

$$\xi = \phi(z), \quad z = \psi(\xi).$$

It is clear that corresponding to any point  $w$  in the vicinity of  $f(z_0)$  the function  $z = \psi(\xi)$  furnishes  $n$  values of  $z$ . Also the form of  $\psi(\xi)$  would depend on the particular circle chosen, but one form may be transformed into any other by replacing  $\xi$  by the product of  $\xi$  and the appropriate  $n$ th root of unity.

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### EMORY McCLINTOCK.

BUT few members of the American Mathematical Society at the present time appreciate the magnitude of the services rendered by its former president, Emory McClintock, who died July 10, 1916.

He was born September 19, 1840, at Carlisle, Pa. His father was the Rev. John McClintock, a learned Methodist Episcopal clergyman, for a time professor of mathematics, Latin, and Greek in Dickinson College, and during the Civil War chaplain of the American Chapel in Paris. He is perhaps best known as the author, with another, of a "Cyclopædia of Biblical, Theological, and Ecclesiastical Literature."

McClintock went to school for the first time at the age of thirteen, and a year later entered the freshman year of Dickinson College. In 1856, when his father left Dickinson College for New York, he entered Yale, and in 1857 he entered Columbia as a member of the class of 1859. His remarkable ability excited the admiration of his teachers, Professors Charles Davies and William Guy Peck. In April, 1859 in order to meet an emergency caused by the illness of a member of the teaching staff, he was graduated and appointed tutor in mathematics. Soon afterwards his father took charge of the American Chapel in Paris, and in 1860 McClintock resigned his position at Columbia to go abroad. In 1861 he studied chemistry at the University of Göttingen. In 1862 he returned to America with the intention of engaging in the Civil War. He was offered an appointment as second lieutenant of topographical engineers in the United States Army, but on his way to Washington suffered a sunstroke which prevented him

from entering the army. From 1863 until 1866 he was consular agent of the United States in Bradford, England. During 1866 and part of 1867 he was connected with a private banking firm in Paris. In 1867 he was appointed actuary of the Asbury Life Insurance Company of New York, and in 1871 he became the actuary of the Northwestern Life Insurance Company of Milwaukee, a position that he retained for eighteen years.

Early in 1889 he was appointed actuary of the Mutual Life Insurance Company of New York to succeed Professor W. H. C. Bartlett. With this company he remained until his death, serving as actuary until 1911, and continuing thereafter as consulting actuary. From 1905 until 1911 he was also vice-president and trustee. In the autumn of 1906 serious ill health compelled him to relinquish a part of his activities and in 1911 he retired altogether from active work for the company.

McClintock applied for membership in the New York Mathematical Society in November, 1889, was elected vice-president the following month and president at the annual meeting in December, 1890. He retired from the presidency at the annual meeting in December, 1894, on which occasion he delivered a very remarkable and interesting address entitled: "The Past and Future of the Society."\* At the same meeting the Society adopted the following resolution:

*"Resolved,* That the American Mathematical Society on the occasion of the retirement from the presidency of Dr. Emory McClintock expresses its appreciation of the great services rendered by him while presiding officer of the Society and its recognition of the fact that to his initiative were due the broadening of organization and extension of membership which have made the Society properly representative of the mathematical interests of America."

The writer, who in 1888 had been offered a position in the actuarial department of the Mutual Life Insurance Company, and who was secretary of the Mathematical Society in its early days, made the acquaintance of Dr. McClintock shortly after his arrival in New York in 1889. He frequently visited McClintock at "Kemble Hill," his home near Morristown, New Jersey, and soon came to admire his learning, scientific ability, breadth of view, and far-sighted wisdom. McClintock at all times displayed the keenest and most active

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\* Published in the BULLETIN, vol. 1, pp. 85-94.

interest in every plan for enlarging the scope of the Society and improving the character of its work. It was chiefly through his encouragement and support that the BULLETIN was founded in 1891. His influence and financial assistance led the Society in 1896 to undertake the publication of the papers read at the International Mathematical Congress in Chicago in 1893. His wise advice, patience in conference, and generous assistance were most helpful to the Society in connection with the establishment of the *Transactions* in 1900.

On one or two occasions the writer heard him express regret that he had not followed an academic career, which would have permitted him to give a larger share of his time to research and enjoy those mutually inspiring relations that so often exist between a teacher and his students. However McClintock never failed to stimulate and inspire everyone of scientific aptitude or taste with whom he came in contact; and as one who was not by profession a teacher of the subject, he stands practically alone among notable American contributors to pure mathematics.

McClintock's scientific publications date from 1868, when he began his epoch-making contributions to the theory of life insurance. For an account of his work in this field the reader is referred to the appreciation recently published in the *Transactions* of the Actuarial Society of America.\*

His contributions to the literature of pure mathematics began when adequate facilities were first afforded for the publication of the mathematical researches of Americans by the establishment of the *American Journal of Mathematics* in 1878. Immediately thereafter he submitted several papers for publication. His first paper, entitled "An essay on the calculus of enlargement," was an effort to present the theory of finite differences and the differential calculus from a unified point of view. The paper may be regarded as a precursor of recent attempts to consider difference equations as differential equations of infinite order.

