A Star in the Western Sky: John Birmingham, Astronomer and Poet

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John Birmingham (1814-1884) of Millbrook, County Galway, was an outstanding amateur astronomer, now completely forgotten. He discovered the 1866 nova, T Coronae Borealis. Later his name was assigned to a feature near Anaxagoras on the Moon. In 1884 the Royal Irish Academy awarded him its Cunningham Gold Medal for his catalogue of the red variable stars. John Birmingham was not only an acute observer, he also wrote numerous semi-popular articles on many aspects of astronomy. He was also active in geology and railway surveying.

John Birmingham

Seven miles north along the highway to Mayo from the twin-cathedral city of Tuam, County Galway, one arrives at the small, well-ordered village of Milltown on the Dalgan River. Half a mile east from there, at the top of a rise along the winding road to Dunmore, a wide and bare field holds the ruined shell of a modest-sized building. One hundred and fifty years ago, Millbrook House was the warm and welcoming home of the tallest of the 'small' landlords of North Galway and South Mayo – a landlord who indeed was tall in more senses than one, not least in his astronomy.

On Tuesday 21 March, 1876, in the star-renowned town of Birr, County Offaly (then, briefly, King's County), a bronze statue was unveiled to honour the late William Parsons, Third Earl of Rosse. His 72-inch (1.83-m) reflecting telescope, operating since 1845, was still, thirty years on, the largest such telescope in the world. The *Irish Times*, in reporting on this event and mulling over Ireland's contributions to astronomical research, made mention of unexpected star-watching from west of the Shannon:[1]

> A few years since a gentleman wrote to the [London] *Times* detailing his observations of a sun, or fixed star, which he found on fire, traversing the heavens. But, seeing that the amateur astronomer wrote from near Tuam, that great journal cast contempt on the pretension that an unknown Irishman could anticipate Greenwich and the many British observatories, and indignantly consigned the letter to the waste basket; thus depriving the scientific world of knowledge of [the early stages of] a phenomenon of the rarest occurrence and the highest interest. The writer of the letter was Mr. BERMINGHAM, Dalgin [corrected to 'Millbrook' in the *Tuam Herald* reprint], near Tuam, a magistrate of the County Galway, who has a private observatory, and is a skilled practical astronomer.

Figure 1. The present-day ruin of Millbrook House (courtesy of A.J. Doran per Evelyn Tully)

Mr Birmingham? An unknown of many parts and a landlord conscientious to a fault, he poured his intellectual energies into the callings of geologist, engineer, surveyor, poet, humorist, musician and *par excellence* amateur astronomer. Oblivion is his name, for he never went east to settle and make a career in Dublin or London: 'John Birmingham did not *come* from the West of Ireland; he *was and remained of* the West of Ireland.'[2] So his name finds no mention in Allan Chapman's recent and authoritative *The Victorian Amateur Astronomer*.[3] Mr Birmingham is long forgotten even in his own country, and more poignantly still in his own county of Galway.

A decade ago, while seeking the bootsteps of the pioneers of Connemara's coruscating geology, I unwittingly stumbled over some articles by one John Birmingham.[4] It took a while to identify him, and by the greatest of good fortune I was just in time to obtain family memories from a great lady, and to have local Milltown folklore related by a fine gentleman, both sadly now gone from among us. John Birmingham (1816–1884) was an only child and a life-long bachelor. His death was followed by the dereliction of his estate; the burning of his letters, astronomy notebooks and drawings and the abandonment of his large library to the elements

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when Millbrook House was unroofed and defenestrated. Only his telescope survived, purchased by the President of St Jarlath's College, Tuam, and then left essentially forgotten for over a century in an old storage cupboard.[5] The investigation of John Birmingham's astronomy therefore suffers from the absence of any original documentation.

John's astronomy was achieved against a sombre backdrop. His inherited and persistent financial insecurity graduated into actual poverty towards the end of his life. He fought a succession of threats to the title of his house and land. And he lived through the gradual but inexorable collapse of Irish landlord-tenant society that led to violent Land League actions against many landlords. In the words of one of his tenants, John Birmingham in old age was 'all spent up and starved with the hunger'.[5]

Not all of John's astronomy can be spanned here, and just two major themes are addressed: his kick-start discovery of the nova T Coronae Borealis, and his comprehensive cataloguing of red variable stars and their spectra. But first, from where did his education in astronomy come?

Early days

The kindling of John's early interest in the night sky is unrecorded. Local tradition firmly has it that as a young man he spent some six years in Berlin, probably in 1848–1854. It must have been in Berlin, then a hub of astronomical research, that he received a measure of formal training in that science. It seems reasonable to assume that he gained his knowledge of comets and their orbits from Johann Encke and his assistants. Though too old to have enrolled as a student at the von Humboldt University, he is likely to have met the hospitable Alexander himself, whose renowned work *Cosmos* (1844, English translation 1846) John was frequently to quote in his geology.

Returned to Millbrook House, in the late 1850s John emerges with fluency in German and probably French also, and with a wide knowledge of European literature. He was now contributing occasional unsigned 'Astronomical Notes' to local newspapers, for which purpose he must have been visiting sources in Dublin and London. He tells us that his telescope at that time was of the simplest, with a magnifying power of a mere 25×. In 1858, the dramatic appearance of Donati's Comet led one self-styled 'Paedaeophilus' (Greek, 'lover of education') to assert pompously, in the largesse of the *Tuam Herald* weekly newspaper, that the solar system was bonded by electrical, not gravitational forces. A devastatingly incisive response in jocular vein from one 'B' (the Millbrook landlord at the age of forty-one) rebounded into a gargantuan, bruising and fruitless correspondence extending over a period of two months.[6] 'B' alluded to the mercurial deviousness of 'Paedaeophilus' in the following words:

> No wonder, indeed, that this essayist should demur to too literal an interpretation of his compositions; and I think that, taking every circumstance into consideration, we may safely conclude that the author who writes in this style – the geometer who speaks of 'irregular magnitudes' – the rhetorician who calls the last of a series of queries, 'a perforation' – the geognosist who believes that the earth is 'hollow at the core' – the architectural *savant* who alludes to the composite, as a Grecian order – the 'space-saturating' astronomer, and the scholar who cannot spell his own name will scarcely ever usurp the place of Newton in the chair of natural philosophy.

