AUGUSTUS DE MORGAN
Photograph by Ernest Edwards, mid-1860s
from the Society's Tucker Collection in the Science Museum Library
in London

facing p. 578

AUGUSTUS DE MORGAN

B. H. NEUMANN

The first President of the London Mathematical Society was Augustus De Morgan (note the capital "D", which he, himself, insisted on). Who was he, what kind of person, what kind of mathematician? In trying to answer these questions, I shall inevitably put forward subjective views. There is no dearth of material on Augustus De Morgan; on the contrary, there is much more than I could hope, in finite time, to assimilate. I am not an historian, and my interest in Augustus De Morgan is amateurish. Thus this sketch should not be taken for a photographic portrait.

The most important source of our knowledge of Augustus De Morgan is the *Memoir of Augustus De Morgan by his wife Sophia Elizabeth De Morgan with selections from his letters* (Longmans, Green, and Co., London, 1882); I have used it extensively. There are obituary notices in the *Athenaeum* (1871) and the *Monthly Notices of the Royal Astronomical Society* (1872); entries in the *Encyclopaedia Britannica*, the *Dictionary of National Biography*, the *World Who's Who in Science*; and the introductions to various posthumous editions of some of his works. There are, of course, his own writings; I possess many of them, but "many" is still a small fraction of the whole. There is much archival material in the libraries of the Royal Astronomical Society, the Royal Society, University College, London, the University of London (Senate House Library), and Trinity College, Cambridge; and I am grateful to the library staffs of these libraries for their helpfulness, and for permission to use some of the materials.

This sketch is not arranged chronologically, but rather following certain strands, as, for example, the family, or the Society for the Diffusion of Useful Knowledge. This makes some repetitions inevitable.

1. *The De Morgan family*

John De Morgan (1772–1816), the father of Augustus, was a Lieutenant-Colonel who served several tours of duty in India, and on one of them, while he was stationed at Madura (now Madurai, Tamil Nadu, in the South of India), his fifth child, Augustus, was born, on 1806-06-27. Early in 1807 the family returned to England, but Colonel De Morgan went out to India again, alone, in 1808, coming home in 1810; went out again in 1812 or 1813, and died in 1816 on his way home to England, from a liver complaint. Living in India, or anywhere else in the world, was in those days a health hazard, and Augustus De Morgan lost the sight of his right eye from "the sore eye of India" soon after birth.

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Elizabeth De Morgan, the mother of Augustus, was the granddaughter of the mathematician James Dodson, FRS (*c.* 1709–1757). She outlived her husband by 40 years. Of her five sons and two daughters, one daughter and three sons survived to adult life. The daughter died in 1836 at the birth of her fourth child. Of the surviving sons, Augustus was the eldest. Next came George, a barrister and conveyancer, and finally Campbell Greig (1811–1875), a surgeon and FRS. The mother must have had musical talents, which her sons inherited: Campbell Greig was described as "a notable musician", and Augustus played the flute "exquisitely".

Another trait that Augustus De Morgan appears to have inherited from his mother was deep anxiety about the fate of family members who returned home later than expected. Also like his mother, Augustus De Morgan was not at all fond of the country, but much preferred town life. When, later, his family would take holidays in the country or at the seaside, he would happily stay in London and relish the solitude of his house and the opportunity to read and write without disturbance.

What Augustus De Morgan did not acquire from either of his parents was their Christian creed—his own creed remained much more generally theistic, he never joined any particular church, describing himself as a "Christian unattached". His mother wanted him to become an Evangelical clergyman, but he did not; and he never proceeded to the Cambridge MA, nor did he become a candidate for a fellowship at Cambridge, because he would not be cast in the Anglican mould.

In 1837, Augustus De Morgan married Sophia Elizabeth, the eldest of the seven children of William Frend (of whom more later). Sophia Elizabeth Frend had been born 1809-11-10, in the heart of London, but always preferred the country, in stark contrast to her husband. She was a talented woman, deeply religious. Among her many interests was higher education for women, and she worked closely with the founder, Mrs Reid, of Bedford College, the first women's college, which began in 1849. She also initiated, with some friends, a short-lived society for providing playgrounds for the poor children of the slums. Later in life she became deeply involved in spiritualism (and her husband was sufficiently tolerant of this to write a foreword, under a pseudonym, to a tract of hers on the subject, also written pseudonymously). She wrote a volume of reminiscences, which was finished in 1887, edited by her daughter Mary, and published (by Richard Bentley and Son, London, 1895) three years after Sophia Elizabeth's death in 1892 at the age of 82 years. More important for my present purpose is the *Memoir of Augustus De Morgan* which she wrote, and which is mentioned in the Introduction.

Augustus and Sophia Elizabeth De Morgan had, like their parents, seven children: Elizabeth Alice (1838–1853), William Frend (1839–1917), George Campbell (1841–1867), Edward Lindsay (1843–1880), Anna Isabella (1845–1884), Helena Christiana ("Chrissie", died 1870), and Mary Augusta (died 1907). They all seem to have been remarkably gifted, but ill health, especially consumption, took its toll. Alice was only 15 when she died. William De Morgan became an artist, mainly in ceramics, and attained fame as the inventor and manufacturer of the "De Morgan Blue" tiles, which decorated the saloons of many a steamship of the end of the 19th century, and which are now highly prized as collectors' items; when he retired, he wrote, for his own amusement and that of his family, a novel, *Joseph Vance*, and let himself be persuaded to publish it. It appeared in 1906 and became an immediate best-seller; and, nearly 80 years later, is still a delight to read. He wrote several more novels, which were published, but did not match the success of his first one. His wife, (Mary) Evelyn (*c.* 1855–1919), was a gifted artist in her own right. Her younger

sister, A. M. W. Stirling (died 1965), wrote, among many other books, *William De Morgan and his Wife* (Thornton Butterworth, London 1922); which has much information on the family, especially also on the paternal ancestors of Augustus De Morgan.

