



Augustus De Morgan

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H. D. ELLIS.

THE LONDON BRANCH.

THE following papers were read at meetings of the London Branch during the summer and autumn of 1914:

“Simple Spherical Geometry.” P. J. Harding.

“Pilot Balloons and the Determination of Wind Velocities.”

F. J. W. Whipple.

“The Teaching of Elementary Arithmetic.” Mrs. F. G. Shinn.

“Some Points in very Elementary Algebra.” L. W. Grenville.

“Puzzles.” F. C. Boon.

The Branch President, Mr. F. W. Dyson, Astronomer Royal, exhibited and explained a machine for solving Spherical Triangles.

The meetings were well attended, and interesting discussions followed all the papers.

AUGUSTUS DE MORGAN.

THE biography of De Morgan by his widow is now more than thirty years old, but the recent republication of three essays by him on Newton, reviewed in the October number of the *Gazette*, serves to recall one of the most striking figures in the London mathematical world of some fifty years ago. Augustus De Morgan created no new branches of knowledge and discovered little of note, yet when the scientific history of England in the nineteenth century is written his name will occupy a prominent position, for he profoundly influenced the opinions of the ordinary man of science and mathematician of his time.

De Morgan was born in 1806. In 1823, after a desultory education, he entered Trinity College, Cambridge, where he came under the influence of Peacock and Whewell. The time spent by a student at Oxford or Cambridge is frequently that in which his character and future course of life are determined, and, in my opinion, this was markedly so in De Morgan's case. His interests at the university spread far beyond the narrow limits of the Tripos, and philosophy, historico-mathematical subjects, music, and novels, in turn attracted his attention. Above all it was at Cambridge that he developed a rugged independence of character and a determination never to let his conduct be swayed by considerations of self-interest—life-long traits which explain various actions that struck his contemporaries as cranky. He had been brought up as a strict evangelical, but even as a lad felt unable to accept fully the beliefs of that school, and finally, though refusing to join any denomination, he came to sympathize generally with the unitarian attitude. Hence he declined to stand for a fellowship or proceed to the M.A. degree, both of which then involved a

declaration of belief ; so to the loss of Cambridge, but gain of London, his direct connection with the former university ceased with his graduation in 1827.

In 1828 he was elected first professor of mathematics at what is now known as University College, London. His subsequent history was closely connected with it, and brings out clearly one side of his character. He resigned his chair in 1831 because the Council had used a power reserved to it of dismissing a teacher without assigning definite reasons. The regulation was subsequently altered, and on a vacancy occurring in 1836 he was reappointed professor. He contemplated resignation again in 1853 because the College accepted a legacy of books to be selected by members of the Church of England. In 1866 a graver issue was raised by the candidature of a unitarian minister for the chair of mental philosophy and logic. De Morgan held that the College was not entitled to consider the ecclesiastical position or creed of a candidate, and held that the refusal to appoint the particular candidate, who was otherwise excellently qualified, was really due to the fact that he held unpopular religious views. Accordingly he finally resigned his chair. His retirement was followed by family bereavements and by illness, and he only survived five years.

This bare sketch shows De Morgan as a man of high character, ever testing his conduct in the court of conscience, but it does not in any way explain the influence he exerted on his contemporaries. We cannot account for this influence by his professorial work, since his lectures, though stimulating, did not attract outside students of special ability ; nor by his text-books, which are now nearly forgotten ; nor by his investigations in formal logic, which, though excellent of their kind and paving the way to Boole's discoveries, appealed to but a limited class ; nor by his connection with learned societies, which, though they brought him into contact with many men of science, gave him no exceptional facilities of intercourse ; while we should have supposed that his authority would have suffered from his avowed belief in spiritualistic mediums, and his self-imposed rigid rules of conduct, which at different times led to his retirement from his professorship, his leaving the Council of the Astronomical Society, his refusal to allow himself to be nominated to a fellowship in the Royal Society, and his rejection of the offer of an honorary degree.

We are driven to seek elsewhere the secret of his undoubted power in the mathematical world, and I believe it is to be found in his historical papers and reviews, his occasional lectures on general subjects, and in the universal recognition of his desire for justice and scorn of all pretence. His bibliography of arithmetical books is a model of how such lists should be compiled, his essays on the calendar and almanacks are excellent specimens of historical research, and the success of the *Penny Cyclopaedia*, of which he wrote nearly one-sixth, was largely due to his articles. His *Budget of Paradoxes*, consisting of a reprint of some of the reviews he had written for the *Athenaeum*, shows humour as well as learning, and his papers, of which the mere list of titles occupies several pages of print in his memoir, cover a wide range of subjects and appealed to men of many tastes. In all this work he put himself in the most intimate relations with his readers, who must indeed have been unappreciative if they did not esteem the sincerity and learning of the writer. He was a good fighter, and in some of his letters admits that he loved controversy, but he was always scrupulously fair.

He wrote at length on extensions of formal logic, and had a sharp controversy with Sir William Hamilton on the subject. He himself attached great importance to these researches, but they now possess

little interest for the general reader. On the other hand, his scientific pursuits were many-sided, and in most of the discussions on subjects which interested him he took a leading part. He was a strong advocate of the introduction of decimal coinage, and studied the theory of probability especially in its application to life assurance; as I have indicated above, he defended the tenets of spiritualism; he also concerned himself with methods of scientific education, opposing all systems which involved competition; but in science, I think it was mathematico-historical questions, notably the follies of circle-squarers and the Newton-Leibnitz controversy, that specially attracted his attention, and by which he will hereafter be chiefly remembered.