At the end, a battered 'B' feelingly remarked, 'Truly, indeed, says the sacred writer – "a stone is heavy and sand weighty, but a fool's wrath is heavier than them both".' Yet John's pain was the historian's gain, for windows were briefly opened onto his personality as well as his astronomy.

The appearance of another comet, the Great Comet of 1861, provoked a normal, straightforward correspondence in the *Sun*, the evening sister of the London *Times*, in which first place was twice given to letters signed by John Birmingham.[7] He was then writing from Cecil Street, off the Strand, the London residence of George Henry Moore MP of Moore Hall, County Mayo, stalwart founder of the Irish 'Brigade' at Westminster. George and John were brother patriots, though of very different styles.

The great discovery

Shortly before midnight on 12 May 1866 – the year in which Professor Julius Schmidt was to announce a volcanic eruption on the Moon, James Stephens a Fenian eruption across Ireland, and Algernon Swinburne an atheist fire among poets – the tall, gaunt figure of a North Galway landlord was striding through the darkness back to his home north of Tuam. John Birmingham slowed to look up at the constellations bejewelled in the night sky, the clouds from Connemara having cleared for once. His sharp eyes were scanning the familiar stars when . . . abruptly he stopped. There, to his utter astonishment, was shining a star that hadn't been there before, a new star added to the constellation of the Northern Crown. His discovery was to spark intense discussion among the international community of astronomers. Like Galileo, he was kick-starting a career at the age of fifty, one that was to make a singular contribution to Irish astronomy.

After stumbling on home – for surely he kept his eye on the new star to check if its brightness or position was changing – John lit his lamp, sat down at his desk and quickly penned, in his broad and

rounded hand, a letter to the London *Times*. Two days later that authoritative organ of knowledge and Empire, that most widely read and respected of all newspapers, was recipient to the announcement of a startling astronomical discovery. The editor read the brief note from Ireland – and threw it in the waste-paper basket. To those familiar with the *Times* of those times, it would be no surprise that he was wishing all things Irish would follow it. Could a western bogman anticipate Greenwich, Berlin and Paris?

Finding (and indeed, half-expecting) rejection of notice by *The Times*, John contacted, not Dunsink nor Greenwich, but William Huggins of Tulse Hill Observatory in London. John was aware not only of the importance of his discovery, but of its implications for stellar research. Huggins was the one who could apply the newly developed technique of telescopic spectroscopy to this nova, T Coronae Borealis. John had evidently been keeping abreast of the astronomical literature.

It was the brightest nova since that of 1604, waxing from the 9th to, briefly, the 2nd magnitude. It was also the first nova to be identified with a previously recorded, much fainter star. Huggins, who later firmly acknowledged Birmingham's priority at a Royal Astronomical Society meeting less ready to do so, immediately turned his spectroscope to the new star. Despite a delay of four days due to the non-response of *The Times*, during which the star had already waned to the 3rd magnitude, Huggins made the revolutionary discovery that the nova had emitted a shell of extremely hot hydrogen gas.[8] Huggins' thesis, well-received, was that combustion of hydrogen expelled from the convulsed star was responsible for the unusually bright spectral lines of that element, while a resulting incandescent heating of a solid photosphere had made more vivid the continuous spectrum of the star.[9]

John also sent a letter to the local press describing his discovery:[10]

> Sir,—I beg to inform you for the benefit of those of your readers who take an interest in such matters, that a new star, which may be called one of he rarest and most wonderful of celestial phenomena, is at present visible in *Corona Septentrionalis*. I discovered it on the night of the 12th instant, when it appeared of the 2nd magnitude, rather more brilliant than *Alpha* of the above constellation, with a bluish tinge, forming nearly a right-angled triangle with *Delta* and *Epsilon*, and rather nearer to the latter than *Gamma* is to *Delta*. It had nothing whatever of a cometary aspect. The state of the atmosphere prevented my seeing it again until the 17th, when it appeared reduced to the 4th magnitude, which size it retained up to 1h. A.M., this morning. I could detect no change in its position. I wrote to Mr Huggins, the able director of the Tulse Hill Observatory that he might test it with the spectrum analysis, in which department of astronomy he has attained such a just celebrity, and have received the following in reply:-

> Upper Tulse Hill, May 17, 1866.
>
> Dear Sir,
>
> Accept my best thanks for the valuable information contained in your letter regarding the new star you have discovered. I received afterwards [on the 15th] a note to the same effect from Mr Boxendell [Baxendell] of Manchester.
>
> I examined its spectrum last night and have just sent a paper on the subject to the Royal Society, in which I have given your description of the star.
>
> When the paper is printed I shall do myself the pleasure of sending you a copy.
>
> With thanks, yours truly,
>
> William Huggins.

John's original letter to Huggins was reproduced by the recipient three decades later in the following purported terms:[11]

> I beg to direct your attention to a new star which I observed last Saturday night, and which must be a most interesting object for spectrum analysis. It is situated in Cor. Bor. [Corona Borealis]; and is very brilliant, of about the second magnitude. I sent an account of it to the *Times* yesterday, but as that journal is not likely to publish communications from this part of the world, I scarcely think that it will find a place for mine.

But Huggins added an unusual assertion: 'On the 16th May, 1866, at 5 P.M. a letter came with the address "Tuam, from an unknown correspondent, one John Birmingham"'! If John really did give that tongue-in-cheek address, not only to Huggins but also to the editor of *The Times* (and one cannot put it past him), it could explain in part why *The Times*' letter sped basketwards. John's several skirmishes with the editor of that illustrious newspaper form another and revealing story told elsewhere.[12]

Henry Crozier Plummer, of Trinity College Dublin and briefly director of Dunsink Observatory, reminisced in 1917 thirty-three years after John's death:[13]

> John Birmingham was an amateur astronomer of the best and most useful type. His discovery of a bright new star would today be cabled around

the world, and it is amusing to note the modest letter sent to Huggins, who made this star still [more] remarkable by the fact that it was the first new star which was observed by spectrum analysis.

