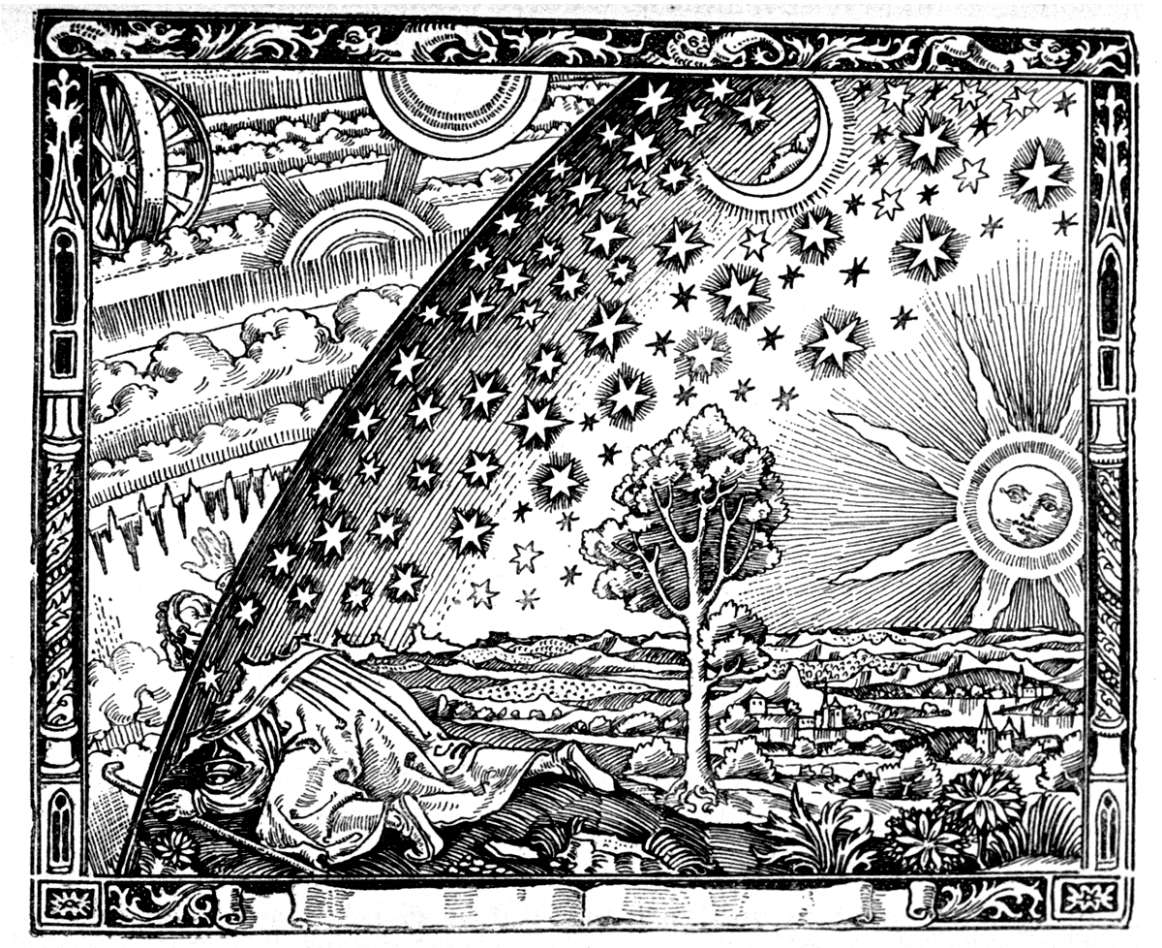
The Antiquarian Astronomer



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It would help the editorial team if you could send a summary of your proposed paper to the editor indicating the title, subject, and expected length. We are looking not just for papers presenting the final results of extensive research, but also for reports of work in progress. We would be interested to see any interesting photographs or illustrations not previously published – please send with either supporting research or just a brief description. If you have no experience of writing a paper, do not despair. The editorial team and council are here to help you. Proposals and papers/articles should be sent preferably by email to the Editor. For Issue 2 please send to Reg Withey, theaa@shastro.org.uk or by post to Dr W. R. Withey, 16 Lennox Close, Gosport, PO12 2UJ.

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Front cover: A woodcut of uncertain provenance, which seems to first appear in black and white in Camille Flammarion, *L'Atmosphere: Météorologie Populaire* (Paris, 1888), p. 163. Image courtesy History of Science Collections, University of Oklahoma Libraries.

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Foreword

The Society for the History of Astronomy was founded in June 2002. Since then we have held several successful meetings and commenced a regional survey of astronomical history in the U.K. We have established a library to which stock is constantly being added, and which offers both lending and reference facilities. We have established collaborations with other bodies, and in particular we have a close association with the Birmingham & Midland Institute, thanks to whose generosity we now have a base for our reference library in their premises. This will be opened in 2005 as the Sir Robert Ball Library. A former President of the B.M.I. as well as an eminent astronomer, Sir Robert Ball (1840−1913) was also arguably the leading populariser of astronomy of his day.

It has always been our intention to establish a journal to provide a medium for the publication of research into astronomical history, reviews of relevant books, etc. We encountered some initial difficulties which have delayed its appearance, but it is now my proud duty to introduce the first issue of The Antiquarian Astronomer. I am sure it will reflect credit upon our Society, and I would like to express our thanks to Callum Potter and his team for their efforts in bringing it into being. I hope it will soon become an established medium for researchers in the field, and I wish it a long and prosperous future.

Gilbert E. Satterthwaite,
Chairman, Society for the History of Astronomy

Preface

I am very pleased to be able to present to you the first issue of The Antiquarian Astronomer. The papers included in this issue range geographically, from England and Ireland, to Africa and India, and historically from the sixth century to the twentieth. A great deal of work has gone into the preparation and publication of this journal, not least by the authors that have contributed papers, and I hope that you will enjoy reading it from cover to cover.

