creased space given to genes and chromosomes, and to condensation of the material dealing with the anatomy of vertebrate embryos into an atlas. Much of the book has been rewritten, partly in an effort to include recent work. The illustrations are numerous and clear, but sometimes rough. There are nineteen chapters, including one on embryological technique, a glossary and twenty pages of index. The book is clearly the outgrowth of much use, and represents a practical adaptation of this experience.

Fundamentals of Comparative Embryology of the Vertebrates. By ALFRED F. HUETTNER. 416 pp. New York: The Macmillan Company. 1941. $4.50.

HERE is another book which has grown out of the experience of the author, more than half of the many excellent figures having come from his own hand. This is an important matter in this case, because they furnish the foundation of the entire work and are beautifully prepared. There are again nineteen chapters, but this time, after four chapters dealing with protoplasm and the cell, development of sex, chromosomes in development, gametes and fertilization, these take up in turn amphioxus, 1 chapter; frog, 3 chapters; chick, 7 chapters; and mammals, 4 chapters. There is thus quite a contrast in the general treatment, as compared with Shumway, and an evident lack of continuity in the account of the different systems. Another instance of similarity in the two books is the use of the same four animals for study.

One would expect accuracy in the treatment of general topics, such as the chromosomes, but does not always find it. Thus in discussing the process of mitosis it is stated that "Mitosis is initiated in the nucleus by the precipitation of chromatin granules and fibers which form an entangled thread-like structure called the *spireme*. . . . These are the chromosomes, their shape being constant from one cell generation to the next in spite of the fact that they disintegrate in the interphase nucleus and are built up from it again in the next mitosis." This gives a very faulty interpretation of the process, for, instead of disintegrating and reforming, they preserve their form by a continuous existence, which is the essence of their being. The number of chromosomes for Anasa is stated to be twenty-two, without indication that that is the female number. In describing the history of the X-chromosome in the grasshopper it is stated to divide in the first spermatocyte, instead of in the second. Such errors as these are unfortunate, but do not affect the general character of the book, which is excellent.

A Manual of Experimental Embryology. By VIKTOR HAMBURGER. 213 pp. University of Chicago Press. 1942. $2.50.

HERE is a book quite different from the preceding two. Its approach is experimental and it details the requirements which this method calls for, including instruments and equipment, Part I. Part II deals with experiments on amphibian embryos. Here we find a discussion of living material, including breeding habits, rates of development, culture media and rearing and feeding larvae. Under experiments there are sections devoted to technical procedures, embryonic areas, pregastrulation stages, transplantation methods, morphological fields, embryonic induction, parabiosis, external factors in development and the development of behavior patterns. Part III concerns itself with the chick embryo, and under the heading "Material and technical procedures" treats incubation, limb bud stages, equipment for operations and staining cartilage *in toto*. The experimental technique here deals with vital staining, chorio-allantoic grafts and intraembryonic transplantations. Part IV takes up regeneration experiments upon Planaria and amphibian larvae, producing the various two-headed and two-tailed larvae, tail regeneration, limb regeneration and lens regeneration effects. Finally in Part V there is a special treatment of the gradient theory of Child, with experiments on Planaria and chick embryos. For each section there is a bibliography, which deals only with the subject-matter treated. It is the opinion of the author that "a course in an experimental branch of biology not only should acquaint the student with new facts but should strengthen his power of reasoning and his logical acuity as well." The experiments outlined are all simple and do not demand any unusual apparatus or special installation. They are all routine class exercises, and none of them require the use of sections for their study. Furthermore they are so planned and stated that they may be taken up in any convenient order at the desire of the teacher. This book is sure to be a successful addition to the series of worthwhile American texts on embryology.

C. E. MCCLUNG

MATHEMATICS

Calculus. By G. E. F. SHERWOOD and ANGUS E. TAYLOR. xiv + 503 pp. New York: Prentice-Hall, Inc. 1942. $3.75.

"CALCULUS" sets a new high standard for text-books for the first course in differential and integral calculus. The topics treated and the order in which they are presented are those which have become largely standard in American texts: differentiation, with the usual applications, comes first; later, integration with geometric and physical applications; finally, partial differentiation, hyperbolic functions, multiple integrals and infinite series. The unique features of the book are to be found in the treatment of the material:

fundamental concepts are emphasized; definitions, especially those of function, limit and integral, are modern and precise; more theorems are proved than usual, and the proofs given are correct.