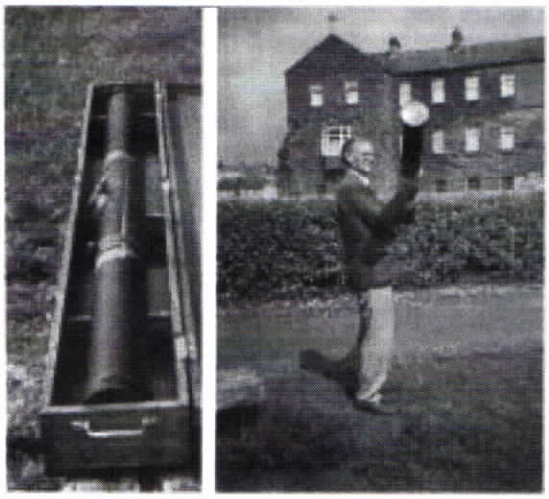


Figure 2. John Birmingham's 4½-inch Cooke refractor, preserved at St. Jarlath's College (background) in Tuam; and the Cookes of York (father and two sons), manufacturers of John Birmingham's telescope (courtesy of the Irish Astronomical Journal).

There can be little doubt that it was this discovery that led John to spend the huge sum, for him, of £120 on the purchase of a telescope from Thomas Cooke of York, England. Why a Cooke? It may be a coincidence that William Huggins was using a Cooke mounting for his telescope, but it is certain that John was visiting good friends in Scarborough, not so far from York. The telescope he purchased, probably in 1869, was a 6-foot (1.8-m) long refractor with a 4½-inch (115-mm) objective lens yielding a regular magnifying power of 53×. This fine instrument enabled him to resolve stars down to the 12th magnitude under the clearest skies. It was set up inside 'a large wooden house with a sliding roof'.[14] A considerable corpus of published observations confirms that whenever he was at home and the weather suitable, John must have been engaged at his telescope from after supper until dawn, in 'that ethereal pursuit to which he lent hundreds of nightly hours'.[15]

The discovery of T Coronae Borealis brought John into contact with the lunar expert Julius Schmidt, trained in Bonn and then director of the Athens Observatory. It was Schmidt who confirmed that only hours before John's observation of the nova, there was no such star visible in Corona Borealis. And it was probably Schmidt, when compiling his giant map of the Moon (published in 1878), who placed the name 'Birmingham' on that map.[16] Schmidt would later see his map receive a thorough and dispassionate review by John Birmingham in the journal *The Observatory*.[17]

Figure 3. Birmingham crater, next to Mare Frigoris. Birmingham, almost completely filled with ejecta, lies some two-thirds of the way up from prominent Plato (in the foreground) to the top of the picture, and just below high-rimmed Anaxagoras (http://www.lpi.usra.edu/resources/cla/info/a12 from the Consolidated Lunar Atlas at the Lunar and Planetary Institute's website).

Thirty-three years after John's death in September 1884, an acquaintance of his recalled at length:[18]

> In his interesting memoirs the late Sir Robert Ball, F.R.S., the eminent astronomer and scientist, thus refers to the late John Birmingham, of Millbrook, near this town [Tuam], a gentleman of high culture and education, so well known here, but a man whose worth was so little appreciated, we fear. That he was a distinguished and eminent man of science every authority of his day admitted and acknowledged and the most remarkable piece of evidence of his ability is that of Sir Robert Ball who wrote as follows:—
>
> 'Tuam, in the West of Ireland, is a place remote from ordinary scientific centres, but in that town there dwelt a very acute observer of the skies, the late Mr. Birmingham. I do not think he ever used a telescope of high power. No doubt he had a fairly good instrument, but he had something else without which the most admirable instruments are of little use—he had genuine interest in his subject. He also possessed that accuracy and care which are so necessary in

faithfully recording observations. One evening Mr Birmingham noticed a bright star in a place where he did not remember having seen a point of light before. He immediately consulted a map of the heavens. This confirmed his recollection. There was no star in the place indicated. He knew that it could not be a planet, as the whereabouts of every planet is regularly set forth in our almanacs. They are always to be found in their proper places.

It seemed that the Tuam astronomer had discovered the birth of an entirely new celestial object. He wrote two letters, one to the 'Times', the other to Mr. Huggins. As he had not been heard of before in scientific circles those who were first told of his discovery came to the conclusion that he was mistaken. It did not seem likely that an event of this kind should have passed unnoticed at recognised observatories by all the well known astronomers only to be detected by a comparatively [?unknown] astronomer in a rather remote part of the country. Mr. Huggins, however, thought that there could be no harm in looking towards the spot in the heavens which Mr. Birmingham's letter had clearly defined. There he found the star blazing brilliantly. He then remembered his spectroscope and turning this instrument upon the star he made a startling discovery.

I have already pointed out that the spectrum of an ordinary star is a long streak of light, coloured from one end to the other with the hues of the rainbow. In the spectrum of this new star, which astronomers now know as T Coronae, because it is in the constellation of Corona, the streak was not indeed wanting, but superimposed upon it were brilliant lines. Even if Mr. Huggins had known nothing of the wonderful history of the object he was studying, he would have immediately pronounced it to be a celestial body of unusual character. He would have been led to this conclusion solely by his spectroscopic observations, for there was nothing in the appearance of the star to attract special attention as distinguished from other stars. Indeed if it had presented any unusual appearance it could scarcely have escaped the vigilance of astronomers and observers other than Mr. Birmingham. It was fortunate that Huggins had so far perfected the spectroscope as to be able to deal with the new object. Indeed it could not have arrived more opportunely if the highest interest of science had to be served.'

Magnum opus: 'The red stars: Observations and catalogue'

A. The listing

John Birmingham's discovery of T Coronae Borealis heightened his enthusiasm for reporting on contemporary astronomy in popular journals and the press. It also led to a close friendship with another amateur astronomer of similar zeal and application, the Rev. Thomas William Webb of Hereford.[19] More than a century on, Webb is still serving the amateur astronomer with his many-editioned *Celestial Objects for Common Telescopes*, reissued as recently as 1962.

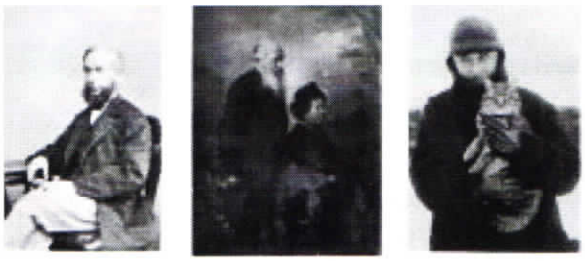


Figure 4. Some of John Birmingham's English colleagues. From left to right: William Huggins, Thomas Webb and wife, and Thomas Espin (courtesy of the Royal Astronomical Society).