In the future that publication will become an annual cycle, but to achieve this we do need a good selection of papers to include. All papers follow a peer-review process in an effort to ensure historical accuracy, relevance, and good English. Thanks goes to the Review Panel for their diligent attention in reading and commenting on the papers. However, this process should not be seen as a barrier, more of a means to ensure the quality of the publication. The editorial team and officers of the Society are here to help you, so please make use of them.

I would particularly like to thank John Woodruff who, as a professional writer and editor, has greatly contributed to the quality of The Antiquarian Astronomer. I would also like to thank Jerry Grover who started as Papers Secretary many months ago, but had to relinquish this role due to ill health. Jerry certainly made valuable contributions to our thinking as the journal started to become a reality. I would also like to thank Kevin Johnson who has volunteered to become paper secretary for future editions.

I am stepping down as Editor at this point and Reg Withey has volunteered to take over the Editorship of the journal for Issue 2. I hope you will give Reg your full support as he takes the journal forwards.

So, please enjoy reading this, the first issue of the Antiquarian Astronomer. If in reading any of the papers this raises questions in your mind, why not air them through a letter to the Newsletter? Or if you would like to contact an author directly, please do so through the Editor. But most of all, if this publication fires a spark and inspires you to write a paper it will have achieved one of its goals for future success.

Callum Potter
Editor, The Antiquarian Astronomer
Society for the History of Astronomy

Agnes Mary Clerke: Ever-popular historian of astronomy

Mary T. Brück
Formerly Senior Lecturer in Astronomy, University of Edinburgh

In her day, Agnes Mary Clerke (1842–1907) was the English-speaking world's most highly regarded writer on the rapidly developing science of astrophysics. This account outlines how, without any formal education but with a deep interest in learning, this remarkable woman rose to the admired position she still holds as a leading historian of astronomy and astrophysics.

In the latter part of the nineteenth century there was no dearth of popularising writers on astronomy with good credentials. Sir Robert Ball, an immensely successful author and lecturer, was a professional scientist, a professor of astronomy first in Dublin and then in Cambridge. Edward Walter Maunder was also a professional astronomer, head of the Solar Department at the Royal Observatory, Greenwich, for the whole of his long career. John Ellard Gore became a serious observational astronomer in his native Ireland after serving as an engineer in India, and wrote extensively on cosmological topics. Agnes Clerke, though she lacked a university education (indeed, she had no formal schooling whatsoever), and though not a practical astronomer, was the most permanently influential of them all.

Clerke's career in the astronomical world spanned exactly thirty years, from 1877 to her death in 1907. She was first and foremost a learned historian; her *Popular History of Astronomy During the Nineteenth Century* remains an indispensable treasure-house of accurate and fascinating information on the origin and rise of astrophysics. She was also a reporter and commentator on contemporary research. Her active years coincided with an exciting period in the progress of astronomy which saw the foundation of the great American and European observatories and the transformation of astronomy from a hobby of leisured amateurs into a recognized area of professional scientific inquiry. Following the publication of her history in 1885, Agnes Clerke took upon herself the task of keeping track of developments. With her aptitude for languages, she could read foreign journals as soon as they appeared and report on them immediately in publications such as *Nature* and *The Observatory*. Her role was what one would call today a 'science correspondent' – someone with specialist knowledge and the ability to communicate it. As a profession, this was wholly new. 'The progress of science and the growth of its literature has been so enormous', wrote Lady Huggins, Clerke's obituarist, 'that a new order of worker is imperatively called for ... whose mission is to collect, collate, correlate and digest the mass of observations and papers – to chronicle, in short, on one hand; and on the other, to discuss and suggest and to expound.'[1] That Clerke succeeded so brilliantly in this role was down to unusually high intellectual gifts, combined with the utmost dedication, enthusiasm and hard work.

For such a successful achiever, Agnes Clerke's private life was simple and undramatic. She was born in 1842, and brought up until the age of nineteen in the little town of Skibbereen, 50 miles from the city of Cork. Her scholarly father, John Clerke, was the local bank manager; a classics graduate, he had also studied mathematics and astronomy and pursued his interest in the sciences throughout his life. He owned a transit telescope which he used to provide a local time service and to show the planets to his children. His wife, Catherine, was an intellectual woman with a talent for music. Agnes and her sister, Ellen, were educated entirely at home by their parents and reached an academic standard exceptional for women of that generation. Astronomy and music were Agnes' favourite subjects. Her father gave her a good grounding in classical astronomy; her only brother, a prizewinner in mathematics and physics at Dublin University, enlightened her when she needed help with more advanced topics.

The Clerke sisters completed their education in Italy, living mainly in Florence. They took their studies seriously. Agnes concentrated on the science of the Renaissance, while Ellen chose literature; but both became erudite in many fields and were fluent in several languages – as is revealed, in Agnes' case, in her frequent reviews of foreign publications. In 1877 the Clerke family were reunited in London, where Agnes, now aged thirty-five, embarked upon her prolific literary career. None of the three Clerke children ever married. They lived together in perfect harmony in their home in Redcliffe Square, Brompton, until death separated them one by one: the brother, a lawyer, was the last of the family, dying in 1923.

Agnes was fortunate in having her first articles accepted by a prestigious London periodical, the *Edinburgh Review*. She continued to write two major essays a year for the *Review*, mainly on scientific subjects, for the rest of her life. Her

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Mary Agnes Clerke
Image Courtesy Royal Observatory Edinburgh

speciality at first was purely historical astronomy, and included her famous biographical essays on Galileo, Laplace, Lagrange and other mathematicians for *Encyclopaedia Britannica*. Her first writings on modern astronomy appeared in 1880, in a review of some works on stellar spectroscopy, entitled 'The chemistry of the stars'. To her, this had been an unfamiliar branch of astronomy. The technique of spectroscopy, by which the chemical composition of the Sun and stars could be deciphered from their spectra, was first developed in 1859 (Agnes' father would not have known about it, and it would not yet have found its way into her brother's undergraduate curriculum). It opened up to astronomers new, undreamt-of realms of knowledge. Agnes became fascinated, and resolutely applied herself to study it in depth:[2]

> That the science of stellar chemistry should not only have become possible, but should already have made material advances, is surely one of the most amazing features in the swift progress of knowledge our age has witnessed. Custom can never blunt the wonder with which we must regard the achievement of compelling rays emanating from a source devoid of sensible magnitude through immeasurable distance, to reveal, by its distinctive qualities, the composition of that source.