George Campbell De Morgan was the only one of the children to become a mathematician; he was a mathematics teacher at University College School, and wrote, shortly before his death in 1867, a mathematical paper that was published by the Cambridge Philosophical Society. It was he who, with his friend Arthur Cowper Ranyard, conceived the idea of a new mathematical society, tentatively called "University College Mathematical Society". It became the London Mathematical Society, with Augustus De Morgan its first President and George Campbell De Morgan one of its first Secretaries. His father was proud of him, and deeply shaken by his death, at the age of 26 years, in 1867.

Of the younger children I know much less. Chrissie, the next to youngest, died 7 months before her father, in her early twenties. Edward and Anne were the only ones to marry and have offspring. Anne's husband, Dr Reginald Edward Thompson (1834–1912), was a physician and an authority on consumption.

Augustus De Morgan's health began to decline in the 1860s, and in 1868 he suffered what his wife called a "sharp attack of congestion of the brain", while the obituary in the *Monthly Notices of the Royal Astronomical Society* speaks of kidney disease. He died on Saturday, 1871-03-18 "just after midnight" according to Sophia Elizabeth, "at one o'clock in the afternoon" according to the obituary in the *MNRAS*.

2. *Education*

Augustus De Morgan's first teacher was his father, who taught the 4-year-old boy "reading and numeration". Later Augustus went to half a dozen different schools in the South of England, learning the three Rs, Latin, Greek, Hebrew, Euclid, and Algebra. In 1823 he entered Trinity College, Cambridge, being then 16½ years old. He worked conscientiously and read prodigiously, and in 1824 his tutor, Mr Higman, commented to his mother on a college examination that "he is not only in our first class, but far, very far, the first in it". In 1825 he was awarded a Trinity scholarship. In the Tripos of 1827 he was fourth wrangler, to the disappointment of his friends, who had expected him to be senior or second wrangler. In the view of his teachers this was due to his reading very widely in mathematics, even the works of Continental mathematicians, instead of concentrating on the mathematics offered at Cambridge. He took with him from Cambridge a deep and lasting dislike of its system of examinations and the encouragement of rote learning that flowed from it.

In 1826 or 1827 Augustus De Morgan joined his mother, sister, and brothers in London, and he entered Lincoln's Inn to study for the Bar; but his scientific interests remained alive. They covered a very wide range, including astronomy, nautical tables, actuarial science, history of mathematics and of mathematicians, mathematical bibliography, apart from mathematics itself. His maxim was "A man should know something about everything, and everything about something". All his life Augustus De Morgan read voraciously and wrote copiously—more of this later.

3. *University College*

To provide academic opportunities to the non-Anglicans, the University of London was founded in 1826, to be renamed University College in 1836, when the University of London as an examining institution came into being. The Anglicans retaliated with the foundation, in 1829, of King's College, London, and of the University of Durham in 1832. The idea of a non-residential educational institution at university level for "Jews and Dissidents" had been around for some years, probably from about 1819, when a group of men, among them William Frend (of whom more later), Henry Peter (later Lord) Brougham (1778–1868), Thomas Campbell (1777–1844), George Birkbeck (1776–1841), discussed the idea and concluded that the time was ripe for the foundation of such an institution, without any religious ties. It was a private venture, funded partly by shares, partly by subscriptions; the proprietors elected, from among themselves, a Council, which managed the college and selected and employed the professors. The first professors were appointed in 1828, and the first lectures given in October of that year. Augustus De Morgan was one of 32 applicants for the chair of mathematics, and much the youngest of them, being not yet 22 years old. His letter of application is terse:

> Mr. A. De Morgan B.A. and Scholar of Trinity College; Cambridge, is desirous of becoming a Candidate for the Mathematical Chair in the University of London He begs to refer the Council to the Tutors of Trinity College, and to his degree in the Tripos of 1827, for testimonials of qualifications &c.
>
> 25, Hatton Garden
> December, 22nd, 1827

