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The *Cambridge Mathematical Journal* and its descendants: the linchpin of a research community in the early and mid-Victorian Age ☆

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Abstract

The *Cambridge Mathematical Journal* and its successors, the *Cambridge and Dublin Mathematical Journal*, and the *Quarterly Journal of Pure and Applied Mathematics*, were a vital link in the establishment of a research ethos in British mathematics in the period 1837–1870. From the beginning, the tension between academic objectives and economic viability shaped the often precarious existence of this line of communication between practitioners. Utilizing archival material, this paper presents episodes in the setting up and maintenance of these journals during their formative years.

Résumé

Dans la période 1837–1870, le *Cambridge Mathematical Journal* et les revues qui lui ont succédé, le *Cambridge and Dublin Mathematical Journal* et le *Quarterly Journal of Pure and Applied Mathematics*, ont joué un rôle essentiel pour promouvoir une culture de recherche dans les mathématiques britanniques. Dès le début, la tension entre les objectifs intellectuels et la rentabilité économique marqua l'existence, souvent précaire, de ce moyen de communication entre professionnels. Sur la base de documents d'archives, cet article présente les épisodes importants dans la création et l'existence de ces revues.

☆ The term early Victorian, I take to commence from the date of Queen Victoria's accession in 1837 and run until 1851, a politically turbulent period ending with the Great Exhibition, a backstop to things "early-Victorian" adopted by many historians of the 19th century [Harrison, J.F.C., 1979. Early Victorian Britain. Fontana, London]. The mid-Victorian period I take to be the 20 year "Age of Equipoise," a period of relative prosperity ending around 1870 with the Franco-Prussian War, when Britain sought a place in the new world order and was about to enter a long period of agricultural depression. The passage of the *QJPAM* during the late Victorian period (1871–1901) and the period until 1930 will be covered in a further paper.

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1. Introduction

That the publication of mathematics is its lifeblood is universally accepted in the mathematical community. G.H. Hardy, one of its preeminent practitioners, was unequivocal: "periodicals are the most important material facts in the mathematical world" [Hardy, 1928, 157]. The *Cambridge Mathematical Journal* (*CMJ*), which came into existence in 1837, was the forerunner of a succession of journals which have maintained British mathematics during the 19th and 20th centuries, a lineage unbroken today: the *CMJ* (1837–1845) was followed in turn by the *Cambridge and Dublin Mathematical Journal* (1846–1854) and by the long-running *Quarterly Journal of Pure and Applied Mathematics* (1855–1927), which was incorporated into the existing *Quarterly Journal of Mathematics* (Oxford Series) in 1930. My principal interest is in the life of these journals, which started as a local production but grew to national and international status.[1]

An examination of these journals will offer a sidelight on the establishment of a mathematical community and growth of mathematics in the United Kingdom from its revival during the period 1810–1840 following a century of relative stagnation to a time when British mathematicians made significant contributions to the mathematical literature.[2] Why were they founded and how did they manage to exist? The story could have been quite different, for dozens of scientific journals were founded only for their existence to be ephemeral [Brock, 1980]. Duncan Farquharson Gregory (1813–1844) and William Thomson (1824–1907), the early editors, are well known, but who were the others who kept the journals afloat? For a different type of question, what aid did the journals give to careers?—if such a term can be applied to gentlemen of science who often prosecuted their subject alongside a professional occupation? [Shapin and Thackray, 1974].

I shall be interested in the mathematicians themselves, their interests and concerns, and not least, by using the correspondence that is extant, "to hear them speak." They were part of a group with disparate interests bound together by their journals. If these could not survive, neither could the group—as has been noted recently, "mathematics may be eternal, but mathematical communities are even more fragile than mathematicians" [Golland and Sigmund, 2000, 34]. Used here, "mathematics" will include pure

[1] The study of journals as historical artefacts is vital for gaining insight into the growth of mathematics, a methodology which has been applied to the history of science generally [Houghton, 1975; Kronick, 1976; Meadows, 1980; Gascoigne, 1985]. In particular, for the history of mathematics, a range of studies now exist specific to the development of journals [Grattan-Guinness, 1985; Ausejo and Hormigón, 1993; Neuenschwander, 1994; Siegmund-Schultze, 1997; Despeaux, 2002a, 2002b]. The beginnings of the *CMJ* and *CDMJ* have themselves been studied previously in the context of the editorship of William Thomson (Lord Kelvin) (1824–1907) [Smith and Wise, 1989, 175–190]. Other work which include studies of the *CMJ* include [Despeaux, 2002a; Allaire and Bradley, 2002].

[2] For the purposes of this paper, I take the United Kingdom as it was defined by the Act of Union (1801) and was governed from London during the 19th century. Geographically it consisted of Great Britain (England, Scotland, Wales) and the whole of the island of Ireland.

mathematics, consisting mainly of geometry and analysis, and the Cambridge "mixed mathematics," linked with such applied subjects as mechanics, optics, heat, and electricity.

To locate the *CMJ* and its descendants in a wider context, the position of Britain in the world of mathematics for the first 40 years of the 19th century needs to be briefly reviewed. The traditional view is that the leading nation in pure mathematics was France. Fabian Franklin (1853–1939), a student of the English mathematician James Joseph Sylvester (1814–1897) at Johns Hopkins University, wrote at the end of the 19th century: "From about the middle of the eighteenth century, until the middle of the nineteenth, English mathematics was in a condition of something like torpor." He went on to say "that in the magnificent extension of the bounds of mathematics which was effected by the continental mathematicians during the first four decades of the present [nineteenth] century, England had no share" [Baker, 1912, xxv]. Thus, according to this view, Newton had been magnificent but his successors failed to match up to his reputation and add to his glories. Though Franklin's judgement now seems superficial, the record of English pure mathematics during the hundred years prior to the Victorian period was not outstanding [Guicciardini, 1989]. In applied mathematics, the period was equally bleak, though one can find remarkable individuals such as William Rowan Hamilton (1805–1865) and George Green (1793–1841).

In the years following the Napoleonic wars, a slow revival began. The leadership in France notwithstanding, there were interesting developments taking place in the United Kingdom in the first decades of the century. In England Robert Woodhouse (1773–1827) was influential at Cambridge. Born of student enterprise, the short-lived Analytical Society at Cambridge was also a precursor of the revival of Cambridge mathematics; among its members, Charles Babbage (1792–1871), J.F.W. Herschel (1792–1871), and George Peacock (1791–1858) were notable [Enros, 1983]. These were closely followed by William Whewell (1794–1866) and George Biddell Airy (1801–1892). Ireland had Hamilton, while in Scotland impetus was given by William Wallace (1768–1843) and James Ivory (1765–1842) who both spent part of their careers in England [Becher, 1980; Panteki, 1987; Craik, 1999, 2000]. All these mathematicians were pre-*CMJ* but helped to establish a climate of mathematical activity which would allow such a journal to exist. However, progress was slow, and Babbage's on-the-spot assessment of English mathematics in 1830 is well known: "We are fast dropping behind. In mathematics we have long since drawn the rein, and given over a hopeless race" [Babbage, 1830, 1].

Certainly in Babbage's year, and for the next few years, there would be nothing remotely comparable to journals published on the mainland of Europe, such as the prestigious

- *Journal für die reine und angewandte Mathematik* (*Crelle's Journal*) founded by A.L. Crelle (1780–1855) in 1826.
- *Journal de Mathématiques Pures et Appliquées* (*Liouville's Journal*) founded by Joseph Liouville (1809–1882) in 1836.

Only a few submissions from British authors were published in these journals prior to 1837. The Scot James Ivory was a contributor to *Liouville's Journal*, while from England W.H. Miller (1801–1880), in partnership with the surgeon Charles Brooke (1804–1879), submitted brief Notes to *Crelle's Journal* [Brooke and Miller, 1835].

The revival of mathematics gained some momentum through the pupils of the pioneers. These are more clearly identifiable as mathematicians: Augustus De Morgan (1806–1871), Green, Arthur Cayley (1821–1895), George Gabriel Stokes (1819–1903), George Boole (1815–1864), J.J. Sylvester (1814–

1897), and Gregory, each with their own specialisms and all highly active. If we make a "census year" of 1837, the year of the *CMJ*'s founding, those who graduated at Cambridge included a rich crop: Sylvester, Green, Gregory, and the polymath A.J. Ellis (1814–1890). These talented individuals did not exist in a vacuum but were part of a wider community, a group defined by the authors and readership of journals and in particular by the *CMJ*.[3] Through its pages we can glimpse a picture of this embryonic research community intent on the advancement of their subject. Whatever their ultimate mathematical accomplishment in terms of mathematical progress, this group is vastly underrated, for they kept the subject alive across the United Kingdom.

The first years of the *CMJ* are perhaps the most interesting as it fought for existence and recognition, for it was born into a country with few social structures supporting research mathematics. For the young gentlemen of Cambridge with their institution more resembling a high school than a modern university, mathematics was for the most part a rather fossilized body of knowledge to be "got up" for examination purposes. The mathematical content of the 15th- and 16th-century curriculum was insignificant but when the modern Mathematical Tripos was established in the middle of the 18th century, a body of mathematical knowledge moved center stage in the lives of undergraduates. Mathematics as taught at the "Mathematical University" of Cambridge provided fodder for the battery of examinations to which the "reading" undergraduates were especially subject—at Trinity College, for instance, an examination regime was in place which would make a modern undergraduate blanch.

If, after leaving their *alma mater*, alumni of Cambridge pursued mathematics at all, it was typically the pastime for a Sunday afternoon before the week's professional activities took over. Scattered around the country were pockets of mathematical activity, but it was largely mathematics as a pastime. Some groups did not last, as when the "old clay and pewter days" of the Spitalfields Mathematical Society drew to a close in 1845 as their membership dwindled and a new industrial age beckoned [De Morgan, 1882, 150; Cassels, 1979]. The Royal Astronomical Society (founded in 1820) which absorbed it, came closest to the interests of mathematicians until the London Mathematical Society was founded in 1865 [Dreyer and Turner, 1923]. As we shall see, in the 1840s a young group of men were emerging with real mathematical ambition. There were not content to conduct their mathematical activity in a casual manner or for private enjoyment. The *CMJ* which published their work became emblematic of a new era, setting out serious attitudes by its overt intention of promoting research.

Today, the terms "amateur" and "professional," as applied to mathematicians, can be referred back to employment status, and sometimes to whether a person is employed as a teachers or as a researcher, or both. In the period circumscribed by the founding of the *CMJ* and the first few years of the *QJPAM*, the distinction between amateur and professional is more problematic. If we apply the modern connotation to our group of mathematicians, we arrive at strange conclusions, for it would be odd for us to cast the lawyer Cayley as an amateur mathematician and to regard Joshua King (1798–1857), the holder of Newton's Lucasian professorial chair in the 1840s, as a professional.

Amateurs and professionals in the 19th century are more realistically separated by attitudes to mathematical research, including awareness of the general drift of current mathematics, and how it fits into broad themes. "Professionals" for us are the people who at the cutting edge of their subject. From this viewpoint Cayley and King would change sides, and the ranks of the "professionals" would include

[3] In her doctoral dissertation, Sloan E. Despeaux comprehensively surveys the publishing of mathematics in Britain during the 19th century [Despeaux, 2002a]. In particular the rich collection of minor and provincial journals are investigated. Many of them sprang up and closed after a short vigorous life.

Sylvester, an actuary for 10 years, and Thomas P. Kirkman (1806–1895) a lifelong clergyman. The "amateurs" would include such people as James Glaisher (the elder) (1809–1903), while those such as James Cockle (1819–1895), the Chief Justice for Queensland but a prolific mathematical author, hovered between amateur and professional. Victorian mathematicians present a heterogeneous group with wide-ranging interests.

If we look at the principal British journal provision in our census year of 1837, the year of Victoria's accession to the British throne, we might ask where a mathematician could publish work. At one level there were the journals coming to the end of their lives, in which editorial policy meant that mathematics of the puzzle variety would be favoured. Two instances are *The Ladies Diary* (published with variants in this title between 1704 and 1840) [Perl, 1979] and *The Gentleman's Diary* (published 1741–1840). These two amalgamated and continued as *The Ladies and Gentlemen's Diary* (1841–1871).

While acknowledging that puzzles have been significant in the growth of mathematical knowledge, journal space was also required to communicate specialist technical mathematics. For this there were the minor mathematical serials which appeared from time to time, but are not considered here in detail; nor are the crammers such as the short-lived *Private Tutor and Cambridge Repository* (1830–1831). One notable journal was the *Mathematical Repository*, edited by Thomas Leybourn (1770–1840). This was published between 1795 and 1835 and catered to serious mathematical topics, similarly, to the *CMJ*.[4] It included

(i) mathematical questions,
(ii) original essays,
(iii) mathematical memoirs extracted from works of eminence, and
(iv) Cambridge problems.

It could count on contributions from such leading lights as Babbage, Herschel, and Peacock, representatives of the Cambridge mathematical generation preceding the founding of the *CMJ* [Archibald, 1929].

"Leybourn's Repository" was succeeded by the *The Mathematician*. Similar in structure to the *CMJ* (each volume published in a two-year period), it came into existence in November 1843, reliant on a circle of friends who undertook to provide the difference between financial debit and credit. It was edited by mathematical masters at the Royal Military Academy at Woolwich,[5] Thomas S. Davies (1794–1851), Secretary of the Royal Astronomical Society, William Rutherford (1798?–1871), and Stephen Fenwick.[6] All were part of the "North-East" contingent who staffed mathematics at Woolwich, a trend set in motion by the widely respected teacher Charles Hutton (1737–1823).

Brought up in Shields in the northeast of England, Davies had moved around the country, and, during its fading years, had edited the *Repository*. In its Prospectus, *The Mathematician* declared (in

[4] The *Mathematical Repository* was put out by Glendinings the printer, who operated in Hatton Garden, London. It appeared irregularly, with gaps ranging between a few months and periods of up to 10 years.

[5] Located not far from Greenwich on the south side of the River Thames.

[6] *The Mathematician* was based at the Royal Military College at Woolwich and printed by a local printer E. Jones, Library, Thomas Street, Woolwich. It was published in three numbers per academic year, six numbers making up a quarto volume: vol. 1 (1843–1845, 338 pages), vol. 2 (1845–1847, 340 pages), vol. 3 (1847–1849, 336 pages) + Suppl. number (1850, 52 pages). The journal ran from November 1843 until August 1850. The subscription was £1 per annum.

September 1843): "Leybourn's Repository was the only periodical publication devoted exclusively to mathematics; and indeed, had that work been continued, the necessity for the present one would not have existed" [Davies et al., 1843, 1]. *The Mathematician* was very similar to the *CMJ*. It was to be a serious mathematical journal, and in particular, made the decision to play down the problem section so that the charge of "creating a race of mere problem-solvers" could not be levelled against it [Davies et al., 1843, 2]. It was also to be an expository journal which sought to explain and provide model work for "young and ardent" students to follow (for example, one article gave an exposition of "Lagrange multipliers"). As a feature it was to promote modern geometry, a term used to distinguish it from the ancient geometry of Euclid. The journal intended to communicate "whatever relates to *method* in treating the geometry of two and three dimensions, and the geometry of spheroidal coordinates; with original speculations in most of them," and what was new in descriptive geometry, the method of poles, the method of projections, and anharmonic ratio [Davies et al., 1843, 2–3].