So she wrote in *A Popular History of Astronomy During the Nineteenth Century*, first published in 1885 when she was forty-three.

In order to place her subject properly in context, Clerke took as her starting point the researches by William Herschel into the structure of the Milky Way and the nature of the nebulae, and worked through the discoveries of spectroscopy to the time of her writing. The book, which was four or five years in the making, was an instant success, acclaimed for its accuracy, its thoroughness and its elegant style. The description 'popular' denoted a non-mathematical treatment – which indeed it was, since the so-called new astronomy was then entirely observational. It made the book accessible to the intelligent general reader, while not for a moment diluting the contents.

This unknown author took the astronomical community by surprise. The earlier essay on 'The chemistry of the stars' in the *Edinburgh Review* had been anonymous. One sharp-eyed reader, however, guessed that the two works had come from the pen of the same 'dark horse', and hastened to make her acquaintance. That reader was Margaret Huggins, astronomer-wife of the revered elderly astrophysicist William Huggins. Huggins, doyen of Britain's Grand Amateurs (to use Dr Allan Chapman's felicitous classification), had been one of the founders of stellar spectroscopy twenty years earlier. His Irish wife, twenty-five years his junior, was also his talented and hard-working collaborator. Their private observatory at Tulse Hill, South London, was splendidly equipped with instruments provided by the Royal Society. Margaret was some years younger than Agnes Clerke. The two women became lifelong 'companions in astronomy' and devoted friends. For her part, Agnes, an ardent admirer of William Huggins, enjoyed the benefit of his kindly encouragement for the rest of her life.

The Hugginses were not Clerke's only champions. She was taken under the wing of Norman Lockyer, the solar physicist and spectroscopist who was famous for his discovery of helium in the Sun in 1868, before it was found on Earth. Lockyer introduced her to his circle of brilliant amateur astronomer friends, including the photographic expert Isaac Roberts and the telescope-maker A.A. Common. Edward Holden, the first director of the newly founded mountain-top Lick Observatory in California, volunteered to keep her supplied with the latest news from the United States. Soon she was corresponding with the directors of Yale and Harvard, Paris and Potsdam. She acquired very special friends in David Gill, director of the Royal Observatory at the Cape, and his wife Isobel, whom she met on one of their visits to London. She spent three months with them in South Africa, where she gained useful experience in observational astronomy and received invaluable astronomical guidance. Within a few years she was the chief expositor of astronomy in the English language.

A Popular History of Astronomy During the Nineteenth Century was published in America and

also translated into German. It was never out of print in her lifetime; the fourth edition appeared in 1902.[3] Agnes Clerke wrote two other major books: *System of the Stars* (1890), which made the case for the one-system universe, the most favoured model at that time; and *Problems in Astrophysics* (1903), a survey of the current state of knowledge. Both are still of historical interest but are naturally out of date. Her less academic books include *The Herschels and Modern Astronomy* (1895), biographies of the members of that great family; and *Modern Cosmologies* (1905), a popular survey of theories of the universe past and present. She also contributed some 150 meticulously researched entries to the original *Dictionary of National Biography* as well as those in *Encyclopaedia Britannica*, which also carried her essays on the history of astronomy. These writings are still highly readable and instructive. In later life she extended her interest to the mysterious new physics of X-rays and radioactivity.

What was the secret of Agnes Clerke's literary success? There was first of all her scrupulous accuracy. She strove to give due credit to everyone who had contributed to the progress of astronomy, putting on record the work of many interesting people whose names might otherwise have been neglected. (There are several hundred names in the index of the last edition of her *Popular History*, and a chronological table listing some 600 events between 1774 and 1901.) She gave the historical background to each topic she discussed, spiced very often with a sketch of the life of the observer or the discoverer. She had the gift of explaining difficult ideas without childish simplification; her writing, in the words of one admirer, was 'a model of style, elegant without affectation, fastidious without sacrifice of meaning, inevitably right in its choice of words'.[4] Above all, her love for astronomy shone through. An American reviewer said truly of one of her books that 'it reads like a romance'.[5]

Agnes Clerke's work appealed particularly to amateur astronomers. Many discoveries and innovations in the past were the work of amateurs whose activities, often pursued with modest instruments, injected a breath of fresh air into the dull world of positional astronomy. 'Orthodox astronomers of the old school', wrote Agnes Clerke,[6]

> looked with a certain contempt upon observers who spent their nights scrutinising the faces of the Moon and planets rather than timing their transits; or devoted their daylight energies, not to reduction and computations, but to counting and measuring spots on the Sun. They were regarded as irregular practitioners, to be tolerated, perhaps, but certainly not encouraged.

Women in Agnes Clerke's day were still on the fringes of science. They were not admitted to Fellowship of the Royal Astronomical Society, but from 1892 she and other like-minded women were permitted to attend its meetings. Eventually, Agnes Clerke and Lady Margaret Huggins were – belatedly, in middle age – made honorary members. Such meagre concessions seem small-minded today, but Agnes Clerke was never an agitator for women's rights; she was happy while she was learning and disseminating knowledge. She assiduously attended lectures at the Royal Institution, to which she was elected towards the end of her life, and was a founder member and supporter of the British Astronomical Association. Apart from music (she played the piano beautifully), her quiet life revolved entirely around astronomy.

Agnes Clerke died unexpectedly, of pneumonia, aged sixty-five, at her London home on 20 January 1907. She is buried in the family plot in Brompton Cemetery.

Notes and references

More about Agnes Clerke may be found in her biography: Mary Brück, *Agnes Mary Clerke and the Rise of Astrophysics* (Cambridge University Press, 2002).