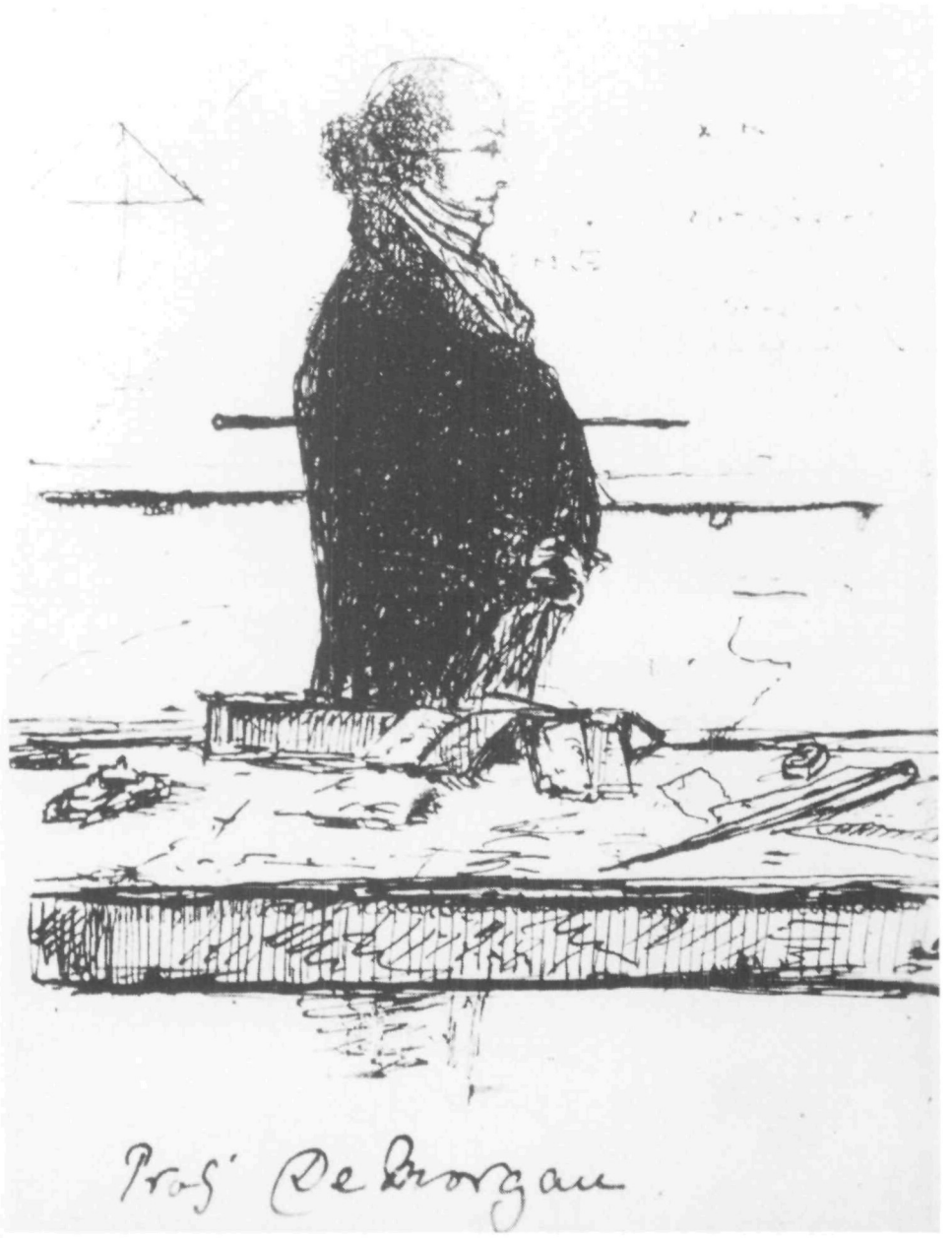
Among the references one from H. A. Hamilton MA &c Fellow of Trin: Coll: Camb: dated Jan.y 30, 1828 reads in part:

> He is accurately versed in the Writings of the Foreign Analysts, and I may be permitted my firm Belief, that, had he directed his Attention more exclusively to the Works of the English Mathematicians, He would have obtained the first Academical Honor of his Year.

Another reference is.

> Trin. Coll. Cambridge
> Jan. 14, 1828
>
> Having examined M.r De Morgan for the degree of B.A. I feel no hesitation in declaring my opinion that he is eminently well qualified for any mathematical appointment. The distinction which he obtained, (that of fourth Wrangler) is hardly a just criterion of his merit, as his reading had been so extensive that it could not all be made available in an examination here, though likely to prove of great service in another place.
>
> Henry Coddington
> late Senior Moderator

There were other references, not all to be found in the D.M.S. Watson Library of University College. They must have been good, because Augustus De Morgan was unanimously elected to the Chair of Mathematics, and gave his inaugural lecture "On the study of mathematics" on 1828-11-05. He says that he "began to teach himself to better purpose than he had been taught, as does every man who is not a



AUGUSTUS DE MORGAN
Professor of Mathematics, University College London, 1828–31 and 1836–66, as drawn by a student

(Reproduced from *The World of University College London 1828–1978* by Negley Harte and John North, by kind permission of The Provost.)

fool, let his former teachers be what they may". He lectured for two hours every day, made himself available to his students for about another hour a day, and spent rather less than another hour on the students' exercises; this would be for six days a week.

As the University of London was governed by an all-powerful Council, representing the interests of the proprietors, and the professors were engaged by the Council like servants, differences were bound to arise, and they arose quite soon. The students of the Professor of Anatomy, Granville Sharp Pattison (1791–1851), complained about him, whereupon he was dismissed in 1831 July. (This is an over-simplification: there were committees and investigations, and Augustus De Morgan addressed at least one committee in person, and the Council in writing.) In dismissing him, Council

> feel it due to Professor Pattison to state that nothing which has come to their knowledge with respect to his conduct has in any way tended to impeach either his general character or professional skill and knowledge.

(Indeed Professor Pattison continued a distinguished academic career in the United States of America.) This dismissal prompted Augustus De Morgan to write to the Council, on 1831-07-24,

> Here is distinctly laid down the principle that a Professor may be removed, and, as far as you can do it, disgraced, without any fault of his own.
>
> This being understood, I should think it discreditable to hold a Professorship under you one moment longer.
>
> I have, therefore, the honour to resign my Professorship, and to remain, gentlemen,
>
> Your obedient servant,
> A. De Morgan

This was not, however, the end of Augustus De Morgan's connection with the institution. For some years he supported himself by taking private pupils and by writing. Then, in 1836, shortly before the beginning of the academic year, his successor, Professor White, was drowned, with wife and child, in a boating accident, and Augustus De Morgan immediately volunteered to take on the mathematical classes until Christmas of that year. He was, inevitably, invited to resume his former Chair and, the constitution of University College meanwhile having been changed so as to give tenure to the professors, he accepted. He held the Chair of Mathematics until, towards the end of 1866, he resigned again. In filling the Chair of Mental Philosophy and Logic, the Council had chosen not the Rev. James Martineau (1805–1900), who had been the first choice of the Senate of University College, but the second choice, Mr George Croom Robertson (1842–1892). Augustus De Morgan believed, as did many of his fellow professors, that this was because Mr Martineau was a Unitarian minister, and that this negated the religious impartiality on which the College had been founded. Augustus De Morgan's letter of resignation fills more than 4 printed pages of Sophia Elizabeth De Morgan's Memoir. Augustus De Morgan writes to Sir John Herschel, on 1867-03-25:

> The question between me and the College is simple. I entered that College on what all the world knows was its loudly vaunted principle, that the creed of neither teacher nor student was to be an element of his competence

> to teach or to learn. After 40 years of existence the college—for worldly reasons—has decided that a teacher must not be too well known to be heterodox: he must not be conspicuous as a Unitarian ....

