FRANK MORLEY—IN MEMORIAM

With the death of Professor Frank Morley in Baltimore on October 17, 1937, there passed one of the more striking figures of the relatively small group of men who initiated that development which, within his own lifetime, brought mathematics in America from a minor position to its present place in the sun. His contribution to this development, through his own untiring research, his scholarly treatises, his wide guidance, and his inspiring teaching, has been most notable.

Frank Morley was born at Woodbridge, Suffolk, England on September 9, 1860, the son of Joseph R. and Elizabeth (Muskett) Morley. He took his A.B. degree at King's College, Cambridge, in 1884, his A.M. degree in 1887. During the period 1884–1887 he served as master in Bath College, England.

His mathematical career in America, extended over a period of fifty years, began with an appointment to an instructorship at Haverford College in 1887. The following year he was promoted to a professorship, a position which he held for twelve years. This was perhaps his most productive period, being marked by the appearance (in collaboration with James Harkness at Bryn Mawr) of two volumes on the theory of functions, and of about twenty of his fifty articles. In 1898 he received the degree of Doctor of Science from Cambridge University.

The period at Haverford was also most eventful in his family life. On July 11, 1889, he married Lilian Janet Bird of Hayward's Heath, Sussex, England. Their three children, Christopher D., Felix M., and Frank V., all were born at Haverford in the decade following.*

The graduate work in mathematics at the Johns Hopkins University, so brilliantly inaugurated by Sylvester, had just before 1900 sunk into a decline, partly because of the poor health of Professor Craig. The death of Craig in the spring of that year, and the retirement of Simon Newcomb from a sort of absentee headship, forced President Gilman to look elsewhere for leadership in this work. With his usual happy judgment of men and their capacities, he invited Professor Morley to become professor of mathematics and head of the department. This carried with it the editorship of the American Journal of Mathematics, at that time under the sole control of the University. That he was able to revive the department, to attract, retain, and train graduate students in adequate numbers, and to maintain over a long period of lean years an active mathematical center, is perhaps the best evidence of his executive ability and his inspiring leadership. This was accomplished in the face of competition from many departments much more amply supported and manned, even though for many years the only form of graduate student aid at his disposal was a single fellowship.

He has said that he entered on his career at Johns Hopkins with some misgivings. It entailed, of course, great changes in his family and social life. The entire content of his teaching had to be raised to the graduate level. On the scientific side he had to follow, in great measure at least, not the paths which he might have chosen for him-

* It may be that some of the Bulletin readers do not know of this unusual family. All three of the brothers held Rhodes scholarships at New College, Oxford, a family record which is likely to stand. Also, all three have attained distinction in literature. Christopher Morley is the well known novelist and critic; Felix Morley, now editor of the Washington Post, is an authority on current political and international problems; and Frank V. Morley, a Ph.D. in mathematics of Oxford University (1923), is an author and publisher with headquarters in London.

self, but rather those along which his students could or should follow him. But apparently the transition was not difficult. He and Mrs. Morley settled easily into the life of the University and the city. When I returned to the University in 1904 as his first instructor, he had acquired an honorable place in that company of individualists which made up the Johns Hopkins faculty, and also a comfortable chair for his regular game of bridge at the down town University Club of Baltimore.

For a number of years Professor Morley participated in research programs of the Carnegie Institution, assisted by various associates including H. Bateman, J. R. Conner, and myself. When he retired from active university service in 1928, he continued his work as research assistant of this Institution. In 1933 he published, in collaboration with his son, Frank V. Morley, a notable volume on *Inversive Geometry*. His last article (with J. R. Musselman) appeared in the American Journal of Mathematics, October, 1937, the month of his death.

Professor Morley was a member of the New York Mathematical Society, and of its successor, the American Mathematical Society, from about the time of organization. He was editor of this Bulletin during the period 1895–1898, and from October 1899 through 1902. He was vice president of this Society in 1902, and president in the 1919–1920 biennium. He served as cooperating editor of the American Journal of Mathematics in 1899–1900 and in 1929–1937, and as editor in the twenty-one year interval, 1900–1921. In 1921 he sponsored the movement for joint control of the Journal by the John Hopkins University and this Society, and served as a member of the joint editorial board over the period 1921–1928. This type of editorial coöperation has since been adopted by other mathematical journals. He was also a member of the London Mathematical Society, the Circolo Matematico di Palermo, the American Philosophical Society, and the American Academy of Arts and Sciences.

