SAMUEL ROBERTS.

SAMUEL ROBERTS was the second son of the Rev. Griffith Roberts, Presbyterian Minister, and Anna his wife, who was the eldest daughter of Mr. Samuel Churchill of Exeter, merchant. He was born on December 15th, 1827, and was educated at Queen Elizabeth's Grammar School, Horncastle, Lincolnshire, his father being then minister of the Presbyterian Chapel at Kirkstead, near Horncastle, and resident at Horncastle.

He entered Manchester New College in June, 1844. He matriculated at the University of London in 1845, with Honours in Classics and Mathematics, and took the degree of B.A. in 1847, with Honours in Mathematics, and the degree of M.A. in 1849, when he was first in Mathematics and Natural Philosophy, and obtained the gold medal.

He was admitted a solicitor in January, 1853, having served his articles of clerkship with Mr. Richard Mason, Town Clerk of Lincoln.

After some years he gave up practice and removed to London, where he devoted himself to mathematical studies.

He was twice married: in 1858 to Mary Ann Astley, only child of the Rev. Richard Astley, formerly of Shrewsbury, who died in 1895; and, in 1896, to Lucy Elizabeth Holland, second daughter of Philip Henry Holland, surgeon, who survives him. By his first wife he had three children, the eldest of whom, Samuel Oliver Roberts, was born in 1859, and died in 1899. He was a scholar of St. John's College, Cambridge, and 7th Wrangler in 1882; he was afterwards Mathematical Master at Merchant Taylors School. His third son died in infancy. His second son, Mr. H. A. Roberts, a solicitor, survives him.

Mr. Roberts was one of the oldest members of the Society, having been elected on June 19th, 1865, five months after the foundation of the Society. It cannot be said of him as it was said of Mr. Thomas Cotterill, that the Society "discovered" him, for he had published a paper in the *Philosophical Magazine* as early as 1848, and had contributed more than a dozen papers to the *Quarterly Journal* before the Society was founded: still it is certainly true that the Society was from the first a powerful incentive to him, and that it always afforded him great encouragement. It brought him into contact with other mathematicians whom he otherwise might not have known personally, for, not having been at Oxford or Cambridge, he was a somewhat solitary worker until the Society came into existence. Within six months of his becoming a member he was

placed on the Council, on which he served from 1866 to 1892, except for a break of one year (1870–71). He was also Treasurer for eight years (1872–80), was twice Vice-President, each time for two years (1871–73, 1882–84), and President (1880–82). He thus rendered valuable and constant service to the Society, and for a number of years was almost as much identified with it as the Secretaries, and even more so in one respect, as he was a frequent contributor of papers.

Mr. Roberts was the second Treasurer of the Society after the separation of the Treasurership from the Secretaryship. As was mentioned in the obituary notice of Mr. Jenkins, one of the Secretaries acted also as Treasurer during the first year of the Society's life, Mr. Jenkins holding the double office from November, 1865, till January, 1866. The Treasurer then became an independent officer, and Dr. Hirst held the position from 1866 to 1872, when he was succeeded by Mr. Roberts, who in 1880 was succeeded by Mr. Merrifield.

Mr. Roberts received the De Morgan Medal in 1896. He was elected a Fellow of the Royal Society in 1878.

Mr. Roberts's contributions to mathematics were numerous and valuable, and they covered a somewhat wide range. Among the subjects to which his principal papers related were plane and solid Geometry, Theory of Numbers, and link motion. He also wrote on the Calculus of operations, interpolation, &c. His writings on Geometry included several important papers on Parallel Curves and Surfaces. In Theory of Numbers he was interested in the Pellian equation and similar problems. A noticeable paper of his related to the proof that the theorems which express the product of 2^m squares by 2^m squares as the sum of 2^m squares do not admit of extension beyond $m = 3$. The greater number of his papers were published in our *Proceedings*, but he contributed about thirty papers to the *Quarterly Journal* and several to the *Messenger*. Cayley once said to the writer that he regretted that joint papers were so rare in mathematics, and that he should have liked to co-operate with Mr. Roberts in several pieces of work. This remark, which was made towards the close of Cayley's life, had special reference to Mr. Roberts's paper " On the Motion of a Plane under given Conditions," published in the third volume of our *Proceedings*, of which Cayley makes use in a paper " On the Kinematics of a Plane," &c., published in 1894 (Vol. XIII, p. 505, of his *Collected Papers*).

Although mathematics was the main occupation of Mr. Roberts's life, he had various other interests, such as geology, microscopy, and working with the lathe. In the last ten years of his life his eyesight almost completely failed him.

Mr. Roberts is an interesting type of mathematician, for he was strictly an amateur—that is to say, he never held any office, directly or indirectly, connected with mathematics or other branch of science or any application of science. He was simply a private gentleman who pursued researches from pure love of investigation and desire to extend the boundaries of subjects that were attractive to him. And he never sought any recognition of his work; for him it was entirely its own reward. Owing mainly to the course of instruction at Cambridge, there are numerous cases in which ecclesiastical dignitaries, barristers, and judges have contributed to our science : indeed, all Cayley's early work was done while he was at the bar, and it was only the foundation of the Sadlerian Professorship at Cambridge that tempted him to forgo his legal career. But instances are rare of men who, not having been Fellows of a College or having had any official connection with mathematics, have yet worked assiduously and with adequate knowledge for its advancement.

