confining formal developments to the main points, without presenting detailed proofs. In concluding his review of the original edition, Einstein recommended Pauli's treatment to "everyone working creatively in the field of relativity as well as to everyone who wants an authoritative orientation in fundamental questions."

Another of Pauli's legacies to modern physics is his equally highly esteemed article on "The general principles of wave mechanics," in the *Handbuch der Physik* [(Springer, Berlin, 1958), vol. 5, part 1]. It would be of at least equal value to the large community of monolingual American physicists if this, too, were to find its way into English.

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Aircraft and Missile Propulsion. vol. 1, *Thermodynamics of Fluid Flow and Applications to Propulsion Engines.* 538 pp. Illus. $11.50. vol. 2, *The Gas Turbine Power Plant, Turboprop, Turbojet, Ramjet, and Rocket Engines.* 636 pp. Illus. $13. M. J. Zucrow. Wiley, New York; Chapman and Hall, London, 1958.

These two volumes represent a considerable step forward from the author's earlier book, *The Principles of Jet Propulsion and Gas Turbines* (Wiley, New York, 1948). Zucrow, a noted expert in jet propulsion and a teacher of many years' standing, has recognized that the practices of jet propulsion have moved forward in the past decade and require a more comprehensive treatment. This he has provided.

He has included rocket propulsion in these volumes, correctly categorizing it as a branch of jet propulsion. That rocket propulsion belongs in this category has not always been well understood by other authors, some of whom have tended to separate air-breathing and rocket jet propulsion.

Volume 1 consists of five chapters, of which the first is a review of fundamental principles. This is one of the more valuable chapters, since it allows the reader to go back and "brush up" on fundamental principles without referring to other volumes. Indeed, laudable as the inclusion of this chapter is, one wishes the author had made it even longer, to include, perhaps, more definitions—in particular of words such as *entropy*—and more background on compression and expansion processes in gases.

One of the very important problems facing the jet engine (and rocket engine) designer is that of heat transfer. Again, a separate chapter on the principles and practices of heat transfer would have been desirable. Indeed, since so much has been written on ballistic equations for space flight, and since other good treatises are available on solid-propellant rocket design, one wishes that the two chapters on ballistics and space flight in volume 2 could have been replaced by one very good chapter on the advanced principles of fluid mechanics and heat transfer.

Nevertheless, the author has vigorously and thoroughly covered (volume 1, chapters 2–5) the general characteristics of propulsion systems, the thermodynamics of compressible fluid flow (inclusion in this chapter of some of the theory and principles of shock tube phenomena would have been interesting), gas flow through nozzles, and flow through diffusers. In these later chapters, a more thorough treatment of rocket and jet-engine nozzle design would have been helpful. Some controversy and some empiricism are manifest in the rocket industry today in connection with the design of the exhaust nozzle. Some designers favor straight cones and other so-called "Prandtl" nozzles. It is true that Zucrow had no thought of catering to the designer (and this is proper), but at least a discussion of the gas flow phenomena in curved nozzles and of the related theory would have been helpful.

In volume 1 Zucrow has included many tables which contribute greatly to an understanding of the theory that he presents. I found his charts of isentropic compressible flow and his tables of conversion factors for dynamic viscosity most helpful.

There is, of necessity, some duplication of material in volumes 1 and 2, but the latter concentrates more on the practical problems of jet engines, covering gas turbine power plant cycles and analysis of ideal cycles (chapter 6); analysis of gas turbine power plants and the turbopropeller engine (chapter 7); and the turbojet engine (chapter 8). These three chapters are easily the most useful I have found in the literature, and section 9 (of chapter 9), on the turbojet engine, which deals with flight performance at the design point, is remarkable for its conciseness and thoroughness.

