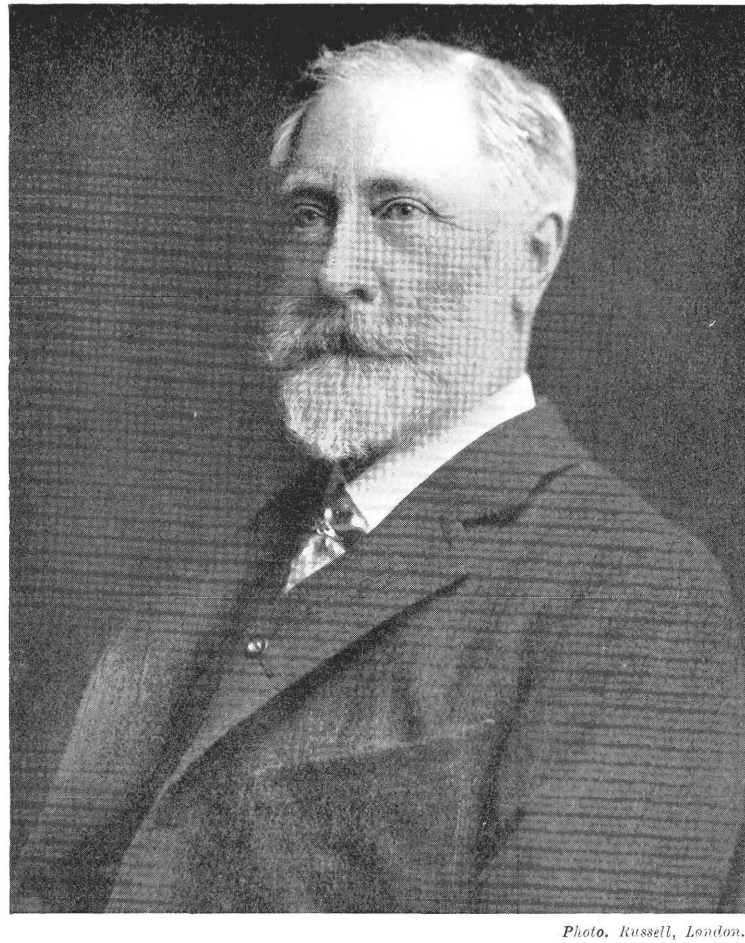

Photo. *Russell, London.*

W. W. ROUSE BALL, M.A.

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Obituary.

W. W. ROUSE BALL.

MATHEMATICIANS all over the world have heard with regret of the death of one who was known to many of them as a man of singularly attractive personality, and to all of them as the author of scientific and historical works of great value and interest.

Walter William Rouse Ball was born on 14th August, 1850, the only son of Walter Frederick Ball, of Hampstead; and began his academic career at the age of seventeen, when he won an Entrance Exhibition to University College, London.

At this time it was not unusual for promising young mathematicians to take a degree at University College before going up to Cambridge. Todhunter and Routh had done it some years before, and the Senior Wranglers of the years immediately before and after Ball's year were both University College men. Of the small company of his fellow-students in London, several rose to distinction afterwards, notably the physicists W. E. Ayrton and J. A. Fleming, J. N. Keynes the logician, and the present Master of St. John's. The Professor of Mathematics was T. A. Hirst, a geometer who had been trained on the Continent, and who had succeeded de Morgan in the chair in 1867.

Concurrently with his mathematical course, Ball read Logic and Moral Philosophy under Professor Croom Robertson, and in 1869 graduated with Honours in that subject. To those who knew him only in the second half of his life, this early interest in philosophical studies seemed to have left but little residue. I never remember hearing him take an active part in philosophical discussion, or comment on philosophical books: and it is difficult to believe that the account of the Greek period in his *History of Mathematics* (long and valuable though it is) was the work of a mind fundamentally interested in philosophical questions.