It was at Webb's urging, in 1872, that John took up the task of updating and upgrading previous listings of the red variable stars. Several partial listings already existed, notably those of John Herschel and Otto Struve, while others were in the process of being compiled. Yet a fully comprehensive catalogue was then eminently desirable, for red variable stars might provide a key to stellar evolution, itself a new intuition. The influential Webb must have recognised talent, industry and an unusually keen eye in the Galwayman. John, employed at his modest 4½-inch Cooke refractor, devoted the next four years to searching for and checking on red stars in the northern skies, down to magnitude 9 and sometimes down to 12. In 1876 John submitted his catalogue of observations to the Royal Irish Academy in Dublin, which promptly accepted it for publication.

In the introduction to his Catalogue, John typically gave clear acknowledgement that the seed for his compilation had been provided by Prof. Hans Schjellerup, Director of the Copenhagen Observatory.[20] During his research, John visited Copenhagen to the extent that his Danish became reasonably proficient. Schjellerup's own 'Catalog der rothen isolierten Sterne' had been published in 1866 in the *Astronomische Nachrichten*.[21] A summary in English, covering some two hundred stars restricted to magnitude 8 and brighter, appeared in the *Intellectual Observer* in the same year, probably provided by the ubiquitous Thomas Webb. The translator added: 'Observers who use reflectors for their observations will find the colours more exactly seen when a glass prism is used instead of a smooth mirror, and achromatic eye-pieces will be

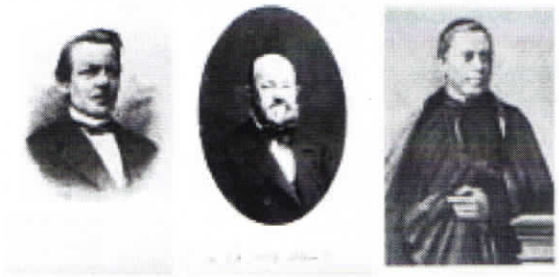


Figure 5. Some of John Birmingham's European colleagues. From left to right: Hans Schjellerup, Julius Schmidt and Angelo Secchi (courtesy of the Observatories of Copenhagen and Athens).

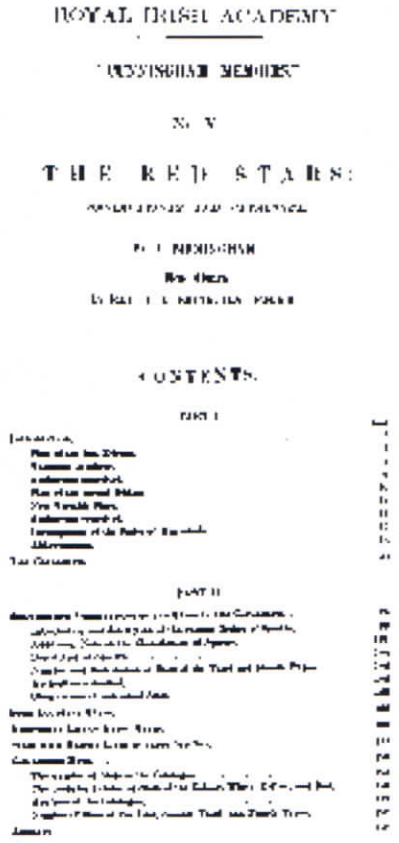
more reliable than Huyghenian.'[22]

Several other professional astronomers were engaged in searching for red stars at the time of John's observing and compiling. His Roman friend Angelo Secchi SJ had in 1868 and 1872 published lists culminating in a total of 444 coloured stars.[23] Secchi's compilation was based on the lists of John Herschel, Lalande, Schjellerup and, surprisingly, John Birmingham.[24] This highly unusual, even unique situation is explained in the preserved correspondence between Secchi and Birmingham,[25] which reveals that they were exchanging information on red variable stars while well aware of each other's work. Secchi, famous for his pioneering spectral classification of stars, and also for extensive solar researches, died unexpectedly in February 1878 – a loss that John deeply lamented.[26]

'The red stars: Observations and catalogue' was presented by John Birmingham to the Royal Irish Academy on 26 June 1876, published in August 1877, and bound into the 1879 volume of the Academy's *Transactions*.[27] In 1878 *The Observatory* provided an extended review of John's work, which also gained broad attention in the Irish press. The format and structure of the Catalogue are summarised in a contents page added to the posthumous second edition, collated by the Rev. Thomas Espin, which closely followed the essentials of the first edition (Figure 6).[28]

John Birmingham scrupulously sought objective colour estimation when allocating (or excluding) a star in the category of 'red'. Objectivity was equally important in describing colour changes linked to brightness variations of a star. Difficulties stemmed not only from an observer's subjective bias, but from the particular optical system employed. John's Catalogue therefore provided tables in which the colours estimated by various observers for given stars were compared, always cited in the language of the original (Figure 7).

Birmingham was equally concerned with accurately estimating the magnitudes of red stars, and exact changes of magnitude for variable stars. In the second edition of the Catalogue, Espin enlarged on



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TRANSACTIONS: SCIENCE

No. V

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CONTENTS.

Figure 6. The title and contents pages of the second edition of the Catalogue, published by the Royal Irish Academy, Dublin.

John's unpublished data which had listed the mean magnitude estimates obtained by various observers set against the standard 'DM scale' at half-magnitude intervals (from the *Bonner Durchmusterung*, compiled by Friedrich Argelander at the Bonn Observatory). Espin's table (Figure 8) reveals that particularly accurate magnitude estimations were obtained in observations by J.L.E. Dreyer (Armagh Observatory) and John Birmingham (Millbrook Observatory).