In chapter 9 the author devotes about 60 pages to the ramjet. This important power plant, somewhat neglected in the literature, warrants all the description and analysis possible. Indeed, the chapter might have been rounded out a bit with a review of actual problems met in the last few years and discussion of the application of ramjets in the field of missile propulsion. There are some interesting variants of the ramjet and turbojet engines called turborockets and ramrockets. It is true that the author concentrates on fundamental principles as much as possible, but a description, at least, of these power plants would have been desirable. Perhaps this will be included in volume 3.

Perhaps the largest single instance of increase in text material over the earlier book on jet propulsion occurs in chapter 10, "Rocket jet propulsion." Some of the nomenclature and standard expressions—for example, "specific impulse"—reflect the author's earlier work and show that standardization of symbols and terms in the field of rocket propulsion has not yet been achieved. I had to refer continuously to the principal notation at the beginning of the chapter (this notation covers more than two pages and is somewhat labored) in order to understand the equations or at least the terms the author has used in this chapter. The last section of the chapter, on questions of space travel and the multistage rocket, covers only eight pages and might as well have been left out, since, as was stated before, there are more voluminous books available on these subjects. Similarly, the author, in trying to cover as wide a field as possible, has included (section 8, chapter 10) a review of interior ballistics of solid-propellant rocket motors. While this material is useful, it might have been better used for, say, a thoroughly theoretical treatment of rocket combustion, particularly in one of the author's pet fields, combustion instability.

Six tables on enthalpies, rocket propellant properties, and equilibrium constants complete this volume.

In general, despite the minor shortcomings I have noted, these two volumes are a most useful addition to the library of the engineer and designer who wants to get a good understanding of jet propulsion principles without having to refer to a vast number of treatises on the subject.

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Hydrogéologie. Introduction à l'étude des eaus destinées à l'alimentation humaine et à l'industrie. P. Fourmarier. Masson, Paris; Vaillant-Carmanne, Liége, Belgium, ed. 2, 1958. 294 pp. Illus. Paper, F. 3000.

This book is the second edition of a well-known textbook of hydrogeology (or ground-water geology) which was published originally in 1939. Although the present edition contains only ten pages more than the previous edition, an expansion of about 20 percent has been accommodated by use of smaller

type. An improved coverage of water quality and of hydrology of arid regions accounts for much of the expansion. A useful summary of water purification methods has also been added as an appendix.

The book has three major parts. The first covers the general principles of occurrence and movement of ground water. Some of the topics in this section are the hydrologic cycle, porosity, permeability, confined water, unconfined water, and ground-water maps. The second part covers the utilization of water and includes discussions of water quality, diversion of surface water, recovery of ground water, ground-water yield, ground water in areas of permafrost, and ground water in arid regions. The third section contains a discussion of ground water that has unusual thermal or chemical properties.

Many of the recent advances in ground-water geology are not discussed. Topics such as well hydraulics, isotopic composition of water, and geophysical exploration for ground water are either not included or are treated superficially. Some of the terminology also lacks a modern perspective. For example, the term *permeability* is used to describe the variable that many hydrologists prefer to call "hydraulic conductivity." The definition of *permeability* used in the book perpetuates Meinzer's cumbersome expression, which, however, has been dressed in metric units.

Despite these limitations, the book will be valuable to those who desire a general coverage of the topic. A liberal use of diagrams, combined with clear and concise writing, will serve to reduce the language barrier for those whose knowledge of French is limited.

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Introduction to Nuclear Power Costs. Arnold Rochman. Simmons-Boardman, New York, 1959. 50 pp. $2.95.

Information on individual nuclear power cost components is presented as a basis for an analytical study of nuclear-power economics. Such a study would be of great interest to the nuclear energy profession if it were based on current information. However, the author uses data derived from the open literature of the period 1946 to 1954, when classification restrictions were still in force. Because of this, information of vital importance to nuclear-power economics, such as the cost of enriching uranium and the cost of processing spent fuel elements, has been excluded. Such an omission gives one the impression that the study was made 5 years ago and just published. A book so out of date will be of little use in the rapidly expanding field of nuclear-power economics. Because more authoritative and more current treatments of the subject are available, the purchase of this book by libraries and individuals is not recommended.

