CAMILLE JORDAN.

CAMILLE JORDAN was born at Lyon on January 5th, 1838. His father, Alexander Jordan, was an engineer of bridges and roads, and deputy of the National Assembly. His mother, *née* Joséphine Puvis de Chavannes, was a sister of the well known painter. His great-uncle Camille was the famous orator and politician. As a boy he studied at the Collège d'Oullins and Lycée de Lyon. He entered the École Polytechnique in 1855, and was a mining engineer for some years at Privas and then at Paris. He married Isabelle Munet in 1862. He had six sons, two daughters, and numerous grandchildren. His latter years were clouded by bereavement. He lost a daughter in 1912, and his wife in 1918. His sons Charles and Pierre fell in 1914, while a third son was badly wounded about the same time and fell in 1915. The eldest child of his son, Prof. Jordan of the Sorbonne, was killed in 1916.

Camille Jordan made his mark early as an able mathematician, and his career was full of distinction. He obtained his doctorate in 1861, was examiner at the École Polytechnique in 1873 and professor there 1876 to 1917, besides being titular professor at the Collège de France, 1883 to 1912. He succeeded Chasles as Membre de l'Institut in 1881; and was vice-président of the Académie des Sciences in 1915, and président in 1916. He was vice-président of the Fourth International Congress of Mathematicians at Rome in 1908, and président d'honneur at the recent Congress at Strasbourg. His fame was recognised by the conferment of several honours by universities and learned societies in other lands.

In 1885 he succeeded Résal as editor of the *Journal de Mathématiques*, and till his death earned the gratitude of mathematicians for his invaluable work in that capacity. His published work was almost entirely mathematical, but he retained an interest in classical studies and was no narrow specialist. He died of sudden heart-failure on January 20th, 1922.

His earliest published papers seem to have been four on topography in 1866. In these he extended the definition of symmetrical polyhedra to those whose general arrangement of edges and angles, apart from their magnitudes, appears the same to an observer, no matter at what vertex he may be stationed. Topography was a subject to which he returned at intervals, and his studies on "Jordan curves," dividing the plane into two distinct portions, are celebrated. It was fitting that his last paper also should have been on the same subject; in the *Journal de Mathématiques* for 1920 he discusses the number of paths joining given points, no one of which crosses itself.

For the next few years Jordan was a most prolific writer. Except for the papers on Analysis Situs above mentioned, and two in 1868 and 1875 on the oscillations of a body about its position of equilibrium, his work seems to have consisted entirely of investigations on group-theory leading up to his *Traité des Substitutions*, published by Gauthier-Villars in 1870; followed by a series of articles extending and amplifying the results contained in that book.

Jordan ascribes his interest in Algebra to Serret's *Cours d'Algèbre supérieure*. The object of his book was "to develop the methods of Galois and to create a theory of them by showing how easily they permit us to solve all the principal problems of the Theory of Equations." The *Traité*, modestly described as "a commentary on Galois' works," was of first-rate importance and high originality, It was divided into four books, the first on congruences in the theory of numbers, the second on permutation-groups and the properties of linear substitutions, the third on irrationals with applications to elliptic functions and geometry of curves and surfaces, and the fourth on the solution of algebraic equations.

Among papers not subsequently incorporated into the *Traité* the most important was that in the *Annali di Matematica* for 1869, on "Groups of Movements," which formed the basis of all subsequent work on the theory of crystal structure as developed by Sohncke, Fedorow, Schoenflies, Barlow, &c., and which has received recently important applications in "X-ray analysis" of crystalline media. Jordan's paper was written solely from the point of view of the pure mathematician, but his use of technical crystallographic terms shows that he realised to some extent the important application which might be made of his results.

As years passed on, Jordan's interest in Algebra seems to have developed in the direction of abstract groups and linear substitutions; for after 1875 he wrote little on permutation-groups or theory of equations. Noteworthy are papers on the canonical shape of bilinear and quadratic forms. His first attempt in 1914 at obtaining all polynomials invariant under a given linear substitution proved incorrect, but he returned to the problem shortly after with success. His proof that groups of order $p^m q^2$ are composite, marked an important advance in the solution of a problem which was finally solved by Prof. Burnside, who showed that the same was true for any group of order $p^m q^n$.

Early in his career Jordan was led by his interest in the theory of substitutions to consider applications to the solution of differential equations and the properties of hyperelliptic and doubly periodic functions. This, and his continued interest in problems of Analysis Situs, bore fruit later in the work by which he is now probably most widely known, his famous *Cours d'Analyse*, which has run through three editions and has played an important part in the education of every analyst of the present day. This work, first published in 1882–7, is, like other French works of a somewhat similar kind, no ordinary textbook, but contains the fruit of a mass of original research, which as time went on absorbed Jordan's attention more and more. It was the first extensive work which contained a serious account of the theory of aggregates, a really rigorous discussion of the fundamental double limit problems of the integral calculus, and an account, in the modern spirit, of the theory of Fourier's series. A good deal of it has now been superseded by the work of Borel and Lebesgue, but it remains a source of inspiration for every student.

Two parts of the book stand out, perhaps, for originality and power. The first is the part which deals with Jordan curves and the problems of Analysis Situs to which they give rise. "Jordan's theorem," already referred to, that a simple closed Jordan curve divides the plane into two distinct connected regions, is one of the most justly famous in modern mathematics. In the discussion of questions of this and a similar kind, connected with areas and lengths of curves, Jordan was led to formulate the concept of a "function of bounded variation," which has played a fundamental part in the later theory of Fourier's series and allied developments. The concept is a generalisation of that of a steadily increasing function; a function is of bounded variation if, and only if, it is the difference of two increasing functions. But the generalisation is one of those which bring wholly new light and unity into a theory, for functions of bounded variation form a group for the elementary operations, whereas monotonic functions do not, and it would be difficult to exaggerate the importance, in all the modern theory of functions of a real variable, of Jordan's illuminating idea.

To the end of his life he was a researcher, though naturally the labour involved in his editorship of an important periodical prevented his output being quite as rapid of late as it was in his earlier years.

He was elected an honorary member of the London Mathematical Society in 1907, but never contributed to the *Proceedings*.

H. H.