During the 30 years from 1836 to 1866, Augustus De Morgan had many loyal students; nevertheless his income, which presumably was proportional to the number of his students at any one time, seems never to have exceeded £500 p.a., and tapered off to about £300 p.a. in the 1860s. Perhaps best known among his pupils were Walter Bagehot (1826–1877) and William Stanley Jevons, FRS (1835–1882), both of them economists.

4. *The Royal Astronomical Society*

On 1828-05-09 Augustus De Morgan was elected a Fellow of the Astronomical Society, on the same day as George (later Sir George) Biddell Airy, FRS (1801–1892), who in 1835 became Astronomer Royal. According to Sophia Elizabeth De Morgan, her husband and Lieutenant William Samuel Stratford (1790–1853) "were both members of the old Mathematical, and subsequently of the Astronomical Society", but I have found no evidence that Augustus De Morgan ever belonged to the Spitalfields Mathematical Society; on the contrary, he writes to Sir John Herschel (1792–1871) on 1845-05-19 that he has, with Capt. (later Admiral William Henry) Smyth (1788–1865) and (Thomas) Galloway (1796–1851) examined the "Math! Society":

> We shall certainly not *lower* the average knowledge of our Fellows by accepting their proposition. I went down rather against the scheme but was perfectly changed by what I saw and heard. Their library is a good one.

(Their proposition was to be absorbed in the Royal Astronomical Society; their library was incorporated in that of the RAS, and they themselves were subsequently exempted from the Annual Contribution to the RAS.)

The Astronomical Society had been founded in 1820 and had quickly become one of the foremost scientific societies in England. It became the Royal Astronomical Society in 1831. Augustus De Morgan was soon elected to its Council, on which he served for some 30 years, as Hon. Secretary, as Vice-President, as editor of the *Monthly Notices*, as just a member. He was repeatedly urged to become its President, but would not, on the grounds that he had "never promoted astronomy otherwise than as promoting mathematics is indirectly doing so"; and "I will vote for and tolerate no President but a practical astronomer".

It seems strange that Augustus De Morgan was never elected to the Fellowship of the Royal Society, like many of his friends and his youngest brother. In fact he never let his name be put forward for candidacy. He may have shared the views of other prominent scientists of his time, like Charles Babbage (1792–1871) and Augustus Bazzi Granville (1783–1872), that the Royal Society was in a sorry state, until, in 1847, it reformed itself. He also refused an honorary degree of LLD from the University of Edinburgh.

The Royal Statistical Society has no De Morgan archives, and Augustus De Morgan appears not to have been a Fellow. This raises a question: the first letter in the collection of 7 letters from Charles Babbage to Augustus De Morgan in the manuscript collection of the Royal Astronomical Society, dated 8 Nov 1835, is

addressed to the Secretary of the Statistical Society and starts "My dear Sir", while the second, dated 26 Feb 1844, starts "Dear De Morgan". Is it possible that Charles Babbage mixed up the Secretary of the Astronomical Society with the Secretary of the Statistical Society? Perhaps a more plausible explanation is that the first letter was not intended for Augustus De Morgan, and has strayed into his collection by accident.

5. *Useful Knowledge*

The first half of the 19th century saw much innovation in educational thought. The old apprenticeship system for those who learned an individual trade was inadequate for the middle ranks, the NCOs, of the new industrial society. They needed more than just the three Rs, and Mechanics Institutes were created, public libraries sprang up, and societies like the Society for the Diffusion of Useful Knowledge were founded; this latter in 1826 by Lord Brougham and others. Augustus De Morgan became a member of its committee in 1843, and when in 1846 it ceased operations, he was charged with overseeing its demise. Long before then he had already written copiously for it, especially very numerous articles for the Penny Cyclopaedia (Sophia Elizabeth De Morgan lists more than 700 of them), over a period of more than 20 years; and also in the Library of Useful Knowledge: *Elementary illustrations of the differential and integral calculus* (2 parts, 1832), *Elements of spherical trigonometry* (1833), *The differential and integral calculus* (1842).

6. *Currency reform*

In 1806 William Frend, in his book *Tangible arithmetic*, had mooted the question of a decimal currency for England. In 1824 Sir John Wrottesley, later (from 1838) the first Baron Wrottesley (1771–1841); whose eldest son, also called Sir John Wrottesley until he succeeded his father to become the second Baron Wrottesley (1789–1867), was among other things an astronomer, on the governing body of the Society for the Diffusion of Useful Knowledge, and served on the Council of the Royal Astronomical Society and the Royal Society, of which he was President from 1854 to 1857; had introduced a motion into the House of Commons (he was then the Member for Staffordshire) to decimalise the currency. This was to be done by subdividing the pound sterling into 1,000 farthings, with intermediate units of 10 and 100 farthings (the pound was then, and into the second half of the 20th century, divided into 20 shillings of 12 pence of four farthings each; so there were 960 farthings to the pound); however, Sir John's motion did not come to a division. Next to advocate a decimal currency was Charles Babbage (1791–1871), in his book *On the economy of manufactures* (1832). Then in 1833 Augustus De Morgan, in the article *Abacus* in the first number of the Penny Cyclopaedia, writes:

> The abacus can never be much used in this country, owing to our various division of weights and measures. We should need one abacus for pounds, shillings, and pence; another for avoirdupois weight; a third for troy weight, and so on. In China, however, where the whole system is decimal, that is, where every measure, weight, &c., is the tenth part of the next greater one, this instrument, called in Chinese Shwanpan, is very much used, and with most astonishing rapidity.