One senses that the *CMJ*, already established 6 years, was thought by some to be somewhat exclusive. In the Prospectus of *The Mathematician*, the editors wrote: "The "Ladies and Gentleman's Diary" is the only work published in this country in which a regular portion of space is allowed to such researches, and which is at the same time open to all correspondents" [Davies et al., 1843, 1]. Undoubtedly the *CMJ* was Cambridge-centric but not exclusively so, George Boole, son of a Lincolnshire cobbler, having published in its pages. However, the journeymen masters at Woolwich may have felt themselves unwelcome. There was some cross-fertilization, for Davies himself was later invited to Cambridge and asked to write articles for the Cambridge journal [CUL K, D47, 3 Mar. 1846].

Another outlet for mathematicians around our census year of 1837 was the scientific journal which catered for scientific subjects generally. The principal ones were the *Proceedings* and *Transactions* of the various Royal Societies (of London, Edinburgh) and of the Academies (Ireland). In London the "*Phil. Mag*.," founded in 1798, was coedited, owned, printed, and published by Richard Taylor (1781–1858). In our census year this journal was titled the *London and Edinburgh Philosophical Magazine and Journal of Science*. It was open to mathematicians and short papers were generally accepted for publication; its Irish connections may have been the reason for Hamilton choosing it to announce his discovery of quaternions to English audiences in 1843.

Having more copy than was needed, the editors of the *Philosophical Magazine* placed a low premium on mathematical articles. Fearing letters of complaint from an overwhelmingly nonmathematical readership, Taylor allowed his coeditors little leeway, as he made clear in a policy statement in the *Phil. Mag.* in 1846:

> It is not in their [the editors'] power to admit any great quantity of *pure* mathematics. The majority of the readers of the Magazine are more interested in other sciences, and the Magazine would soon cease to exist if it were more than sparingly supplied with articles on lofty mathematical subjects. ... The pages of the Philosophical Transactions, of the Memoirs of the Royal Irish Academy, of the Cambridge Philosophical Society, of the Cambridge Mathematical Journal, &c, are much fitter vehicles for extensive mathematical discussion than those of the Philosophical Magazine. [Brewster et al., 1846, 146; Brock and Meadows, 1984, 87]

Thomson's reaction to this statement emphasizes the necessity for the existence of a separate mathematical journal in which the editors had specific competence in judging the worthiness of submitted articles. In a letter to Boole, he wrote:

> I quite agree with you regarding the incautiousness of the Editors of the Philosophical Magazine in their insertions on Mathematical subjects. An immense number of papers filled with most narrow and blundering views of all that is commonplace have been admitted, besides controversial letters in which neither the tone nor the reasoning can be respected. The editors themselves seem to be rather

> out of humour with their Mathematical correspondents, as they entered a kind of protest (wh[ich] I suppose you have seen) sometime since against *rubbish shot here*, & hinted that such communications would be better suited for more mathematical localities, such as "the Mathematical Journal, the Cambridge Transactions &c."! [GUL, B22, 18 April 1848; Smith, 1984, 77]

When *The Mathematician* folded in 1850, T.S. Davies complained of the lack of interest in publishing mathematics, particularly pure mathematics. Davies regretted that "[t]he science now acquired, or even sought for, is becoming more superficial, . . . results are only valued for their uses." There was something, he argued, about the native character of the English of always insisting on practicality, "as if it were a positive ordinance that abstract science should no longer be cultivated in England." He obviously had the *Philosophical Magazine* in mind, when he continued, "[e]ven journals that were formerly accustomed to insert a considerable number of mathematical papers, seldom give one now; and always when they do, it is with reluctance. Complaints constantly pour in upon the Editors of such journals, respecting 'so much space being wasted upon such uninteresting topics' " [Davies, 1850, 41].

A development which came much later was the provision of separate mathematical sections allied to existing science journals, as for example occurred for the *Transactions of the Cambridge Philosophical Society*, first published in 1821, and which spawned the *Proceedings* in 1844. This became the preserve of mathematics and physics around the 1920s, and its content formally recognized the title *Mathematical Proceedings of the Cambridge Philosophical Society* only in 1975 [Johnstone, 1986, 3]. As matters stood in the 1830s, the *Transactions* fulfilled a local need in Cambridge and was practically the only outlet for mathematics in the university town before the arrival of the *CMJ*.[7]

While De Morgan often treated the Mathematical Tripos to his scurrilous wit, he acknowledged the important part which the *Transactions* played in the scientific life of the university: "There is, you may safely say, sufficient proof in them that the ordinary system of University reading, which crams details of methods, put together in examination form, with fearful rapidity upon the young student, does not destroy the power of reflecting upon the basis of mathematical knowledge, or physical" [De Morgan, 1882, 150–151]. De Morgan favored the *Transactions* for many of his own papers, but though it allowed members of the society to publicize results, it did not cater to young tyros especially, and its nature was of a generalist scientific journal. There was clearly a niche for a British journal of a kind which would cater to a mathematical audience, and at the same time allow the young to cut their mathematical teeth.

2. The founding

The *CMJ* came out for the first time in November 1837, a milestone in British mathematics. The founding at Trinity College is surprising since Classics was its intellectual strength, from which it derived its academic reputation [Trevelyan, 1943, 89]. It consistently failed to capture the top position in the annual Mathematical Tripos examination. With its large size (150 freshman entered Trinity in 1837) greater success in this test of academic mettle might be expected.[8]

[7] The Cambridge Philosophical Society was founded in 1819. Membership of the Society itself was open to graduates of the university on payment of an annual payment of a guinea, which entitled them to use of the library and attendance at the term-time fortnightly meetings [Bury and Pickles, 2000, 6 fn.]. For further details of the society see [Hall, 1969]. Its *Transactions* first appeared in 1821, printed by the University Press and sold by Deighton and Sons, Nicolson and Son, in Cambridge and by T. Cadell (Strand), London. The *Proceedings of the Cambridge Philosophical Society* appeared in 1844.

Before this, Trinity had been the birthplace of a move to broaden the university curriculum by allowing the possibility of degrees in subjects other than mathematics. This resulted in the formation of the Classical Tripos in 1824. Christopher Wordsworth (younger brother of the poet), the Master of Trinity, was the innovator of this reform, which played to the popularity of Classics in the public schools, the principal supply route of students to the university population.[9] Yet mathematics remained the indelible Cambridge subject until the midcentury by the requirement that students qualify for admittance to the B.A. Classics degree by first obtaining honours degree standard in the Mathematical Tripos examination. That those with aristocratic connections were exempt from this requirement reminds us that the colleges operated under statutes laid down during the reign of Queen Elizabeth I in the 16th century—though this would change in the later 1840s [Trevelyan, 1943].

It is significant that the impetus to found the *CMJ* came from students brought to Cambridge from "outside" and ones who came to the university far better prepared than the normal English entry to higher education. A feature of the higher educational system was that students from other parts of the United Kingdom proceeded to Cambridge to top up their study, which they had begun elsewhere, usually at their home university. It was customary for students to head south from Scotland and east from Ireland, and when the University of London was established in 1836 as a body to examine and confer degrees on students of University College and King's College, London, the holders of its degrees were sent to Cambridge to "finish" their mathematical education, a practice which continues to the present day.[10]

The *CMJ*'s founders were the Scots Duncan Gregory and Archibald Smith (1813–1872) and the Englishman Samuel S. Greatheed (1813–1887)—each in his twenty-fourth year. The Scots came from highly academic families. Smith's grandfather had been Professor of Astronomy at Glasgow University and he himself had emerged from that university successful in classics, physics, and mathematics. Gregory was the scion of the illustrious scientific and mathematical Gregory family, his father being the professor of medicine at the university [Gregory, 1865]. In his own right he was "undoubtedly the best and most original math[ematicia]n in Cam[bridge]," as the newly arrived undergraduate William Thomson reported to his father [CUL K, T201, [Feb/Mar] 1842].

Archibald Smith was the mainspring. A Trinity College fellow, and a Senior Wrangler in 1836, the first from Scotland to ever top the Cambridge list, he wrote to Gregory on the eve of his Tripos examination suggesting the establishment of a journal for the publication of short papers on mathematical subjects. Gregory replied on 4 December 1836 that he would be willing to take on the editorship after the examinations in January 1837. As he put it in his expressive letter to Smith: "But all this must be

[8] The order of merit was divided into three classes: Wranglers, Senior Optimes, Junior Optimes. In 1837, for example, there were 52 Wranglers, 32 Senior Optimes, 39 Junior Optimes. The Senior Wrangler (the champion student), at the top of the order of merit, was the object of most attention and a college enhanced its reputation by having one of its students gain this position. From 1830 until 1860 Trinity housed the Senior Wrangler on only six occasions (Heath (1832), Smith (1836), Ellis (1840), Cayley (1842), Hensley (1846), Stirling (1860)). A recent book which treats the Cambridge Mathematical Tripos in detail is [Warwick, 2003].

[9] In Britain the public schools are *private* schools, such as Eton, Harrow, and Winchester.

[10] For example, Isaac Todhunter (1820–1884), who studied under De Morgan and Sylvester at University College London and obtained a London B.A. in 1842, afterwards went to Cambridge and was the Senior Wrangler in 1848. The reverse was also the case. Students sometimes topped up their Cambridge degree with one from London. W.K. Clifford (1845–1879), who attended King's College London before entering Cambridge as a student, is an example of this practice. The Second Wrangler after the Cambridge Tripos in January 1867, he took London examinations in June of that year. The University of London grew out of London University, which had been set up as a joint stock company in 1826 [Rice, 1997, 37, 149–150].

done after the degree; for 'business before pleasure,' as Richard said when he went to kill the king before he murdered the babes" [Thomson, 1874, iii]. After the examination, from which he emerged the fifth Wrangler, Gregory took over the reins.

Greatheed appeared to play a lesser part in the journal's formation. His early articles in the *CMJ* were on geometry and the use of the operator method in the solution of differential equations; his contributions were almost entirely made in the first volume of the journal, but afterwards his contributions fell away.[11] While companions thought he would settle into his Trinity fellowship and be a life-long college resident, this "little, shy, silent, squeaking voiced man" surprised them by marrying his cousin, thus breaking the iron rule which required Fellows of Trinity to be unmarried, and he was obliged to leave [Smith and Stray, 2003, 124].[12] Smith had begun reading Law at Lincoln's Inn and had a legal career to consider, even if the demands placed on law pupils of that time were minimal. A very capable mathematician, Smith was uncertain about an academic career, turning down a lecturing post at Trinity in 1839 offered by Whewell but almost accepting it when the offer was repeated the following year. Vacillating between these temptations and other opportunities, he eventually settled for the barrister's life, but scientific research was ever his constant companion.

While Smith could claim to have originated the *CMJ*, Gregory was the working editor. He would have made the link with the interest in mathematics in Edinburgh. A "Physico-Mathematical Society" was founded there in 1836 and for the first three years enjoyed a "vigorous existence," and he must have hoped for a similar experience in Cambridge through the pages of the *CMJ*—though he may also have been aware that student enthusiasms can be ephemeral, like those that brought the short-lived Analytical Society into existence.[13]

What were the primary aims of the new *CMJ*? Tied to this question was its motto, or in modern parlance its "mission and vision" statement. Reflecting the classical training at the university, mottos would be apt quotations from Greek authors. The chosen one for the first volume of the *CMJ* was taken from Hessiod's *Works and Days*, a motto placed on the title page, which underlined the policy of publishing *short* articles.[14] (See Fig. 1.)

The *Preface* to the first volume of the *CMJ* set out its agenda, based on the perceived need for a journal specializing in mathematics and a vehicle for mathematical ideas which would not otherwise be published. The editors believed "that there are many persons here who are both able and willing to communicate much valuable matter to a Mathematical periodical, while the very existence of such a work is likely to draw out others, and make them direct their attention in some degree to original research." They continued:

> Our primary object, then, is to supply a means of publication for original papers. But we conceive that our Journal may likewise be rendered useful in another way—by publishing abstracts of important and interesting papers that have appeared in the Memoirs of foreign Academies, and in works not easily accessible to the generality of students. We hope in this way to keep our readers, as it

[11] Only two of his articles are reported in the *Royal Society Catalogue*.

[12] Of the Trinity College dons, only the Master was allowed to marry. After the death of his first wife, William Whewell married the sister of R.L. Ellis.

[13] The level of interest in the Edinburgh Physico-Mathematical Society was not sustained and it finally collapsed in 1850 [Rankin, 1983, 136].

[14] Νήπιοι, ούδέ ϊσασιν ό´σῳ πλέον ήμισυ παντός. It was quoted by Plato in *The Republic* in the chapter on the Unity of the State (in translation): "how wisely Hesiod spoke, when he said, 'half is more than the whole"' [Jowett, 1871, 201; Cornford, 1941, 164, fn.]. As noted in [Allaire, 1997, 111], different classical Greek quotations appeared on later volumes.

THE

CAMBRIDGE

MATHEMATICAL JOURNAL.

VOL. I.

Νήπιοι, οὐδε ἴσασιν ὅσῳ πλέον ἥμισυ παντός.

CAMBRIDGE:
PUBLISHED BY E. JOHNSON, TRINITY STREET;
AND WHITTAKER & CO., LONDON.

1839.

Fig. 1. Title page of the *Cambridge Mathematical Journal*.

were, on a level with the progressive state of Mathematical science, and so lead them to feel a greater interest in the study of it. For this purpose we shall spare no pains in selecting the most useful and important papers from which to take abstracts for the benefit of our readers, while we shall put them in such a form as to make them available in the studies of this place. At the same time we shall endeavour always to have such a variety of subjects treated of, that all classes of students may find in our journal something which may be useful to them. (*CMJ*, 1837, Preface)

Thus the journal operated with a wide perspective. Importantly, mathematics was to be seen as a *progressive* subject, one which was open to change, expansion, and development, rather than as a fossilized branch of certain knowledge suitable only for the Tripos examination. In the pages of *CMJ* appeared articles on n-dimensional algebra and differential equations (via the D operator), articles encouraging the growth of symbolic algebra (as distinct from ordinary arithmetical algebra), and papers on "mixed mathematics," where mathematics was applied to physical problems of one sort or another.

The *CMJ* got off to a good start.[15] Gregory showed his respect for his old teacher, the elderly Scot, William Wallace. Wallace had been professor of mathematics at Edinburgh since 1819 and Gregory had been one of his most promising pupils. On the eve of his retirement from academic life in 1838, Gregory invited him to contribute to the journal—his two pieces were on the geometry of the triangle, while his penchant for the "doctrine of limits" did not penetrate the pages of the *CMJ* [Wallace, 1837; 1841].

The journal's concentration on pure mathematics (plane geometry, analytical geometry of three dimensions, algebra, differential calculus, and calculus of finite differences) and mixed mathematics (astronomy, light and sound, mechanics, hydrostatics) reflected the Tripos curriculum. The close connection between the published material and tripos preparation is conveyed by Smith when, in a letter to William Thomson, he recollected the early days of the journal and the use of signatures to disguise authors' identities:

The article [on analytical geometry] signed R.S. was so signed because the method was shown me by poor Stevenson (Richard).[16] He insisted on showing it to me one evening when I was not much inclined to listen but did so out of civility and was rewarded by its enabling me to work out three problems in the Senate House and Smiths prize papers which I sh[oul]d. probably not otherwise have done.[17] You had better either sign the article Richard Stevenson—or if you wish your signatures to be very authentic you can put a note to the effect that the method is due to the Late R[ichar]d. Stevenson fellow of Trin[ity]. Coll[ege]. I should like to have his name connected with the Journal. [CUL K, S146, 5 Aug. 1845]

[15] The *CMJ* was printed by Metcalfe & Palmer of Cambridge and sold by the publisher/bookseller Elijah Johnson of 30 Trinity Street nearby, and distributed in London by the educational publishing house of Whittaker & Co (of 13 Ave Maria Lane, EC4). It was tied to the university year and published each term (in November, February, May), each volume consisting of six parts spaced over two years. Vol. 1 (1837–1839); vol. 2 (1839–1841); vol. 3 (1841–1843); vol. 4 (1843–1845). The quarto volumes consisted of vol. 1, 282 pages; vol. 2, 284 pages; vol. 3, 292 pages; vol. 4, 288 pages. In the second edition of the *CMJ*, published by Macmillan, Barclay & Macmillan (1846), each bound volume sold for 18 shillings.