In 1870 Ball went up to Trinity College, Cambridge, as a Minor Scholar, being elected in the following year to the foundation. The group of scholars of Trinity, among whom he now found himself, included the brothers Gerald Balfour (afterwards classical lecturer of the College and Chief Secretary for Ireland) and F. M. Balfour (afterwards Professor of Animal Morphology),

the brothers S. H. Butcher (afterwards President of the British Academy and M.P. for the University), and J. L. Butcher (Lord Danesfort), the classical scholars Verrall, Archer-Hind, and Hicks, Rendall (Headmaster of Charterhouse), Gow (the historian of Greek Mathematics), W. Cunningham the economist, F. W. Maitland (Downing Professor of Laws), A. B. Kempe (ecclesiastical lawyer and Treasurer of the Royal Society), and W. Leaf, the banker and Homeric scholar. The mathematical teaching (which in those days was entirely within the College) was provided by H. M. Taylor, W. D. Niven, J. W. L. Glaisher, and H. Lamb. Ball was regarded as one of the most promising men of his year, and indeed as the prospective Senior Wrangler: he was, however, placed Second in the Tripos of 1874. The Smith's Prize examination followed close on the Tripos, and Ball came out at the head of the list. In 1875 he was elected to a Trinity Fellowship.

His ambition now seems to have been towards a career in law. In 1876 he was called to the Bar by the Inner Temple, going the South-Eastern circuit. This, like the degree in Philosophy, is something of a puzzle: for he was a shy and reluctant speaker before any audience larger than a small committee. However, towards the end of the same year, W. K. Clifford, who had been appointed to the Chair of Applied Mathematics in University College, London, about the time Ball had gone up to Cambridge, broke down in health, and Ball was invited to act as his deputy. With the double experience of life as a practising barrister and as an academic teacher of mathematics, Ball now saw clearly where his real gifts and interests lay: and when in 1878 the opportunity came of returning to Trinity as lecturer, he had no hesitation in accepting it. For the next forty-seven years the tall bearded figure with the upright carriage was to be seen daily in the Great Court. He had found his life-work: and before long he began to put forth the works of scholarship on which his reputation rests.

The first of these, *The Origin and History of the Mathematical Tripos* (1880), was a pamphlet of only thirty-four pages, which, as its substance was incorporated in his later studies, need not be noticed specially here: but in 1888 appeared the *Short History of Mathematics*, which won an immediate and lasting popularity.

The causes of that popularity were not far to seek. The book may be compared in some respects with a historical work in a different field by another member of the College, Macaulay's *England*. In both cases, success was due in the first instance to the unparalleled ease, clarity and attractiveness of the style: the story was told round personalities, and was enlivened from time to time by deft touches of the picturesque, the dramatic, and the scandalous: and as Macaulay's work was designed primarily to glorify the Whigs, and in particular William of Orange, so it may perhaps be said that in some of Ball's presentation there was an undercurrent of glorification of Trinity, and in particular of Newton.

The task of the historian of science is, above all, to trace the origin and development of fruitful ideas: to reconstruct the intellectual outlook, the antecedent knowledge, the desires, the gropings, the intuitions, the connexions of thought, in the minds of the great investigators; and to exhibit the growth of conceptions and the elaboration of theories as they are transmitted from one mind to another.

In one part of his book—that devoted to the life and works of Newton—Ball comes very near to this ideal. A deep and penetrating study of all the literature of the Newtonian age had given him a complete mastery of the subject: and his analysis and solution of the difficult questions which it presents was a notable contribution to learning.

In dealing with other periods he was sometimes less successful. At the beginning of the book, in the account of Greek mathematics, he fails to conjure up the atmosphere and setting of Greek thought, or to indicate clearly the ruling

principles of the different schools and their relations to each other: and as a result, he leaves us with little more than a string of names, with anecdotes and theorems attached to them. In justice to Ball, it should be said that the two well-known (and in many respects excellent) Histories of Mathematics by American scholars, which have appeared since his, fail in this particular quite as deplorably as he did. The first really intelligible account in English of the origin of mathematics, so far as I know, was written not by a mathematician but by a classical scholar, Professor John Burnet, in his *Early Greek Philosophy*.

