The chapter on vertebrate digestion includes a discussion of the functions of the liver.

The section on water balance is a useful factual account. The ecological applications of osmoregulation are mentioned briefly for each major animal group. Under mineral metabolism are considered the principal inorganic cations and some of the trace elements. The principal functions of each of these are listed, and tables of ion concentrations in various tissues and body fluids in various kinds of animals are given. Some important functions are omitted—for example, the role of cobalt in vitamin $B_{12}$. Active transport of ions as a factor in regulation is mentioned only briefly.

This book, together with the other volumes comprising the total work, will stand as the classical summary of comparative physiology prior to about 1950. Reviewers of modern literature can refer with confidence to von Buddenbrock for the older material. The text is written in a clear, concise style that can be read by a student who has only moderate facility with German. The book provides a good background for a student entering the field of comparative physiology, and it serves as a reference source for zoologists who seek leads to specific older papers. The literature of physiology is becoming so vast that it is doubtful that one man will ever again be able to write such a broad, multivolume work, and the subject is changing so rapidly that monographs are now replacing the handbooks of past generations. It is fortunate that von Buddenbrock's vast knowledge can be recorded, and his remaining volumes are awaited with interest.

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**Matrix Calculus.** E. Bodewig. North-Holland, Amsterdam; Interscience, New York, 1956. 334 pp. $7.50.

One reads *Matrix Calculus* with alternating feelings of exasperation and admiration. The book is concerned primarily with the computational aspects of the subject, yet, on page 1, a scalar product of two simple numerical vectors is incorrectly given. This is a simple proofreading error, of course, but hardly an auspicious beginning. Perhaps it will serve to warn the reader to be on his guard in the succeeding pages.

During 1947 and 1948, E. Bodewig published, in the *Proceedings of the Royal Academy of Science, Amsterdam,* a series of papers in which he summarized known methods of inverting matrices and solving systems of equations, comparing them with respect to operational counts and other considerations. This material is reworked and brought up to date in the present volume. Curiously, though, no reference is made to Forsythe's summary, which appeared in 1953 in the *Bulletin of the American Mathematical Society.*

In 1949 and 1950 the author published an analogous summary of methods of obtaining proper values and vectors, this time in the *Atti Seminario Matematico e Fisico dell' Universita di Modena.* It is well worth while to have all this material gathered into a single volume, and those who are interested in computing will find *Matrix Calculus* a useful and stimulating reference book. Nothing else comparable to the Modena papers has been published on the proper value problem.

Presentation of this material is preceded by an introductory section that is intended to supply the required background in matrix theory. Also, this section advocates the use of a system of notation which aims, in particular, at exploiting matrix symbolism to the full and at avoiding, wherever possible, the exhibition of specific elements or coordinates. With this thesis I am in wholehearted agreement. There is no space here to illustrate, but often much can be gained in simplicity and elegance. Unfortunately, the author does not always have the courage of his convictions, and, furthermore, he sometimes introduces irrelevant complexities. Thus, in order to exploit the differential of a matrix, he devotes nearly the whole of page 30 to deriving the standard binomial expansion for $(E+Q)^{-1}$ where $E$ is the identity. This is the essential, although not the stated, content of equations 3.19. Here and elsewhere the differential is only confusing.

On page 32 and the following pages there is a painful derivation, with applications, of a formula for inverting a modified matrix. No reference is made to Woodbury, who proved the formula in its complete generality, although Sherman, Morrison, and Bartlett are mentioned for having given special cases. The author considers only the formula for $(A+B)^{-1}$ where $A^{-1}$ is given and $B$ has rank 1. He does not seem to know that the formula can be generalized to the case of $B$ having rank $r$, which is Woodbury's formula.

It is perhaps not fair to criticize a book for what it does not contain. Nevertheless, *Matrix Calculus* is evidence of a considerable degree of erudition on the part of the author—repeatedly one sees an attempt to trace a method to its source and there are historical remarks, such as those on page 127, about the systems that arise in geodesic surveys—and it seems fair to expect some uniformity in depth. But the uniformity is not there.

To give some other examples: On page 144 is summarized a discussion of convergence of iterative methods of the single-step ("Seidel") and of the total-step types. The author calls those types II and I, respectively. He states Reich's theorem by saying, "For a real symmetrical $A$, Seidel's process converges if, and only if, $A$ is definite." Actually, the theorem states, "For a real symmetrical nonsingular $A$ with positive diagonal, Seidel's process converges if, and only if, $A$ is definite."

A few lines below it is stated as a theorem that "For definite matrices, iteration $I$ may diverge." This should hardly be dignified with the label "theorem." In fact, the author has all the information necessary to establish the very simple necessary and sufficient condition for convergence of iteration $I$ when the matrix is symmetrical with positive diagonal.

In short, the book should be on the shelf of every numerical analyst, but let him read with caution!

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**Nuclear Power Engineering.** Henry C. Schwenk and Robert H. Shannon. McGraw-Hill, New York, 1957. xvi + 319 pp. Illus. $6.50.

*Nuclear Power Engineering* is a well-written book, obviously intended for the practical man. It is based on articles which appeared serially in the magazine *Power* over the past several years. A college-level knowledge of mathematics, chemistry, or physics is not a prerequisite for an understanding of the material presented. The book, as such, should have a rather limited appeal for anyone having a direct interest in the science or engineering of nuclear reactors for power. It should have an appeal for those whose interests are more peripheral or are in power engineering as derived from nuclear sources.

The introductory chapters cover, in simple, straightforward language, the general subjects of atomic particles, radioactivity, conversion of mass to energy, nuclear reactors, the behavior of neutrons and neutron fission, and the control of chain reactions. Later chapters cover descriptions of nuclear reactors, reactor materials and systems, and reactor design problems. Other chapters describe each of the reactors now being constructed as part of the Atomic Energy Commission's 5-year reactor development program. A useful 18-page glossary of terms used in the nuclear power field is appended.

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