

had actually gone from among them, but that a successor had been appointed for the immediate discharge of professorial duties. Although reticent on the matter, there is no doubt he experienced a very grievous disappointment at having to withdraw his services after so many years of earnest devotion to the cause of public education, and that too under conditions of peculiar hardship to which no other class of members of the Civil Service are subjected. A memorial on his behalf, signed by the President and a large number of Fellows of the Royal Society, and Professors in the principal Universities of the United Kingdom, was presented to the Government, but without effect. He had to spend the remainder of his days in retirement on a small pension entirely inadequate in amount, especially considering the services he had rendered. He resided abroad for some time, but, under medical advice, returned to Ireland, and died at Bray, co. Wicklow, on the 8th of March last. It is much to be regretted that his widow is but slenderly provided for out of the savings put by from the small income attached to his professorship. In the estimation of his colleagues his personal character was that of an amiable, courteous, and high-minded gentleman.

W. N. H.

CHARLES HERMITE. 1822—1901.

Charles Hermite, the distinguished French mathematician, was born at Dieuze, in Lorraine, on December 24, 1822. His education was begun at Nancy, and was continued at Paris, where the marked mathematical powers of the youth greatly impressed the professor* in the Collège Louis-le-Grand.

Hermite's first memoir belongs to 1842, the greater part of that year being spent in preparing for entrance into the École Polytechnique. Some idea of his attainments and his ability may be gathered from the fact that, immediately after entering, and on the advice of Liouville, he wrote (in January, 1843) to Jacobi submitting some theorems which he had obtained relating to hyper elliptic functions; and in the succeeding year, he similarly submitted some results in elliptic functions. This work was deemed of high value by the older mathematician, who caused the letters to be printed in "Crelle's Journal,"† together with an encouraging reply of his own, concluding with the words: "Ne soyez pas fâché, monsieur, si quelques-unes de vos découvertes se sont rencontrées avec mes anciennes recherches.

* M. Richard, who had had Galois for one of his pupils fifteen years earlier.

† Vol. 32. See also Jacobi's "Ges. Werke," vol. 2, pp. 87—130.

Comme vous dûtes commencer par où je finis, il y a nécessairement une petite sphère de contact. Dans la suite, si vous m'honorez de vos communications, je n'aurai qu'à apprendre."

The talent that Hermite showed during his course at the École Polytechnique indicated mathematics as his obvious career. He passed through the usual initial stages until, in 1862, he was appointed to a post specially created for him on the initiative of Pasteur. This post he held until 1869, when he succeeded Dubamel as professor of higher algebra at the Sorbonne, and as professor of analysis at the Ecole Polytechnique. The latter chair he occupied only until 1876; he continued the former until 1897, when he retired from active teaching. His life appears to have passed in a quiet round, devoid of events of general external interest; but its influence was indicated by the character of the formal celebration of his seventieth birthday, when he was presented by pupils and a host of friends and admirers from all countries with a medal struck for the occasion.

Hermite had been elected a member of the Académie des Sciences in 1856, in succession to Binet. He became a Foreign Member of our Society in 1873; at the time of his death, there was only one Foreign Member senior to him. He was made an honorary member or a foreign associate of many (perhaps of most) of the learned societies of the world. In recognition of his discoveries, he had received a number of decorations from various countries: thus he was numbered among the knights of the Prussian "Ordre pour le Mérite."

He died in Paris on the 14th of January, 1901. The words of Jordan, Darboux, Appell, Painlevé, and others, were an indication, not merely of the loss to science, but also of the sense of personal loss to friends which was caused by his death.*

He wrote nearly 200 papers, which have been published in a great variety of places.† Many of these papers appear in the guise of letters to mathematical friends, a form of communication which he practised through his whole life.

In addition, his lectures at the École Polytechnique were published (in book form) in 1873: his lectures at the Sorbonne were published (in lithographed form) first in 1882, and they have now reached the fourth edition. Also he appended, to the 1894 edition of Serret's 'Differential and Integral Calculus,' a "Note on the Theory of Elliptic

* The writer of this notice wishes to acknowledge his indebtedness to an article by M. Émile Picard, "L'Œuvre scientifique de Charles Hermite," *Ann. de l'Éc. Normale*, 3^e sér., vol. 18 (1901), pp. 2—34. There is also a brief notice by M. Jordan in "Liouville's Journal," 5^e sér., vol. 7 (1901), pp. 91—95; and a sketch, together with a bibliography of Hermite's writings, is given by M. P. Mansion in the "Revue des Questions Scientifiques," 2^e sér., vol. 19 (1901), pp. 353—396.