[16] [Stevenson, 1837]. R.S. or Richard Stevenson (c. 1812–1837) was third Wrangler in 1834 and elected a Fellow of Trinity College in the following year. He was a respected mathematician in Cambridge but failed to fulfil his promise. Archibald Smith's pity for him and desire for a memorial derives from the tragedy of Stevenson's circumstances, alcoholism and a "descent into madness" [Smith and Stray, 2003, 82]. He left the College in July 1837 and died of consumption in Beeston (near Nottingham) on 27 September 1837, aged 25 years.

[17] Each year two Smith's prizes were awarded to undergraduates who came out top in a week-long battery of higher level examinations sat immediately after the Tripos examinations. They carried further prestige, so that to be Senior Wrangler and First Smith's prizeman was the ultimate undergraduate accolade [Barrow-Green, 1999].

During Gregory's editorship, contributors frequently used the Greek σ, α, β, γ, δ, ε, λ, π, φ or Latin letters as pseudonyms. Some were readily identifiable, for example, A.S. (Smith), R.S. (Stevenson), P.Q.R. (Thomson), π or P. (Pirie),[18] W.W. (Wallace, *not* William Walton), γ (Gregory), but some less so. Some writers used several signatures, as did Pirie and Smith. Smith wrote under the signatures G.A.S., H.T., O., M.S., H.M., σ, α, ασ, which meant that he could cleverly disguise the fact that the early numbers of the *CMJ* were largely written by its editors. One of Thomson's letters to his father on first arriving in Cambridge backs this up: "Archie Smith (who writes under a great many signatures . . .) and Gregory have written nearly all the good articles in the Journal. Gregory especially has introduced a great deal of new & original matter, in his articles on the separation of symbols, the application of algebra to geometry, impossible logarithms, ex. gra.)" [CUL K, T201, [Feb/Mar] 1842].

It was the material presented which was important and it was a matter of accepted social form that the author should not draw attention to himself by self-advertisement. It also enabled an attack to be mounted without the wider world being aware the identity of the attacker. In the rumbustious *Phil. Mag.* in the 1840s, "Jesuiticus," alias Archibald Smith castigated Robert Moon for being mathematically ignorant in his treatment of Fresnel's optical theory: "Does Mr Moon know anything of analysis? He was eighth wrangler in 1838, and therefore he ought to know something" [Smith, 1846, 145].[19]

Signatures also enabled an author to try out an idea without risking controversy, so that undergraduates published anonymously, presumably under the principle that they could be heard but not seen.[20] In 1841 the 16-year-old Thomson, not yet a student at Cambridge, submitted an article on Fourier series for publication in the *CMJ*, and, by writing as P.Q.R., was shielded from public controversy with Philip Kelland, the Senior Wrangler in 1834.[21] Thomson wrote to Gregory: "[i]t has been written, not for any wish to detract from the merit of Mr Kelland's excellent treatise on heat, but the purpose of for doing justice to Fourier, the celebrated philosopher to whom we are indebted for the math[ematics]" [CUL K, G179, [Feb. 1841, draft]; Thomson, 1841].

Later on, when Thomson had assumed the mantle of editor, and was planning a reprint of the *CMJ*, a letter from Smith alluded to this anonymity:

> I have great objections to have my name prefixed to any articles except perhaps those on the Wave theory tho[ugh]' others were the mere sweepings of any undergraduate M.S.S. to which I was ashamed even to put my initials and though I have more courage now[,] the name printed at full length looks too formidable—[William] Pirie objects to have his name attached to his articles though he does not object so strongly to have his initials printed and his name in the key. [CUL K, S151, 15 Dec. 1845]

While Smith wanted to bury his "mere sweepings," he was justly proud of his paper on the Fresnel wave surface, published originally in the *Cambridge Philosophical Transactions* (1838) and the

[18] William Pirie (c. 1815–) from Aberdeen was fifth Wrangler in 1836.

[19] Robert Moon (1817–1889) gained his publishing spurs with the *CMJ*. He was his own worst enemy; De Morgan said of him: "his indiscriminate onslaught upon everybody—and his mode of estimating others—prudence requires us to be prepared for more than charity will justify us in supposing" [CUL K, D72, 15 Oct. 1849]. Smith privately thought Moon "a very narrow mathematician" [CUL K, S150, 11 Dec. 1845].

[20] They were carrying on the 18th-century tradition of using aliases. This literary tradition prevailed in mathematical writing too: the Rev. Charles Wildbore (d. 1802), an editor of the *Gentleman's Diary*, came across to readers of the *Ladies Diary* as "Amicus" [Perl, 1979, 49]. The editor of *The Mathematician* wrote under such names as Shadow, the Rev. Peter Twaddleton, and Diedrich Knickerbocker. In the *Mathematical Repository* the editor Thomas Leybourn sometimes wrote through his anagrammatic persona, Samuel Thornoby.

[21] Kelland was preferred over Gregory in the contest for the chair of mathematics at Edinburgh when Wallace gave it up.

Philosophical Magazine (1838), followed by "On the propagation of a wave in an elastic medium" in the *CMJ* [Smith, 1839a, 1839b].[22]

The *CMJ* followed the course of the academic year, one number coming out in each of three terms. Writing to Greatheed in Berlin, 18 months after the journal had begun, Gregory wrote that "[t]he Journal is getting on pretty well—the 5th number is far advanced, and I have considered material for the 6th with which I intend to complete a volume. Are you going to send anything—a paper on the application of symbols to marriage proposals would be highly acceptable" [TCC, Add Letters. C.1/136, 3 Feb. 1839]. Soon Gregory found himself under pressure. He was doing all the work for the journal, and getting little or no help from Smith. His frustration surfaced in a letter to Greatheed just after the newlywed had returned from his Continental sojourn:

> You surely have had enough of play by this time, and you may well bethink yourself of the propriety of a little exertion after so long a period of idleness. Seriously speaking I am extremely anxious for some assistance in carrying on the Journal. Smith had promised to work, but he has been seized with one of his continual lazyfits and will not put pen to paper. He is going to spend the summer yachting in Scotland, so that I suppose there is no hope of anything from him for a long time. I have got no other person on whom I can rely so I must draw on you, and if you do not honour my draft—why then I take it I will be sold—which is more than the Journal is likely to be. Have you seen the 6th number which completes the volume? Don't you think on the whole that we have made a very respectable book of it. [TCC, Add Letters. C.1/138, 7 July 1839][23]

The *CMJ* was turning out to be popular and the first number of the first volume out of print. It was used for the setting of questions in the Tripos examination, a use which met with Gregory's approval. He continued his letter to Greatheed: "It is getting pretty well into vogue now & things having been set [in the examination] out of it. Smith is to be Examiner[24] next year & he will think himself in duty bound to set out of the Journal." It seems clear *why* Gregory was under such pressure. He was on the lookout for an academic post and being from Edinburgh, and an acknowledged "local genius" he had been a favourite contender for the vacant mathematical professorship in 1838, but was narrowly defeated and retreated to Cambridge [Davie, 1961, 119].

At this stage of his career, Gregory was a talented Bachelor of Arts, and though he had a scientific reputation, he was in need of a fellowship at Trinity College, with its generous financial provision. At this college, with St. John's the largest in Cambridge, fellowships were only awarded after a set of competitive examinations in classics, (elementary) mathematics, history, and philosophy. These were held each October and the competition was strong, the contenders in the 1840s chasing only a few vacancies each year. No wonder he wrote to Greatheed a few weeks later in a somewhat agitated state:

> I am glad to hear that you are inclined to bestir yourself about the Journal, but I shall be still more glad to find that you do so immediately, as this is the very time when I am least able to do anything myself on account of the Fellowship reading [in preparation for the fellowship examinations]. Will you therefore send me something as soon after receipt of this as you possibly can. [TCC, Add Letters. C.1/139, 26 July 1839]

[22] This contribution contracted Fresnel's and Ampère's long-winded algebraic presentations of the wave surface to a few lines by an elegant analytical argument using the "symmetrical method" of algebraic geometry (using $ax + by = c$ instead of $y = mx + c$, for instance) but there is not yet the sophistication of the symmetry achieved by Cayley in treating it as $ax + by + cz = 0$ using Plücker's homogeneous coordinates).

[23] This letter is quoted in Allaire and Bradley [2002, 401].

[24] Archibald Smith was an Examiner 1840 but had not been Moderator in the previous year, as was the custom.

A fifth Wrangler does not have the same éclat as the Senior Wrangler, and Gregory was only made a fellow of Trinity College in October 1840.[25]

Greatheed had to give up his fellowship because he married. He moved to London to follow a church career and in this capacity he became a noted composer of church music. With both Greatheed and Smith residing in London, Gregory was left to run the journal single-handedly. But just when the *CMJ* was in demand, Gregory's health began to cause concern. The first attack of illness took place towards the close of 1842 and in the Spring of 1843 he left Cambridge. He continued to edit the journal from Edinburgh but by the first term of the new academic year in October, he had not returned. When he wrote to Thomson that he "should have written sooner but for illness" he was already on a downward path and he never returned to Cambridge [CUL K, G188, 13 Oct. 1843]. The November Number of the *CMJ* was the last number he edited, and he died in Scotland on February 23, 1844, just 30 years old.

3. New editors

Friends rallied to keep the *CMJ* going (Robert) Leslie Ellis (1817–1859) and William Walton (1813–1901) edited the journal jointly when it was published in February 1844.[26] Both were Cambridge stars.

In 1840, Ellis (see Fig. 2) was the Senior Wrangler, well ahead of the competition—he impressed the examiners by his wide knowledge and philosophical maturity and was for them the senior wrangler amongst senior wranglers. As a boy growing up in Bath, Ellis had actually been tutored by T.S. Davies [Ellis, 1863, xiii fn.]. A stylish writer and urbane figure, Ellis conducted the business of the *CMJ* from Cambridge, from the family seat at Bath, or when in London, from the Oxford and Cambridge Club in Pall Mall. He wrote widely on scientific subjects and was more of a broad scholar than a dedicated mathematician, though he was obviously talented in mathematics. Boole was to write to Thomson, "[w]hen I look at his few papers on mathematical subjects they seem to me to show more at once of the refinement and the power of genius than anything of the kind that has appeared in modern times" [CUL K, B175, 29 Dec. 1854; Smith, 1984, 91].

In 1844 Ellis was moderator for the Tripos and, though he hoped to escape from the traditional pattern of being an examiner in the following year, he did serve.[27] It was an opportunity for Ellis to examine Thomson, and on his being placed second Wrangler (a great disappointment to Thomson and his father), Ellis remarked to a colleague that we "are just about fit to mend his pens" [Ellis, 1863, xix]. The *CMJ* would be a common interest for them.

William Walton graduated eighth Wrangler in Smith's 1836 cohort and was to remain in Cambridge all his life. As a private tutor in his early years, he was inundated with teaching, but he was a mainstay of the *CMJ*.[28] A diehard geometer, he playfully warned Thomson: "Whenever you happen to call upon me, by giving your name to the man you will get into my smithy. I am now barred in against *classical* analysts"

[25] William Pirie, a contributor to the *CMJ*, and the fifth Wrangler in 1836, narrowly missed a fellowship in 1838, losing out to a classicist [Winstanley, 1955, 425]. Although candidates sat the fellowship examinations, the voting of the Trinity Seniority often followed subject-based lines.

[26] R.L. Ellis and William Walton edited the Feb., May, and Nov. numbers of 1844 and Feb. and May of 1845.

[27] "I feel all the better for having done something plucky," he remarked, making full use of the Cambridge slang of "plucking" or the act of failing students in examinations [Ellis, 1863, xix].

[28] He took charge of editing the eighth number, that is, the second number of vol. 2, which came out in February, 1840.

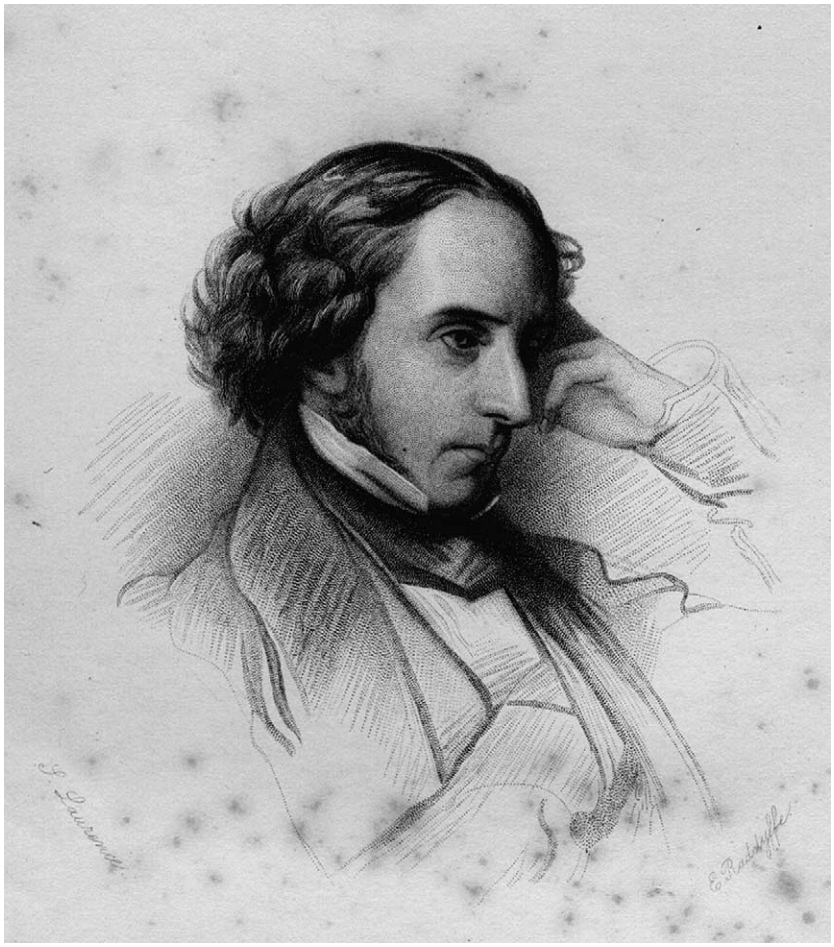

Fig. 2. R.L. Ellis.

[CUL K, W21, postscript, 16 Dec. 1844]. Endowed with a touch of whimsy in his writing, he was to thank Thomson for "packing up my asymptotes, and particularly for your hint about the second order equation—some Algebraic Puck must have been at the nib of my pen—or I must have been in a state of barleycorn" [CUL K, W25, 23 Jan. 1847]. In the frequency of his publications in the journal he was second only to Cayley. When all his friends had left the town, he kept them abreast of Cambridge news and as the years rolled by, he became a Cambridge character, "Old Father Time," with his flowing white beard clearly recognizable at a distance by his garb of "Scotch bonnet and plaid" [Venn, 1940–1954, 6: 338].

