ing, that is because the author has resisted the temptation to make things easy by the time-honored method of omitting the difficult parts. The bibliography is extensive and includes many references to papers published in 1962.

Those concerned with linear problems would do well to study the book carefully before embarking on computation. Nothing at all is said in it about nonlinear systems, and this too is a fairly accurate reflection of our present state of knowledge!

Hilbertsche Räume mit Kernfunktion. By Herbert Meschkowski. 256 pp. Springer-Verlag, Berlin, 1962. Clothbound DM 58, paperbound DM 53. *Reviewed by Dagmar Renate Henney, University of Maryland.*

WERE it not for the first two chapters which contain an introduction to the theory of Hilbert spaces, this book could be recommended as an informative reference book. The notation used by the author is not the standard one and is liable to confuse anyone whose first contact with Hilbert spaces is through this text. There are mistakes in the proofs of certain theorems, and it might have been better had the author referred the reader to other well-known books for such a background. Here are a few of the reviewer's objections:

On page 6, a linear space with inner product is defined to be a metric space. This notation is very unfortunate, impractical, and easy to misunderstand, since it is not standard notation.

On page 15, a subset $H' \subset H$ is defined to be complete, if the orthogonal space consists only of the origin. From this it would follow that every dense set H' of H is a complete metric space.

The remainder of the book obviously contains the subject matter which is dear to the author. Here the material is well organized and carefully presented. The following subjects are discussed in detail: orthonormal systems with special properties, Hilbert spaces with reproducing kernels, Hilbert spaces with positive matrices, double orthogonality and extremal problems, Hilbert spaces of solutions of elliptic differential equations, and kernel functions in the theory of several complex variables. I do not know of any other book in this field that contains such a variety of material. It develops into a remarkable book as the author progresses.

Distributions. An Outline. By Jean-Paul Marchand. 90 pp. North-Holland Publishing Co., Amsterdam, 1962. Distr. in US by Interscience, New York. Paperbound $4.75. *Reviewed by T. Teichmann, General Atomic Division, General Dynamics Corporation.*

THE theory of distributions (with its concomitant, the theory of generalized functions) has become a fashionable and useful part of modern pure and applied analysis. Together with the related, though not entirely equivalent, modern operational calculus, it enables the direct solution of a variety of important problems involving some degree of nonuniformity which previously required special and not entirely unequivocal treatment in each case. Because the subject was developed from the pure mathematical side, it has, however, been difficult to find adequate short descriptions for the reader more interested in applications—though the books of Erdelyi and Lighthill do cover restricted areas rather well, while the more extensive works of Mikunsinski and Gelfand and Schilow (in German) provide comprehensive and clear treatments of both the theories and their applications. The present book purports to cover a wider range concisely and from a simple point of view. It is allegedly aimed at the physicist, and as such, it should be welcomed. Unfortunately, while the 80-odd pages (at more than five cents a page!) do contain the essence of the theory of distributions and operational calculus, this is somewhat obscured, at least to the physicists, by the author's evident desire to prove his mathematical purity by complicated notations and a specious axiomatic treatment. If one overcomes these hurdles, one finds very little to get one's teeth into: in the chapter on distributions, for instance, there is not even an explicit treatment of improper integrals! The chapter on operational calculus is somewhat more down to earth, but still replete with unnecessary formal jargon.

There is certainly a need for a book covering what this one purports to do, but it has not yet been met. The reader who wishes to learn about these topics, even if only for some applications, will have to do so from the more extensive works mentioned earlier.

Flows in Networks. By L. R. Ford, Jr. and D. R. Fulkerson. 194 pp. Princeton Univ. Press, Princeton, N. J., 1962. $6.00. *Reviewed by Arthur Ziffer, US Naval Research Laboratory.*

THIS book presents one approach to that part of linear programming theory that has come to be encompassed by the phrase "transportation problems" or "network flow problems". Ford and Fulkerson use the latter designation because it is more nearly suggestive of the mathematical content of the subject and also because many of the applications they examine have nothing to do with transportation.

The first chapter, "Static Maximal Flow," studies the problem of maximizing flow from one point to another in a capacity-constrained network. Most of the chapter is concerned with the statement, proof, amplification, and extension of a basic result which the authors call the max-flow min-cut theorem. The proof is constructive and yields a process which forms the basis for almost all the algorithms presented later in the book. Also included in this chapter is a brief discussion of how the max-flow min-cut theorem is a kind of combinatorial counterpart, for the special case of the maximal flow problem, of the more general duality theorem for linear programs.