[Incidentally, Sophia Elizabeth De Morgan, in her Memoir, quotes this passage with some slight differences, perhaps from her husband's manuscript: the printed version, which I have quoted, may exhibit an editor's "improvements".]

Others, in the next few years, were more explicit about the advantages of a decimal system of money, weights, and measures, and a Royal Commission was set up in 1838 to examine weights and measures. Augustus De Morgan explicitly advocated a decimal coinage in his article "On the use of small tables of logarithms in commercial calculations, and on the practicality of a decimal coinage", Companion to the Almanac for 1841, pp. 5–21, proposing to divide the pound into 10 royals, the royal into 10 new groats, the new groat into 10 farthings, so that 1,000 farthings, instead of 960, would make a pound. He commends the French for having "succeeded in establishing a purely decimal coinage", but goes on to comment that the "inconvenience and even absurdity of their system is, that it subdivides the franc too far: the centime is hardly in use". He had, of course, no experience of monetary inflation, except as something in the distant past: had he known that inflation would continue, unsteadily between almost nil and 20% per annum, with a long-term average of about 3% per annum, he would have appreciated the fact that the farthing, like the centime, was doomed, and so would be his new groat (today's P), and eventually his royal, until in about 120 years from now—perhaps much earlier—the pound will be the smallest unit of account. Thus decimalisation of the coinage was, in fact, unnecessary. However, Augustus De Morgan believed in it, and pursued the idea in publications, correspondence, and from 1854—after two Royal Commissions and one Parliamentary Committee had reported in favour of decimalisation—through the Decimal Association. After the House of Commons, in 1854, had voted in favour of the pound and mil (one-thousandth of a pound, to replace the farthing) system, Augustus De Morgan was optimistic about the early introduction of a decimal British coinage; but all that in fact happened was the introduction of a new coin, "one florin, one-tenth of a pound", equal to 2 shillings and somewhat smaller than the half-crown, which then was fixed at two shillings and six pence. They existed side by side until decimalisation was at last achieved a few years ago, when the florin survived temporarily as the 10P coin, and the half-crown died.

In writing in 1856 at length on the then state of the decimal coinage debates (*Notes on the state of the decimal coinage question*, Companion to the Almanac for 1857), Augustus De Morgan comments (footnote to page 6):

> It is not uncommon to affirm that the pound and mil system is supported chiefly by *mathematicians from Cambridge*. It is a characteristic of our country that *any* name which indicates knowledge and study can be effectively used as a term of contempt in political discussions.

Has this changed in the last 130 years?

One of the most influential opponents of a decimal coinage was Samuel Jones Loyd (1796–1883), who in 1860 was created Baron Overstone. He was at his death one of the richest men in England. After Augustus De Morgan's death he purchased his library (*vide infra*) and donated it to the University of London.

7. *William Frend*

An early (in fact, I believe, the first) Secretary of the Astronomical Society was Lieutenant Stratford, RN, mentioned earlier, who, about the time Augustus De

Morgan was elected to its fellowship, introduced him to William Frend (1757–1841), then in his early seventies. William Frend had been a Second Wrangler and Smith's Prizeman at Cambridge in 1780, had then taken orders in the Church of England, but in 1787 he was converted to unitarianism and became, in the eyes of the senior members of the University of Cambridge, something of a rebel—which he remained to the end of his life. He was deprived of his tutorship and eventually banned from his college, Jesus College, though he retained the emoluments of his fellowship until 1808, when he married, and remained a member of his college and of the senate of the university for the rest of his life. Among his numerous writings on many subjects are *Principles of Algebra* (1796) and *Is it Impossible to Free the Atmosphere of London in a very considerable degree from Smoke?* (1819). Sophia Elizabeth, who in 1837 was married to Augustus De Morgan (in the St Pancras Registry Offices—something rather novel then), was the eldest of William Frend's seven children.

William Frend and Augustus De Morgan had many interests in common, although nearly 50 years apart in age. One of them was the actuarial side of insurance: William Frend had been involved in the foundation, in 1806, of the Rock Life Insurance Company, of which he then became actuary for some 20 years. Augustus De Morgan at one time (about 1833) applied unsuccessfully to become Registrar of the Amicable Assurance Office, and he later wrote extensively on actuarial matters (for example "An essay on probabilities and on their application to life contingencies and insurance offices" in the Cabinet Cyclopaedia, vol. 107, 1838) and acted as a consultant to a number of insurance companies. He was conscious of another root of his actuarial interests: his great-grandfather James Dodson had been one of the founders of the Equitable Life Assurance Company, and had calculated its first contingency tables. Even as late as 1867, when his health was failing, Augustus De Morgan undertook large calculations for an insurance company.

William Frend taught many private pupils, his favourite among them being (Anna Isabella) Lady Noel Byron (1792–1860; from 1856 Baroness Wentworth), the wife of the poet. Augustus De Morgan also had private pupils, among them Byron's only legitimate child, Lady Ada Augusta Lovelace (1815–1852), of whose mathematical powers and originality he thought highly:

> But I feel bound to tell you that the power of thinking on these matters which Lady L. has always shown from the beginning of my correspondence with her, has been something ... utterly out of the common way for any beginner, man or woman .... Had any young beginner, about to go to Cambridge, shown the same power, I should have prophesied first that his aptitude at grasping the strong points and the real difficulties of first *principles* would have very much lowered his chance of being senior wrangler; secondly, that they would have certainly made him an original mathematical investigator, perhaps of first-rate eminence.

