beginning stands in the relation R or a power of R. Thus we might have a species, a man, a cell, or a gene within a cell, together with all its descendants.

More general is the "*dend*," which allows both many-one and one-many relations, so that there need be neither a unique beginner nor a unique final term. The noun "δένδρον" is of course the source. In particular we have "*zgdend*" and "*cpdend*"—dendra, respectively, of cells (including gametes which, by fusion, yield zygotes) and of cell-parts (in particular such "continuous" or essential parts as chromosomes and genes). Cytology is further developed by a treatment of A-pairs—abstractly defined pairs, exemplified by allelomorphic pairs of genes in the same cell.

Genetics, naturally the next topic, is well outlined—some of the concepts are Mendelian classes of zygotes, A-classes of gene-pairs, a-classes of genes, in each case classes of genetically related objects. The probability calculus of heredity is briefly developed. Woodger points out that Mendelian theory cannot take account of the "discontinuous" components of a cell—those, such as the cytoplasm, which are not certainly transmitted to all descendants of a cell.

Of embryology and taxonomy Woodger does not pretend to give more than a sketch. A requisite in a logical study of the former would seem to be a clear distinction between embryo and adult. The author sets the division at the instant after which no further structural complexity develops. But, as structural complexity is one of the undefined concepts, and is not even furnished with adequate axioms, we gain little. There is, however, a careful description of various phases of the development of an organism. In taxonomy Woodger distinguishes between varieties, species, and larger groups, substantially on the basis of sterility and epochs of differentiation, those distinctive features which fit most readily into his present theory.

Of course this book is but a beginning of the axiomatic treatment of biology. For one thing, it holds to topology, avoiding metric statements of size, duration, spatial separation. Again, it restricts definitions to typical cases, which are by no means universal. Cell division is always taken to be a one-two relation. "A woman who gives birth to identical twins does not stand in the relation of sexual parenthood to either twin in the sense here defined." Likewise, continuous components of zygdendra are forbidden to divide in precisely the second "generation" before a gamete. As this, though typical, is not universal, a mathematician might well prefer to say "precisely the nth generation."

There have been mistakes in biological reasoning in the past. The reviewer would be glad to have cases cited in which the existence of Mr. Woodger's calculus would have prevented errors.* Once mastered by biologists, it may well help them to more rapid, reliable reasoning in the future.

E. S. ALLEN

Introduction to the Theory of Fourier Integrals. By E. C. Titchmarsh. Oxford, Clarendon Press, 1937. 10+390 pp.

The theory of Fourier integrals, although originating as early as that of Fourier series, has not been adequately treated in monograph form until recently, when "introductions" to the subject were published by Bochner, Wiener, and Zygmund (a chapter in his excellent book on trigonometric series). The method of Fourier trans-

* Cf. R. A. Fisher, loc. cit., p. 7: "It is a remarkable fact that had any thinker in the middle of the nineteenth century undertaken, as a piece of abstract and theoretical analysis, the task of constructing a particulate theory of inheritance, he would have been led, on the basis of a few very simple assumptions, to produce a system identical with the modern scheme of Mendelian or factorial inheritance."

forms and of more general Fourier-Stieltjes transforms (and also of related Laplace, Mellin, Hankel, Watson, $\cdots$, transforms) on the one hand is becoming an almost universal tool for treating various problems arising in the theory of functions of a complex variable, theory of linear operators, harmonic analysis, probabilities, mathematical physics; on the other hand it offers an inexhaustible source of formulas and relations which are interesting, or at least curious, in themselves, irrespective of possible applications. The present monograph, which hardly can be considered as an "introduction," centers its attention mainly in the latter aspect of the theory of Fourier integrals and presents a wealth of interesting material, a considerable portion of which is due to most recent investigations. A partial list of contents follows.

Chapter I (Convergence and summability, pp. 1–49) treats of formal aspects of Fourier, Laplace, and Mellin transforms, and gives fundamental results concerning convergence and summability (Cesàro, Cauchy, Poisson, Weierstrass) of the corresponding integrals. Chapter II (Auxiliary formulae, pp. 50–68) gives a preliminary survey of the Parseval formula, theory of convolution (Faltung) of Fourier transforms, and Poisson summation formula. Chapter III (Transforms of the class L^2, pp. 69–95) is devoted to a treatment of Fourier transforms in L^2 together with some related topics. Results of this chapter are partially extended to transforms in L^p in Chapter IV (Transforms of other L-classes, pp. 96–118). The theory of conjugate trigonometric integrals and the closely related theory of Hilbert transforms is dealt with in Chapter V (Conjugate integrals, Hilbert transforms, pp. 119–151), while the next, Chapter VI (Uniqueness and miscellaneous theorems, pp. 152–176), in addition to the problem of unique representation, treats of some refinements of the Parseval formula and problems of growth of Fourier transforms. Chapter VII (Examples and applications, pp. 177–211) contains a considerable number of special formulas involving Fourier integrals. The theory of "general transforms," which was originated recently by Watson, and the theory of "self-reciprocal" functions with their various generalizations are discussed in Chapter VIII (General transforms, pp. 212–244) and Chapter IX (Self-reciprocal functions, pp. 245–274). Next, Chapter X (Differential and difference equations, pp. 275–302) contains numerous special applications to the theory of difference and differential equations, giving a rigorous exposition of some parts of the theory known under the name of "operational calculus." The last chapter, XI (Integral equations, pp. 303–369), deals with a considerable number of special integral equations. The book closes with a substantial bibliography (pp. 370–387) and a short index.

J. D. Tamarkin

Methoden und Probleme der dynamischen Meteorologie. By H. Ertel. (Ergebnisse der Mathematik und Ihrer Grenzgebiete, vol. 5, no. 3.) Berlin, Springer, 1938. 4+122 pp.

The mathematician will perhaps be surprised to learn that the difficulties in the study of the dynamics of our atmosphere are essentially of a mathematical nature. In fact this subject, as well as stellar hydrodynamics, offers a virgin field for the applied mathematician, and it is to be hoped that Ertel's monograph will serve to attract the mathematical skill which meteorology needs.

As can be inferred from the title, Ertel's monograph is not intended to serve as a textbook in meteorology. One important omission is atmospheric turbulence. The problems that are treated have mostly been the subject of Ertel's own researches and here, as in the original papers, the elegance of the treatment may seem a bit luxurious to the practical meteorologist.

A feature which is not found in textbooks is the formulation of the variational