The major contributions of Professor Morley to mathematical science are the treatises of which he was a joint author. The first of these, *A Treatise on the Theory of Functions* (Macmillan, 1893), was a most ambitious undertaking. It aimed to give to American and English readers an account of that great body of doctrine which had been developed in the main by continental mathematicians. That the need for such a book was widely felt is shown by the appearance, somewhat earlier in the same year, of Forsyth's *Theory of Functions of a Complex Variable* (Cambridge University Press). For a number of years these two books served English-speaking students as standard introductions to this field. Five years later Harkness and Morley published their *Introduction to the Theory of Analytic Functions* (Macmillan, 1898). This admirably written book still maintains its place as a classic.

Professor Morley was deeply versed in the metric and projective geometry, the invariant algebra, and the kinematical and physical theory which constituted the major portion of the scholastic mathematics of his time. A fairly large proportion of his papers deal with the geometry of kinematic problems. It was quite natural that his early work in function theory should suggest an exploration of the geometry in the complex plane. This led him, not merely to many new theorems, but also to elegant expositions, within a wide field of metric geometry. It constitutes perhaps his greatest individual achievement. His work in this direction, together with a great deal of related material, is collected in the stimulating volume, *Inversive Geometry* (with Frank V. Morley, 1933). One quotation from the authors' preface is illuminating:—"We believe that the tradition that simple geometrical and mechanical questions are to be handled only as Euclid or Descartes might have handled them is very hampering; that the ideas of Riemann, Poincaré, Klein, and others have pleasant reverberations in the investigation of elementary questions by students of proper maturity and leisure."

His papers on projective geometry are models of precise and resourceful thought and of concise and artistic exposition. They deal with rather clearly defined situations and objectives. He used to say that every author owed to the reader at least one good illustrative example. He usually conceded to the reader enough imagination to take care of the nth case if given a good start. Thus in *Projective coordinates*, Transactions of this Society, vol. 4 (1903), §10, referring to a planar theorem of Dr. Hun, he says:—"I wish to prove this fact in such form that the restriction to two dimensions falls away." Again in the paper *On the extension of a theorem of W. Stahl*, Cambridge Congress, 1912, the extension in question reads as follows ($\rho_2{}^m$ being a rational planar m-ic): "For the curve $\rho_2{}^m$ the curve of lowest class on the double lines is of class $2(m-3)$; the common lines of this and ρ give an $I_{m-3}^{4(m-3)}$; and my point is that this is *the dual form of the counter-curve*." He goes on to say: "I shall give the proof in the case of $\rho_2{}^5$ by a method which applies to all cases." The case $m=5$ here chosen is the first really illustrative case, since Stahl's $m=4$ is too simple even to indicate the extension. Professor White thinks most highly of the paper *On the geometry whose element is the 3-point of a plane*, Transactions of this Society, vol. 4 (1903), but my own favorite is the four-page article *On the Lüroth quartic curve*, American Journal of Mathematics, vol. 41 (1919). It is a penetrating geometric analysis of kaleidoscopic character which eventually yields an algebraic result quite unattainable by conventional methods. Two articles in the Mathematische Annalen, vols. 49, 51, on ruler constructions for a linear covariant of the quintic and for certain polars should not be overlooked. One remarkable theorem might be singled out (Proceedings of the London Mathematical Society, (2), vol. 2 (1904)): A quintic curve on the nine flexes of a cubic curve and on the twelve other intersections of the lines of flexes has forty-five flex tangents which pass by nines through five points on the curve.

Professor Morley's chief contribution to algebra is in the field of elimination (American Journal of Mathematics, vols. 47, 49). The first paragraph of this first paper is worth quoting as an example of his happy way of relating the past to the future (references are omitted):

"Salmon, considering a plane curve and its tangent at a point x, wrote a connex which cuts out the remaining intersections of the tangent and the curve. It is of the form $A^3x^{2(m-1)}y^{m-1}$ when the curve is Ax^{m+1}. A^3 indicates that the coefficients are of the third degree in the coefficients A.