The other place where all Histories of Mathematics break down is the modern period. The development of the science has been continuous, and is proceeding as rapidly as ever to-day: several thousand research papers—most of them, it must be confessed, of no great merit—are published every year. To compass this vast literature, extended throughout the last century, is beyond human powers; and even if the task could be achieved by some superman, to give a proper account of it in two or three chapters of a moderate-sized book would be impossible. Professor David Eugene Smith cuts the knot by simply omitting all reference to the work of men now living, and giving only a hasty sketch of what has happened since 1830, confined almost entirely to personal history. Professor Cajori, on the other hand, makes an heroic effort, and devotes (in his second edition) over two hundred pages to the nineteenth and twentieth centuries. The labour of preparation must have been enormous; and the result is extraordinarily careful and accurate. I do not suppose that any one else could have done it better; but for all that, it is unsatisfactory: it is, in fact, scarcely readable; and one might hazard the guess that of the hundreds of names of modern mathematicians to be found in his colossal index, the majority will in a few years be totally and deservedly forgotten.

Between these extreme policies, Ball steered with his native tact and with some measure of success. While the fifty pages which he devotes to the nineteenth century in his third edition cannot be taken very seriously, they display the outlines of development pretty fairly: and his tendency to gossip always saves him from becoming hopelessly dull.

To write a general history of mathematics, from Thales to Einstein, is a task for which perhaps no one is ever likely to be perfectly qualified. Ball produced a sound and good book which has given delight and instruction to thousands, and we may leave it at that.

His next literary project was remarkably well chosen. It was original in conception, perfectly commensurate with his powers, and such as none but he could have written: it may, I think, be described as his most interesting and most valuable work. I refer to the *History of the Study of Mathematics at Cambridge*, which was published in 1889.

Of this it is difficult to say anything that is not unstinted praise. From the first page to the last it is as fascinating as a good novel; one could almost believe that Ball had lived in Cambridge continuously since the thirteenth century and remembered everybody that had taught there. The Jacobean mathematicians, Newton and his disciples, the eighteenth-century professors who never lectured, the revival of Cambridge mathematics in the days of the Analytical Society, the history of the Tripos, were topics on which he knew everything that was to be known, and told exactly what was worth telling.

About this time the Syndics of the University Press were publishing a series of schoolbooks, under the name of the *Pitt Press Series*. H. M. Taylor was invited to prepare an edition of Euclid, which was published in 1889-95, and is still in my opinion the best text-book of school geometry; and Ball was invited to prepare an *Algebra*, which appeared in 1890. It is clearly written, and thoughtfully warns the young student against innumerable pitfalls—rather an unexpected feature, since Ball cannot have had much experience of elementary teaching; but it follows the traditional exposition closely, and is not specially

remarkable for outlook, originality, or rigour. I do not know to what extent it came into use.

During these years Ball's pen was very active: in 1892 he produced *Mathematical Recreations and Problems*, a work so well-known that to describe it here is superfluous. The subject was congenial to him, and he had tremendous resources in this field; the idea of a book of mathematical recreations was not new, but he extended it in many fresh directions. The best parts—and they are very good—are those dealing with arithmetical and geometrical pastimes such as magic squares, mazes, and the knight's path on a chess-board. In the more subtle argumentative topics, such as the Paradoxes of Zeno and Hyper-Space, he is less successful, from the defect of philosophical quality in his mind. The three famous problems of antiquity—the duplication of the cube, the trisection of the angle, and the quadrature of the circle—he introduces by legends and discusses as isolated puzzles: this is hardly adequate, for to the Greeks the three problems were involved in a serious and far-reaching logical programme of research into the nature of things. But against these and all other criticisms may be set the fact that the copy which now lies before me is coming to pieces from constant use.