This letter (of 1844) to Lady Byron shows incidentally the low opinion, already mentioned, Augustus De Morgan had of the Cambridge tripos and the cramming needed for success in it; an opinion he shared with his father-in-law.

In their approach to algebra, William Frend and Augustus De Morgan did not agree. To William Frend only magnitudes possessed meaning, and he objected to negative numbers and imaginary numbers. I do not know whether he accepted surds, but venture to guess that he did. Augustus De Morgan saw algebra as formal, the meaning of its symbols not being of paramount importance. Apparently this mathematical disagreement in no way impaired the friendship and mutual respect of the two men.

William Frend was a fascinating man, but I can here do no more than refer the reader to Frida Knight's biography *University rebel. The life of William Frend* (1757–1841) (Victor Gollancz Ltd, London 1971).

8. *Correspondence*

Augustus De Morgan had many friends and acquaintances, and corresponded copiously with them. Many of his letters and those of his correspondents are still extant; and in her Memoir, Sophia Elizabeth De Morgan has five sections totalling nearly 150 pages, that is well over one-third of the whole book, of his correspondence; and much correspondence is also quoted in the rest of the Memoir. Among the correspondents, Charles Babbage and Lady Lovelace have already been mentioned. Others were Sir George Biddell Airy, FRS (1801–1892), Astronomer Royal from 1835 to 1881; the astronomer Francis Baily, FRS (1771–1844), one of the founders of the Astronomical Society; Lord Brougham (1778–1868); and especially Sir John (Frederick William) Herschel, FRS (1792–1871); Richard Sheepshanks, FRS (1784–1855); the Rev. William Whewell, FRS (1794–1866). The Royal Society has more than 250 letters from Augustus De Morgan to Sir John Herschel, and a few also from Sophia Elizabeth De Morgan. One of the latter, undated, describes "an instance of sensorial vision", and was forwarded at her desire by Augustus De Morgan, who adds a postscript:

> Q. What insult do you offer a person when you tell him that he is not a donkey's tail? A. Why, of course, you want to intimate that he is no end of an ass.

Another letter to Sir John Herschel, dated "Dec 25/43", starts with two infinite product formulae. Then

> My dear Sir John. I send you the compliments of the season in the shape of two formulae, fattened expressly for Christmas, or at least expanded ...

Augustus De Morgan's sense of fun comes out in many of his letters. He would happily pun, especially also with his own name, and appreciate his friends' puns: from a letter to Lord Brougham written 1863-09-19:

> I must have written *August* for *September*. ... Returning to August, I was alone all the month—my family being in Wales. Solitude for a while is the greatest of relaxations. A friend of mine [possibly John Thomas Graves, FRS (1806–1870), who was a colleague of Augustus De Morgan's at University College?] made 81 anagrams on my name—one of them was a hit—and not one only
>
> Sunt agro—Gaudeamus.

Augustus De Morgan also drew charming caricatures. There is, in the library of the Royal Astronomical Society, a bound volume of 12 biographies by Augustus De Morgan, reprinted from *Gallery of portraits*. This has annotations and drawings by De Morgan, various insertions, including letters from Sir John Herschel, and Herschel has added some notes, mainly to the biography of his father, Sir William Herschel (*né* Friederich Wilhelm Herschel), FRS (1738–1822). A sample is the last page of the article on Jean-Baptiste Delambre (1749–1822):

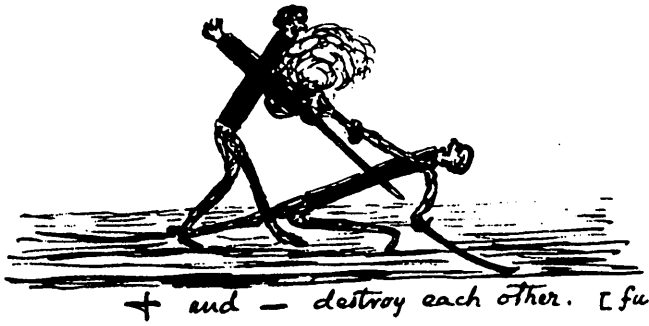
mission, began to fear lest a latent tinge of royalism in some one of their agents might infect the new standard. At least such a suspicion forces itself upon us, when we find that "The Committee of Public Safety, considering how important it was to the amelioration of the public mind that those employed by government," in the Survey for instance, "should be distinguished," not by their knowledge of the theodolite and repeating circle, but "by their republican virtues and hatred of kings," struck Delambre and others off the list, and would have served Méchain in the same way (who was on the frontier, with public money in his possession), had not they found within themselves the suspicion that he would play them false. But we must not be less than just to the instances of liberal feeling which the most bigoted times produce. When Delambre returned to Paris, he was allowed, after some hesitation, to retain the diploma of the Royal Society of London, written in Latin, with the arms of the King of England upon it.

Such were the feelings with which the government regarded even their own favourite project, and we may therefore be surprised at the endurance with which Delambre solicited, and at length partially obtained, leave to recommence his operations; add to which, that his astronomical instruments caused him frequently to be molested as a spy by the ignorant populace of the departments—a fact nowise to be wondered at, when we remember that at Paris Lalande's observatory was searched for arms, and the tube of a telescope carried off to the authorities as some strange species of gun.

Delambre did not interfere in politics; it would have been strange indeed if he had found time. It was amply sufficient for one man to link his name to the science of astronomy, past, present, and future, by history, observations, and tables.

Laplace spells Machin. M, é, c, h, a, i, n, and so makes Méchain for Bradley his notion about the sign of nutation

Capt" Smyth informs me, and I believe says he had it from Delambre, that the marriage of our astronomer was made in this wise. When he was setting out for the survey during the reign of terror, with the only passport which the authorities would grant, he found on his return home the evening before he set off a lady who threw herself at his feet, and the like of that, and entreated him to allow her son, who was proscribed, to leave Paris as his attendant and under his passport. So Delambre saved the son's life, and having shewn the lady, he vice versâ'd her initial process, and she became Madame Delambre.