John considered the possible cause of magnitude variations in red stars. First, he noted many instances where, when a variable star brightened, it became paler in colour, and when it faded, its hue deepened. From this he felt able to exclude the possibility that red stars are cooling, dying stars. Second, he found it difficult to ascribe regular brightness variations to a rotating star having opposing hemispheres of differing surface characters. For how could such a situation persist for long on a mobile stellar surface, such as that of our own star, the Sun? For variable stars with irregular periods, a rotational cause for their brightness changes was evidently unreasonable. Third, variable

brightness could not be ascribed to 'periodic outbursts of incandescent gas'. For, John noted, Secchi had reported (in French) that the bright lines in the spectrum of Mira did not themselves become '*less* bright' towards the minimum; and Vogel had reported (in German) that the lines did not '*increase* in brightness, as does the continuous spectrum', at maximum. For John, therefore, there remained a fourth possibility: the 'intervention and recession of [a belt of] nebulous matter' around the star. This helped explain the deepening of colour as the star approached its minimum brightness, if there were a thickening of the intervening veil, much as the Sun's disc dims and reddens behind haze when close to the horizon. The ring of nebulous matter could be either regular or irregular in its circumferential density. Even the Sun, John speculated from historical accounts, may hold trains of nebulous matter in its atmosphere that could cause the solar constant to vary. He referred in this instance to an observation of his own on 22 May 1870 from the west of Ireland, when on a cloudless day a pinkish Sun could be regarded with the unprotected eye[29] (explained today as having been caused by airborne Sahara dust).

Birmingham appears to have been the first to emphasise that red variable stars are unequally distributed in the firmament. In particular, he found a sector of the Milky Way and bordering areas within the constellations of Aquila, Lyra and Cygnus to be particularly rich in red stars, to the extent that he named it the 'Red Region'.

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While Struve refers to the discordant performances of different classes of telescopes, it may be interesting to compare his remarks with those of observers like Secchi, who also used a first-class refractor; and in the following Table, where I give Secchi's notes of colours as I find them in his *Mirare Micrometriche*, it will be seen that the observations of both astronomers show differences which can be explained only by the actual variability of the objects.

No. in 2.	Star's Name.	Struve's Colours.	Secchi's Colours.
69	η Cassiopeiæ.	Major, flava; minor, purpurea.	1866·722; maj. alb.; min. rub. „ 815; maj. flav.; min. rub. „ 925; maj. alb.; min. flu. „ 964; maj. flu.; min. alb.
941	. . . . .	Maj. albacærulea; min. olbasubpurpurea.	Maj. cærulea; min. rubra.
1119	Castor.	Maj. min. subviridies [H called both white.]	Maj. alba; min. aurea.
1116	. . . . .	Maj. min. albæ.	Maj. albæ; min. rubra.
1273	. . . . .	Maj. fla. min. cærulea.	Maj. albæ; min. flava
1365	. . . . .	Maj. subd. min. albasubcærulea.	Maj. flava; min. rubra.
1388	. . . . .	Maj. fla. min. rubro-purpurea; colore insignes.	Maj. albæ; min. aurea.
2114	. . . . .	Maj. min. albæ.	Maj. flavæ; min. cæruleæ.
2218	. . . . .	Maj. alba; min. cinerea.	Maj. min. flavæ.
2264	95 Herculis.	1828·71; maj. flava-subviridis; min. flavasubrubra. 1829·76; maj. subvirid.; min. subflava. 1829·92; maj. virkidiflava; min. egregie rubra.	1873·829; maj. rubra; min. viridis.
2272	70 ρ Ophiuchi.	Maj. fla.; min. purpurea. [H. called the larger white and the smaller reddish.]	Maj. alba; min. aurea.
2281	73 Ophiuchi.	Maj. min. albæ.	Maj. flava; min. subrubra.
2382	ε Lyræ.	Maj. albasubvir.; min. albasubcærulea.	Maj. viridis; min. rubra.
2345	. . . . .	Maj. alb. min. cærulea.	Maj. flava; min. cærulea.
2822	μ Cygni.	Maj. alb. min. albasubpurpurea.	Maj. albæ; min. flava.
3062	. . . . .	Maj. min. flavæ.	Maj. flava; min. cærulea.

It will thus be seen that the colours of certain stars seemed completely altered after a lapse of several years; and in some cases equal changes were noticed by a single observer within very short periods. It will be also remarked that there are instances where the tint of one component of a double

Figure 7. Colours of some prominent red variable stars, as estimated by Otto Struve (Pulkova, Petrograd) and Angelo Secchi (Rome).

Mr. J. Birmingham and Rev. T. E. Espin—*On the Red Stars.* 17

The Magnitudes.—The question of variation makes it of paramount importance that the magnitudes of each observer should be investigated. In the following Table I have collected the observations of Birmingham, Copeland, Dreyer, Webb, and my own:—

D. M.	Birm.	Copeland.	Dreyer.	Webb.	Espin I.	Espin II.	Pickering.
4·2	4·1	—	4·1	—	—	—	4·3
4·7	4·8	5·1	4·8	—	—	—	4·7
5·2	5·0	5·3	5·1	—	—	—	5·2
5·7	5·7	6·2	5·7	—	6·1	5·8	5·5
6·2	6·5	6·3	6·1	7·1	6·7	6·8	6·0
6·7	7·0	6·8	6·7	7·4	7·0	6·9	6·5
7·2	7·3	7·7	7·3	7·7	7·3	7·3	7·0
7·7	7·5	7·6	7·6	8·2	7·8	7·8	7·5
8·2	8·5	8·5	7·9	8·8	8·0	8·0	8·1
8·7	8·8	8·6	9·5	8·7	8·4	8·5	8·7
9·2	9·1	8·7	8·9	9·2	8·7	8·7	9·6
9·5	—	9·3	9·3	—	—	9·1	10·5
Total obs. used.	277	219	281	62	257	208	—

Columns 6 and 7 contain the magnitudes of my own new red and ruddy stars, and of the observed magnitudes of stars in the first edition of the Red Stars. Column 8 gives the scale of the D. M., as found in a preliminary investigation by Professor Pickering (*Annals of the Harvard College Observatory*, vol. xiii., part ii., page 356) for the fainter stars at + 1°, and for the brighter stars (*Annals of the Harvard College*, vol. xiv., part ii., page 362). The apertures of the telescopes used for the observations from which the Table is drawn are as follows:—

Birmingham, 4·5 in.; Copeland and Dreyer, 6·38 in.; Webb, 9·33 in.; Espin, 17·25 in. The first two instruments are refractors; the second two reflectors.

Figure 8. Mean magnitude estimates by various observers of some red stars, compared with Argelander's Durchmusterung standard (from the second edition of the Catalogue).