The *Essay on Newton's Principia*, which appeared in the following year (1893), was an excellent piece of work, the fruit of long-continued original investigations. It is greatly to be regretted that Ball never found time to carry out his intention of bringing out a critical edition of the *Principia* itself. Some shorter Newtonian studies, on the *Enumeratio linearum tertii ordinis*, and on a fragment relating to centripetal forces, preserved in the Portsmouth collection, were published * in the *Proceedings of the London Mathematical Society*. About this time he wrote several other papers in the mathematical journals: one, of date 1891, on *a hypothesis relating to the nature of the ether and gravity*.† As is well known, the wave-theory of light, in the form in which it was presented in the nineteenth century, postulated a medium or "ether," filling all space and having elastic properties similar to those of an ordinary solid body. It was a standing difficulty in the way of this theory that the hypothetical medium does not reveal its existence in any of the other ways we should expect, *e.g.* by resisting the motion of bodies immersed in it. Ball's hypothesis, which was intended to get over this difficulty, was that the ether occupies a three-dimensional space like our own, but very slightly displaced from it in the fourth dimension; so that every particle of matter (being, so to speak, a point of contact between the two spaces) is in contact with the ether, and can influence other particles of matter by means of vibrations propagated through the ether, although the ether itself, as a whole, is not in our space at all, and therefore cannot be perceived directly by us. One wonders that this hypothesis was never taken up by the spiritualists. Perhaps they never heard of it.

In the same volume ‡ he discussed Mersenne's numbers, *i.e.* the values of p which make $2^p - 1$ a prime number. Soon after appeared a note on the resolution of numbers of a certain form into factors,§ and then a short paper on a new method of constructing magic squares. To a Swedish journal which had been established specially for papers on the History of Mathematics he contributed a note,‖ *On the Use of a Single Symbol to denote the Incommensurable Number* 3·14159....

Meanwhile, important events had taken place in his life. In 1893 he succeeded Glaisher as Tutor of Trinity: and he and Mrs. Ball (to whom he had been married in 1885) soon won the reputation of being the best tutor and tutor's wife that had ever been. They built a house not far beyond the Trinity Fellows' Garden, in the new western suburb which had begun to rise when the compulsory celibacy of Fellows was abolished; and here they welcomed and

* *Proc. L.M.S.* **22** (1891), p. 104; **23** (1892), p. 226. † *Mess. of Math.* **21** (1891), p. 20.
‡ *Ibid.* **21** (1891), p. 34. § *Ibid.* **22** (1892), p. 82. ‖ *Bibl. Math.* 1894, p. 206.

entertained an endless succession of pupils. Their charm as host and hostess was beyond all power of description: both of them were, I think, shy and reserved by nature, but shyness was swallowed up in goodness of heart.

With the influence of his new position, Ball set himself to foster the corporate life of the College. He was the moving spirit in the institution of a common-room for undergraduates, of a reference-library and reading-room for them, of breakfasts and luncheons in Hall, the acquisition of a new playing-field, and the formation of the Trinity Field Club. All these were highly successful except the breakfasts in Hall, which were subjected to a rule requiring the meal to be begun before 9.0 a.m., and consequently after a short trial were given up.

With the same motive he began to issue at the beginning of each academic year a little pamphlet of *Trinity Notes*, which was given to everyone on his "side." The topics were such as would be likely to interest the men and strengthen College feeling: the right age for coming up, the careers of those who were going down, the College clubs, inter-College and inter-University contests, compulsory Greek in the Little-go, and plans for making a sub-way to Whewell's Court.

In 1898 he became Senior Tutor and Chairman of the College Education Committee, and was now in a position to do more than ever for his cherished hope of making Trinity the chief centre of mathematical discovery. The young men who were elected to Fellowships just about the end of the century—Bertrand Russell, Barnes, Hardy, Jeans, and myself—were tremendously keen on research, and we had the warmest encouragement from the older Fellows, particularly Forsyth and Whitehead. On the administrative side, Ball saw to it that we were given every chance. A spirit was thus created which carried all before it, and reacted powerfully on the teaching of the undergraduates, many of whom have since become men of distinction; among the scholars of Trinity in the first decade of the present century who have since become Fellows of the Royal Society may be mentioned Eddington, Nicholson, Littlewood, Mercer, Watson, G. I. Taylor, Darwin, Chapman, and Proudman.

In addition to his College duties, Ball served the University as a member of the Financial Board, Auditor of the Chest, and (from 1905) representative of the University on the Borough Council. He was also a Governor of Westminster School and of the Perse School, and Treasurer of the University Boat Club.