+ and − destroy each other. [fun'y Algebra]

Augustus De Morgan on Jean-Baptiste Delambre
(Reproduced with permission from the librarian of the Royal Astronomical Society)

A few more examples of Augustus De Morgan's more serious concerns must suffice: To Sir John Herschel, 1848-04-28:

> Boys begin earlier now than they used to do. I had only just got my first book of logarithms when I was fifteen years old. They have very often (now) begun the Diff. Calc. at fifteen, but it is not usual to have advanced so far as the depth of the integral Calculus.

Again on 1856-06-08:

> I have long had the idea of a pianoforte in which each set of strings belonging to one note is to communicate with a pipe for resonance ... and sometimes I have thought that a spring at the mouth of a pipe, struck by a hammer, would make a good instrument.

[This is accompanied by sketches.]

To Sir John William Lubbock, FRS (1803–1865) on 1838-04-04:

> I have thought a good deal of vivā voce exam^{ns}. and I am convinced, though not without reluctance that it is of almost hopeless difficulty to make them efficient. The order of merit cannot be a function of the results of such an exam^{n}. and the failures which frequently take place at Oxford from nervousness or ineptitude to speak, are well known.

To Mr. Thomas Coates (about whom I have been unable to find out anything, except that he was Secretary of the Society for the Diffusion of Useful Knowledge) on 1838-12-07:

> ... it is almost impossible to manufacture useful examples in Algebra, except in the details of some other science: the application of Algebra to Geometry is a good one: the Differential Calculus still better. You may work a student in Algebra in parade exercise for five years, and find the first piece of actual service put him altogether hors de combat. ... examples are wanted, not examples of Algebra marshalled under heads, but wild fieldwork, where a man has to choose between a hedge and a ditch, and a nasty swamp at every step ...

Not a country-lover, he.

9. *Mathematics*

Not all of Augustus De Morgan's correspondence was so friendly. In 1836 he had written "A treatise on the theory of probabilities" for the Encyclopaedia Metropolitana; and in 1838 there appeared in The Cabinet Cyclopaedia, vol. 107, "An essay on probabilities and on their application to life contingencies and insurance offices". This led to some acrimonious correspondence between the proprietors of the Encyclopaedia Metropolitana and Augustus De Morgan who, later in 1838, published a small pamphlet "Remarks on an accusation made by the proprietors of the Encyclopaedia Metropolitana against the author of an 'essay on probabilities, and on their application to life contingencies and insurance offices'. By Augustus De Morgan, Professor of Mathematics in University College." After much serious argument, showing that the "treatise" is serious mathematics, while the

"essay" is much more popular and quite different, he can not suppress his sense of humour: near the bottom of p. 14 we read:

> ... and let them [the proprietors] seriously reflect how much better it would have been, instead of throwing away good grumbling upon nothing at all, to have directed it against the excise on paper, the postage tax, or the advertisement duty.

To this he added, in the copy now in the University of London Senate House Library, the marginal:

> Read this Oct 14, 1861, just after the repeal of the paper duty, the last survivor of the three odious imposts. ADeM.

Perhaps more serious was the polemic between Augustus De Morgan and Sir William Hamilton (1788–1856) (the Scottish philosopher, not to be confused with the Irish mathematician Sir William Rowan Hamilton (1805–1865), the inventor of the quaternions). Both had attempted to develop aristotelian logic further beyond the syllogisms Barbara, Celarent, &c, and had inevitably had overlapping ideas. Sir William Hamilton charged Augustus De Morgan with plagiarism, but later withdrew the charge. The controversy can be read about in Sophia Elizabeth De Morgan's Memoir, and also, quite fully, in the appendix to Augustus De Morgan's book *Formal logic: or, the calculus of inference, necessary and probable* (Taylor and Walton, London, 1847). This was, perhaps, Augustus De Morgan's mathematically most ambitious work. It influenced, but was soon to be eclipsed by, the work of George Boole, FRS (1815–1864), in his *An investigation of the laws of thought* (1854), and what is remembered today is only De Morgan's Laws in set theory or in boolean algebra.

The controversy between Augustus De Morgan and Sir William Hamilton may have soured their relations for a time, but according to Sophia Elizabeth De Morgan it can not have lasted more than 5 years, because "in the year 1852 controversial warmth must have abated, for books and courteous letters were then exchanged between the Logicians". She goes on to comment:

> I cannot deny that he rather enjoyed such encounters, but no one engaged in them with less feeling of personal animosity. It was like a game of chess—a passage of arms.

The controversy is also alluded to in Augustus De Morgan's *A budget of paradoxes*, published posthumously in 1872: this is a collection of articles reprinted from the *Athenaeum*, but contains additions by the author, and was edited by Sophia Elizabeth De Morgan. It contains essays on some of the books that Augustus De Morgan owned—he was a bibliophile and collected a remarkable library of old, and not so old, scientific books. After his death, Lord Overstone who had opposed him on the decimal currency question, bought the library of about 3,000 books from his widow and presented it to the University of London.

I do not mean to imply that Augustus De Morgan was unproductive as a mathematician, other than in logic: he wrote papers on geometry, ordinary differential equations, partial differential equations, algebra, as well as on probability, astronomy—in fact on a very wide range of subjects. But he was, first and foremost, a skilled expositor and a dedicated—and highly successful—teacher. It should also be borne in mind that English mathematics was in his time, compared to mathematics on the Continent of Europe, only half awake.