1. *Agnes Mary Clerke and Ellen Mary Clerke: An Appreciation* (London, 1907, privately printed).
2. London: Adam and Charles Black, 3rd edn (1893), p. 450; 4th edn (1902), p. 273.
3. The second and third editions appeared in 1887 and 1893. A facsimile edition of the fourth edition has been published in the USA by Sattre Press (http://sattre-press.com).
4. 'E.S.G.', *Knowledge and Scientific News*, **4**, 31–2 (1907).
5. *Astronomy and Astrophysics*, **14**, 846 (1893).
6. *A Popular History of Astronomy* (all edns), Introduction, p. 2.

Edward J. Lowe and the Nottingham observatories

Madeline Cox

Edward Lowe and his father owned no fewer than three observatories. In 1851 Lowe became secretary of the Lawson Committee, set up to fund a public observatory in Nottingham. This paper gives a brief account of his astronomical work at both local and national level.

Edward Joseph Lowe was born on 11 November 1825 at Highfield House, Lenton, two and a half miles south-west of Nottingham. He came from a wealthy landowning family, and his father, Alfred Lowe, was a member of many national and local learned societies. Alfred was particularly interested in meteorology and astronomy, and Edward inherited these interests from him.

Both father and son were founder members of the Meteorological (later Royal Meteorological) Society, and Edward wrote several books on the subject. He wrote weather reports for the "Times" newspaper for many years and also telegraphed his daily observations to Greenwich. He was a member of many other institutions, including the Royal, Geological and Linnaean Societies. In later life he became an expert on shells and British ferns and won many medals for his collections. He was elected a member of the Royal Astronomical Society in January 1848, at the age of 23, and read several papers to the Society.

Figure 1. Edward J. Lowe

Sun, Moon and weather

Lowe's first paper, read to the Royal Astronomical Society in April 1849[1] and published in the Society's *Monthly Notices* (*MNRAS)* later that year, described how he and other observers had seen the umbra of a sunspot open in the centre and divide into two parts. In a footnote he described a 'simple and neat' contrivance for registering the spots – a reticule of small squares now known as a réseau. The observations are carefully recorded, and the attention to detail is typical of Lowe's work.

In the same volume of *MNRAS,*[2] Lowe gave a brief report on the phases of the Moon and the weather. He had studied his own and other weather records since 1840, and now concluded that there was no correlation between the lunar phases and the weather at all. The French astronomer François Arago and the meteorologist at Greenwich, James Glaisher, held the same view. Lowe had been taking part in an experiment for the Royal Agricultural Society to ascertain whether there was any astronomical basis for popular weather lore, and had written a book on the subject entitled *Prognostications of the Weather.* One interesting conclusion he reached in *Prognostications* was that 'experiment decisively shows that no difference can be observed in the qualities of vegetables planted at different times of the lunar month'.[3]

In a later work, *The Coming Drought,*[4] Lowe trawled through all known records of severe frosts and droughts and estimated that the weather followed a cycle with a period of about eleven years. In all probability the disturbing cause was magnetism, he said, possibly brought about by earthquakes and volcanic eruptions. Lowe seems to have identified the eleven-year periodicity of the solar cycle as manifested in its effect on the Earth's weather. Lowe identified an 11-year cycle in the weather, which he thought was due to magnetic disturbances, but did not connect it with the Sun.

The zodiacal light and meteors

The zodiacal light was one of Lowe's favourite subjects, and four of his papers were published in *MNRAS.* It may seem astonishing to us, in our light-polluted skies, that this phenomenon was once observed so often. Lowe seems to have seen it numerous occasions on clear spring evenings, and recorded his observations, again in great detail and with great clarity. In his earliest report, published in

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1850,[5] he noted that the zodiacal light exceeded the brightness of the Milky Way ('the brightest I have observed in seven years') and that variations in brightness led to small stars being alternately visible and invisible. Three years later he described how he observed the apex of the cone of light advancing and receding by about 5°.[6] It again displayed pulsations of brilliancy and was capable of dimming stars in its path. He had previously observed similar pulsations at 30-second intervals, and noted that the band of light seemed to widen when at its brightest.[7] Lowe concluded that 'changes in the brightness and the expansion and contraction of the cone are not produced by our atmospheric influence, as [they are] always apparent when the phenomenon is brilliant, whatever the hygrometrical state of the air'. The cone appeared to rotate, and he inferred that the light may be 'the edge of a ring surrounding the sun', though at an immense distance from it.[8]

Meteors were another interest of Lowe's. In 1846, when only twenty-one, he wrote what was considered to be an important book on the subject. *A Treatise on Atmospheric Phenomena*[9] made the distinction for the first time between meteorology and the study of meteorites. His later report of the Great Meteor Shower of 27 November 1872 is particularly interesting. This shower of Andromedids (or Bielids) was recorded by many other observers, and lasted for over five hours.

Lowe carefully traced the Andromedid radiant and observed that at least 20 meteors were detected motionless close to the radiant. Most of the meteor trails early in the shower were extremely short, especially those near the radiant. All had 'tails' and few left 'streaks'. They differed considerably from those of the 'ordinary November epoch'. In one 40-minute period an average of 43 meteors per minute were observed in one quarter of the sky. There was 'no doubt that a small proportion of meteors came from a second radiant', which was confirmed by a motionless meteor.[10] Lowe asked if these two points could be related to the twin nuclei of Biela's Comet, which had broken in two some years earlier (in fact they were). He estimated that a staggering 58,660 meteors fell between 5.50 and 10.30 p.m. Several times during the evening he heard noises resembling very distant gunshots (which must have been bolides), leaving him in no doubt that the phenomena were connected.

The Nottingham Observatory

Lowe was acquainted with many of the leading astronomers and telescope-makers of the day, including George Dollond. The two of them wrote a paper, published in the *Proceedings of the British Association for the Advancement of Science* in 1846, about the possibility of establishing a weather station that would register its findings on a continuous roll of paper, without the need for a human observer. This instrument sounds like the sort of chart recorder that was in widespread use in the twentieth century.