The definition of function, which differs from that still found in many texts, and the ε, δ definition of limit are given in the first chapter. The treatment of limits distinguishes and includes limits of sequences and of functions of a continuous variable; the fundamental theorems on limits are stated and proved by ε, δ methods. The Cauchy condition is taken as fundamental in the treatment of limits of sequences; it is proved that a bounded monotonic sequence has a limit.

A correct proof is given for the formula for the derivative of a composite function (the customary proof in American text-books is simple and suggestive, but unfortunately it is not correct). It is proved that if a function has a derivative at a relative maximum or minimum, this derivative is zero (a beginning text usually bases this result on intuition). The definite integral is introduced before the indefinite; it is proved, using the Cauchy condition for the limit of a sequence, that a continuous function has a definite integral. It is stated, though not proved, that a function which is continuous on a closed interval is uniformly continuous. Duhamel's Principle is stated and proved and used systematically in setting up the integrals that occur in the geometrical and physical applications. The treatment of partial differentiation, which includes Jacobians and applications to curves and surfaces, is preceded by a chapter which gives a brief but adequate treatment of analytic geometry of three dimensions.

It may perhaps appear from this account that the book is a mathematical treatise and not a text for beginners, but such is not the case. It is undoubtedly true that the book will be most appreciated by good students, but rigor and precision have not been made stumbling blocks. Intuition has not been replaced by mathematical rigor; rather there is a happy blending of the two with each reinforcing the other. The treatment is fresh and lively; the exposition proceeds with ease and assurance.

Finally, it is in order to record the passing of the infinitesimal; the term itself does not occur in the index. The book is calculus, not infinitesimal calculus. Infinitesimals, meaning something "infinitely small," were introduced into calculus by Leibniz, and the fact that the subject was based on something mystical, unproven and lacking reality did much to hinder its early understanding and acceptance. Klein has pointed out that these "infinitely small" quantities persisted in texts even into the twentieth century in a country so mathematically advanced as Germany. Beginning with Cauchy, "infinitesimal" has more often meant something which becomes infinitely small, but even in this sense the concept has lost favor with mathematicians. At the present time calculus is based solidly on the notion of limit; at last we have a beginning text that eliminates infinitesimals entirely and enlarges the treatment of limits.

The Gist of Mathematics. By JUSTIN H. MOORE and JULIO A. MIRA. xii + 726 pp. New York: Prentice-Hall, Inc. 1942. Trade, \$5.35; school, \$4.00.

"THE GIST OF MATHEMATICS" is a text-book for a survey course. There are fairly complete treatments of elementary algebra, plane geometry and solid geometry, partial accounts of plane analytic geometry and plane trigonometry, and a brief introduction to differential calculus. The book was written to teach mathematics, but the emphasis is on elementary concepts, the facts and their applications rather than on logical development and mathematical completeness. Each chapter closes with a set of exercises. Also, there are 105 pages of additional exercises and problems at the end of the book; they are grouped according to the chapters of the book, and there are precise references to relevant pages of the text. The problems will appeal to the student as modern and practical. No answers are given. Three appendices explain the method of extracting square root, list the Greek alphabet, the symbols used, mensuration formulas and facts regarding spatial relationships (plane and solid geometry theorems from the text). There is a brief set of tables in a pocket inside the back cover. A detailed index of 16 pages enhances the book's value as a reference work. The book is attractively printed; there are many figures, pen drawings, reproductions of old prints and woodcuts and photographs. The attention paid to mensuration formulas, the theorems of plane and solid geometry, and systems of weights and measures, including tables of equivalents for different systems, serve to emphasize the authors' interest in the usefulness and applications of mathematics; in the preface they refer to the needs of accountants, economists, biologists and scientific workers in all fields.

This book should be a useful text for a course in which the students have not had much previous training in mathematics, and in which the emphasis is on applications of a practical and everyday nature. The mathematics courses in a good high school cover nearly all the material in the book. Judged by standard college courses, it is elementary, all-inclusive and yet incomplete. For example, it includes six subjects, but in trigonometry the treatment of the solution of triangles is incomplete, and there is hardly any mention of trigonometric identities. Thus, it is a well-written book designed for a survey course.