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No.	No. in Sch.	No. in Schm.	Star's Name.	Right Ascension 1890.	Annual Precession in R. A.	Declination 1890.	Annual Precession in Declination.	Magnitude.
				h. m. s.	s.	° ′ ″	″	
328	169	—	. . . .	14 18 47	+ 2·60	+ 24 16 0	0·28	8·0
329	170	—	. . . .	14 23 24	3·10	− 5 28 4	0·27	9·0†
330	171	75	ρ Bootis.	14 26 40	+ 3·60	+ 30 53 9	0·27	4·0
331	173a	—	B Camelopardalis.	14 26 41	− 3·31	+ 64 22 5	0·27	var.
332	—	76	A Canæ Minoris.	14 27 48	− 0·21*	+ 7·6 13 7	0·27	5·0
333	172	—	. . . .	14 28 10	+ 3·90	− 42 49 4	0·27	8·0†
334	173	—	. . . .	14 29 44	2·48	+ 37 9 2	0·27	6·2
335	175b	—	α Centauri.	14 31 29	4·03	− 60 29 4	0·26	1·0†
336	173c	—	B Bootis.	14 31 54	3·60	+ 27 15·6	0·26	var.
337	173d	77	34 Bootis.	14 36 9	3·64	+ 27 2·4	0·26	5·8
338	—	—	34 Hydræ.	14 39 4	3·47*	− 24 55·9	0·26	5·8†
339	—	78	ε Scutis.	14 39 44	2·62	− 27 34·9	0·26	2·8
340	—	79	π Libræ.	14 42 15	+ 3·82	− 27 27·8	0·25	5·0†
341	—	80	13 Ursæ Minoris.	14 57 1	− 0·54*	+ 74 28·7	0·24	2·1
342	—	—	. . . .	14 55 31	+ 0·91*	+ 66 24·8	0·24	4·8
343	—	81	20 Libræ.	14 57 3	3·50	− 24 48·5	0·24	5–6†
344	—	82	ε Libræ.	14 59 56	3·24	− 15 47·3	0·24	5·0
345	174	—	. . . .	15 2 50	3·61	− 6·8 37·6	0·24	5·0†
346	175	—	S Lupi.	15 10 32	3·63	− 33 42·4	0·23	4·7†
347	176	—	. . . .	15 12 54	3·66	− 25 20·7	0·23	7·0†
348	176a	—	S Libræ.	15 14 36	3·42	− 10 57·2	0·22	var.
349	177	—	S Serpentis.	15 16 2	2·81	+ 14 44·8	0·22	var.
350	177a	83	S Coronæ.	15 16 30	+ 2·41	+ 31 48·0	0·22	var.
351	—	84	11 Ursæ Minoris.	15 17 15	− 0·66*	+ 72 15·6	0·22	5·5
352	—	85	ε Draconis.	15 22 26	+ 1·33	+ 69 23·5	0·21	3·9
353	—	86	γ Libræ.	15 28 49	3·24	− 14 32·2	0·21	4–5
354	—	—	α Coronæ.	15 29 37	2·53	+ 27 7·5	0·20	10·0†
355	—	87	29 Libræ.	15 29 45	3·63	− 27 44·1	0·20	4–5†
356	178	—	. . . .	15 30 34	4·2·77	+ 18 30·0	0·20	6·7
357	—	88	β Ursæ Minoris.	15 32 0	− 1·93	+ 77 44·9	0·20	3·0
358	—	89	ε Serpentis.	15 43 20	− 2·70	+ 14 30·8	− 0·19	4·0

Figure 9. A pages from the red star listings in John Birmingham's Catalogue

An example of a page of star listings from the Catalogue is shown in Figure 9. The listing com-

prises nine columns plus a column for 'observations':
The number of the star assigned by John Birmingham.
The number assigned by Hans Schjellerup in his second catalogue, published in *Vierteljahrsschrift der Astronomischen Gesellschaft* (1874).
The number assigned by Julius Schmidt in his listing published in *Astronomische Nachrichten*, No. 1902.
The name of the star.
The star's right ascension adjusted to 1880.
The annual precession in right ascension.
The star's declination adjusted to 1880.
The annual precession in declination.
The magnitude of the star.
Notes on observations by other observers.

B. Stellar spectra

The second part of the Catalogue was entitled 'Spectroscopic observations of stars in the Catalogue'. Here John summarised all published spectral observations to date on the stars listed in his Catalogue, adding simple spectral diagrams when available. Espin, in the second edition of the Catalogue, considered the spectroscopic listing to be the most important part of the whole work. All sources of information were meticulously listed, including the observations by Schjellerup, Schmidt, Secchi, D'Arrest, Vogel, Webb, Ball, Burton, Struve and Herschel.

John adopted the fourfold classification of stellar spectra then newly devised by Angelo Secchi, itself based on a scheme developed by the American astronomer Lewis Rutherfurd:

Type I. Continuous spectra without prominent lines, characteristic of blue and white stars such as Sirius and Vega (α Lyrae).

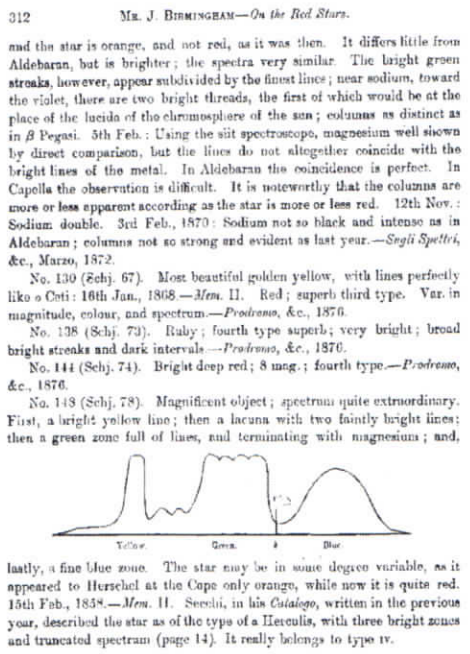
Type II. Fine-line spectra, characteristic of pale yellow stars such as the Sun, Arcturus and Pollux.

Type III. So-called 'columnar' spectra, characteristic of deep yellow or red stars such as Betelgeuse, α Scorpii, α Herculis, β Pegasi and ρ Persei. These spectra consisted of six or seven bright, broad zones separated by black absorption lines, and with nebulous intervals. The continuous spectrum brightened towards the red.

Type IV. The spectra of some red stars had three principal zones widely separated: a very bright one in the green, a faint one in the blue and 'a pretty bright one' in the red subdivided into smaller zones. Carbon and metal lines were prominent. The continuous spectrum brightened towards the violet.