His other more important papers were a series of researches on solvable quintic equations published in the *American Journal of Mathematics* and a paper on the theory of numbers published in the third volume of the *Transactions*. During the years 1879 to 1899 McClintock published fifteen papers in the *American Journal of Mathematics*, being for a number of

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\* Vol. 17, part II, (Oct., 1916).

years the most frequent American contributor not on the editorial staff of the Journal.

When one considers that McClintock made no use of the powerful labor saving machinery which has revolutionized modern analysis, the results obtained by him in his researches on quintic equations, as well as some of his other achievements, appear to indicate a truly wonderful power of manipulation and clearness of vision.

He received the honorary degree of Ph.D. from the University of Wisconsin in 1884, LL.D. from Columbia in 1885, and LL.D. from Yale in 1899. He was president of the Actuarial Society of America from 1895 to 1897. He was an honorary fellow of the American Academy of Arts and Sciences, a member of the London Mathematical Society, and a fellow of the Institute of Actuaries.

A list of McClintock's mathematical publications is given below:

1. "An essay on the calculus of enlargement." *American Journal of Mathematics*, volume 2 (1879), pages 101-161.
2. "A new general method of interpolation." *American Journal of Mathematics*, volume 2 (1879), pages 307-314.
3. "On a theorem for expanding functions of functions." *American Journal of Mathematics*, volume 2 (1879), pages 348-353.
4. "Note on a theorem for expanding functions of functions." *American Journal of Mathematics*, volume 3 (1880), page 173.
5. "On certain expansion theorems." *American Journal of Mathematics*, volume 4 (1881), pages 16-24.
6. "On the remainder of Laplace's series." *American Journal of Mathematics*, volume 4 (1881), page 96.
7. "On the resolution of equations of the fifth degree." *American Journal of Mathematics*, volume 6 (1884), pages 301-315.
8. "Analysis of quintic equations." *American Journal of Mathematics*, volume 8 (1885), pages 45-84.
9. "On the algebraic proof of a certain series." Presented to the Society March 6, 1891. *American Journal of Mathematics*, volume 14 (1891), pages 67-71.
10. "On independent definitions of the functions  $\log(x)$  and  $e^x$ ." Presented to the Society March 6, 1891. *American Journal of Mathematics*, volume 14 (1891), pages 72-86.
11. "On lists of covariants." *Bulletin of the New York Mathematical Society*, volume 1 (1892), pages 85-91.
12. "On the computation of covariants by transvection." Presented to the Society January 2, 1892. *American Journal of Mathematics*, volume 14 (1892), pages 222-229.
13. "On the non-euclidian geometry." *Bulletin of the New York Mathematical Society*, volume 2 (1892), pages 21-33.
14. "On the early history of the non-euclidian geometry." *Bulletin of the New York Mathematical Society*, volume 2 (1893), pages 144-147.
15. "Theorems in the calculus of enlargement." Presented to the Society August 14, 1894. *American Journal of Mathematics*, volume 17 (1895), pages 69-80.

16. "A method for calculating simultaneously all the roots of an equation." Presented to the Society August 14 and October 27, 1894. *American Journal of Mathematics*, volume 17 (1895), pages 89-110.
17. "The past and future of the Society." Presidential Address, delivered before the Society December 28, 1894. *Bulletin of the American Mathematical Society*, volume 1 (1895), pages 85-94.
18. "On the most perfect forms of magic squares, with methods for their production." Presented to the Society April 25, 1896. *American Journal of Mathematics*, volume 19 (1897), pages 99-120.
19. "On a solution of the biquadratic which combines the methods of Descartes and Euler." Presented to the Society May 29, 1897. *Bulletin of the American Mathematical Society*, volume 3 (1897), pages 389-390.
20. "Further researches in the theory of quintic equations." Presented to the Society August 17, 1897. *American Journal of Mathematics*, volume 20 (1898), pages 157-192.
21. "A simplified solution of the cubic." Presented to the Society December 28, 1900. *Annals of Mathematics*, series 2, volume 2 (1901), pages 151-152.
22. "On the nature and use of the functions employed in the recognition of quadratic residues." Presented to the Society December 27, 1901. *Transactions of the American Mathematical Society*, volume 3 (1902), pages 92-109.
23. "The logarithm as a direct function." Presented to the Society February 28, 1903. *Bulletin of the American Mathematical Society*, volume 9 (1903), pages 467-469.

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## ON FOCI OF CONICS.

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THE study of the properties of conic sections, and of certain related points and lines has afforded ample scope for the faculties of all mathematicians from the Greeks on down through the ages. And not the least important among the points connected with the sections are the foci. It is the object of the present paper to give (I) a short historical sketch of the development of the properties of conics connected with the foci; (II) some of the theorems from Pappus which have a bearing on foci and tangents.

### I. *Historical Sketch.*

What name should be connected with the discovery of the foci is still a matter of conjecture. Zeuthen\* seems to think

\* Geschichte der Mathematik im Alterthum und Mittelalter, Kopenhagen, 1896, p. 211.