During their custodianship of the *CMJ* an attempt was made to broaden the readership, but their tenure was only temporary, barely 6 months duration. By the summer of 1844 Ellis was involving the young undergraduate Thomson with the operation of the journal. Fired with enthusiasm, Thomson discussed its future with interested parties, and, building on previous success, proposed that its scope be expanded. He wrote to his father about the Cambridge ambitions:

> We [Ellis and I] have been talking about a plan wh[ich] I proposed for enlarging the Math[ematica]l Journal, so as to make it something of the nature of Liouville's if possible. Of course the two great difficulties will be to get contributors of memoirs, and money enough to defray expenses, but as mathematical study is considerably on the increase here at least, we are in hopes that in a few years we may succeed [*sic*] in doing something for the object. If the plan be carried out at all, the great object of course would be to make the Journal be as general as possible in this country, and to get it made known on the continent. I have been speaking to Cayley since, and he quite enters into the plan. One great assistance he thinks would be, that there is at present no journal of the kind in this country, and that the want is very much felt by math[ematica]l men. [CUL K, T264, 2 June 1844]

When Thomson visited Paris after the Tripos in 1845, Ellis wrote to him: "I should be much pleased if Bachelier [a Paris-based publisher] would receive subscriptions for the Journal: which however is so dear that no Frenchman will buy it." In hope, he encouraged Thomson to drum up support within the group of Paris mathematicians, and in the same letter Ellis wrote, "I shall be glad to have it understood that any contribution in French will be quite as acceptable as in English and that any accounts or aperçus of longer memoirs would be especially useful" [CUL K, E53, 20 Feb. 1845].

Liouville requested a copy of the journal and passed it on to Michel Chasles, who was also impressed by it [Thompson, 1910, 118]. Significantly, Liouville and Chasles became closely connected with the evolution of British mathematics. A change of policy in the *CMJ* in which Ellis could express satisfaction was that every article would now bear the writer's name and that the erstwhile practice of shielding identities by signatures would be discontinued from the May number of 1845 [CUL K, E54, 1 Apr. 1845].

The *CMJ* gave an outlet for many previously unpublished authors, thus providing the vital encouragement at an opportune point in their lives. De Morgan praised it in a letter to Sir John Herschel as "full of very original communications" adding with the understanding of a dedicated teacher, "as is natural in the doings of young mathematicians, [it is] very full of symbols" (28 May 1845 [De Morgan, 1882, 151]). It was also a financial success. The *CMJ* numbers for Oct. 1844/May 1845 were selling well and the London publisher had written for more copies, so it was natural that Cambridge thoughts should turn to expansion [CUL K, T317, 17 Aug. 1845].

There was an inherent risk to be taken, for unlike *Crelle's Journal*, which enjoyed financial aid from the Prussian state, it received no subsidy from official sources, and had to be financially self-sufficient. Paper Duty was one drain on finances but postal charges were alleviated by the introduction of standard charges. However, many local journals had short lives, and giving evidence before a parliamentary select committee, Richard Taylor of the *Philosophical Magazine* warned:

> Scientific Journals in this country are supported with very great difficulty; they can hardly be supported at all; I have witnessed in my own recollection a failure of all the scientific journals almost that have been set on foot . . . they have all of them failed from an ability to cover their expense, and it is almost an impracticable thing to keep a scientific journal alive in this country. [Brock, 1980, 101]

All difficulties aside, Thomson had the will to expand the journal, and the auguries were good. It was time, he suggested, to take the *CMJ* to a higher plane: to take a local journal and put it on a par with the more prestigious Continental productions.

4. Transition

In the summer of 1845, the British Association for the Advancement of Science descended on Cambridge for its annual pilgrimage. The British Association was founded in 1831 and though it still

continues to meet for a week each year, its heyday took place in the 19th century. Founded on the German model of the *Gesellschaft Deutscher Naturforscher und Ärzte*, which first met 10 years earlier, its object was to provide a forum where gentlemen of science could meet together, and "stimulate one another to new exertions—to bring the objects of science more before the public eye and to take measures for advancing its interests and accelerating its progress" [Howarth, 1931, 14].

In addition to holding meetings, the British Association awarded grants for research and commissioned reports from the perceived authorities. In mathematics, for example, Peacock prepared a "Report on the recent progress and present state of certain branches of Analysis" for the Cambridge meeting of 1833, and two years later, Whewell prepared a "Report on the recent progress and present condition of the mathematical theories of electricity, magnetism, and heat" for the meeting held in Dublin. G.G. Stokes wrote one in similar vein on "Hydrodynamics" for the 1846 meeting held in Southampton.

At the 1845 meeting Ellis undertook to prepare an Association report on "Analysis" for the following year, so he might well have looked forward to some free time for drafting it [Rawnsley, 1896, 60]. While he undertook multifarious intellectual projects, he was constantly in a poor state of health, and was keen to give notice to Thomson of his intention to give up the *CMJ*:

> I do wish you would permit me to resign the editorship in your favour—You will in all probability be longer in Cambridge than I shall, & I should be so much better pleased to see it in your hands than in mine. You know I only took it as a jury mast[29] on Gregory's being obliged to give it up. Please accede to my very earnest wish on the subject & believe me with the most sincere regard. [CUL K, E55, 13 June 1845]

At the British Association meeting, a group of Dublin mathematicians expressed their wish to make the new journal a joint one between themselves and the Cambridge mathematicians [CUL K, S595, 19 Nov. 1845].

Two events coincided in Thomson's life at the end of June (see Fig. 3). He was elected to a fellowship at Peterhouse and he agreed to take on the editorship.[30] Thomson was born in Ireland, in Belfast, and the expansion of the journal's domain of influence to include Trinity College, in Dublin, would have been very agreeable to him. In proposing the wider objectives for the journal which he had outlined to his father, Thomson believed it would benefit from a change of name. In this he sought advice from fellow Glaswegian Archibald Smith the initiator of the *CMJ*. Now a hard-working Chancery barrister, in London, Smith wrote:

> The C.M.J. has hitherto been useful and successful and in the particular of stimulating men reading for and who have recently taken their degree to put into shape and preserve any thing pretty or ingenious which they hit on [and] it is probably more useful than a journal of a more general character would be.
>
> But notwithstanding this and my prejudices in favour of the C.M.J. as it is I think if you have a fair prospect of sufficient support to keep up a noteworthy publication and that by making the name more general and the publication more relevant [?] you would much increase the number of contributors. I think it would be a pity not to do so.
>
> Of the two names you propose I should prefer the "Mathematical Journal." "Cambridge" in the present title has a definite & appropriate meaning which Cambridge & Dublin would not have. And if the title is changed to show that it is not meant for Cambridge contributors alone I would like to have it so selected as to show it is not meant for *University* contributors alone. Mr Boole, Mr Bronwin & Mr Cockle are not university men that I know. And I think you should encourage meritorious men of that kind. [CUL K, S145, 16 July 1845]

[29] A nautical term for a spar erected to replace a broken mast. Contrary to this "probability" Thomson soon left Cambridge, and Ellis remained there until his death in 1859.

[30] Indispensible references in connection with Thomson's editorship of the *CDMJ* are [Wilson, 1976, 1987, 1990].

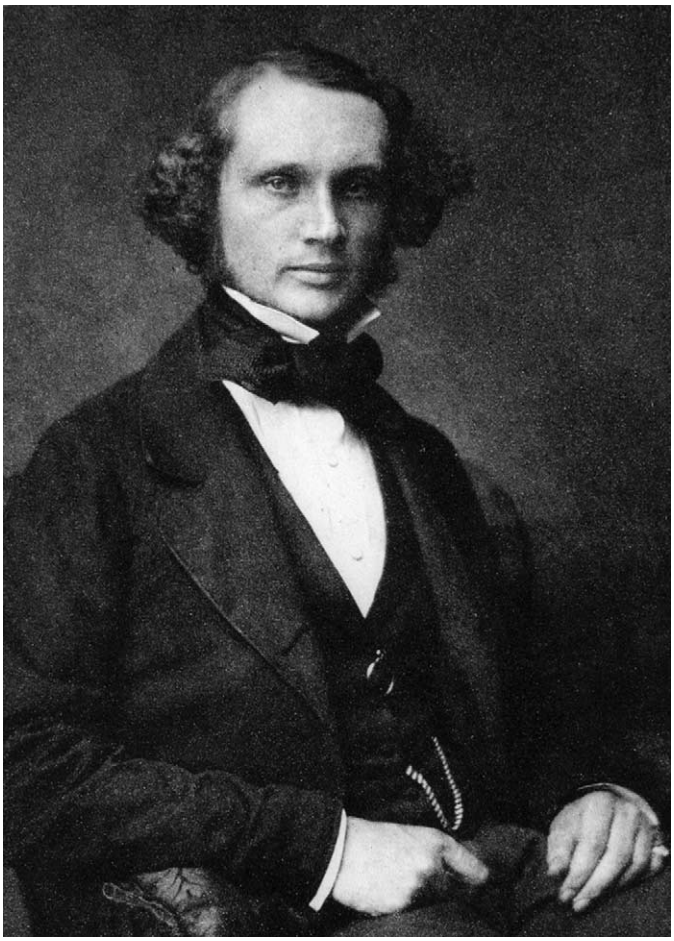

Fig. 3. William Thomson.

Since leaving Cambridge for the study of law in London, Smith had lost touch with the *CMJ* and its contributors, a band which included accomplished mathematicians out in the country with little or no contact with the national seats of learning.

The Anglican cleric Brice Bronwin (c. 1786–1869), Boole, and Cockle regularly published articles in the *CMJ*. While Boole flirted with the idea of studying at Cambridge, in the end he was entirely self-taught, albeit with the support of a patron [MacHale, 1985]. This may also be true of Bronwin, who was born in Norfolk and served for many years as curate in the parish of Denby Dale in Yorkshire, in which position he sustained an extensive publication record in pure mathematics and astronomy. Bronwin was involved in controversy with both Boole and Cayley but both thought his work had merit. James Cockle was educated at Cambridge but may have escaped Smith's notice, since he graduated only thirty-third in the order of merit of 1842. He wrote over a hundred papers, but his attention was diverted from mathematics by his legal career in Australia. On his return to England he focused on his

Fig. 4. Daniel Macmillan.

researches with renewed energy and became the 12th president of the London Mathematical Society in 1886.[31]

On the proposed changes in the *CMJ* there was some vivid discussion. Ellis argued against Smith's idea that it was primarily a journal for undergraduate juvenilia. In his view it was time for the journal to act its age. On the thorny question of changing the journal's title, Ellis cautioned Thomson that "Boole & A. Smith are men in themselves of weight and likely to indicate the opinion of others." He argued that the previous title had not proved a barrier to authors not attached to the university but the very act of changing it might cut out the unaligned following who hailed from neither Cambridge nor Dublin. Ellis wrote further in the same letter: "My own impression has been that the journal has derived and would derive respectability from an appearance of connection with an academical body—such connection not being kept up in an exclusive spirit. . . . it must be remembered that the journal is growing up from youth to manhood and that what was true seven years ago is not true now" [CUL K, E59, 24 July 1845].

With the transition, moves were afoot to engage a new publisher. There were two competitors, Elijah Johnson, who had published the *CMJ*, had a shop at 30 Trinity Street, in Cambridge, and the Macmillan firm which had opened at Number 17 in late 1843.[32] There was in fact a close connection between the two establishments, as Johnson had introduced young Daniel Macmillan (see Fig. 4) to the Cambridge

[31] Boole, Bronwin, and Cockle were three of the most prolific contributors and are exemplars of the heterogeneous character of the social group who contributed to the Cambridge journals. Boole wrote from his school, situated in the shadow of Lincoln Cathedral, Bronwin was a curate of the Anglican church from Gunthwaite Hall near Barnsley in Yorkshire, and James Cockle, barrister, wrote from Pump Court in the midst of "Legal London."

[32] The company was run by Daniel Macmillan (1813–1857) and his younger brother Alexander (c. 1818–1896). In moving to Number 17, the Macmillans bought the business of the bookseller Richard Newby. The debt was manageable, for they bought Newby's house on a lease for 14 years with an annual rent of £84 [Stokes, 1919]. In Cambridge the company became more

bookselling business as an apprentice for three years from September 1833.[33] He learned the trade so well, and proved so adept in his dealings with academics, that 10 years later he was Johnson's competitor.

The Macmillan book empire was in the ascendancy. At the time the *CMJ* was being considered, the business was expanding from one of pure bookselling to one of publishing as well. In 1843, the year Daniel moved back to Cambridge, the firm published a single book, but by 1845 it published seven, and it would double that number in 1846 [McKitterick, 1998, 388]. They moved to 1 Trinity Street in 1846 when they bought the business of Thomas Stevenson, a focal position in Cambridge on the corner where Academe met the everyday life of the town.[34]

Macmillan's sought to put the publishing of academic work on a commercial basis for the "purpose of money-making," a difficult objective for academics to appreciate.[35] One of their first publishing ventures in mathematics was George Boole's *Mathematical Analysis of Logic* (1847), but they made most from text books, and one of the first of these was Isaac Todhunter's *Differential Calculus and the Elements of the Integral Calculus* (1852), which turned out to be a bestseller [Graves, 1910, 56].[36]

In having to choose between the two rivals for the *CMJ* business, Ellis saw that Thomson was placed in an invidious position:

> I can quite well understand that you find yourself disagreeably placed between the rival publishers—there can be no question as to your being quite at liberty to do that which suits you best—but it is not pleasant to bring two Christians into the tempers of wild cats, & to fill them full of envy[,] hatred & malice & all uncharitableness. I knew how it would be (as nurses say to children)—when you were so good as to take the journal off my hands, which would soon have wearied of holding the balance between Johnson & MacMillan. [CUL K, E60, 26 July 1845]

"The only stipulation I should make," wrote Ellis, "is that the negotiation with Johnson should not be *abruptly* discontinued" [CUL K, E55, 13 June 1845]. Johnson relinquished the *CMJ*, as he did not wish to handle the proposed reprinting of the first volume of the *CMJ*, which was going out of print but still in demand [CUL K, B12, 17 July 1845].[37] Thomson employed Macmillan and the journal continued with the Cambridge firm of Metcalfe and Palmer as printers.[38] Through links between Macmillan's and the London bookseller, Williams and Norgate, Thomson exchanged copies with the *Archiv der Mathematik*

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attractive to academics than the long-established Deighton's, the university bookseller and publisher [Topham, 1998]. They opened a London office at 23 Henrietta Street, Covent Garden, but remained in Cambridge until 1863 [Morgan, 1943].

[33] Boarding in Johnson's house, Daniel had worked each day from 7.30 a.m. until 7 p.m. and received £30 per annum [Hughes, 1882, 46–47].

[34] The acquisition of Stevenson's large bookselling business at a price of £6000 obliged Macmillan to take a partner who could provide the capital for the investment [Hughes, 1882, 221]. The premises at 1 Trinity Street, opposite the university Senate House, are now occupied as the bookshop of the Cambridge University Press.

[35] Daniel Macmillan to J.C. Hare, June 21, 1844, quoted in McKitterick [1998, 388].