The first part of Chapter 2 develops several theo-

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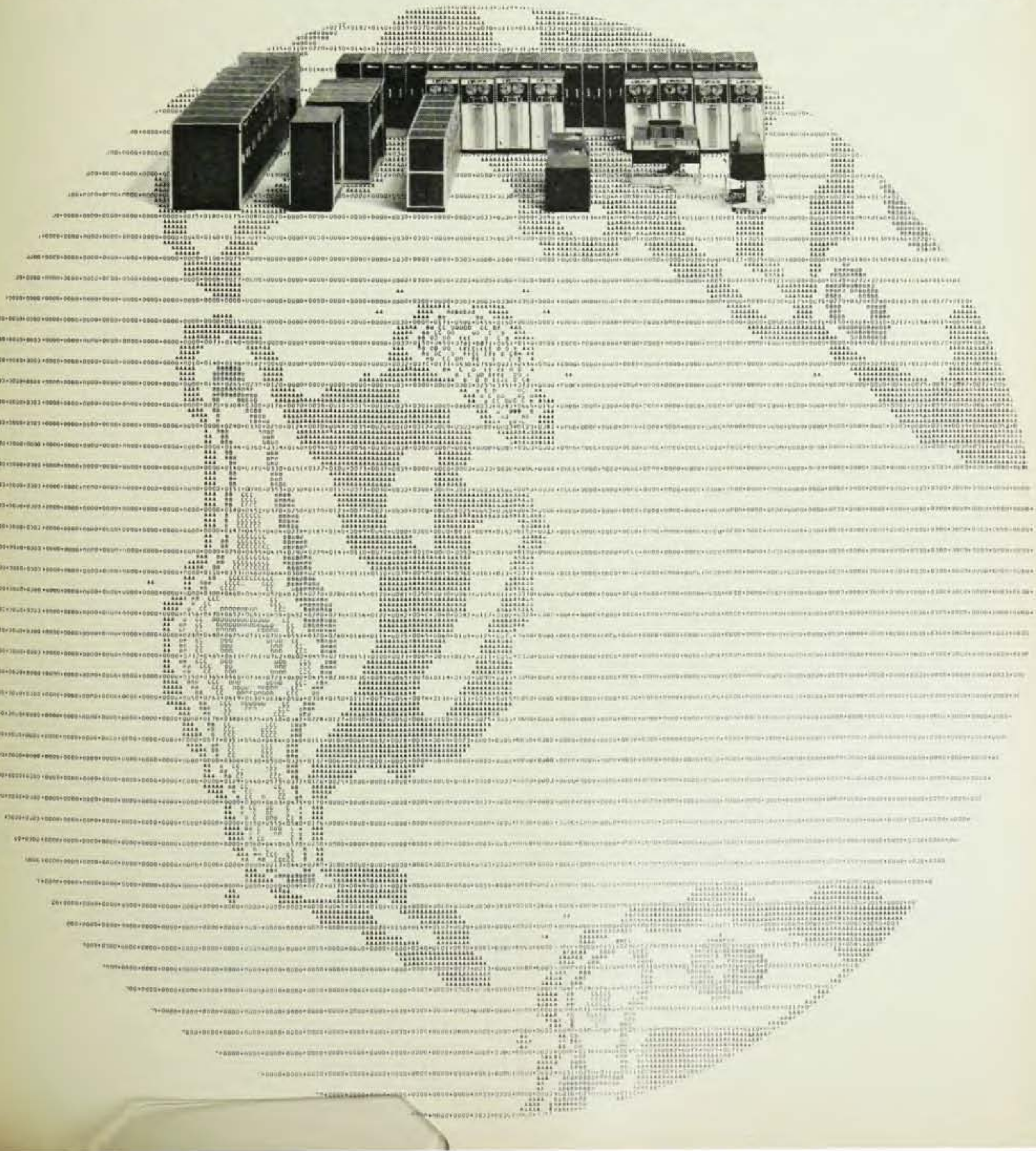

rems which give necessary and sufficient conditions for the existence of network flows that satisfy additional linear inequalities of various kinds. Adopting linear programming terminology, the authors call these feasibility theorems. These results, combined with the use of a theorem obtained in Chapter 1, the integrity theorem, are then used to consider various combinatorial problems for the remainder of the chapter. Examples of the latter are the König-Egerváry and Menger graph theorems.

