

rary member of the English, French, and German Chemical Societies. These associations, the second of which originated in Dumas' laboratory, elected him as a matter of course immediately after their institution. In 1843 the Royal Society awarded to him the much-coveted Copley Medal. That he was the first to obtain the Faraday Medal in the gift of the Chemical Society of London, has been already mentioned. Dumas was a Knight of the Prussian Order *pour le Mérite*, the highest scientific honour Germany can bestow, and it may further be added that he received the Grand Cross of the Legion of Honour, and was a Knight of a goodly number of other Orders in Christendom.

In the autumn of 1883 Dumas' health, which up to that time had been unimpaired, began to fail. By the advice of his physicians he passed the winter in the south of France. He died at Cannes on 11th of April, 1884.

A. W. H.

[For further information the reader is referred to a sketch of Dumas' life and labours, by Professor A. W. Hofmann, of which the above notice is an abstract. See series of Scientific Worthies ("Nature," 1880, Feb. 6).]

A short account of the life of Dr. TODHUNTER, founded on personal knowledge, and information derived from papers and letters and notes communicated by his relations, has recently been published by his intimate friend, Professor Mayor. From this pamphlet we learn that Dr. Todhunter was born in 1820, and that he was the second of four sons of a Congregationalist Minister at Rye. We are also told that as a child he was unusually backward, and gave no promise of his future eminence. If this be correct, it is a fact from which many boys may draw some encouragement. Passing over his boyhood we find him an assistant-master in a school at Peckham, and at the same time attending the evening classes at University College, and among others the lectures of De Morgan. Here he seems to have come under the fascination which so many of the pupils of that great teacher experienced. We are told that his admiration for that mathematician was unbounded. Need we wonder that the influence of that teaching is seen in so many of the books he afterwards wrote? In 1839 he matriculated in the University of London, obtaining the exhibition for mathematics, and in 1842 he carried off the scholarship at B.A. Finally in 1847 he gained the gold medal at M.A., which was then the highest honour to be obtained in that University. Having thus acquired the means of coming to Cambridge he entered at St. John's College, and took his degree in 1848. That he would be Senior Wrangler and take the first Smith's Prize was never doubtful. Coming up rather older than men usually do, and having brilliant talents, he found himself so much in advance of his year that he was

able to devote a great part of his attention to other than the usual studies. He once told the writer of this notice how as an undergraduate he read *Electricity* to fill up his time, though the subject did not then enter into the Tripos Examination List.

In the same year in which he took his degree he gained the Burney Prize. According to the regulations, this prize is to be awarded to a graduate of the University who is not of more than three years' standing from admission to his first degree, and who shall produce the best English Essay "on some Moral or Metaphysical subject, on the Existence, Nature, and Attributes of God, or on the Truth and Evidence of the Christian Religion." His essay was printed in 1849 under the title "The Doctrine of a Divine Providence is inseparable from the belief in the existence of an absolutely perfect Creator." These headings are mentioned here to show how widely he was accustomed to spread his studies.

Soon after his degree he established himself in his college as a mathematical tutor, and then acquired a great reputation for his skill as a teacher. Afterwards when new arrangements were made at St. John's College he was appointed Principal Lecturer, and was expected to devote his teaching powers chiefly to the service of his college. Soon after this he vacated his fellowship by marriage, and following the rules of the college he retired from his position at the head of the staff of lecturers. He continued, however, to lecture for some years, but gradually he turned his attention more and more to the work of writing books. Finally he gave up all share in the tuition of his college, and devoted himself to those labours by the results of which he is best known.

Dr. Todhunter also spent much of his time as an Examiner. He was Examiner for the University of London for the five years ending 1869. He examined for the Indian Civil Service Commissioners more than once. He was Senior Moderator in 1865 and Senior Examiner in the following year, but though asked several times to examine again he always declined, declaring that the work was so onerous that it took up too much of his time. This is an opinion held by many other distinguished mathematicians who have examined once. At the same time this circumstance illustrates the care and patience usually given to the preparation of examination papers. He also examined for the Smith's Prize. But the Mathematical Tripos did not alone obtain his attention, he also examined for the Moral Sciences Tripos in the three years 1863, 1864, and 1865.