[36] MacMillan's sharp commercial sense extended to publishing textbooks with mass circulation, cleverly availing themselves of the services of the University Press to have them printed. It was not until the 1870s that the University Press fully realised their own potential for acting as publishers themselves [Roberts, 1956, 35–37].

[37] The second edition was published by Macmillan, Barclay, and Macmillan, and sold through George Bell, a university bookseller of Fleet Street, London. It sold for 18 shillings per volume, or 3 shillings for each number.

[38] Macmillan's estimate for supplying copies of the *CDMJ* in the first year of operation (not including advertising and the expense of authors' corrections) was £16 10s 0d for a print run of 500 copies of each number of the journal (including paper, cover, and sewing) *plus* £1 15s 0d for supplying twenty-five offprints to each author [CUL K, M55, 9 July 1845]. In terms of circulation, it might be compared with a (monthly) print run of 750 copies of the *Philosophical Magazine* with sales estimated at 450 in 1850 [Brock, 1980, 106]. The financial outlay was about a fifth that of some commercial science journals, as was

und Physik, a journal less elevated than *Crelle's Journal*, which began life in 1841 and lasted until 1920, and one of particular interest to teachers [CUL K, M56, 3 Sept. 1845].

Meanwhile little progress had been made on the critical issue of the journal's name, a long-running consultation which drifted as Thomson took advice from among interested parties. He wrote to Boole:

> I am in great perplexity about the name. Either "Cambridge M[athematical] J[ournal]" or "Cambridge and Dublin" is objectionable as particularising too much what we wish to make as general as possible, and the title "Mathematical Journal" (without any article as I suppose would have to be the case) though in itself much preferable, I think, to either of the others, is I am afraid rather bare. [GUL, B10, 17 July 1845; Smith, 1984, 8]

Boole attempted to free him from the dilemma, and to alleviate the matter with some mathematical humour, pressing into service the analogous wave theories of light and sound with which Thomson was quite familiar. Boole urged Thomson to make the decision himself:

> I fear that I cannot give you any advice which will enable you to steer between the Scylla and Charybdis of your present difficulties with reference to the naming of the Journal. Of the two titles I should prefer the more general one "Math[ematica]l Journal." Your objection that it is bare can only apply to the sound (for the sense expresses all you want unless you wish to confine the Journal to a certain class of contribution)—and sound is a matter about which a genuine mathematician, I suppose, for I am not one myself, cares nothing except as it illustrates the theory of undulations; so that on the whole you may, I think, adopt the title "Math[ematica]l Journal" with great safety. [CUL K, B143, 18 July 1845; Smith, 1984, 9–10]

Towards the end of July 1845, Thomson came to a tentative conclusion, and informed Boole that he would after all, adopt his suggestion of *Mathematical Journal*: "I hope Dublin men will join and not allow any provincial feelings to keep them from cooperating with a thing which would be much more useful when quite general than it could be if restricted in any manner. I think unless they are repealers[39] they must consider any work which is not confined even in title, to any particular place here, as being *national* even though it is printed at Cambridge" [GUL, B12, 27 July 1845; Smith, 1984, 14–15]

Thomson had indeed consulted widely, but his nearly permanent conclusion proved slippery and Ellis caused him to have second thoughts. On a visit to Dublin, Ellis dined with Charles Graves (1821–1899) and reported back that the introduction of "Dublin" would be welcomed: "I dined with [Charles] Graves yesterday, [&] he thinks the introduction of the word Dublin into the title of the journal would tell very much here. He says many of the younger men tell him they would be happy to contribute if they could look on the journal as in any degree an organ of their university" [CUL K, E57, 17 July 1845].

At the beginning of August, Thomson was still in doubt. Graves and Hamilton were in favor of putting "Cambridge and Dublin" in the title but Graves offered "British and Irish" as an alternative [CUL K, G161, 1 Aug. 1845]. Still Thomson procrastinated and took the collected thoughts back to Boole, who advised that it would be wise to have Graves and Hamilton as allies. This seemed to seal the matter and he abandoned *Mathematical Journal* and settled on amalgamating "Dublin" with the previous *Cambridge Mathematical Journal* title. In retrospect it was a wise decision, and the uniting of the two universities, a fillip in the establishment of the Irish school of mathematics centered on Dublin [McConnell, 1944–1945, 87].

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the case with the *Annals of Natural History* for 1838–1839 [Brock, 1980, 99]. The production of *all* journals was subject to an excise tax on paper (abolished in 1861).

39 There was considerable political agitation in Ireland from those who advocated repeal of the Union between Great Britain and Ireland which was established in 1801.

5. Extension

Anxious to make the *Cambridge and Dublin Mathematical Journal* (*CDMJ*) a success, Thomson appealed to his friends for support. He wrote to Boole to send him his paper on Laplace's equation "as it would be very pleasant to have some good things in the first number," adding, "I have got several papers from Cayley for the first and second N°, and I hope to p[rin]t something from Ellis, to put at the beginning" [GUL, B10, 17 July 1845; Smith, 1984, 8]. Predictions for a healthy future of the journal were the order of the day. Archibald Smith indicated his full support for the offshoot of the *CMJ* and the scope the new journal might take: "I think if the Journal flourishes it would be found very useful that it should introduce into notice in this way[,] of all important publications on the subjects on which many mathematicians are at work—as heat & light electricity at the present time" [CUL K, S148, 19 Nov. 1845].

At this point that unmatchable character of British mathematics, J.J. Sylvester, made his presence known to the editor. At 31 years of age, Sylvester was an FRS, had been a professor twice over (at University College, London, and at the University of Virginia), and, returning to England at the end of 1843, was appointed to work at the newly established Equity and Law Life Assurance Society a year later. He continued with mathematics and he attended the British Association Meeting on York in 1844, where he spoke on the theory of numbers. Reorienting himself to his new surroundings, he noted the extension of the *CMJ* with some interest. Following the British Association Meeting at Cambridge in 1845, which he attended, he wrote to Thomson:

> I hail with much pleasure the auspicious conjunction of Cambridge and Dublin Mathematics under your able guidance—as likely to lend in a most material degree to introduce a Catholic Spirit among your readers and exhibit an agreeable and instructive spectacle of the union of the Sister Sciences of Analysis & Geometry: the one [Analysis] the creation of a Metaphysical & Utilitarian Age—the other [Geometry], the revival under a maturer form and animated by a bolder genius, of the beautiful speculations of a more objective and imaginative period in the world's history. [CUL K, S594, 18 Nov. 1845]

Sylvester informed Thomson that he had "some old papers lying by me, which I think it would be a pity should [they] be consigned to the moths & worms, as they relate to a department of thought [Combinatorial mathematics] which must some day take its place among the Mathematical Sciences. ... The ideas are entirely new and will I believe be found at some future day, to admit of important theoretical & also practical applications. I lay claim to the honour of bringing up, the Third & Unbethought of Grace (still a mere child) who is wanting to complete the Mathematic Braid—Will you kindly take her by the hand & introduce her to the world?" [CUL K, S594, 18 Nov. 1845].

In the year before, 1844, Sylvester had published a paper on "combinatorial aggregation" (what he later called "Tactic") in the *Philosophical Magazine*—it was a subject which had captivated him as a young boy and would continually attract him [Sylvester, 1844]. Nevertheless nothing appeared in the *CDMJ* and the work was most likely left incomplete at this stage. From Sylvester's return to England until his voluminous publications in the theory of invariants, seven years later, it was generally a desultory period in his mathematical life. He kept up Continental mathematical contacts but busied himself with his law pupillage and the life of an insurance man in Lincoln's Inn Fields. In a few years time, his mathematics in full flow, he would take up the reins as a coeditor of the successor to the *CDMJ*.

There was no shortage of contributors to the inaugural volume of the *CDMJ*, planned for the end of October 1845. When it did come out in January, it was a bumper edition—the challenge would be to

maintain the same level after the fanfare had died down.[40] Writing to Thomson, De Morgan was the bearer of praise and sound advice: "If there were anything to complain of in the old series, it was the number of errors of press. This was perhaps the *genius loci* [genius of the place]—We Cambridge men are not very famous for accurate printing—and I feel as guilty as any one. It has not hitherto been the uniform practice to send proof of their papers to the authors—I should recommend it—When I was Secret[ary]y to the [Royal] Astron[omical]. Soc[iety].[41] I always used to make the author if accessible share the responsibility with me; and though I have corrected many a misprint which escaped his eye, I found he generally had a right to say as much about me" [CUL K, D63, 12 Nov. 1845]. But De Morgan found the new journal a significant improvement, and writing again, "your printer turns out excellent proofs in correctness and arrangement" [CUL K, D70, 20 July 1846].

Promotion and diffusion of science was the overall objective for the *CDMJ* with the subgoals of

(i) serving as a record,
(ii) performing a teaching role for young mathematicians by printing expository material,
(iii) covering a broad field from authors from both home and abroad, and
(iv) furnishing historical references so that readers could trace progress and locate their work in the larger scheme of mathematics.

Thomson wrote to Sylvester that "[y]ou will I am sure agree with me in thinking that the principal object of any scientific journal *should* be the publication of original investigations and discoveries, and I hope that, both *commercially* and *mathematically* [his emphasis], the Cambridge and Dublin Journal may be sufficiently prosperous to allow such a course to be followed."

Original discoveries comprise the total content of a modern research journal but in considering the commercial objective, Thomson had to develop a strategy for attracting a wider readership. To this end, he informed Sylvester in the same letter, that he would "publish papers of a more elementary kind, in which either simpler methods of proving known theorems, or more elegant forms of known results, which are met with in ordinary mathematical reading, may be given" [CUL K, S595, 19 Nov. 1845].

As with the *CMJ*, there was the usual canvassing among supporters for suitable mottos. Indeed, the relaunch was made with a strong sense of continuity with the *CMJ*. The organization of the opening volume of the *CDMJ* is virtually the same as that of its precursor, but one obvious difference was the introduction of a category on Thomson's speciality of heat, electricity, and magnetism in place of hydrostatics. The central corps of *CMJ* authors continued to contribute to the new journal. Besides the stalwarts of *CMJ* days, such as Cayley, Ellis, Boole, Bronwin, Andrew Bell (fl. 1834–1851), and Percival Frost (1817–1898), Thomson attracted new contributors in Stokes, Hugh Blackburn (1823–1909), and the undergraduate E.R. Turner (1826–1899) from Cambridge and De Morgan and T.S. Davies, based in London. He had some success in attracting French writers, J.A. Serret (1819–1885) and Liouville, with both contributing. From Dublin, Townsend, Hamilton, John H. Jellett (1817–1888) and Samuel Haughton (1821–1897) wrote articles for the first volume.

The range of articles in the *CDMJ* indicates that it was no longer a journal for undergraduates to try out ideas as the *CMJ* had been. Several authors who had written as undergraduates or junior fellows

[40] The *CDMJ* came out in nine volumes corresponding to each year 1846–1854 (inclusive). Each volume consisted of approximately 288 pages.

[41] Augustus De Morgan was secretary of the Royal Astronomical Society 1831–1839 and 1847–1855.

of Colleges for the *CMJ* were now writing as mature mathematicians and there seemed to be few replacement tyros. In effect undergraduates of 1846, apart from a few exceptions like Turner, had lost a medium. While the new journal could boast new blood, notably from Dublin, it was hardly fresh blood: the arithmetic mean age of contributors who had not published in the journal previously was 32 years, compared with an average of 33 years for all contributors. As the age of the Cambridge journal advanced, initially at least, so did the average age of its authorship.[42]

Thomson enlisted his friends to write for the new journal and his close friend Hugh Blackburn was evidently induced to write an article on mathematical astronomy—the only article he ever wrote [Blackburn, 1846]. Thomson was constantly on the lookout for contributors of standing in the mathematical world. The barrister C.J. Hargreave (1820–1866), Professor of Jurisprudence at University College, a rising figure in the law profession, and the winner of a Royal Society Gold Medal for his mathematical work on the solution of linear differential equations, was one [Hargreave, 1848]. "I shall be very glad if you will recommend the Journal to Mr Hargreave," he wrote to Boole, "who I am sure would, as a correspondent, be a great acquisition, as I suppose he must be a very good mathematician. We are not 'in want of correspondents,' but still a new one, if good, is always most acceptable" [GUL, B19, 21 Feb. 1847; Smith, 1984, 71].

Hargreave was indeed a good mathematician and his range wide: differential equations, number theory, life tables, the three-body problem, and the solution of the quintic equation. But he could not oblige Thomson, perhaps because he was appointed as a government Law Commissioner to expedite the sale of land in Ireland following the famine. Thomson need not have worried. Following the successful first volume, would not an editor have welcomed a postscript from Cayley: "I have 14 papers for you—wh[ich] I will not trouble with just now, as you seem to have stock enough" [CUL K, C45, 5 Dec. 1846].

The *CDMJ* spread its wings and sought to attract writers from the Continent. Thomson had little respect for Cambridge as a place for scientific innovation, or indeed one which gave much attention to the pursuance of science generally. In one of his hard-hitting letters, he wrote to Stokes, pointing out that this was the case with astronomy: "[t]he recent proceeding about Oceanus, or Neptune,[43] or Le Verrier, seem rather to indicate that Cambridge is behind the rest of the world in information on scientific subjects" [CUL S, K14, 25 Oct. 1846] He would double his efforts to encourage authors from the European mainland to write mathematical and astronomical articles for the *CDMJ*.

Liouville's article in the first volume of the *CDMJ* was inspired by Green's *Essay on the Application of Mathematical Analysis to the Theories of Electricity and Magnetism* [Liouville, 1846; Lützen, 1990, 594–595]. In the more adult *CDMJ*, authors from outside the United Kingdom who presented *abstracts* of their work included Olry Terqem (1797–1887), Carl J. Malmstén (1818–1886) (who worked in actuarial science) from Uppsala in Sweden, Ferdinand Joachimsthal (1818–1861) from Berlin, Charles Hermite (1822–1901) from Paris, Riccardo Felici (1819–1902) from Pisa (who fought with the Tuscan volunteers against the Austrian empire at the Battle of Curtatone in 1848), and Francesco Brioschi (1824–1897) from Pavia.

Now that "Dublin" was in the title, it was important to ensure that Dublin mathematicians took part. Richard Townsend (1821–1884) was Thomson's main Dublin contact, "good at geometry," according to Ellis, "but very modest and unaware of his own merits" [CUL K, E57, 17 July 1845]. Nervous about

[42] A full analysis of the age profiles of contributors awaits the attention of a statistician.