Lowe was keen to establish a public observatory in Nottingham, and after the Great Exhibition of 1851 had led to the funding of such projects around the country, he and Dollond discussed how they might set one up locally. Lowe contacted the Nottingham Corporation with his ideas, while his friend Henry Lawson FRAS, of Bath, offered to donate his collection of meteorological and astro-

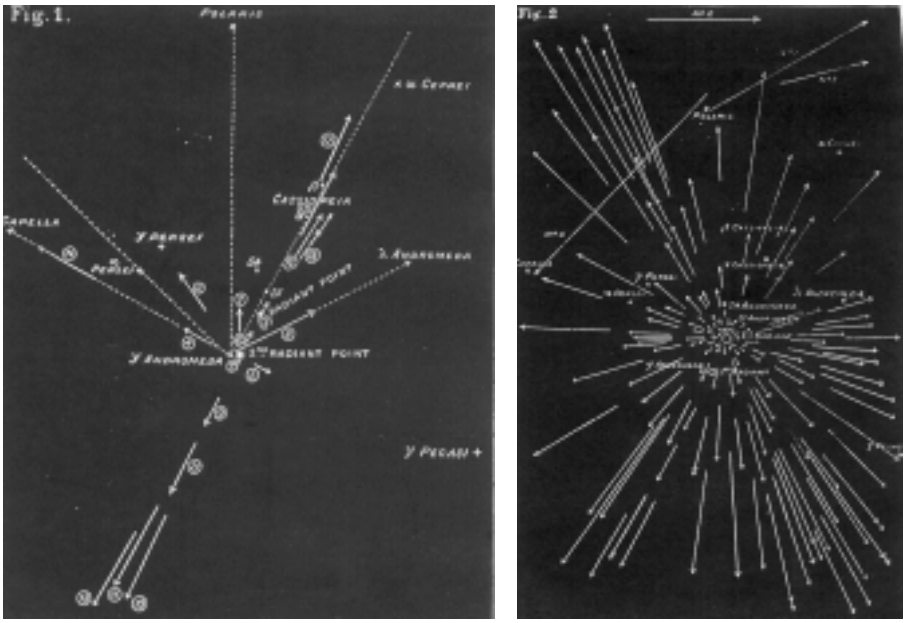

Figure 2. Plots by Lowe of the Great Meteor Shower of 27 November 1872. The left shows two possible radiants; the right shows, in addition to many Andromedids, the paths of four sporadics.

nomical instruments, plus a thousand guineas, on condition that sufficient public funds could be raised to house them and to pay an observer £200 per annum. The Corporation agreed, and the Lawson Observatory Committee was set up in December 1851, with Lowe as secretary and the Duke of Newcastle as chairman. A site was eventually chosen north of the city, at Coppice Farm in Mapperly, which the Council offered to sell for £100. The Government said it would donate £2,000 for the project, and the Trustees of the project advertised for subscribers, of whom 800 came forward in the next three years.

All seemed to be going well, and in 1854 a local directory[11] announced that the observatory would be ready to house the instruments in 1855. But this announcement was premature, and behind the scenes a tragedy was unfolding with unhappy consequences. The Government had withdrawn its funding, and the subscribers and local council were unable to raise enough cash, despite a pledge of more money from Henry Lawson.

So why did the Government change its mind, and refuse the £2,000 promised in 1851? First, it appears that the Treasury had offered the money for both meteorological and astronomical work, whereas the House of Commons motion said it was to be for meteorological observation only, without the need for an observer. They understood that Lawson's instruments were purely for astronomical pursuits and thus not suitable (which was incorrect – see below). Second, the Government maintained it had been misled about the value of the instruments, which it had had valued at £2,000, whereas the Lawson Committee had valued them at £10,000. So, like all governments the world over, it found an excuse to withhold the funding.[12]

How had this confusion arisen? John Herschel and the Astronomer Royal, George Biddell Airy, had been asked by the Government for their opinion and had concluded that another astronomical observatory was unnecessary. However, a meteorological one somewhere in the Midlands would be of great benefit to science. Herschel had been one of the original supporters of the project, and why he had then changed his mind is unclear. It would be illuminating to examine his correspondence with Lowe on this matter in the archives of the Royal Society. To its disadvantage, the Lawson Committee had not lobbied for parliamentary support – even though it had been warned before the House of Commons debate that the grant might be withheld. There was dismay in Nottingham that even its most famous astronomer son, John Russell Hind, had not been asked to come out in support of the project.

Herschel had been asked to value Lawson's instruments, but had delegated the task to William Rutter Dawes, who along with many other eminent astronomers, including James South, Lawson himself and George Dollond's nephew, said they were worth at most £2,000 (Lawson had purchased them from Dollond for this price). But Lowe himself had told the Government that George Dollond, who had made the instruments, had valued them at £10,000 – an enormous sum of money in 1854, equivalent to about £675,000 today. Right to the end, Lowe maintained this figure was correct, but he had never bothered to inform the subscribers that there was a disagreement with the Government.

How and why he came up with this figure is a mystery (George Dollond had recently died so couldn't be asked), although everyone who saw the instruments acknowledged that they were of superb quality. Did Lowe think that by putting a high value on them it would increase the project's prestige? We shall probably never know, but this was one factor that dealt a fatal blow to the project, which was abandoned in September 1854, the subscribers' money being returned to them. Nottingham never did get a public observatory, though there is a flourishing astronomical society there today who do have their own. Lowe and the Lawson Committee obviously handled the whole project badly, and the Government must also take its share of the blame. This affair seems to be the only blot in Lowe's otherwise illustrious public career.