He was a member of many learned Societies. He became a Fellow of the Royal Society in 1862, and served on the Council during the years 1871-1873. He was elected a member of the Mathematical Society of London in 1865, the first year of its existence. He was also a member of the Royal Astronomical Society.

Some time after his marriage he was elected to be an Honorary Fellow of his college. This was a distinction which he evidently prized so much that he sometimes placed this title by itself after his name, joined solely to the letters M.A. or F.R.S. Later on in his life he was chosen as an Elector to three University Professorships, viz., the Knightbridge Professorship of Moral Philosophy, the Plumian Professorship of Astronomy and Experimental Philosophy, and the Professorship of Mental Philosophy and Logic. Lastly, when the University of Cambridge established its new degree of Doctor of Science, restricted to those who have made original contributions to the advancement of science or learning, he was one of those whose application was granted within the first few months.

The great work of Dr. Todhunter's life lies in the part he has taken in the education of this generation. There are few of us who have not studied some of his books. Many have made their first acquaintance with mathematics through his aid; and not their first acquaintance only, for his books conduct the student through a vast range of mathematical learning. Writing to his wife in 1878, when he was Examiner for the Indian Civil Service, he says: "There is a library of mathematical books provided by the Civil Service Commissioners for the use of the Examiners. It consists of fourteen volumes, ten of which are by myself. Thus you see I am able to do much of that labour which Matthew Arnold thinks distasteful, namely, that of perusing your own books."

A detailed account of the numerous educational books he has written would be too long for so slight a sketch of his life as the present. A simple list of these books is a history of the labours of his life, as the dates run on we see his time filled up with correcting one edition after another.

In writing, his first care was to be accurate. He once told the writer of this notice that, with the assistance of two of his pupils in correcting the press, the first misprint in his "Integral Calculus" did not occur till past the seventieth page. It might have been thought that he would have stereotyped his elementary books, but this was not done until many editions had been issued. Though at pecuniary loss, and with great labour, he yet preferred to correct edition after edition in hopes of eliminating all errors.

In constructing his books, he seems to have discovered that, for the teaching of boys, novelties would be out of place. What was wanted in any subject was a short and accurate account of the things then known. The object was to put the reader as quickly as possible in possession of all the knowledge which was most likely to be useful to him afterwards. Accordingly he gives in his books a clear statement of the well-known principles of each subject, arranged in a logical order. Each step in the argument is explained at length in clear

English. Nothing is assumed but what a reader should know. Every page makes it evident how thoroughly he was keeping in mind that he was writing for beginners.

Whatever his own ideas were, his books were certainly a great success. His "Euclid" and his "Elementary Algebra" have in twenty years run through fifteen or sixteen editions. They were appreciated by the schoolmasters, and by those who had to teach these subjects. With their recommendations, the sale has grown into something enormous. His more advanced text-books being addressed to a more limited circle of readers could not be expected to run through so many editions; yet we find his "Differential Calculus" reaching its ninth and his "Integral Calculus" a seventh edition.

His reputation in future time will undoubtedly rest on his histories, for the fashion of elementary books will pass away, and a new generation will like a new arrangement of old things. The most important of these are (1) "A History of the progress of the Calculus of Variations during the nineteenth century:" 1861; (2) "A History of the Mathematical Theory of Probability from the time of Pascal to that of Laplace:" 1865; (3) "A History of the Mathematical Theories of Attraction and the Figure of the Earth from the time of Newton to that of Laplace:" 1873. The first of these is a continuation of Woodhouse's history of the Calculus of Variations from its origin until the close of the eighteenth century; and it has been stated that it was his admiration for this work that led him to write this history.

These books appear to the writer of this notice to be of great importance. It is a great boon to the student to have a short and clear account of what has been already done, and what remains to be accomplished in any subject. Though the third of these histories extends over two volumes of nearly five hundred pages each, yet these are not too much for so great a subject.