[43] Neptune was discovered in late September 1846; "Oceanus" was a proposed alternative name but quickly discarded in favour of "Neptune."

his own ability to contribute, Townsend warned there was mathematical competition looming between Britain and the Continent. He ventured a paper on analysis when his own specialty was pure geometry:

> I hope you will let me know if you find any obvious mistakes in the reasoning—for now the time has come when we of the British Islands must endeavour to hold our own, and not put forward anything which would be seized upon to our disadvantage, when there are those abroad so ready and so willing to take advantage of any slip we may chance to make—a recent occurrence which certainly made me very indignant has shown to what extent that unworthy spirit and feeling has existed and does exist amongst them still. [CUL K, T584, 30 Jan. 1847][44]

Thomson was astute enough to seek Hamilton's active support for the journal. No doubt they had met, for both had spoken at the British Association meeting at Cambridge, Thomson as a tyro and Hamilton the eminent man of Irish science and mathematics. In the Autumn of 1845, Hamilton gave the *CDMJ* his blessing and lined up Hodges and Smith as the Dublin agents. He apologized for not sending anything for publication:

> However I have been turning the whole subject of my speculations on quaternions very carefully in my mind, and hope to be able soon to contribute something which, without being long:—& at all events it can be *cut* short,—may throw some new light upon the matter, & interest the readers of the new mathematical Journal.
>
> With this latter view, I have lately been considering the subject in connection with the principles of Symbolical Algebra, which have been favourite topics with some of the contributors to the "Cambridge" Journal; of which distinguished periodical, the "Cambridge and Dublin" will doubtless be generally regarded as being a sort of continuation. [CUL K, H7, 29 Sept. 1845]

Hamilton saw the journal as another vehicle for spreading the quaternion word, a subject which totally occupied him from the day he carved their formulae into the stonework of Brougham Bridge in 1843, and he never lost an opportunity to promote them. On writing his paper for the *CDMJ*, he reported to Thomson, "when I came to date the introductory remarks today, I found it to be *exactly two years* (without having in any degree designed that it should be so), since the day (Oct. 16, 1843) which a printed letter of mine to John Graves enables me to identify, when the fundamental formula of quaternions first occurred to me. You will smile at this . . ." [CUL K, H8, 16 Oct. 1845]. Two months later he rejoined:

> I take it as a compliment, & an advantage, that you wish to have a few copies of my paper, such as it is, and I shall be very happy in putting them at your disposal—when they are at mine. I own that I should be glad if I could interest even a few mathematicians in the view which I am trying to open. But most will think it trifling, or too elementary; while others perhaps will find it obscure, from its departure from ordinary forms. [CUL K, H10, 17 Dec. 1845]

The *CDMJ* lived up to Thomson's idea of expansion, for when Hamilton's long paper came out in the first volume of the journal, it was only the first part of a series of articles [Hamilton, 1846]. In this, and in the next three volumes, Hamilton described a symbolical geometry analogous to symbolic algebra, in which relentless formalism was to demonstrate the great utility of quaternions [Hamilton, 1846–1849].

Meanwhile, Thomson's career was about to take another turn, and on September 11, 1846, he was elected Professor of Natural Philosophy at Glasgow at the age of 22. It was the university where he had matriculated at the age of 10, and where his own father was professor of mathematics. The removal from Cambridge posed a question for the *CDMJ*. Not doubting Thomson's capabilities and the possibilities opened up by the new penny-post, Smith teased: "What will the C & D M. Journal do without you?

[44] This is possibly a reference to the controversy between England and France arising from the discovery of the planet Neptune by John Couch Adams (1819–1892) and Urbain Le Verrier (1811–1877).

If you continue to edit it you should call it the C D & Glasgow M.J" [CUL K, S155, 18 Sept. 1846]. Thomson recognized the value of the journal for the mathematical community, but the fact that it was a useful channel for maintaining a wide range of contacts in the academic community would not have escaped his notice.

What proportion of received articles were actually published is difficult to judge, but Thomson put a refereeing system in place, implying criteria for acceptance. Such systems were not new, a refereeing system for Royal Society of London journals was established in 1832 [Craik, 2002]. A system for the *Phil. Mag.* was also in place, and the case of this journal indicates why specialist screening was so necessary. The editors were able to judge scientific articles but were incompetent when it came to mathematics and on this subject they "must be guided by opinions." They feared controversy in mathematical articles about which they were powerless to judge [Brewster et al., 1846, 146].

One might surmise that Thomson administered his own system with a light touch, as did Gregory—they were glad to have articles to publish. The editor of a new journal could hardly afford to turn away genuine mathematical copy, but equally, could not afford to publish inferior articles. But having a fairly formal system altered the nature of the journal; in modern terms the *CDMJ* became more of a research journal when the name changed. Of course, this begs the question of what actually constituted *research*.

The Victorian idea of research would certainly include the component of "novelty" as a valued element, and the quest for it as an ideal provided a link between the *CMJ* and the *CDMJ*. When A.Q.G. Craufurd (1808–1876) wrote an otherwise excellent paper for the *CMJ* on differential equations, he confessed he had been beaten to the post and that this rendered his article almost worthless.[45] He did not complain that the idea was wrong but that he had committed the sin of coming in second:

> When I sent my article [on the theory of algebraic elimination] to you, I was entirely ignorant that any other mathematician had been occupied with the subject, and was not aware that there was any known method of elimination between algebraic equations, except that which makes the problem depend on the method of finding the greatest common measure. From Professor Sylvester's interesting paper in your last number, and from his paper in the *Phil[osophical]. Magazine* to which you referred me, I find that that gentleman has not only anticipated me in the fundamental idea, but has likewise devised some very ingenious rules for the most expeditious, and even more mechanical, application of it. [Craufurd, 1841, 281–282]

From Gregory's perspective, an article such as Craufurd's was still publishable, though the author was naturally disappointed that he had been anticipated. To rub salt into the wound, Sylvester had produced a striking result which he termed the "dialytic method of elimination," a result which established his reputation in pure mathematics.

Important to authors was that publication sealed priority of discovery, although claiming it publicly courted controversy when the merits of the case were subjected to scrutiny. Under unstated rules, once results had been published they became owned by the person who published first—and thus there commenced some effervescent personal clashes of a vitriolic kind. In the highly competitive atmosphere, especially bred at Cambridge in mathematics by the Tripos system, ownership disputes and what constituted fairness often depended on a legalistic turn of phrase. The proprietorship of what became known as invariant theory in the 1850s was an example of ownership confirmed by an appearance in the *CMJ*.[46] When in May 1845 Cayley wrote to Boole about the origins of the subject, he dismissed

[45] A.Q.G. Craufurd (c. 1809–1876), whose father, Major General Robert Craufurd (1764–1812), was a distinguished British soldier in the Peninsular War, had an eventful university career, including changing colleges and being rusticated. He was fifteenth Wrangler in 1837 and M.A. in 1841 (as A.Q. Gregan) [Bury and Pickles, 1994, 45–46].

the claims of Gotthold Eisenstein (1823–1852) and Otto Hesse (1811–1874), if they ever made them, because their work did not focus on linear transformations *per se*:

> None of the papers of Hesse and Eisenstein that I know of refer professedly to linear transformations; you have I think the completest claim to originating the subject [of invariant theory]. Eisenstein's papers are principally on the theory of numbers and Hesse's on Analytical Geometry. [TCC, R2.88.21, 5 May 1845]

Cayley was not a priority chaser but he thought it important to set the record straight in this respect.[47]

The "novelty" objective was unconsciously implanted in the minds of referees as one criterion for acceptance, but general criteria or guidelines for referees seem unspecified. They are detectable from individual cases. One article submitted to the *CDMJ* by Stephen Fenwick, an editor of *The Mathematician*, did not measure up in Cayley's eyes. Fenwick was an experienced mathematician who had edited the *Northumbrian Mirror* in 1841, having been previously employed at Mr. Bruce's Academy, Newcastle-upon-Tyne, a church teaching establishment with a high reputation. With William Rutherford, he coauthored *Elementary Course of Mathematics Prepared for the Royal Military Academy* (1850) and by himself the *Mechanics of Construction* (1861). But asked to referee his work, Cayley advised Thomson:

> I do not think you ought to print Fenwicks paper; almost all, if not the whole of it is known, & I believe might be found in a memoir of Chasles "Sur les lignes conjointes dans les coniques" (somewhere in Liouville) [Chasles, 1838] besides treating the subject in that way without any reference to general geometrical theories or without any attempt to make a "Zusammengesetzung" [a composition] of the whole mass of theorems one obtains, is very uninteresting work. [CUL K, C45, 8 Feb. 1847]

To gain an idea of what Fenwick may have submitted, we consider the articles he published in *The Mathematician* around this time. In January 1847 he published a long piece, "On the plane quadrilateral," and it is possible he salvaged some of the content for his submitted *CMJ* article for the two notes on elementary analytical geometry later in the year [Fenwick, 1847a, 1847b, 1847c]. In these notes Fenwick treated relatively straightforward questions using coordinate geometry. It was not just the supposed lack of originality objected to by Cayley, for his overriding concern was that the work could not be located in the subject. Fenwick's paper appeared to portray geometry as a succession of "pretty" but unconnected results.

Cayley took his role as a gatekeeper of standards quite seriously. No doubt he regarded Fenwick's paper as having some merit, for he reserved especial criticism for those who treated mathematics as an pastime, a charge which could not be leveled against Fenwick, who had produced useful papers in *The Mathematician* on the theory of pole and polar in geometry [Fenwick, 1843]. As an ambitious young mathematician starting off, Cayley's intention was to exclude inferior work from the printed record. Boole's refereeing standpoint was less stringent, for while acknowledging that one of Bronwin's paper on differential equations did not contain anything useful, it was his opinion it should be published since "it is desirable to have records of our own progress even in directions in which nothing is to be hoped for" [CUL K, B166, 3 April 1847; Smith, 1984, 74].

[46] Invariant theory was referred to as the theory of hyperdeterminants or theory of linear transformations in the 1840s by Cayley.

[47] In the standard history of invariant theory, Boole is given credit as the instigator of the theory. Karen Parshall has shown that Sylvester did not accept this verdict [Parshall, 1998, 104–105].

6. Collapse

After only three years of operation, the *CDMJ* found itself in financial difficulties. In an endpiece to the third volume the publishers appealed directly to the readership "that the sale is not sufficient to meet the expenses . . . [t]hey therefore propose, after the completion of the present volume [volume 3, 1848], to publish the *Journal by Annual Subscriptions, payable in advance*."[48] It was the policy of the Macmillans not to give "long credit" to their customers. Evidently the *CDMJ* was only a small part of the Macmillan empire for Daniel wrote to his supporter J.C. Hare in February 1847, "things go very smoothly and very prosperously with us," and he repeated the same satisfaction a few years later [Hughes, 1882, 170, 247]. Nevertheless every corner of the Macmillan empire had to pull its weight.

The majority of contributions were in pure mathematics and the balance between applied subjects and pure mathematics, which Thomson had hoped for at the outset of his taking on the editorship, had not fully materialized. An exception to the pure mathematical content was the work published by his collaborator, the physicist and civil engineer William J.M. Rankine (1820–1872), who published papers on sound and electricity in the *CDMJ* at the beginning of the 1850s. Between 1847 and 1849 Thomson and Stokes each contributed three articles on topics for their sequence of "Notes on Hydrodynamics."

The Irish polymath Samuel Haughton (1821–1897) wanted to publish mathematical papers of an applied nature. A disciple of James MacCullagh (1809–1847), in 1851 he was elected to the Dublin chair of geology and mineralogy—a man who vigorously opposed Darwin's theory of evolution when it was first published. His work was mainly mathematical and was awarded the Cunningham Medal in 1848 by the Royal Irish Academy for a memoir "On the equilibrium and motion of solid and fluid bodies" [Spearman, 1990]. In February, 1850, he wrote to Thomson:

> I sh[oul]d. like to commence in the next Number [of the *CDMJ*], a series of Short "*Notes on Molecular Mechanics*," similar to what you have been publishing on Hydrodynamics. The ultimate object of my Notes w[oul]d. be to compare the different Theories of Light with observed facts & thus dispel some illusions, wh[ich]. seem to prevail on this subject, both in France & in our own country—M. Cauchy seems to have it all his own way in France—He is a good Mathematician, but in my humble judgement, does not pay that homage to facts wh[ich] they imperatively demand. [CUL K, H48, 14 Feb. 1850]

Whether Thomson was still listening with full attention is doubtful. He had evidently grown tired of the journal and was "overwhelmed" with other occupations. "Now I have a very serious matter to talk to you about," he wrote to Stokes, "I have been finding the management of the Journal more and more trying to me for some years back on account of my numerous duties here [in Glasgow] and the distance I am from Cambridge, and I am beginning to be anxious to retire. By next October [1851] I shall have held the post of Editor for 6 years, and in that time brought out 6 volumes, or 3/4 of the amount brought out by my predecessors in the eight preceding years" [CUL S, K49, 21 April 1851]. What Thomson wrote next, Stokes might have anticipated: "Do you feel inclined to take a turn of editorship?"

In hoping Stokes would take on the post, Thomson stressed the lighter side of the attached duties and the help he received from colleagues in reviewing specialist papers, assuring him this would continue. He made no attempt to hide the gap between credit and debit on the money side, but thought the acquisition of only a few more subscribers would "make the two ends meet." Though the "existence of the journal

[48] Publisher's Notice, *CDMJ*, 1848, vol. 3; quoted in Despeaux [2002a, 175]. Beginning with vol. 4, the journal was issued in three numbers per year (keeping the same number of pages in each volume) to take advantage of the sixpenny postage. The annual subscription was 16s 6d annually (including postage) and 15s for residents of Cambridge.

was a perpetual struggle," he said, "it is clear that the Journal *must* be kept up; but the publishers cannot be expected to continue it as a loss."[49] Unfortunately, Thomson's plea to "be allowed to retire on half pay in consideration of long services" did not have the desired effect on Stokes, and not for the first time (or the last) did he fail to fall in with Thomson's designs. By the middle of the next year, Thomson was still disgruntled and the journal was in the same financial plight.[50]

The man who stepped into the *CDMJ* breach and accepted the poisoned chalice was Norman Macleod Ferrers (1829–1903), the Senior Wrangler at Cambridge in 1851, who was training for the law in Lincoln's Inn, and filling in time by taking private pupils [Routh, 1905]. Appointed as assistant editor to Thomson, Ferrers wrote to him in June 1852:

> I have done little or nothing for the Mathematical Journal yet, as I have been travelling about the country; but shall begin to work for it now. The Macmillans to whom I was speaking about it lately, threw out a suggestion that at the termination of the present volume [Vol. 7], the present Journal should be stopped, and a new one commenced under a different name. I said that for my part I did not think such a plan would be at all likely to answer [the circulation problem]; and that I conceived you would be of the same opinion, whereupon the idea was dropped. [CUL K, F60A, 30 June 1852]

Ferrers saw at once that the journal had to be made more attractive to readers. He was not convinced that a "rebranding" of the journal as suggested by Macmillan would solve the problem.[51] Similarly, the publisher's ploy of beginning a new series, as used by the proprietors of the *Philosophical Magazine*, might fail. Macmillan might worry that the journal was becoming more abstruse, but could not the overproduction by one author be counterproductive in terms of appeal to the readership?

The bane of mathematical editors came under the spotlight when Ferrers asked Thomson in the same letter, "How much of the ensuing number will Sylvester occupy? and what other papers have you in hand?" [CUL K, F60A, 30 June 1852]. He was keen to take part in the organization of the journal, but Sylvester's paper would try him: "Do you think any means could be devised to make Sylvester's papers more intelligible? I am quite satisfied of their intrinsic merit, but there is such an utter want of revision and finish about them that it is an almost hopeless task to read them" [CUL K, F60B, 9 Aug. 1852]. Luckily there were other suppliers of academic copy, and Ferrers could report to Thomson that "[Robert] Anstice has sent me a continuation of his paper on Combinations, & [Thomas] Weddle sends a paper on Geometry of three Dimensions" [CUL K, F60D, 4 Dec. 1852].

Ferrers took over as sole editor in 1853, from the beginning of Volume 8. Thomson's name remained formally as editor on this volume at the suggestion of the publishers, as his was a recognized name in the scientific community, but young Ferrers was unknown. Even this minimal attachment proved too much for Thomson. In May 1853 his wife was taken seriously ill, and they spent time travelling in Europe visiting the spa towns to seek a cure. The fate of a journal hundreds of miles away must have been seemed of very little consequence. When he got back, he wrote to Stokes, "I had a delightful tour through Malta Sicily Italy etc. in summer with my wife and only arrived [back] about the time of the meeting of the British Association to wh[ich] I therefore felt scarcely up to going [to Hull in September

[49] This letter is quoted in Despeaux [2002a, 176–177].