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Conference on the Chemistry of Muscular Contraction. Igaku Shoin Ltd., Tokyo, Japan, 1958 (distributed in the United States by Charles E. Tuttle, Rutland, Vt.). 140 pp. Illus.

The Committee of Muscle Chemistry of Japan has published in this book the papers presented at the Conference on the Chemistry of Muscular Contraction held in Tokyo in October 1957. Though it was organized on an international level, many leading laboratories in the field were not represented at the conference, very probably for geographical reasons. Thus, the papers do not give a complete picture of the muscle research of today but present, understandably enough, a fairly good cross section of the work of Japanese investigators. In the postwar era a group of very active and enthusiastic Japanese workers made important contributions in the field of muscular contraction. The world-wide recognition that their work has received is reflected in the success of this conference, where 11 of the 24 papers were presented by 22 foreign participants, from five countries.

The character of the great majority of the papers is that of journal articles, complete with experimental materials, methods, and results. The presentation of discussions, written comments, and addenda, following each paper, helps put the data presented in the right perspective. Though the conference was held nearly one and a half years ago, much of the material has not been published elsewhere as yet.

It is beyond the scope of this review to evaluate critically the papers presented. On the other hand, a few highlights may be more appropriate than a mere table of contents. The controversy over whether myosin B dissociates or only changes its shape upon the addition of adenosine triphosphate is resolved in a conciliatory manner by von Hippel, Gellert, and Morales. Myosin B contains three different types of particles; of these, upon the addition of adenosine triphosphate, the largest ones extend, the middle ones dissociate, and the smallest ones—corresponding to myosin A—do not change. Gergely and Kohler calculate from light-scattering data, with oversimplified theory, the stoichiometry and association constants of myosin A and F actin. Association and dissociation reactions in this system are established beyond any doubt; however, one should bear in mind that synthetic actomyosin and the natural myosin B appear to be quite different in nature. On the other hand, it seems that myosin B is not a simple polymer of myosin A, as the Morales group originally thought, but contains some sort of cement, which can be removed by centrifugation, as von Hippel reports in an addendum.

Kominz, Saad, and Laki give an account of the work on invertebrate tropomyosin and discuss the possible participation of the tropomyosins in the structure of myosin. Tryptic digestion of denatured myosin liberates a tropomyosin-like fragment, thus substantiating Laki's theory that the tropomyosins are building stones of myosin.

Asakura, Hotta, Imai, Ooi, and Oosawa, in a very instructive paper, show that the polymerization of actin is similar to the formation of a three-dimensional network. Polymerization proceeds only above a critical protein concentration, which is decreased by increasing divalent cation concentration. The binding of the cations to actin can be demonstrated by electrophoretic and conductivity measurements, but there is no change in the binding properties when actin polymerizes or depolymerizes, or even when it is inactivated by denaturation. Therefore, it is likely that the cation and the actin-to-actin binding sites are at a considerable distance from each other. The authors report in an addendum the striking observation that under certain conditions actin will act as an adenosine triphosphatase, dephosphorylating slowly not only the intrinsically bound, but also the extraneous, adenosine triphosphate.

Tonomura, Matsumiya, Morita, and Kitagawa present double refraction of flow and viscosity data on myosin B solutions, which show that the particles interact strongly, forming an intermolecular entanglement. They also studied the binding of pyrophosphate to myosin B by the equilibrium dialysis technique. The polyanion causes deformation of the myosin particles, and the deformed protein has a much lower affinity for the pyrophosphate anions. Thus, most of the pyrophosphate is liberated upon deformation, but the deformation, once it has been accomplished, is not affected by the removal of the pyrophosphate anions.

The interaction of pyrophosphate with myosin B was studied along different lines by Uchida, Miyazaki, and Nagai. Presumably pyrophosphate binds to the