† It is understood that his works will be published in a collected edition by Gauthier-Villars, to be edited by Picard, who is Hermite's son-in-law.

Functions," which in the course of 160 pages gives an admirable outline of that theory.

As is shown by the list of his papers, Hermite wrote on many topics within the range of analysis: the subjects which recur most frequently are the theory of numbers, invariants and covariants, definite integrals, theory of functions, theory of equations, and elliptic functions. If special mention may be made of advances that are due to him, and of substantial discoveries achieved by him, instances can be selected from each of those subjects.

Thus, in the theory of numbers, he connected the use of continuous variables with quadratic forms: and he introduced conjugate indeterminates into the discussion of those forms. Perhaps the most wonderful of all his researches in this region was his proof (1873) of the transcendence of e , the base of the exponential function—a proof which, duly modified, led Lindemann to the establishment of the transcendence of π , and so showed the quadrature of a circle to be impossible.

In the theory of invariants and covariants, where he was a fellow-worker with Cayley and Sylvester, Hermite had an important share. He was responsible for the law of reciprocity whereby, to every covariant of degree n in the coefficients of a quantic of order m , there corresponds a covariant of degree m in the coefficients of a quantic of order n . He discovered the skew invariant of the quintic, which was the first example of any skew invariant. He discovered the linear covariants belonging to quantics of odd order greater than 3, and he applied them to obtain the typical expression of the quantic in which the coefficients are invariants. He also invented the associated covariants of a quantic; these constitute the simplest set of algebraically complete systems as distinguished from systems that are linearly complete.

In the theory of functions, it is almost difficult to select representative instances from among his many contributions to that subject, in which he may be regarded as the foremost of French writers since Cauchy. Not the least important are the special advances he made in the transformation of the double theta-functions and the associated Abelian functions: his memoir has been the suggestive starting-point for many other investigations. Anyone acquainted with the progress of the subject in the last 30 or 40 years will recognise that Hermite has given an entirely new significance to the use of definite integrals in the theory of functions: it is enough merely to mention the developments of the properties of the gamma-function which have been thus initiated. Indeed, he seems to have been the one mathematician of the later half of the nineteenth century who could work easily with definite integrals, almost recalling the fruitful activity of Euler in the

same medium, but with an accuracy and a precision that were impossible in Euler's day.

The theory of elliptic functions, on the Jacobian rather than on the Weierstrassian basis, is selected by Picard as having been Hermite's favourite study; and the selection appears justified by the number of his papers on the subject. To him is due the reduction of an elliptic integral to its canonical form by means of the syzygy among the concomitants of a binary quartic. His investigations on modular functions and modular equations are of the highest importance. It was Hermite who discovered pseudo-periodic functions of the second kind, and developed their properties. In a memoir that may be fairly described as classical,* he applied these functions to the integration of the unspecialised form of Lamé's differential equation; and elliptic functions generally were applied in that memoir to obtain the solution of a number of physical problems.

In the theory of equations, there are two significant contributions which will be specially associated with his name. One of these is the form which he gave to Tschirnhausen's transformation, with its accompanying property of securing invariance for the transformed equation; he also applied it to obtain invariante criteria for the reality of the roots of a quintic equation. The other of the contributions indicated the actual solution of the quintic equation by means of modular functions; in this result of supreme importance he was followed by Kronecker and Brioschi.

One quality of his papers deserve notice: it is the singular clearness with which they are written. It is a commonplace to refer to style as a characteristic of French writers; but mathematical investigations do not always lend themselves to clear and finished exposition. Hermite's papers are remarkable for this quality.

This brief sketch may be sufficient to give a slight indication of the range of activity of Hermite's genius. His interest in mathematics remained undiminished to the last. For many years he had been regarded as the venerated chief among French mathematicians, sustaining the great traditions of the past and sympathetic with the rising workers of his later days.

A. R. F.

* "Sur quelques applications des fonctions elliptiques"; it appeared in the 'Comptes Rendus,' vol. 85 (1877), vol. 86 (1878), vol. 89 (1879), vol. 90 (1880), vol. 93 (1881), vol. 94 (1882); and the various parts were afterwards gathered into a quarto volume of 146 pages (Paris, Gauthier-Villars, 1885).