The problem of constructing network flows that minimize cost is the substance of Chapter 3. An algorithm is given for obtaining solutions to the Hitchcock problem (the standard transportation problem) which is a generalization of a combinatorial procedure developed by Kuhn for the optimal assignment problem (a special case of the Hitchcock problem), and the equivalence of the Hitchcock and minimal cost flow problems is shown. This chapter also contains brief discussions of the warehousing and caterer problems.

In the short concluding chapter, "Multi-Terminal Maximal Flows," a return is made to the topic discussed in the first chapter. However, instead of focusing on the value of a maximal flow from one specified node to another, attention is shifted to certain questions that arise when all pairs of nodes are considered.

The book should be of value not only to those interested in linear programming but also to those who are concerned with graph theory.

Biophysical Science. By Eugene Ackerman. 626 pp. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1962. $13.35. *Reviewed by Joseph G. Hoffman, University of Buffalo.*

BIOPHYSICS is a vast and sprawling area which probably will never become defined. Ackerman's book does not define areas but rather shows the general approach to biology from the physical sciences side. The title is appropriate because in the 31 chapters he discusses 31 distinctly different facets of biology covering a wide range of diverse subjects. The range is enormous and presupposes a teacher who will be fluent in both physical and biological sciences. I refer to "teacher" because this is a classroom text. It is a guide to an interdisciplinary subject whose involuted topics require pedagogic elaboration.

Take for example the statement in Chapter 21, p. 389 that: "The second law of thermodynamics is concerned with the direction of time." In the context presented, the student might be led to believe that physical entropy could be used as a kind of measure of time. Physical theory does not permit this inference. It may yet turn out that our biological sense of time originates in some as yet unknown feeling of entropy. On the other hand, there are the pacemaker ideas according to which the brain may have in it cells that are electromechanical oscillators and serve as chronometers. Thus entropy, as a thermodynamic quantity, becomes a starting point for the examination of our biologic concept of time. One is reminded of Eddington's earlier discourse on time and its possible relation to entropy.

Entropy might be a starting point for another basic exploration: on p. 465, Chapter 25, Information Theory and Biology, a single sentence is devoted to the relation between negative entropy and average information. Here much discussion is called for, and a teacher will have to expound the possible relationship between these strange quantities in the life process. Ackerman has left the topic wide open, which is undoubtedly the best approach for pedagogic purposes. Physical entropy of a cell is a lively and unresolved problem. Its mention in this text gives an indication of the author's broad point of view toward problems of living systems.

The format is of the best. There is a generous supply of figures and tables, as well as four appendices. The table of contents and index serve the reader well. Each chapter has at its end a list of selected references. Each of the six major sections into which the book is partitioned ends with about twenty questions aimed to illuminate further the several chapters of each section. For pedagogic purposes this is a highly commendable text.

Physicomathematical Aspects of Biology. Proc. of Internat'l School of Physics "Enrico Fermi" (Varenna, Italy, July 1960). N. Rashevsky, ed. 524 pp. Academic Press Inc., New York, 1962. $16.00. *Reviewed by George H. Weiss, University of Maryland.*

RECENT years have seen increasing expression of the feeling that biological research suffers a lack of theoretical underpinnings. In just the same way as physics acquired direction with Newton's axioms so, it is argued, will biology benefit from a systematic application of those quantitative techniques which have been successful in theoretical physics. For the last twenty years or more, Professor N. Rashevsky of the University of Chicago has been the leader of a most vocal school of mathematical biology. The present volume contains a collection of papers which to a great degree have been influenced by the work of his school.

Perhaps the best—and in a sense the most disappointing—of the papers is one by M. E. Wise on human radiation hazards. It is an extensive discussion of the relation between radiation and leukemia incidence and gives a careful summary of all of the factors which are believed to be operative. Unfortunately, all of the conclusions of the paper seem to be beset by many approximations and assumptions. As a consequence, it would not be difficult to take exception to any of them. This is due not to the author, who has done an excellent job of marshaling data, but rather to the nature of biological phenomena which seem always to be compounded of many mechanisms that cannot easily be separated. Other interesting articles include a review by Bartholomay of reaction-rate theory and a review of enzyme reactions of biological interest by Boeri. There are twelve other papers discussing mathematical models of lung ventilation, neural nets, the ingestion