The three *Essays on Newton* serve well to illustrate his historical research, love of justice, and vigorous style. The first essay was written for a collection of biographies which appeared in 1846 and contains an excellent account of Newton's life and writings: the value of his discoveries, his astonishing ability, and the high standard of his private life are fully recognized, but it is argued that he was of a morbidly suspicious temperament, and was unjust to Leibnitz and Flamsteed. It was well that these issues should be raised, for new and important evidence bearing on them had then been recently published. We may say that the charge in regard to Flamsteed is made out. The dispute between Newton and Leibnitz about the invention of the calculus stands on a somewhat different footing. In regard to it, De Morgan was an out-and-out supporter of Leibnitz, and put that side of the case forcibly. The second essay (1852) dealt entirely with this matter, as also did a considerable part of the third essay (1855), which is a review of Brewster's *Memoirs of Newton*. In these memoirs Brewster had gone at length into the controversy, and came to the opposite conclusion, namely, that Leibnitz was at fault. This verdict was warmly contested by De Morgan, who expressed surprise that the comments he had made on the subject in 1852 should have been ignored. I do not propose to discuss here this old and well-worn dispute. De Morgan showed that Leibnitz's case had not been fairly presented in 1712, but this does not settle the question at issue.

Much of De Morgan's *Budget of Paradoxes* is given up to circle-squarers. Its discursive character renders description almost impossible, but it brings out clearly his knowledge of books and men.

As illustrative of his ingenuity in applying the laws of probability to numerous problems, I will mention a test which he proposed for determining the authorship of books. He believed that if different books on similar subjects written by a particular author were examined it would be found that the average number of letters per word in each book would agree to (perhaps) one place of decimal. Hence, if the average number of letters per word in two books on the same subject differed by more than that percentage, it was probable that the books were by different authors. He thought this experiment might be well worth making in cases where authorship was in question, and in particular in the case of the Greek text of some of the books of the New Testament, but as far as I know the test has never been applied.

Although De Morgan declined to connect himself with any denomination, he accepted literally the historical statements in the New Testament, and was a convinced theist. But he held strongly that no one had a right to ask for information on his religious views, and never would allow a statement of his holding or rejecting any theological opinion to be used as a step towards position or material success. After his death it was found that he had inserted in his will a sentence to the effect that he had never confessed his belief that Christ was the Son of God, because during his life such confession had always been

the way up in the world. That refusal was characteristic of the man.

The emoluments of De Morgan's chair and his other earnings, though somewhat slight, were sufficient for his needs. The library which he gradually accumulated was, apart from review copies of books, mainly got by diligent search in second-hand shops and stalls, assuredly of all ways the most attractive. Fortunately, after his death it was purchased as a whole, and has been preserved; I do not think he would have wished a better memorial. Throughout his life he worked hard, and for several hours most evenings was accustomed to write articles and letters. It was difficult to tempt him from London, where alone he felt at home. It was never my good fortune to make his acquaintance, but when I was a small boy he was pointed out to me, walking down the Adelaide and Hampstead Roads from his residence to University College, touching with his forefinger every tenth post on his way, and I was told that to the residents on his route his daily progress was one of the incidents of the day. It was said that he knew certain posts which he would reach in due course, and if one of these did not come in the decennial series he was accustomed to go home and start again.

That De Morgan was obstinate and somewhat eccentric I readily admit, and I do not consider he was a genius, but he leaves on my mind the impression of a lovable man, with intense convictions, of marked originality, having many interests, and possessing exceptional powers of exposition. In those cases where his actions were criticized it would seem that the explanation is to be found in his determination always to take the highest standard of conduct without regard to consequences; he hated suggestions of compromise, expediency, or opportunism. Such men are rare, and we do well to honour them.

W. W. ROUSE BALL.

MATHEMATICAL NOTES.

436. [A. 1. a.] *On the sum of an A.P.*

The usual formula for the summation of an A.P.

$$S_n = \frac{n}{2} \{2a + (n-1)d\}$$

is a quadratic in n . To determine n , so as to satisfy given conditions for a , d and S (for S_n), write it

$$n^2d + n(2a - d) - 2S = 0. \dots\dots\dots(1.)$$

1. Considering only those cases in which one root is a positive integer, *i.e.* in which there is at any rate one solution with a concrete interpretation, we shall have a second root which must be rational, but which may be fractional or negative, or both.

Let the positive integral root be n_1 and the other n_2 .

Then
$$n_1 + n_2 = 1 - \frac{2a}{d} \quad \text{and} \quad n_1 n_2 = -\frac{2S}{d},$$

and from these it is to be concluded that :

- (a) n_2 will be positive if S and d have different signs; a and d must also have different signs.
- (β) n_2 will be negative if S and d have the same sign.
- (γ) n_2 will be integral if d is a factor of $2a$ and dn_1 is a factor of $2S$.
- (δ) the denominator of a fractional solution will be d or a factor of d ; it will be d if d is prime to $2a$.