The Lawson Observatory

After this fiasco, the dying Lawson persuaded Lowe to accept the instruments for himself, which he eventually did, and the Lawson Observatory was set up in 1855 at Lowe's house in Beeston, about half a mile south of Highfield. Broadgate House had been purpose-built a few years earlier as an observatory, with a rotating cupola roof. Despite extensive enquiries I have been unable to find a contemporary picture of the house. However, a complete description of it and the Lawson collection of instruments was provided by William Fyfe.[13]

Fyfe, a Nottingham writer who visited the observatory in 1855, called it 'one of the most complete meteorological observatories that ever existed'.[14] Its instruments included, among other things, an

Figure 3. Broadgate House as it appears today

earthquake pendulum, a gimbal vane, an ozonometer, an evaporator, an electrical kite, an automatic atmospheric recorder and 30 thermometers. There was also a dead-beat clock that had been made by a Dr Narne in London and had been the first transit clock erected at the Cambridge Observatory. Other astronomical instruments included a 'beautiful little pocket sextant'[15] and Lowe's 11-foot (3.4-m) focal length telescope with an object glass 4 inches (100 mm) in diameter. The eyepiece contained five fine cross-wires made of spiders' webs. There were also Lawson's 'exquisitely beautiful transit instrument'[16] and a sidereal clock, both housed in a purpose-built transit room. Lowe himself gave Fyfe a guided tour of his observatory in the summer of 1855, shortly after the Lawson instruments had been installed. The building still exists today (see Figure 3), though the dome has been removed from the roof.

The 'Beeston Lighthouse'

Edward's father, Alfred, had another observatory built at Beeston, an octagonal tower used mainly for weather recording but which also housed a telescope (see Figure 4). It was built on low-lying ground near the railway station, apparently in a very damp and foggy area. Like Broadgate House, this tower was also called the Beeston Observatory, which is confusing, and it was also nicknamed the 'Beeston Lighthouse', 'Pepperbox Hall' and the 'Beeston Fogworks' by locals.

Figure 4. The 'Beeston Lighthouse' shortly before demolition.

In 1864 a penny pamphlet appeared in Nottingham called 'Prospectus of a New Ass-tronomical Magazine, wherein to make known the wonderful discoveries of Pepper Box Hall'.[17] This lampoon, signed by 'The Thistle-eater', included the following verses:

Oh! Have you heard the news of late!
About my master wise and great!
Who built a tower on his estate!!
He built it with an octagonal wall
And gave it the name of Pepper Box Hall.

What is this tower at Beeston station,
Daily causing such botheration,
To many a traveller through the nation,
Who vainly ask for its explanation?
'Tis like an overgrown pepper-box,
The houses we build in lieu of the stocks:
Or the places where roost young turkey-cocks.
'Tis called the lighthouse to the Ryland locks.
But he who understands it must be able
To add a story to this tower of Babel.

There was a reference as well to 'the wonderful and extraordinary instruments which we have purchased'. Perhaps the author was confusing the tower with the observatory at Broadgate House. What Edward made of this lampoon is not known (his father had died in 1856), but the observatory was obviously a great topic of conversation in the district. The building was eventually abandoned to the elements and was demolished sometime in the 1960s.

Highfield House Observatory

The third observatory was that at Highfield House itself. The house had been built by Edward's grandfather Joseph Lowe in 1797, and the observatory on the roof was added by his father. Edward moved back here – the place of his birth – after the death of his mother in 1866, and eventually all the instruments from both the Beeston observatories came back also. The building now houses the University of Nottingham's Personnel Department.

Figure 5. Highfield House, depicted in 1890.

As well as 'the usual meteorological instruments' it had 'a large and beautiful telescope'[18] on the roof and an instrument for determining solar radiation. On the night of Fyfe's visit, Lowe Senior showed

him the rings of Saturn, star clouds in the Milky Way and the Orion Nebula. The zodiacal light was also partially visible. The house itself commanded a wonderful view over the Trent Valley, and even today it has a lovely vista on the south side.

In 1882 Edward Lowe and his family moved to Shirenewton Hall in Monmouthshire, where he died in 1900. It would be interesting to find out what eventually became of his collection of instruments. There is no evidence that any of Lowe's children were interested in astronomy.

Assessment of Lowe's astronomical career

So how would we sum up Lowe's astronomical career? During his life, he had a worldwide reputation as an astronomer and meteorologist,[19] and Fyfe described him as 'the best expositor of philosophical instruments whom we ever chanced to accompany'.[20] He was obviously an excellent observer and recorder, and a real enthusiast – one of the last of the wealthy amateurs who had the leisure and resources to follow their passions full-time. He contributed a great deal to the scientific and cultural life of Nottingham, and to astronomy in general in this country.

Acknowledgements

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William E. Wilson and his contemporaries

Ian Elliott
Pinecroft, Kilternan, Dublin 18 (formerly of Dunsink Observatory)

Although he never attended school or university, William E. Wilson FRS, of Daramona, County Westmeath, made pioneering contributions to solar physics, celestial photography and stellar photometry. His well-equipped observatory attracted collaborators who included George Francis FitzGerald of Trinity College Dublin and Arthur Rambaut of Dunsink Observatory.

William Edward Wilson was born on 19 July 1851 at Greenisland, just north of Belfast. He was the only son of John and Frances Wilson of Daramona House, Streete, County Westmeath. John Wilson and his three younger brothers, James, George and Robert, had each been given large estates in Leinster by their father, also named William, who had made his fortune in the shipping industry in Belfast, in particular by exporting pork to feed the British Army. All four brothers were educated at Trinity College Dublin, the two eldest becoming barristers.

On account of his delicate health, the young William was educated at home. His aptitude for mathematics was attributed to his mother, who belonged to the Nangle family of Belfast, who were said to possess 'considerable mathematical ability'. In 1870, when William was nineteen, he had the opportunity of joining a expedition to Algeria to observe a total solar eclipse. The expedition was led by William Huggins and included John Tyndall. Although the eclipse was clouded out, Wilson was inspired to take up astronomy, and the following year he took delivery of a 12-inch (300-mm) reflector from Grubb's of Dublin and installed it in the garden of Daramona House. His other equipment included a small transit instrument, made by himself, for timekeeping. Over the course of the next few years he experimented with wet-plate photography of the Moon and measured solar radiation with thermopiles.