[50] By then Thomson had even less appetite for the journal, for his priorities had changed radically; he was in love with Sabina, the sister of Archibald Smith. She rejected him but almost immediately he proposed to Margaret Crum and they were married on September 15, 1852 [Smith and Wise, 1989, 141].

[51] All these efforts to save the *CDMJ* were taking place at the time when the Great Exhibition of 1851 was asserting Britain's leading position in the industrializing world.

1853]" [CUL S, K62, 20 Feb. 1854]. Two months later, he was at the Royal Society reading a paper on "thermo-electricity," but his mathematical notebook showed no further entries until 1855 [Thompson, 1910, 1, 238].

Of overriding concern to Ferrers were the financial difficulties and the effect they would have on the nature of the journal. He abandoned the previous practice of segmenting articles into different types in the table of contents, though this minor editorial change could not of itself accomplish much. To boost sales, Macmillans were looking for wider appeal and sought to dilute the batch of specialist articles, which were of limited interest to the multitude. The *Educational Times*, which had been launched in 1849, carried a "Mathematics Department," and no doubt the Macmillans would have noted the appeal of such an idea [Delve, 2003].

An instance of the Macmillans' interference in editorial matters of the *CDMJ* was their suggestion of introducing a Problems Page with solutions to appear in the following number [CUL K, F60C, 8 Oct. 1852]. Ferrers acceded to this but the change failed to turn the journal to profit, and the Macmillans were not prepared to go on subsidizing it. As Sloan Despeaux has argued, the mix of articles written by authors writing at different levels, clearly aimed at a wide audience, probably ended up by pleasing no one [Despeaux, 2002a, 174–175]. Matters came to a head at the beginning of 1854. A letter from Ferrers to Thomson is worth quoting at length, as it puts the dilemma center stage:

> I fully agree with you that the Mathematical Journal [*CDMJ*] must not be allowed to drop. But I would put it to you, whether, after the Macmillans have stated that they are constantly losing by it, and have expressed so strong a wish to abandon it, it would not be more consistent with the position which the Journal occupies, to look out for some other publisher? Sylvester has often told me that he is quite sure the publishers of the Philosophical Magazine [Taylor & Francis] would be glad to take it up and would advertise it extensively and energetically. ... It may certainly be said that if it be taken up by London publishers, its connexion with Cambridge which gave it birth would altogether cease, except in name, but I do not think this is a serious objection, as its principal market is out of Cambridge, and only a small proportion of its contributions come from *resident* members of the university. ...
>
> ... I have not yet communicated with Cayley or Sylvester nor do I propose doing so, till I hear from you whether you think it would be desirable to continue diplomatic negotiations with the Macmillans, or to look out for another publisher. In the latter event perhaps some slight modification of the name of the Journal might be desirable. I can imagine how Cayley, and more particularly Sylvester would receive the suggestion of the Journal stopping. [CUL K, F62, 20 Feb. 1854]

At the end of Vol. 9, the stark announcement of "THE END" signaled the journal's closure. Commercial considerations dictated, and the *CDMJ* went into liquidation at the end of 1854.

7. The phoenix

The *Quarterly Journal of Pure and Applied Mathematics* (*QJPAM*) rose from the ashes of the *CDMJ* in April 1855 with publication of its first number. Officially, the difficulties with the *CDMJ* were smoothed over and its closure very properly attributed to causes "upon the nature of which it is not necessary here to insist" [Ferrers and Sylvester, 1857, iii]. With the demise of the *CDMJ*, the *QJPAM* gained a new publisher, John William Parker and Son.[52] John William Parker (the elder) (1792–1870) had one foot in the London publishing world and one in Cambridge, where he was the official University Printer

[52] Establishing itself in London at 445 West Strand, the office of John William Parker and Son became a repository for the religious publications of the Cambridge University Press. Resuming the business for a short while after the son's death, the company went into liquidation and was sold to Longman in 1863. A strong supporter of "Broad Church" Anglicanism, the company published such authors as Charles Kingsley and F.D. Maurice, and it thus became a nursery of "muscular Christianity"

[Topham, 1998, 367–369]. He published many mathematical texts, and with his son (who predeceased him), John William Parker (1820–1860), the firm specialized in religious publishing and a connection with the Society for the Promotion of Christian Knowledge. Around this time, the Macmillans were in negotiations with the Parkers about other matters, perhaps suggesting a link which made the transfer easier [Graves, 1910, 87].

Ferrers and Sylvester were the two British editors. Contact with France was formally recognized with the appointment of Charles Hermite as Corresponding Editor in Paris, while Stokes and Cayley assisted. Thus the editorial board was a balance between pure and applied mathematics as well as "internationality." A broad stance was indicated for the new journal.[53]

In the Preface to the *QJPAM*, the editors announced:

> All who are interested in the cause of Mathematical Science are aware of the great and beneficial influence which has been brought to bear upon the study of mathematics in this country by the publication of the *Cambridge* and subsequently of the *Cambridge and Dublin Mathematical Journals*, which, if they cannot strictly be said to have created the present school of English mathematicians, may fairly lay claim to have provided the arena in which they have been able to measure their strength and give evidence of their capabilities. [Ferrers and Sylvester, 1857, iii]

With his experience with the *CDMJ*, Ferrers moved across to the *QJPAM*. He completed his pupillage at Lincoln's Inn and was called to the Bar in 1855. Thereupon his career turned away from the law and he returned to Cambridge in the year following, where he took up a post as College lecturer and in 1861 was ordained an Anglican priest. Ferrers lived in Cambridge for the remainder of his life, ending up as Master of Gonville and Caius College. He was a Cambridge man through and through.

Ferrers was a reforming voice in the university, but a conservative, who "held strongly the old view that a thorough training in mathematics was essential to a sound education," and he had scant sympathy for new subjects such as natural science and mechanical engineering [Venn, 1912, 21]. To him, "the Mathematical Tripos seemed the supreme glory of Cambridge, and to touch it was to lay one's hand on the Ark" [Roberts and Gross, 1912, 153]. A service to mathematics was his edition of the *Mathematical Papers of George Green* (1871), for Green had been a fellow of Gonville and Caius in the 1830s.

Ferrers now had the ebullient Sylvester alongside, bringing with him his boundless enthusiasm for new projects. It was an interesting team; they were both Cambridge-trained, but unlike Ferrers, Sylvester had little interest in preserving tradition. Together they argued that the more ambitious journal was necessary in view of the growing state of the subject, and one which would render British mathematicians less "indebted to the courtesy of the editors of foreign Journals" [Ferrers and Sylvester, 1857, iii]. Notwithstanding, it would welcome contributions from foreign authors, as the presence of Hermite as corresponding editor attested. Nationalistic pride was a motivating factor in the choice of title, for it would rival Liouville's *Journal de Mathématiques Pures et Appliquées* and A.L. Crelle's *Journal für die reine und angewandte Mathematik*. The similarly titled Italian *Annali di Matematica Pura ed Applicata* appeared in 1858.[54]

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and a cradle of Christian socialism [Curwen, 1873, 321]. For background on Parker's business, see [McKitterick, 1998]. Following the early experience of the *CDMJ* with Macmillan it thus came under the control of another Scot, Thomas Longman (1804–1879).

[53] Sylvester claimed to be "nominally the chief editor" and he served until June 1877 (on his appointment to the Chair at Johns Hopkins University), but Ferrers was an editor until 1891 [Baker, 1912, xxviii].

As with previous journals, only secondary in importance to choice of title were the mottos, and in seeking one, Sylvester cast about for suggestions.[55] It was eventually decided that a quotation from Plato's *Republic* was most suitable: (in translation)[56] "As being is to becoming, so is pure intellect to opinion. And as intellect is to opinion, so is science to belief, and understanding to the perception of shadows" [Jowett, 1871, 293; Cornford, 1941, 249]. It is contained in Plato's chapter on "The Allegory of the Cave" and is an expression of the mathematical philosophy of many Victorians. Cayley was to write of his own Platonist stance:

> I would myself say that the purely imaginary objects are the only realities, the ουτως οντα [really real] in regard to which the corresponding physical objects are as the shadows in the cave; and it is only by means of them that we are able to deny the existence of a corresponding physical object; if there is no conception of straightness, then it is meaningless to deny the existence of a perfectly straight line. [Cayley, 1883, 7]

Between January and April of 1855 De Morgan wrote letters offering contributions and advice: "I think a small space of the Journal might well be given to correcting errors of demonstration in fundamental theorems—and insufficiencies. There are more than any one dreams of who does not come again & again into contact with the demonstrations in teaching" [SJC, SylP.2, 14 Feb. 1855; Parshall, 1998, 84–85].[57] To this end, he commentated upon the work of Ferdinand Minding (1806–1885), a professor from Dorpat in Russia (now in Estonia), with typical De Morganesque humour:

> This theorem of Minding (he is worth minding, and on this point nobody else is worth Minding) will be *the* theorem of the books for determining multiple points: the diff[erential]l coeff[icien]ts will retire on a pension. Minding had his head full of the special subject for which he [was] invented, or he would have seen this. [SJC, SylP.2, 23 Mar. 1855]

De Morgan was generally supportive of the *QJPAM*, praising the opening as "a very good first number," just as he had been, when the *CDMJ* was founded [SJC, SylP.2, 29 Apr. [1855]]. But academic praise was not enough. Writing to the Swiss geometer Ludwig Schläfli (1814–1895) Cayley expressed doubts whether the journal would be continued after the first volume: "it would have given me very great pleasure to have inserted in the *Quarterly Mathematical Journal* [*QJPAM*] the memoirs you speak of, but I am sorry to say that no arrangements are at present made for publishing the second volume and [it] is very uncertain whether the journal will be continued" [SJC, SylP.2, 19 Mar. 1856; Graf, 1905, 75–76]. A few days later he wrote of a reprieve: "It is still uncertain whether the Journal will ultimately be continued, but there is to be at any rate another number and we are proposing to print in it the second or third of the three memoirs [sent by you]" [SJC, SylP/2, 22 Mar. 1856; Graf, 1905, 81; Schläfli, 1858a, 1858b, 1858c]. Evidently the teething problems were surmounted, and after a faltering start, the journal continued for a further 72 years.

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[54] Though the *QJPAM* stood for its official title, the journal was frequently referred to, formally and informally, as the *Quarterly Journal of Mathematics* or the *Quarterly Mathematical Journal*.

[55] De Morgan provided several suggestions, and at the top of these: ΣΟΦΙΑ—ΣΟΦΩΝ—ΣΥΜΒΟΥΛΙΑ which he translated as "Wisdom is the taking counsel together of the wise." He thought it "legitimate and an argument for multiple editorship, and the three words may mystically shadow forth the three editors" [SJC, SylP.2, 14 Feb. 1855].

[56] Greek text: ὅ τι ούσία πρός γένεσιν, έπιστημή πρός πίστιν καί διάνοια πρός είκασίαν έστι.

[57] The editors accepted proofs of known theorems and did not insist on novelty as a *sine qua non* [Parshall, 1998, 84, fn. 6].

8. Careers

The *CMJ* started by being Cambridge-centric, though these constraints weakened as it renewed itself under new titles. Its strength was that it appealed to a wide group of academically minded individuals drawn from disparate backgrounds. Its contributors included churchmen, barristers and schoolteachers, forming a heterogeneous social constituent group [Becher, 1984].

The journals were instrumental in launching several *mathematical* careers. The most conspicuous beneficiaries were the administrators of the journal, for not only did they have an avenue for publishing their work, but it enabled them to network effectively. Thomson was able to publish notable papers on heat, electricity, and magnetism, but the editorship itself served to widen his circle of scientific acquaintanceship, a group pressed into service when he applied for the Glasgow chair in 1846. Gregory and Ellis became well known in the mathematical world through their connection with the *CMJ*.

Arthur Cayley's advancement in the mathematical world was bolstered by having 13 papers published in the *CMJ* before he published in Continental journals. In his case, Salmon noted that the journal's founders "rendered a service to English mathematics that it would be difficult to estimate," adding that he saw that the "journal roused the energies of the younger members of the University by making known to them that others of no higher standing than themselves were engaged in original research and by promising them the means of publishing whatever they might discover; and certainly it is no small thing that it can boast to have given Cayley his first opportunity of coming before the world" [Salmon, 1883, 481].

Without the *CMJ*, Boole would have almost certainly languished in Lincoln, there to remain, an erudite school proprietor, instead of becoming a leading mathematician of the Age. Through the *CMJ* and Gregory's eye for scientific talent, he was assimilated into the scientific circles of Cambridge and London where the quality of his work was clearly recognised. Thomas Kirkman is also in this "Boole category." He came to the notice of the Cambridge mathematicians through his paper on combinatorics submitted to the journal [Kirkman, 1847]. At the same time as rejecting Fenwick's paper, Cayley judged that "Kirkman's paper is decidedly interesting and his main result a very elegant one," a formula for calculating the maximum number of triples which can be formed with x [given] symbols, so that no two triples contain the same pair [CUL K, C45, 8 Feb. 1847]. His reaction was admirably sound and the paper has become a beacon for mathematicians since that time.[58]

Others wrote on topics whose value was not recognized until later. A paper on spinning tops was treated by Archibald Smith, writing under the signature "H.T."[59] Smith did not think highly of Euler's explanation of the reasons for a top rising (it being "the reverse of the truth"), while his own arguments could be checked using a Victorian toy top known as a teetotum [Smith, 1839a, 43]. Smith's novelty was in taking the effect of friction into account; previously the top was assumed to spin on a smooth table.[60] The educationalist John Perry (1850–1920), who championed the practical uses of mathematics, ascribed

[58] A generalized question involved the existence of systems S_n of triples formed from n symbols such that no pair of symbols occurs more than once in a triple (Kirkman's famous "schoolgirl's problem" involves S_{15}). For S_n to exist it is necessary that $n \equiv 1$ or 3 (mod 6). The proof that this condition is also sufficient was first produced by D.K. Ray-Chaudhuri and R.M. Wilson in 1971 [Biggs, 1981, 100].

[59] The signature H.T. was perhaps obtained by taking the fourth letters of "Archibald Smith."

[60] Smith credited William Whewell with raising awareness of the rotating top problem and the need to extend Euler's and Lagrange's work.

the theory of the rising tops to Smith's paper in the *CMJ*, noting that it was fully solved by Thomson and Blackburn on their Norfolk reading party in 1844 prior to their sitting the Tripos examinations [Perry, 1890, 68; Gray and Nickel, 2000].

Death cut short the careers of some who had begun their work in the Cambridge journals. Robert Richard Anstice (1813–1853) wrote remarkable papers on combinatorics, not then recognized as a subject of much importance compared with other branches of algebra. At the time of his death he was rector of Wigginton, near Tring in Hertfordshire. Shown to have discovered many modern results in the theory of designs, he pioneered the use of primitive roots in the construction of combinatorial designs [Anstice, 1852; 1853]. He anticipated work on Steiner's triple systems carried out by Eugen Netto (1846–1919) by 40 years and he knew examples of designs which only resurfaced in the 1970s [Anderson, 1995; Anderson and Griggs, 1999]. Among his achievements was the construction of infinitely many Room squares (a type of square design made up of unordered pairs) well before T.G. Room (1902–1986) in 1955. Like a good Victorian he believed his work to be little more than a "trifle."