10. *Publications*

In 1828 August De Morgan, then just 22 years of age, published his first work, a translation into English of part of Bourdon's *Elements of algebra.* He went on to write and publish at a prodigious rate. Sophia Elizabeth De Morgan has a list of his writings in her Memoir, 15 printed pages long, containing 180 items, apart from the 712 articles he wrote for the Penny Cyclopaedia (six of them of uncertain attribution); and she omits many obituaries and other shorter articles, and writes:

> The voluminous contributions to the 'Athenaeum', 'Notes and Queries', &c., I have been obliged to omit on account of their number.

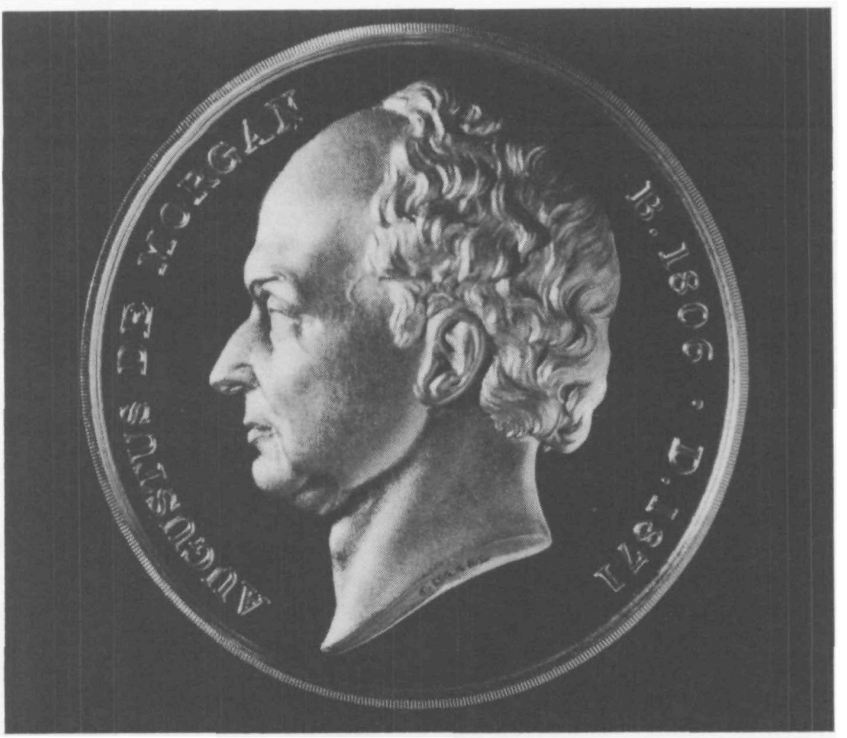
According to her, his first published work after the Bourdon translation was his *Elements of arithmetic* (1831); but in fact my copy of the book bears the imprint 1830. It went through many editions [Sophia Elizabeth De Morgan dates the third edition 1833, but my copy of it has the imprint date 1835].

There is an article on "Almanacs" in the Companion to the Almanac for 1829 (so it would have been written and published late in 1828), which Mr F. E. Whitehart, a highly experienced antiquarian bookseller, who has found many De Morgan items for me, ascribes to Augustus De Morgan. It is not listed by Sophia Elizabeth De Morgan.

The British Almanac and Companion to the Almanac had started publication in 1828, under the auspices of the Society for the Diffusion of Useful Knowledge until the SDUK went to sleep in 1846, and under the editorship of the writer, publisher, and editor Charles Knight (1791–1873). It was a serious publication, shunning the wild prophesies that had been, and still were, a notable feature of the existing almanacs, like Old Moore's Almanac. I do not know whether Augustus De Morgan contributed to the Companion to the Almanac for 1830, but he did write a piece for each of the next 27 Companions, on astronomical subjects, life insurance, history of mathematics and physics, decimal coinage, and whatever else seemed of interest. When in 1857 he wrote an article on the Leibnitz–Newton controversy, Charles Knight writes to him (1857-10-15) that it "... will not interest one reader in a thousand of the Companion" and suggests shortening it, as it had already been advertised. Augustus De Morgan's immediate reaction was to withdraw the article, and he never again contributed to the Companion to the Almanac. The article in question, or part of it, was revised and augmented in 1864–66 and again at an unspecified later date, and finally published as *Newton: his Friend: and his Niece, By the late Augustus De Morgan. Edited by his wife, and by his pupil, Arthur Cowper Ranyard* in 1885. (We have met Arthur Cowper Ranyard already, as a friend of George Campbell De Morgan and co-founder and joint secretary with him of the London Mathematical Society. For the above book he made a diligent search of the rate-books of various parishes near what is now Leicester Square, to try, unsuccessfully, to find out whether Lord Halifax (1661–1715) lived close to Isaac Newton (1643–1727) between 1706 and his death (dates are new style).)

The posthumous *Budget of paradoxes* has already been mentioned. New editions were published in 1915 and 1954. Several of Augustus De Morgan's other works went through posthumous editions; for example the Open Court Publishing Company of Chicago published a new edition of *On the study and difficulties of Mathematics* in 1898 and repeatedly since, and of *Elementary illustrations of the differential and integral calculus* in 1899 and 1909; and *On the syllogism* was, with other logical writings, collected by Peter Heath in *Rare masterpieces of philosophy*

and science (Routledge & Kegan Paul, London 1966). The best bibliography of Augustus De Morgan is contained in G. C. Smith: *The Boole–De Morgan correspondence* 1842–1864 (Clarendon Press, Oxford 1982). And so interest in Augustus De Morgan remains alive—the World Directory of Historians of Mathematics (second edition, University of Toronto, 1978) lists 5 people who give Augustus De Morgan among their special interests. Will one of them perhaps write a new, full, and reliable biography of this fascinating subject?



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