In 1881 Wilson replaced his first telescope with a 24-inch (600-mm) Grubb Cassegrain reflector and dome erected on a new site adjoining the house, and he fitted out a physical laboratory, a darkroom and a workshop. Initially the original telescope mount was used for the 24-inch, but in 1892 he bought a new Grubb mount with an electrically controlled clock drive which led to a very fruitful period of observation and research. The precision drive allowed Wilson to make long exposures of celestial objects, and his photographs compared favourably with any taken elsewhere at that time.

From 1888 onwards Wilson measured the solar photospheric limb darkening with high accuracy, and he attempted to detect variations in the sunspot cycle. He collaborated with Arthur A. Rambaut, who was then director of Dunsink Observatory, and a joint paper entitled 'On the heat of the solar atmosphere' was published in the *Proceedings of the Royal Irish Academy* in 1892.

Figure 1. Photograph of William Wilson about 35 years old

In 1893 and 1894 Wilson investigated the centre-to-limb variation of sunspot umbrae. He showed that the umbrae of sunspots do not exhibit a limb darkening effect, thus contradicting similar observations by Samuel P. Langley made twenty years earlier.

In 1894 Wilson started a programme to estimate the temperature of the solar photosphere – the visible surface of the Sun seen in white light. He used a 15-inch (375-mm) Grubb heliostat on loan from the Royal Society and was assisted by P.L. Gray of Mason College in Birmingham. The sensitive detector was a differential radiomicrometer designed by C.V. Boys and made by Yeates & Son in Dublin. The detector was used as a null device to balance the heat from a small portion of the photosphere by the heat given off by an electrically heated platinum wire. The final value for the photospheric temperature of 6590°C compares well with modern estimates and was an important step forward in understanding the physical nature of the Sun and other stars.

Wilson photographed sunspots regularly with a 4-inch (100-mm) Grubb photoheliograph. In August 1898 he took a series of 400 photographs of a sunspot in almost four hours. This was probably the first application of cinematography to astronomy. Wilson sent his photographs and the cine camera to George Ellery Hale at Mount Wilson.

Another pioneering achievement at Daramona was the measurement of stellar brightness using photovoltaic detectors. The first measurements of the brightness of planets was carried out from a

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Figure 2. The Great Nebula in Orion taken 1897 Jan 23, 40min. exposure

Dublin back garden in 1892 by William H.S. Monck and Stephen M. Dixon using selenium cells prepared by George M. Minchin of Coopers Hill College in London. In 1895/96 Minchin brought some improved cells to Daramona and, with the help of Wilson and G.F. FitzGerald, measured the brightnesses of ten stars, the brightest being Betelgeuse. These were the first ever photoelectric measurements of stars.

In 1900 Wilson took part in the joint Royal Irish Academy/Royal Dublin Society eclipse expedition to Plasencia in Spain. Other members of the expedition included Arthur Rambaut, Charles Joly, Howard Grubb and Grubb's son Rudolph. The expedition was successful, and Wilson took some high-quality photographs of the corona through a specially made green filter.

One of Wilson's closest collaborators was George Francis FitzGerald, his junior by two weeks, who is probably best remembered for the effect that bears his name – the FitzGerald–Lorentz contraction in special relativity. FitzGerald visited Daramona regularly to carry out experiments in Wilson's laboratory, and there can be little doubt that Wilson benefited greatly from his advice and discussions. Some of their joint investigations included the effects of high pressures on an electric arc and on radioactive substances. FitzGerald's tragically early death in 1901 at the age of forty-nine must have been a sad blow.

Wilson collected his major papers and published them privately in 1900 as *Astronomical and Physical Researches made at Mr. Wilson's Observatory, Daramona, Westmeath*. His other astronomical activities included the observation of the transit of Venus in 1882, a search for a trans-Neptunian planet in 1901 and observations of Nova Persei in 1902. Wilson invented a 'radio-integrator' for recording sunshine which was adopted by the weather stations at Kew, Falmouth, Aberdeen and Valentia (Ireland). In 1903 he wrote a short letter to *Nature* suggesting that the source of the Sun's energy might be the disintegration of radium.

Wilson was a skilled observer in the laboratory as well as at the telescope. In 1896 he X-rayed a man's arm to assist in a diagnosis, and in 1898 he used X-rays to examine a portrait. He also experimented with wireless telegraphy. He was fortunate in having the means to obtain the best equipment available and in having access to good advice through a network of friends and acquaintances. He travelled regularly to scientific meetings in London and kept in close contact with Irish colleagues through the meetings of the Royal Dublin Society and the Royal Irish Academy.

One regular visitor to Daramona was Wilson's nephew, Kenneth E. Edgeworth, who was introduced to astronomy by his uncle. After a military career in the Royal Engineers, Edgeworth turned his attention to the origin of the solar system. In 1943 he suggested the existence of a reservoir of cometary material beyond the orbit of Neptune. This was seven years before Jan Oort made a similar suggestion, and eight years before Gerald Kuiper presented his ideas on this topic. The reservoir of cometary material is now known as the Edgeworth–Kuiper Belt.

Wilson died in March 1908 at the age of fifty-six and was survived by his widow, one son and two daughters. In 1922 the family moved to England, and in 1925 his 24-inch telescope was offered to the University of London. The Mill Hill Observatory of UCL was officially opened in 1929, and the Wilson telescope served the needs of research and tuition there until 1974, when it was presented to Merseyside County Museum in Liverpool (see http://www.liverpoolmuseums.org.uk).

Despite his lack of formal qualifications, Wilson was elected a Fellow of the Royal Society in 1896, having been a Member of the Royal Irish Academy since 1888. He was awarded an honorary D.Sc. by the University of Dublin in 1901.