During the strenuous years of Tutorship, he had little time to write books; and when he returned to literary work, it was as historian of the College. The *History of Trinity College, Cambridge*, the *History of the First Trinity Boat Club*, and the *Records of Admission to Trinity College*, 1546-1900, were followed in 1918 by a collection of his magazine articles and lectures to undergraduate societies, which was published under the title *Cambridge Papers*. About half of them are concerned with Trinity—the Chapel, the Library, the Portraits, the Statues, the Plate, the Auditors, the Scholars, and everything else that he knew so well—and the rest with studies of Newton and the University. Appreciation of their charm is by no means confined to those who know Cambridge.

Soon after the end of the War he founded a society for the promotion of conjuring in the University. Last year in writing to him I referred to it and enquired about its origin; the following is taken from his reply:

"Some five years ago I founded a society of undergraduates interested in conjuring and such like shows: if members can conjure so much the better, but that is not essential. I took as our symbol the re-entrant pentacle, which, as you may perhaps know, was sometimes used as a sign by magicians in the middle ages and probably also in classical times. The Society prospers, and at the end of an academic year numbers something like 100 members. Nearly four years ago we received the unexpected compliment of being asked to give a show in London before the leading professional conjurers. The invitation

was embarrassing, but could not be declined: however, in fact, we gave a really good show.

"I was the more inclined to introduce a pentacle by the fact that, according to the historians, it was the symbol selected by Pythagoras as the badge of his school. This seems to be true, and hence to mathematicians it should have interest."

On one occasion Ball himself gave to the members an exhibition of string figures—a subject on which he had written a short pamphlet.

The most sensational of the Club's public displays was given last Lent Term. A woman was sawn in two, before an audience who saw her head and feet continuously from the time she came on to the platform to the time when, having been reconstituted, she walked away again. It was rumoured that in the preliminary rehearsals she had once been injured actually.

Ball's interest in games of all kinds, which made him to the end of his life such an entertaining talker to undergraduates, was once the subject of a burlesque in the *Granta*. It was at the time when the success of bridge and ping-pong (then newly introduced) had led to an outburst of invention. A game, of a decidedly lively character, was advertised and described under the name of "Rous-ball."

Another of his interests was making a collection of portraits of mathematicians, past and present: probably the most extensive that has ever been formed. In 1914 he kindly allowed it to be exhibited at the Napier Tercentenary Celebration in Edinburgh; and a catalogue of the subjects will be found printed in the *Handbook to the Napier Exhibition*. Seven volumes are devoted to the General Collection, one to mathematicians of special excellence, and one to professors and University lecturers in mathematics at Cambridge. He attended the Napier Celebration, at which many who were specially interested in the History of Mathematics were gathered, and was received with marked respect. Afterwards he instituted a medal, commemorative of the discoveries of Napier, to be awarded annually in the University of Edinburgh to the most distinguished graduand in Mathematics.

The death of Mrs. Ball in December 1919 was a great blow to him, from which perhaps he never really recovered; but outwardly he seemed well and active. Last September he was pleased to meet again many of his old pupils, who had come up to Cambridge to celebrate the six hundredth anniversary of the founding of Michaelhouse (from which Trinity ultimately developed). I noticed that he walked with a stick, and understood that he had had some trouble affecting the heart, but in mind he seemed as bright and alert as ever.

He passed away at Elmside on Saturday, 4th April: the funeral service, attended by many from far and near, was held in the Chapel of Trinity on Wednesday, 8th April.

E. T. WHITTAKER.

GLEANINGS FAR AND NEAR.

325. Newton and Poetry.—A friend once said to him, "Sir Isaac, what is your opinion of poetry?" His answer was: "I'll tell you that of Barrow;—he said that poetry was a kind of ingenious nonsense." (Singer's edition of Joseph Spence's *Anecdotes*: Supplemental Anecdotes, Second Memorandum Book, 1756.) Spence gives as his authority John Robartes, Earl of Radnor, F.R.S. (1732). Prof. E. Bensly (*N. and Q.*, April 11, 1925) is reminded by Barrow's opinion of the Cambridge mathematician who "after the perusal of *Paradise Lost* delivered himself of the criticism that the author had proved nothing, a story to which Bishop Lightfoot presumably alluded when he remarked in a University sermon that there were some men to whom the noblest work of the imagination seemed nothing but a tissue of unproven statements."