"The connex naturally occurs in the theory of Abelian integrals of the third kind.

"If now we remark that when the curve has a double point x, y becomes arbitrary, we have at once from Salmon's connex $m(m+1)/2$ curves of order $2m-2$ on the double point.

"As all first polars are also on the double point, we have 3 curves of order m which give $3(m-1)m/2$ independent curves of order $2m-2$, so that in all we have a basis of $m(2m-1)$ curves of order $2m-2$, whence the discriminant is written down as a determinant. What is necessary then is to adapt Salmon's connex to a net which is not a net of first polars."

This he proceeds to do and thus writes the ternary eliminant for three curves of the same order as a determinant. In the second paper (written jointly with myself) the syzygy used is extended to all orders and any number of variables. Its range of applicability is however limited so that it effects only two-thirds (roughly) of all cases of ternary elimination, with a reduced range as the dimension increases.

I think our members would enjoy reading, and even rereading, the philosophic observations and practical hints in his retiring address entitled *Pleasant questions and wonderful effects* (this Bulletin, vol. 27 (1921), pp. 309–312). In the same vein is the following rough draft of some of his remarks at a dinner given in his honor at the time of his retirement.

"The people of this country are alert and are usually intelligent. They are capable without any strain of a far wider knowledge of mathematics than they actually possess. As a game or as a form of poetry the science should and could appeal not only to a bunch of specialists but to any one with a mind at once active and deliberate. All that is necessary is to let the fascination appear in the early stages of teaching. To this end some of the brotherhood of teachers must be cranks and not cogs.

"It is becoming essential that the delights of controlled imagination should be broadcast. For this seems the readiest way to sugar the coming of the new feudalism, the division of the universe into big-business; and to avoid a quite probable danger, that universities become one division of big business."

Professor Morley was a great teacher. It was his custom to lecture four or five times a week, and for many years all the students in the department, whether first or fourth year men, attended these lectures. In this situation his unusual talent for the application of advanced ideas to more elementary topics, and for striking translation of the abstract into the concrete, enabled him to interest and stimulate the entire group. In those days the standard test of progress was the fractional part of the lecture which was understood. As a rule the students met his challenge and ultimately attained a fair approximation to unity. He had a way of sensing any undue tension in his audience and of relieving it by a charmingly humorous remark.

Of the many who attended these lectures, forty-five took the doctorate under his immediate direction. It was a cardinal point with him to have on hand a sufficient variety of thesis problems to accommodate particular tastes and capacities. Many promising ideas which occurred to him were laid aside for student use. He followed the development of each one with great solicitude and felt fully rewarded when some evidence of independent thinking appeared. Each student was to him also a personality which he felt impelled to understand. The pleasant hospitality extended by Mrs. Morley to his young people, which will always be a delightful memory to the many who enjoyed it, helped him greatly in this endeavor. As a whole the departmental life presented an interesting adaptation of the English university system to the American scene.

Professor Morley had a strong conviction that geometry was the ideal medium for the presentation of abstract mathematical ideas to the general intellectual public and he welcomed the opportunities which came to him to spread this gospel in other universities.

Though mathematics was the chief preoccupation of Professor Morley, he had a variety of other interests and diversions. He was always a critical, but charitable, observer of the contemporary scene, more inclined to hold fast to what he thought good in the older order than to become enthusiastic over new departures. He had an unusual sense of proper balance. He liked to travel, but not too far. He liked to walk, and even to take walking trips of five or six days, but he also liked to linger for a time if an unusually attractive stopping place appeared. He enjoyed music, and was for a number of years a member of the Baltimore Choral Society, but he probably enjoyed most the lighter forms of music. Though he did some things well, he never confessed to any form of skill. I knew that he played chess on occasions, but was surprised to learn recently that he was sufficiently expert to have once beaten Lasker at a time when Lasker was world champion. This interesting fact he had not seemed to think worth mentioning.

Those who were privileged to know him well will never forget the kindly aspects of his daily life nor the devotion with which he pursued the high cultural and scientific ideals which he had set. His personal achievements and his stimulating influence on the mathematics of his time assure him a permanent place in the history of the science.

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