In the seventies and eighties the members who attended the Society's meetings with some regularity formed almost a family party, and among them Mr. Roberts occupied a conspicuous position. He was always present at the Council meetings and those of the Society, and was most willing to do any work which he was asked to undertake, but he was somewhat reserved and reticent, and did not take a leading part in the business of the Council. The value and amount of his work prove his devotion to mathematics, but he never gave way to any manifestation of enthusiasm, nor did his undemonstrative manner seem to indicate any very keen interest, but the meetings of the Society were evidently very congenial to him.

It is perhaps, at this distance of time, of some interest to recall the diversity of manner in which some of the regular frequenters of the Society communicated their papers to the audience. All were no doubt greatly interested in their subject, but they differed fundamentally in the way they they gave an account of their work to the Society, and in the importance which they attached to the oral explanation of their results. Cayley regarded the reading of a paper as a disagreeable formality that had to be gone through before it could be printed. Nevertheless he endeavoured to give a clear account of the contents of his paper, and was never lengthy. Still, unless one knew the subject beforehand, his method of running over the leading formulæ was not instructive. Henry J. S. Smith once said to the writer that he thought that the account given of a paper ought to end where the paper began. He carried out this principle and the reading of a paper by him was an admirable exposition, gracefully delivered, of the nature of the subject to which the paper belonged. He started *ab initio*,

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and when the point of departure of the paper was reached, he briefly indicated the kind of problem he was dealing with, which had then become comprehensible to all. It was always possible for anyone to learn something of a new subject from Henry Smith's reading of a paper; and if the subject was already familiar, his clearness of mind and charm of expression gave it new interest. Clifford's expositions or discourses were perhaps even more attractive than Henry Smith's, but he allowed himself more latitude and they were even less closely connected with the subject of the paper, or perhaps they related to work he had merely proposed to himself or ideas that were not yet worked out. So much, however, depended upon Clifford's manner, his versatility, and his imagery, that after an address from him it was difficult to recall what really were the essential features of a discourse which had been so fascinating at the time. Mr. Roberts followed Cayley's method, only he gave details of working as well as results. With his paper in his hand he would go steadily through it, writing down the principal formulæ on the blackboard. Thus unless the subject was elementary, which was only occasionally the case, not much could be gained by an auditor who had no previous acquaintance with the state of the subject. Mr. J. J. Walker was careful and slow in his explanations, but the subjects he dealt with were usually more or less known to the audience. Sylvester very rarely attended a meeting of the Society, but when he did his excited enthusiasm was apparent in every word and action. Whatever interested him at the moment seemed to him of consummate importance to the science. Looking back on the twenty years (1870–90) no other very distinct personalities seem to stand out, except perhaps Hirst, whose papers related to subjects which at that time had not been much studied in this country. There was no attempt among the younger members to imitate Henry Smith or Clifford: as a rule we were content to do our best to describe our papers as well as we could without being too technical or tiring the audience.

It may be here remarked that very different opinions were held as to the actual utility of reading mathematical papers at the meetings. The views expressed depended very much upon the advantages the speaker himself was able to derive. Sylvester and Cayley were at opposite extremes. The former always set great store on verbal communications and personal intercourse, but Cayley said he rarely gained anything appreciable except from the printed page. It is unquestionable that Mr. Roberts received benefit from the reading of papers. He was an attentive listener, and probably more than any other member always kept his mind on the paper being read. For him the reading of a paper was very far from a formality.

For a number of years the Council met at 7.30, the Society's meeting being at 8 and lasting about two hours, sometimes more, but generally less. At length the time came when the half-hour allowed for the Council was found to be insufficient, and it then met at 7. When the Society moved to Albemarle Street in 1870, and for a number of years afterwards, the Council met in the small room at the back of the building on the first floor, and sat at the round table which, though it occupied most of the space in the room, afforded barely sufficient accommodation for a full Council, the meeting of the Society taking place in the large front room, in which the Council met in later years. All the associations of the early Council meetings in Albemarle Street are connected with this small room at the back.

It has always seemed to the writer very surprising that so young a Society should have been so precise with respect to reporting upon papers. Two independent referees were always appointed, their separate reports obtained and read, and the question of the publication of the paper was decided by ballot. In no case in the writer's experience was there any bias; nor was any distinction made in favour of distinguished mathematicians or on personal grounds. All papers were adjudicated upon by exactly the same procedure and with the same impartiality. In this respect the new Society was a pattern to many older and more dignified institutions, and perhaps no Society has ever been more strict or thorough in its attempt to maintain a definite standard and be equally fair to all. It is also probable that no Society has ever done so much for its subject with so small an income. Except for the rent of rooms and a trifling expenditure on the Library, all the income was spent on the *Proceedings*, and, until Lord Rayleigh made his gift of £1,000 to the Society, the means of the Society were very narrow.

In connection with the system of appointing referees, the writer may mention that his first introduction to Mr. Roberts was when he attended a meeting of the Society as a visitor in 1868. The meeting was held in the rooms of the Chemical Society at Burlington House, which had not then been rebuilt; and, while waiting in the meeting room, Mr. Roberts entered from the Council room and explained that he had temporarily left the Council while referees were being appointed for a paper of his.

Mathematicians are usually long lived and happily several of our earliest members are still with us. Prof. Clifton was an original member, and Prof. Crofton and Lord Justice Stirling served on the Council in 1867–68; but with the death of Mr. Jenkins and Mr. Roberts, all who were regular attendants at the Society's meetings during the first ten years of its existence have passed away. J. W. L. G.