It is unnecessary to give a particular account of these histories, as they have now been some time before the public. But we would call the attention of those who have not yet read them to their extreme interest. As we read one of them, it seems as if a new light were thrown on the subject. The difficulties of each investigator are put before us; we see how the subject advances, each discoverer adding a little, until step by step we arrive at our present state of knowledge. We see here sketched out before us the gradual growth of those modern methods which we now find so ready to our hands. Thus, in one place, Dr. Todhunter points out the first appearance of those confocal shells which play so important a part in modern works of attraction. These appear in a memoir of Maclaurin's, who introduces them in a remarkable manner without appearing to realise their

importance. In another place, we find a sketch in eight pages of a memoir of Legendre's which Dr. Todhunter considers to be the foundation of all that Laplace added in the theories of attraction and the figure of the earth to the works of Maclaurin and Clairaut. As we read the sketch, we see the first beginning of Laplace's coefficients and a recognition of the importance of the potential. This was the commencement of a new era in mathematical physics. In a third place, the history shows us how D'Alembert, trying to find the attraction of an ellipsoid, makes it depend on a single definite integral. This result, Dr. Todhunter reminds us, is the point at which modern investigations have finally arrived. But D'Alembert, after effecting this, strangely rejects his result as inadmissible. "In this process," says Dr. Todhunter, "there is nothing wrong in principle, but he has omitted a bracket which renders his result slightly inaccurate. He gives some invalid argument against his method. Thus D'Alembert deliberately rejects one of the most important formulæ of the subject, which in fact quite supersedes a large part of his memoir. This is perhaps the strangest of all his strange mistakes." A little further on in the history, we read how Laplace values and appropriates the treasure which D'Alembert deliberately threw away.

In 1869, the subject prescribed for the Adams' Prize was "A determination of the circumstances under which Discontinuity of any kind presents itself in the solution of a problem of Maximum or Minimum in the Calculus of Variations." The proposal of this subject seems to have arisen from a controversy which had been carried on in the "Philosophical Magazine" a few years previously. In this controversy Dr. Todhunter had taken part, and when the subject was proposed for the essay he was anxious that his own view should prevail. This view is given in the opening sentences of his essay:—"We shall find that, speaking generally, discontinuity is introduced by virtue of some restriction which we impose, either explicitly or implicitly, in the statement of the problems which we propose to solve." This thesis he supports by considering in turn the usual applications of the calculus, and pointing out where he considers the discontinuities which occur to have been introduced into the conditions of the problem. This he successfully proves in many instances. In some cases, the want of a distinct test of what discontinuity is, somewhat obscures the argument. His essay was rewarded with the prize. It is published under the title "Researches in the Calculus of Variations."

In the midst of so busy a life, Dr. Todhunter could yet find time to write for others. The second edition of Boole's "Differential Equations" was published under his care; and, what is more, he undertook the labour of arranging and editing the supplementary

volume. This task was undertaken from friendship to the late Professor Boole. The difficulty of preparing unfinished papers for the press is obvious; and it is not surprising that, as he once mentioned to the writer, it should have cost him some months of hard work.

Dr. Todhunter has left a treatise on Elasticity, which was very nearly finished. The time and labour he spent over this work injured his eyesight, and probably led to his final illness. These MSS. had been sent to Professor Cayley to report on; and we learn from Professor Mayor's pamphlet that the investigation shows that they are of the same class as the history of the Theory of Attraction, and seem fairly complete.

Another result of the labours of his latter years is a treatise on Arithmetic. Such a work when perfected would have smoothed the way for the young beginner over many difficulties. It is greatly to be regretted that he did not undertake it sooner.

In the summer of 1880 Dr. Todhunter first began to suffer from his eyesight, and from that date he gradually and slowly became weaker. But it was not until September, 1883, when he was at Tunstanton, that the worst symptoms came on. He then partially lost by paralysis the use of the right arm, and, though he afterwards recovered from this, he was left much weaker. In January of the next year he had another attack, and on the 1st of March, 1884, he died at his own residence in Cambridge, surrounded by his dearest relatives. It was a fit ending to an honourable and respected life spent in the advancement of that science which he loved so well.

E. J. R.

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