John addressed some disagreement among astronomers on the viability of Secchi's classification, which indeed Secchi himself was subjecting to ongoing revision. One such revision was probably made in response to John's letter of 13 February 1877 to Secchi, in which he queried the assignment of Wolf–Rayet stars to Type IV. John further noted, in the Catalogue, that whereas Vogel disputed the distinction between Secchi's Type III and IV spectra, D'Arrest had adopted Secchi's scheme but with reservations, since Type III spectra were also obtained from many white stars (John quotes D'Arrest at length in the original German). Where citing D'Arrest's denial of Secchi's claim that differing parts of the sky were dominated by particular spectral types, John mentioned in passing his own 'Red Region'.

The discussion on stellar spectra concluded as follows:



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and the star is orange, and not red, as it was then. It differs little from Aldebaran, but is brighter; the spectra very similar. The bright green streaks, however, appear subdivided by the finest lines; near sodium, toward the violet, there are two bright threads, the first of which would be at the place of the lucida of the chromosphere of the sun; columns as distinct as in β Pegasi. 5th Feb.: Using the slit spectroscope, magnesium well shown by direct comparison, but the lines do not altogether coincide with the bright lines of the metal. In Aldebaran the coincidence is perfect. In Capella the observation is difficult. It is noteworthy that the columns are more or less apparent according as the star is more or less red. 12th Nov.: Sodium double. 3rd Feb., 1870: Sodium not so black and intense as in Aldebaran; columns not so strong and evident as last year.—*Secchi Spettri*, &c., Marzo, 1872.

No. 130 (Schj. 67). Most beautiful golden yellow, with lines perfectly like α Ceti: 16th Jan., 1868.—*Mem.* II. Red; superb third type. Var. in magnitude, colour, and spectrum.—*Prodromo*, &c., 1870.

No. 138 (Schj. 73). Ruby; fourth type superb; very bright; broad bright streaks and dark intervals.—*Prodromo*, &c., 1870.

No. 144 (Schj. 74). Bright deep red; 8 mag.; fourth type.—*Prodromo*, &c., 1870.

No. 148 (Schj. 78). Magnificent object; spectrum quite extraordinary. First, a bright yellow line; then a lacuna with two faintly bright lines; then a green zone full of lines, and terminating with magnesium; and, lastly, a fine blue zone. The star may be in some degree variable, as it appeared to Herschel at the Cape only orange, while now it is quite red. 15th Feb., 1858.—*Mem.* II. Secchi, in his *Catalogo*, written in the previous year, described the star as of the type of a Herculis, with three bright zones and truncated spectrum (page 14). It really belongs to type IV.

Figure 10. A page from the spectrographic listings in John Birmingham's Catalogue. John notes, under no. 164, R Geminorum, that the spectrum for this star is analogous to that of T Coronae Borealis.

> Exactness of observation, difficult in all astronomical work, seems specially so in spectroscopic researches; and to the ordinary errors of mechanical, physiological, and psychical origin must be added the uncertainties arising from the physical state, depending chiefly on temperature, of the object examined. The attempt to find out the compositions of the stars by means of their spectroscopic features involves, indeed, a labour more difficult, and as a result less reliable than, perhaps, is generally conceived. Their atmospheres are complicated; and we see that in our

> own atmosphere there are substances, powerfully absorptive of the Sun's light, which we are not as yet able to identify. What an instrument can do in modifying a spectrum may be understood from Secchi's account of his observations of 132 Schj., which showed a well-marked fourth [spectral] type with a cylindrical lens, and a third type with a spherical; and that different spectra are really given by the same element under different circumstances of pressure and temperature is a fact now well known ...

The spectral observations in John Birmingham's Catalogue were presented in four parts:

1. Secchi's series of observations published in 1867, 1868, 1872 and 1876, based on Schjellerup's catalogue of red stars.
2. Secchi's observations published in 1867, based on Schmidt's list of red stars.
3. D'Arrest's observations, based on Schjellerup's catalogue.
4. Vogel's observations, based on both Schjellerup and Schmidt.

Award of the Cunningham Gold Medal

John Birmingham's Catalogue was to win him the Cunningham Gold Medal of the Royal Irish Academy, awarded in the last year of his life.[30] Poet Sir Samuel Ferguson (highly esteemed by the young William Butler Yeats) was President of the Academy at that time. In the presentation ceremony, held in the Academy's rooms at Dawson Street in Dublin on 14 January 1884, Samuel Ferguson's words suggest a meeting of poetic minds. 'The President, calling on Mr. John Birmingham, addressed him as follows:'[31]

> You, Mr. Birmingham, from your Vald, Arno in the West, where the feudal lords of Athenry and Tuam used formerly to prosecute pursuits of so different a nature, took your place as one of our leading Irish representatives in this walk of Science. You had already, on the outburst of T. Coronae in 1866, been the first to observe that notable addition to the class then attracting so general an attention. It was at this time, when your name was rising into distinction in the observatories of the world, that your Danish precursor, Schjellerup, published his list of the Red Stars observed up to that time. It for about ten years was the authoritative source for past observations, but the growth of newly-recorded phenomena, to which your own discoveries began materially to contribute, ultimately called for a revised and supplemented catalogue; and in furnishing [your Catalogue] to our Transactions, in 1876, you established your claim to this, the highest scientific distinction the Academy can bestow.
>
> In this catalogue, which you are now revising and supplementing down to the present time, you include every coloured star, with its place of indication, and a digest by date of every observation hitherto recorded of it by yourself and others. To this you have added a similar spectroscopic digest equally minute, comprehensive, and authentic. No one could now think of essaying any generalisation on the subject without resorting to these lists as a necessary companion of his steps and foundation for his inference.

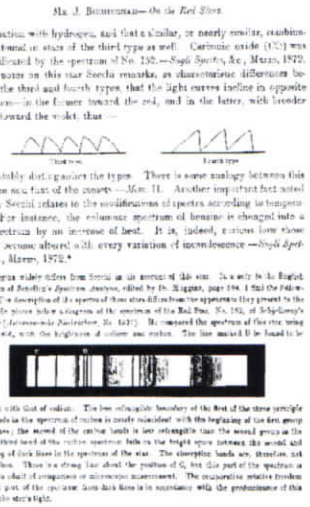

Figure 11. A page from the Catalogue showing line-upon-continuum spectra.

