



Review

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In an appendix to his memoir, M. Combebiac has collected many elegant examples and interpretations of the products of triquaternions of special types. The paper will doubtless be read by many with great interest, for the invention of geometrical algebras seems of recent years to have become quite a popular amusement. We may mention those of Gibbs, Heaviside, Macfarlane, McAulay, Hyde, and Major Ronald Ross of malaria fame, but in some ways the calculus of triquaternions is the most ambitious of all. C. J. JOLY.

Theory of Differential Equations. Part III. Ordinary Linear Equations. A. R. FORSYTH. 1902. Pp. xvi. + 534.

This, the fourth and latest volume of a complete work on Differential Equations, contains the theory of ordinary linear equations treated from the point of view of the theory of functions. In consequence of this limitation several branches of the subject have been omitted, such as the formal theory, the theory of invariants and covariants, and the application of the theory of groups. The volume opens with a general discussion of linear equations with uniform coefficients, and the existence of integrals which are regular functions in the domain of an ordinary point is established. These integrals are called 'synectic,' as the term 'regular' is reserved for integrals of the form $(z-a)^r [\phi_0 + \phi_1 \log(z-a) + \dots + \phi_k \{\log(z-a)\}^k]$ in the vicinity of a single point $z=a$. Chapter II. is concerned with fundamental systems of integrals near a singularity and the corresponding fundamental equation; groups of integrals associated with a multiple root are considered in relation to the elementary divisors. Chapter III. deals with regular integrals in the neighbourhood of a particular singularity and the indicial equation is introduced. The two succeeding chapters contain a discussion of Fuchsian equations, having all their integrals regular in the vicinity of every singularity, and equations possessing algebraic integrals. Chapter VI. determines limits to the number of regular integrals, and contains an account of Lagrange's adjoint equation. In Chapter VII. we come to essential singularities and integrals of the types called 'normal' and 'sub-normal,' together with Poincaré's development of Laplace's definite-integral solution. Chapter VIII. contains an account of infinite determinants which will be new to most readers, and their properties are developed so far as they are required for the solution of linear equations. The last two chapters deal with equations possessing coefficients of particular types, simply-periodic, doubly-periodic, and algebraic; in connection with the latter, automorphic functions are introduced. On the whole the results are mostly descriptive and of a widely general character. Instances of special functions occur in dealing with the hypergeometric equation and with Lamé's equation.

Mathematical and Physical Papers. By Sir GEORGE GABRIEL STOKES, Bart., M.A., etc. Vol. III. Pp. viii., 416. (Cambridge University Press.)

Everyone will be pleased that the publication of Sir George Stokes's scientific papers has at last been resumed. The papers contained in this volume were originally published in the years 1850-52; the three longest are "On the Effect of the Internal Friction of Thirds on the Motion of Pendulums," "On the Colours of Thick Plates," and "On the Change of Refrangibility of Light." To the last a short addition has been made, explaining how the author's view of the nature of fluorescence was subsequently modified; with the exception of this, and a few occasional footnotes, the papers have been reprinted as they originally appeared.

Linear Groups: with an Exposition of the Galois Field Theory. By L. E. DICKSON, Ph.D. Pp. x., 312. (Leipzig: B. G. Teubner.)

The author of this book writes with complete mastery of his subject, to which, indeed, he has made many original contributions. The theory of groups, *per se*, is one of the most abstract fields of mathematical speculation; and there are not many, even among mathematicians, who take real pleasure in it for its own sake. But its influence upon analysis is so far-reaching that some acquaintance with it is becoming almost indispensable; even in problems of pure geometry, questions of group-theory force themselves upon the attention. For this and other reasons it is, perhaps, to be regretted that Professor Dickson has preferred to expound his theme in the most abstract possible way. Thus the Galois field is reduced to a system of 'marks' devoid even of arithmetical significance; and even the