Mathematics in Human Affairs. By FRANKLIN WESLEY KOKOMOOR. xi + 754 pp. New York: Prentice-Hall, Inc. 1942. Trade, $5.35; school, $4.00.

"MATHEMATICS IN HUMAN AFFAIRS" is undoubtedly intended as a text for a course in college mathematics which has been given with increasing frequency in recent years: a course which is cultural in nature and terminal in character—does not prepare the student for the usual trigonometry-analytic geometry-calculus sequence; the author states that it was written for "the reader of average ability with almost no previous preparation." For such a course Professor Kokomoor has written a text of unusual excellence.

"Mathematics in Human Affairs" covers practically the entire field of elementary mathematics: it begins with the simplest concepts and ends in the calculus. There are chapters on statistics, probability, mathematics of finance and geometric constructions as well as the more usual topics of algebra, trigonometry, analytic geometry and calculus. The book has the informal character of the lecture room; it is discursive and entertaining. Most of the chapters can be read independently of the others. On almost every page one finds new and interesting bits of history of mathematics, of mathematicians and of civilization in general; explanations of the origins and meanings of words; discussions of economics, philosophy and sociology; indications of the applications of mathematics; elegant solutions of certain problems not treated in the usual elementary courses; illustrative anecdotes that enliven the account; and mathematical figures, pen drawings and reproductions of old prints. It was the author's intention to show that mathematics has been one of the component parts of civilization throughout its history, and he has succeeded well.

But just because mathematics is playing such an important rôle at present in the lives of Americans, this book will probably have few readers. It can not be considered a satisfactory text for the development of those mathematical techniques needed in science, industry and the armed services (it was not intended to be such), and no young man of college age now has the leisure to study any other kind of mathematics book.

Furthermore, as a result of his decision to treat only elementary matters, Professor Kokomoor tells only part of the story of mathematics in human affairs—the part which deals with mathematics in the past: "But after all, the major portion of what we have considered is old, its age running for several centuries to several thousands of years." Mathematics is not portrayed as one of the all-important tools in the construction of the *modern* world. No stratosphere aeroplanes fly across the pages of this book, and no mention is made of the part mathematics plays in their construction and navigation.

Books on physics, chemistry, engineering and medicine for the general public contrast sharply with those on mathematics: the former tell of the wonders that are being accomplished to-day and the new world that will be built to-morrow; the latter usually tell of the subject's long and dignified past. The public, well informed about progress in other sciences, still does not know of the part applied mathematics is playing in building the new world, nor of recent brilliant results in pure mathematics such as the proof of the Ergodic Theorem, the proof of Waring's Theorem and the solution of the Problem of Plateau.

Our mathematical unpreparedness at the outbreak of the present war was one result of the public's lack of information about the subject. Although research in pure mathematics had been advancing rapidly, there were no centers for research in applied mathematics or the training of applied mathematicians for industry. Furthermore, mathematics no longer held the position of honor, nor even one of high esteem, in a liberal education; industry and the armed services were impeded because so many lacked a knowledge of even the elements of mathematics. The recent list compiled by Professor Dresden indicates to what extent America's leading position in mathematical research may have been attained by importing scholars from Europe.

The wonder books and popular expositions of science serve a useful purpose. Hermite said, "Abel has left mathematicians enough to keep them busy for five hundred years." Asked how he had accomplished so much in the six or seven years of his working life, Abel replied, "By studying the masters, not the pupils." But we are apt to overlook the sources of the initial inspiration to study the masters. Charles Darwin has recorded that Humboldt's "Personal Narrative" and Herschel's "Preliminary Discourse on the Study of Natural Philosophy," two of the leading books of popular science of his day, "stirred up in me a burning zeal to add even the most humble contribution to the noble structure of Natural Science. No one or a dozen books influenced me nearly so much as these two." Napoleon I wrote, "The advancement and perfection of mathematics are intimately connected with the prosperity of the state." Napoleon as a patron was sufficient, but in a democracy mathematics will attract able students and win support only from an informed public.

It is to be hoped that Professor Kokomoor or another will write the other volume on mathematics in human affairs—the story of the wonders of the present and the future.

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