Outside the Oxford–Cambridge network, the Northumberland mathematician Thomas Weddle (1817–1853) never lived to enjoy a full career. A mathematician who deserves further attention, he published a series of notes on the numerical solution of equations, numerical integration, and geometry in the Cambridge journals. After appointments in the north-east of England he held a succession of positions in and around London, culminating in a mathematical professorship at the Royal Military College, Sandhurst. Amongst his work is "Weddle's Rule," used in numerical integration, a formula similar in kind to the better-known Simpson's Rule. Weddle's result found early application in electromagnetic theory [Gordon, 1877]. He is also remembered in algebraic geometry for "Weddle's surface," an algebraic quartic surface with many striking properties and a close relation of Kummer's quartic surface [Weddle, 1852, 1854].

Other papers published in the Cambridge journals came to wider notice when their authors had ceased to care. Henry Wilbraham (1825–1883) was a Lincoln's Inn barrister who wrote papers on elasticity, mechanics, the theory of functions, and probability. In the theory of probability, he was drawn into controversy with Cayley, Boole, and Richard Dedekind (1831–1916). His paper on the "Gibbs phenomenon," a surprising result in the theory of Fourier series, was subsequently published by Josiah W. Gibbs (1839–1903) almost 50 years after Wilbraham's paper had appeared in the *CDMJ* [Wilbraham, 1848]. Toward the end of the 19th century the American physicist A.A. Michelson (1852–1931) initiated a discussion which was taken up by the Cambridge mathematician A.E.H. Love (1863–1940). Gibbs put the various ideas together and isolated the phenomenon [Ustina, 1974].

Hamnet Holditch (1799–1867), was by all contemporary accounts an ingenious mathematician. He was the Senior Wrangler and First Smith's prize winner at Cambridge in 1822 and published 10 papers in the period 1838–1863. Remarkable for his shyness, Holditch became a recluse at Gonville and Caius, the college where he was elected a fellow in 1823—so much so that he was once shown around the college by a colleague thinking him a stranger. In connection with a paper of his in the new *QJPAM*, De Morgan wrote:

> It is curious to see [Hamnet] Holditch coming out of his den, which he does once in ten years, with something about rolling curves or Caustics. He was senior wrangler the year before Airy, and what has made a man of such decided talent shut himself up I never heard. [SJC, SylP.2, 29 Apr. [1865]]

Holditch originally published a paper on "On rolling curves" in 1842 and several on caustics when the *CDMJ* arrived [Holditch, 1842, 1857, 1858a, 1858b, 1859]. A paper of his on geometry has recently been considered [Cooker, 1998].

No doubt the *QJPAM* helped launch the career of the Irish mathematician John Casey (1820–1891). He became known as a first-rate geometer who gained acclaim both for his numerous papers and *A Sequel to the First Six Books of the Elements of Euclid* (1881). Casey was a latecomer to the world of research. He taught himself geometry and was encouraged to enter Trinity College Dublin (TCD) by Richard Townsend, a man known for his kindness to students [Carlyle, 1909a]. A Roman Catholic admitted to the stronghold of Protestantism may have been an unusual event, but religious difference was not an absolute barrier to entry to that College. Unlike Cambridge, Dublin awarded degrees to non-Anglicans, and Casey was admitted B.A. in 1862 at the age of 42. Casey's first paper in the *QJPAM* was published when he was a student at TCD [Carlyle, 1909b]. While an undergraduate he became one of the editors of the *Oxford, Cambridge, and Dublin Messenger of Mathematics*, a junior version of the *QJPAM* linking the three universities. Cayley praised his work and supported his election to the Royal Society in 1875.

Another Irish mathematician, Robert Carmichael (1828–1861), represents the apogee of the calculus of operations a subject of intense British interest, and one written about in the Cambridge journals between 1837 and 1860 [Pantecki, 1992, Allaire and Bradley, 2002]. Brought up by the British as foster parents after adoption from the early 19th century French mathematicians, the calculus of operations may have lacked "rigor" but it was amazingly fruitful. The D operator method of solving differential equations is an heirloom but it also has connection with the algebra of logic and algebra itself. Gregory, Boole, and Cayley were among those who published work on this subject in the *CMJ*, the *CDMJ*, and the *QJPAM*. In particular, the calculus of operations provided a viewpoint for Cayley in his work on invariant theory, group theory, and matrix algebra [Crilly, 1986]. It provided a mechanism which allowed him to *generalize* previous ideas in group theory [Crilly, 2000]. In this period when the calculus of operations attracted so many authors, Carmichael wrote a definitive book on the subject [Carmichael, 1855].

We might ask about the most notable absences in the roll call of authors, those with Cambridge connections who achieved mathematical success but never published anything in these journals. Perhaps the most obvious absence is John Couch Adams (1819–1892). The *CMJ* catered to astronomy and although he worked at the forefront of that subject soon after his arrival in Cambridge in 1839, he did not contribute to the pages of the *CMJ*. Adams preferred to make his relatively few publications through the *Monthly Notices of the Royal Astronomical Society*. The *CMJ* enterprise was based in Trinity College in the early years, and Adams was a student at St. John's, reminding us that Cambridge was not a centralized institution but a loose amalgam of self-governing colleges. George Green, a member of Gonville and Caius College, did not publish in the new journal either. Thomson championed Green's cause for recognition and it was a matter of his personal regret that when he had the opportunity as editor of the *CDMJ*, he did not republish Green's famous *Essay* in the journal.

Over the period 1837–1870, very few of the Senior Wranglers published mathematical papers in the Cambridge journals, lending credence to the view that performance in the Tripos had little to do with mathematical creativity. The clever schoolboys who went to Cambridge were taught to jump through hoops by their private tutors, but only rarely did their obvious mathematical facility translate itself into creativity and the urge to publish papers.

What can be said about the generality of authors who were active in the early and mid-Victorian period? Of the 160 contributors to the *CMJ*, the *CDMJ*, and the *QJPAM* during the period 1837–1870, about half the authors published only a single paper. The median number of papers produced by any one

Table 1
Number of publication of authors in the *CMJ*, *CDMJ*, and *QJPAM* (1837–1870)[a]

Papers published	Frequency (number of authors)	Frequency (%)	Cum. frequency
1–4	108	67.5	108
5–9	25	15.6	133
10–14	8	5	141
15–19	6	3.8	147
20–24	5	3.1	152
25–29	4	2.5	156
In excess of 39	4	2.5	160
	160	100	

[a] Here a paper is a delineated article published by an identifiable author; papers by unknown anonymous authors have not been counted, nor have educational notes, scraps, or corrections. Each part of a multipart paper is counted separately. Papers written by more than one author are ascribed separately to each author [Gregory and Smith, 1841], but instances of this are rare. Thus the *median* number of papers produced by authors over our period 1837–1870 is 3, a figure which may be compared with the (arithmetic) average output for mathematical authors over the whole century of 6.48 [Wagner-Döbler and Berg, 1996, 297]. The discrepancy my be partially explained by the poor organization of mathematics as a professional activity in Britain during the period.

author is 3. At the other end of the spectrum, serial publishers (literally) were led by Cayley and Walton (Table 1). The distribution shows the usual phenomenon of most authors publishing a few articles and a small number of authors publishing most.

9. In conclusion

The journals that sustained mathematics until the mid-1860s, and that existed as an unbroken chain until 1930, were the "Cambridge journals." At the beginning of this chain was the *CMJ*, conceived as a local vehicle of use to Cambridge dons and undergraduates studying for the Mathematical Tripos. As it turned out, it was something more than this, and the historian R.C. Archibald described it as "England's first exclusively mathematical periodical of a research character" [Archibald, 1929, 396].

Considering prolific authors, Table 2 (below) contains a list of those who published 10 or more papers in the Cambridge journals in 1837–1870. It is a reflection of the heterogeneous social group which made up the constituency of authors and readers, an undoubted strength of the journal in which idiosyncratic choices of subject threw up a multitude of questions and fields for future work. Boole, Bronwin, Roberts, and Weddle did not come through the traditional route of Oxford, Cambridge, or Trinity College Dublin. The professions were variously represented. Roberts was a solicitor who never held any paid post connected with mathematics; Cayley was a barrister and professor (from 1863). The list of contributors from the clergy were headed by Greatheed, Bronwin, Blissard, and Goodwin (a bishop). Others such as Ferrers, Frost, and Walton remained in academe at Cambridge.

The constituency of authors comprised a varied group from across the United Kingdom and beyond, but its prime movers, Smith Gregory, Thomson, and the Macmillans, were from Scotland. They were all outsiders to the Cambridge system, and perhaps because of it, they could see the need for such a

Table 2
Authors who published ten or more papers in the *CMJ*, *CDMJ*, and *QJPAM* in the period 1837–1870

Name[a]	Forenames	Cat.[b]	Coll.[c]	Degree year	Pos'n[d]	First paper[e]	Last paper[f]	Birth	Death
Besant	William Henry	C	SJC	1850	SW	1860	1873	1828	1917
Blissard	John Charles	C	SJC	1858	3W	1862	1868	c1835	1904
Boole	George	–	–	−−	–	1841	1852	1815	1864
Bronwin	Brice	–	–	−−	–	1841	1848	c1786	1869
Cayley	Arthur	C	TCC	1842	SW	1841	1895	1821	1895
Cockle	James	C	TCC	1841	33	1841	1889	1819	1895
De Morgan	Augustus	C	TCC	1827	4W	1841	1858	1806	1871
Ellis	Robert Leslie	C	TCC	1840	SW	1839	1852	1817	1859
Ferrers	Norman Macleod	C	Caius	1851	SW	1857	1882	1829	1903
Frost	Percival	C	SJC	1839	2W	1845	1893	1817	1898
Goodwin	Harvey	C	Caius	1840	2W	1841	1848	1818	1891
Greatheed	Samuel Stephenson	C	TCC	1835	4W	1839	1843	1813	1887
Gregory	Duncan F.	C	TCC	1837	5W	1839	1845	1813	1844
Griffiths	John[g]	O	Jesus	1860	–	1864	1871	1837	
Horner	Joseph	C	Clare	1838	12W	1860	1877	c1816	1875
Jeffery	Henry Martyn	O	Cath	1849	6W	1861	1891	1826	1891
Roberts	Samuel	L	–	1847	Note[h]	1858	1885	1827	1913
Salmon	George	D	TCD	1839	SM	1847	1867	1819	1904
Smith	Archibald	C	TCC	1836	SW	1839	1841	1813	1872
Stokes	George Gabriel	C	Pem	1841	SW	1845	1851	1819	1903
Sylvester	James Joseph	C	SJC	1837	2W	1841	1885	1814	1897
Thomson	William	C	Pet	1845	2W	1841	1857	1824	1907
Townsend	Richard	D	TCD	1842		1846	1879	1821	1884
Walker	John James	D	TCD	1849	SM	1864	1878	1825	1900
Walton	William	C	TCC	1836	8W	1841	1891	c1813	1901
Warren	James William	D	TCD	1858	–	1861	1885		
Weddle	Thomas	–	–			1847	1854	1817	1853

[a] Cayley, Cockle, De Morgan, Roberts, Thomson, and J.J. Walker served as presidents of the London Mathematical Society.
[b] The abbreviations used in this "Category" of university attended as an undergraduate are C = Cambridge, D = Dublin, L = London, O = Oxford.
[c] Caius = Gonville and Caius, Cath. = St Catherine's, Pem. = Pembroke, Pet. = Peterhouse, SJC = St. John's, TCC = Trinity, Cambridge, TCD = Trinity, Dublin.
[d] The graduation position in the undergraduate degree: nW = nth position in the Wrangler Class (n = the position in the "order of merit" without necessarily being a Wrangler); SW = Senior Wrangler, the top position in the order of merit; SM = Senior Moderator, the top position in the order of merit in Dublin.
[e] Date of first paper author published in *CMJ*, *CDMJ*, or *QJPAM*.
[f] Date of last paper author published in *CMJ*, *CDMJ*, or *QJPAM*.
[g] Not to be confused with John Griffith, 10W (1840), who wrote papers in mathematics and physics.
[h] S.O. Roberts obtained an M.A. from London in 1849 and was awarded its Gold Medal in that year.

publication. Left to insiders the journal might never have happened. Daniel Macmillan registered an element of self-satisfaction in the irony he found in some Cambridge gossip, which he relayed to a friend: "[t]he notion which Cambridge men have about the Scotch universities is that they know very

little about mathematics . . .” [Hughes, 1882, 223]. In many British minds, achievement was equated with Tripos success, but the *CMJ* posed a challenge to this position.

The sequence of Cambridge journals, *CMJ*, *CDMJ*, and the *QJPAM*, led a precarious existence at times, and survival depended on the delicate balance between readers, writers, an editors as well as the need to remain financially solvent. Their fate can be compared with that of *The Mathematician*. Both were created to meet a similar need but by the midcentury both were experiencing difficulties. *The Mathematician* was short of funds but in attempting to economize, the time burden thrust on editors became unsustainable, and it went out of existence. The *CDMJ* tottered, but successfully bridged its low point and successfully rebranded itself as the *QJPAM* in 1855. Paradoxically, *The Mathematician* ceased publication just as it was gaining a following; its three volumes were reprinted in 1856.

While both the *CDMJ* and *The Mathematician* were international in their outlook, the Cambridge journals had a *university* following of writers and readers, and from this association they gained stability. This was recognized by Leslie Ellis when expansion was being considered in 1845, and he expressed the belief that the new journal “would continue to derive respectability from an appearance of connection with an academic body” [CUL K, E59, 24 July 1845]. *The Mathematician*, by comparison, was based at the Royal Military Academy Woolwich, whose main business was in training engineers, for whom mathematics was a service subject. Woolwich was never a center like Cambridge and its writers and readership was a loosely constituted group with only the journal to bind them. It embraced Continental mathematics and, indeed, many of its own articles were reproduced in Germany, but it was dependent on editors who were hard-pressed mathematical masters, in comparison to dons in the universities with leisure to organise a journal and a constituency of authors and readers on their doorstep.

Even with the advent of the *QJPAM* in 1855, mathematics was still leading a threadbare existence. In the early 1860s, signs were emerging that a healthier future was on the way. In the summer of 1864 the London Mathematical Society (LMS) was mooted and it met for its inaugural meeting on 16 January of the following year. Mathematics was on the road to becoming professionalized and new journals inaugurated [Collingwood, 1966, Gardner et al., 1995, Rice and Wilson, 1998].

The *QJPAM* could not maintain its pivotal position. In 1865, it had the company of the *Proceedings of the London Mathematical Society*, which would take over the role of disseminating research mathematics. The *QJPAM* was left betwixt and between the LMS journal and the new British mathematical education journals such as the *Oxford, Cambridge, and Dublin Messenger of Mathematics*, which began publication in November 1861, a junior version and an outgrowth of the *QJPAM*. The *QJPAM* lost its centrality but its articles were reported on in the abstracting journal *Jahrbuch der Mathematik* when this was established in 1868, and it continued to have a role to play where it started: publishing short mathematical articles at a variety of mathematical levels. Of the overall importance of the Cambridge journals there can be no doubt, and in the emergence of British mathematical research the *CMJ* and its descendants played a fundamental role.

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CUL S. Cambridge University Library, Stokes Papers Add.MS 7656.
TCC. Trinity College Cambridge.
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