The President concluded:

> If I might express an individual opinion, I would say that ... you content yourself with noting facts; and shunning plausible but doubtful methods of accounting for them. It is thus [that] solid knowledge is ultimately attained to. Of you, let it be said, *itur ad astra*. Proceed, with the best wishes of the Academy, in your philosophic method; and bear back with you to the Bermingham country this medal, as a token and assurance to our brethren beyond the Shannon that wherever Irishmen devote their leisure to higher learning, there exists for them here, in the capital of their own part of the United Kingdom, a body having perpetual succession, and speaking with the voice of the constituted authority, whose business it is to sympathise with them, to encourage and to reward.

Professor Samuel Haughton of Trinity College Dublin, in seconding the President's speech,

> said he had known Mr Bermingham's labours for several years, conducted under circumstances that few persons not gifted like himself ... could have persevered in (hear hear). In a remote county of their country he had in his patient, consistent way, which they now had the

> great privilege to honour that night by the gold medal, done a lasting service of extreme importance, which he himself no doubt undervalued. He hoped that the Society's Cunningham Medal would always be conferred upon men as worthy of their distribution as the recipient of the Medal this night (applause).

'...which he himself no doubt undervalued' – those words spoke volumes.

The second edition of *The Red Stars*

Following the submission of his Catalogue to the Royal Irish Academy in 1876, and its acceptance by the Academy for its *Transactions*, John's continuing intense interest in the red stars and their spectra is attested to in two substantial addenda added in the press. One was a list of red stars supplied by Carl Frederik Fearnley of Christiana (Oslo), the other was taken from Struve's and Herschel's catalogues of double stars.[32] Observations and discussion were also added on the peculiar spectra of the newly discovered Wolf–Rayet (class W, extremely hot) stars, and on the 1876 nova in Cygnus discovered by Schmidt, the spectrum of which revealed the lines of Lockyer's newly identified element, helium. John, in his introduction to these addenda, proposed a clear distinction between regular or near-regular variables, and nova outbursts which he considered to be of a catastrophic character. He now mooted a test for his hypothesis that red stars might owe their colour to an encircling atmosphere: by selecting an eclipsing binary composed of a red–white pair, the spectrum of the white star could be scrutinised at the moment of its occultation, when transmitting white light through the atmosphere of the red star.

John worked assiduously to the end on the updating of his Catalogue. During the last year of his life he was corresponding with the Royal Irish Academy to seek publication of a new edition enlarged with a further and substantial addendum. The Rev. Maxwell Close replied on behalf of the Academy that this format was not acceptable. Instead it would consider a single, enlarged list arranged by right ascension and declination, but in which all the previously listed red stars would merely feature as a note referring the reader back to the first publication for information. Cost reduction was evidently of the essence. John, now under severe pressure from social duties (he had additionally taken on the appointment of Local Inspector for the Commission of Public Works), appears never to have replied to that suggestion.

Posthumously, John Birmingham's unpublished manuscripts and observations reached Rev. Thomas Espin in Yorkshire:[33]

> Mr. Birmingham, on his deathbed, wrote to the Rev. T. W. Webb, requesting him to undertake the new Edition of the *Red Stars*. Mr. Webb being unable to spare the time, placed it in the hands of Dr. Copeland. At the end of April, 1886, Dr. Copeland finding that it would be impossible for him to do it, wrote to me requesting me to undertake it. This I did the more willingly that the Rev. T. W. Webb had expressed a wish that I should assist in the New Edition. [Webb had died six months after Birmingham.]

Espin, after two further years of concentrated labour, produced a superb second edition of the Catalogue that was again published by the Royal Irish Academy. John Birmingham's achievement is heightened in a simple comparison made by Espin: 'The apertures of the telescopes used for the observations from which the Table [of star magnitudes] is drawn are as follows: Birmingham, 4.5 in. [115 mm]; Copeland and Dreyer, 6.38 in. [162 mm]; Webb, 9.33 in. [237 mm]; Espin, 17.25 in. [440 mm]. The first two instruments are refractors; the second two reflectors.'

But John had now passed on to 'a better and brighter world'. Days before his death, which came in the small hours of Sunday 7 September 1884, he had let his hand fall on the unfinished manuscripts beside his bed. In brotherhood with Thomas Aquinas he breathed, 'that is all straw'.[34] Might we hazard that, for all his marvellous devotion to astronomy, John had had an intimation of something even more wonderful and beckoning than the universe of stars?

A 'wide-knowledged man'

Richard J. Kelly, editor of the *Tuam Herald*, devoted a lengthy obituary to John Birmingham. After surveying the Millbrook landlord's astronomy as best he could, he wrote:[35]

> Mr. Birmingham was a deeply read and accurate mathematician, a profound geologist, a most eminent naturalist, and a clever amateur at practical engineering. As a German and French scholar he had no equal in this locality, and his general acquaintance with continental literature was very extensive. Even our old tongue and its quaint antiquarian beauties did not appear too obscure for his varied and brilliant intellect, for he studied Celtic literature with very deep research.
>
> His knowledge of music was most comprehensive and exact, enabling him to appreciate the Art more keenly than an untrained ear can pretend to. His character was as was said of Sir Isaac Newton, 'that which combines to distinguish the scholar, the philosopher and the patriot, his modesty was as great as his genius'. As a friend he was genial, good humoured, and open hearted, hospitable and highly gifted – a

delightful 'raconteur', an accurate historian, a much-travelled and wide-knowledged man, a devout Catholic and a true gentleman.

To live among the people where he was bred and born was his desire, and that local lure kept him unhappily from going where he would easily have won material honours. In physical as in intellectual development he was a Titan... [H]is giant muscular strength was unexampled and unequalled. His pedestrian feats were wondrously great and, in throwing a sledge or a weight, no man ever beat him, while in jumping he outdistanced any competitor. Such a fine specimen of humanity so well dowered by Nature with every gift and grace was child-like in self-suppression and humility, unduly sensitive to every passing difference and disagreement. He was a good neighbour, alive to every local want which he ever strove by pen and purse to redress and alleviate. Such was the honoured dead.

Acknowledgements

The incipient birth of just repute for John Birmingham's life and work would never have occurred without the enthusiastic and generous assistance of the late Dr Evelyn Tully of Galway, and the late Mr Christie Molloy of Milltown. I thank Dr Maire Brück and Mr Michael Viney for helpful and insightful suggestions.

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