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A Brief History of Manchester Astronomical Society

Kevin J. Kilburn

Manchester Astronomical Society celebrated its centenary in September 2003. But that centenary was of a hundred years as the MAS; the history of the society goes back much further, and can be traced directly to that great era of public awareness of astronomy and amateur interest in Victorian England in the last half of the nineteenth century. Allan Chapman has discussed this period in detail,[1] so the present paper concentrates on the MAS's particular influence on Manchester astronomers and recent work on the history of the society.[2]

Astronomy in the north-west of England goes back to the early to mid-seventeenth century. Jeremiah Horrox, William Crabtree and William Gascoigne, all known to one another, were working at the time of the English Civil War. Had their lives not been so tragically curtailed by their early deaths, they would surely have earned for themselves, especially Horrox, international recognition equal to that now enjoyed by their continental forebears in the understanding of planetary motion, Johannes Kepler and Tycho Brahe. Horrox's knowledge of Kepler's work was so thorough that he was able to show that it contained errors, which he was able to correct, and so predict a transit of Venus across the face of the Sun observed by himself and Crabtree in November 1639 (Old Style). In Gascoigne, Horrox and Crabtree we have, respectively, astronomers who hailed from geographical parts of the north-west that two centuries later were to spawn three big Victorian astronomical societies: Leeds, Liverpool and Manchester. Leeds AS was formed in 1859, Liverpool AS in 1881; Manchester AS traces its roots directly back to those of Liverpool and the British Astronomical Association.

An astronomical society for Liverpool

Liverpool Astronomical Society was formed in 1881 but missed by about two decades the heyday of the so-called Grand Amateur,[3] when the likes of the Liverpool brewer William Lassell and the Manchester engineer James Nasmyth were building what were then giant telescopes in pursuance of their hobby. They had both moved on from what Chapman has called the 'battleship-rigged' reflectors of Herschel's day and were using the new technology of the Victorian ironmaster to construct their telescopes. Their telescope mountings, in particular, were innovative. Lassell had the first really big equatorially mounted reflectors, while Nasmyth designed and constructed the prototypical Nasmyth mounting, used by most twenty-first-century computer-controlled instruments. But neither Lassell nor Nasmyth had a local society at which to meet, although Nasmyth was a member of the Literary and Philosophical Society of Manchester.[4] Of course there was the Royal Astronomical Society, of which they were both members, in which like-minded astronomers could share their interests, but in many respects the RAS was 'not for the likes of us'. The RAS was an expensive and rather exclusive London Club to which the majority of those interested in astronomy were excluded by the sheer costs of membership and travel to London for midweek meetings. By contrast, the Liverpool AS, like Leeds twenty years before, was aimed at those who had some time for the hobby but not necessarily the means to finance what we would now call cutting-edge research. Having said that, membership was still a very middle-class affair, with self-employed businessmen, clergymen, lawyers and stockbrokers figuring prominently. Mr R.C. Johnson was the first president of Liverpool AS from 1882 to 1884.

Liverpool AS's main asset was the way in which it was structured into sections of specialised interests. There was a solar section, a lunar section, one devoted to double stars and one concerning the colour of stars. Its section directors were not necessarily local people, and in this and other respects Liverpool AS was a national and international society. It also laid claim to being one of the first scientific societies that allowed women members, forty years before the suffragette movement. Although Liverpool AS was the first really large provincial astronomical society, its success quickly became its downfall: less than a decade after its formation, it was essentially bankrupt. With more than three thousand members in the UK and as far away as South America, the cost of producing and sending its journals to its members became prohibitive. The society began to fail, both financially and within its management structure.

The BAA and its North Western Branch

In 1890, Miss Elizabeth Brown FRMetSoc, who lived in Gloucestershire, director of the Solar Section of the LAS since 1883, urged the formation of a new national amateur astronomical society. Soon after, on 18 July that year, a letter from William Henry Stanley Monck appeared in the

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English Mechanic, a widely read publication devoted to technical and scientific matters. Monck's letter advocated the formation of an Amateur Astronomical Association to be based in London. This was not to be a rival of the Royal Astronomical Society but would cater for those amateur astronomers who found the subscription to the RAS too high, its papers too technical, or, being women, were excluded. The British Astronomical Association was founded, on 24 October 1890, in direct response to the general interest in matters scientific, particularly at an amateur level, prevalent in the country in the last decade of the nineteenth century. Like the Liverpool AS before it, the BAA was organised into observing sections. Subsequently, their section reports and memoirs would build up into a valuable archive of observations.

However, within two years of the founding of the BAA, there were plans to create a 'North Western Branch'. Many members lived in the north-west and had nowhere to meet locally. Leeds Astronomical Society was active, although it had suffered a rocky ride in its early days, but what was needed was a branch of the BAA in the north-west for members living on the Liverpool–Manchester-–Leeds axis and taking in Lancashire, north Cheshire and parts of Yorkshire on the western side of the Pennines.

The first meeting of local BAA members was held in the Drawing Room of the YMCA, Peter Street, Manchester, on 18 January 1892. There were seventeen people present, and Mr Samuel Okell,[5] a Manchester businessman, was voted to the Chair. Walter Maunder,[6] explaining the need for such an association, gave a brief review of the history of the BAA. On Monday 1 February, in the library of the Manchester Geographical Society at 44 Brown Street, the decision was taken to form a North Western Branch of the British Astronomical Association.

Many of the Branch members lived in the then affluent Manchester suburbs a mile or so south of the city centre, in Ardwick, Longsight and Chorlton. We do not know how many of these were ex-Liverpool AS members or members of the Manchester Literary & Philosophical Society.[7] Some lived in the 'good' areas of Salford. Relatively few, with the exception of professional men, doctors and clergymen, came from the Lancashire mill towns that extended in an arc north, north-east and east of Manchester. Those who did live further afield came from Hale, Wilmslow and Alderley, in the stockbroker belt of north Cheshire, 10 to 15 miles south of the city. And, in the wake of the collapse of the Liverpool AS, members also joined the Branch from Liverpool, Southport, Preston and the Fylde coast of Lancashire.

At the meeting on 1 February 1892, it was resolved that the Branch's catchment area was to be bounded on the north by the towns of Preston, Clitheroe and Halifax, on the east by Halifax, Huddersfield and Buxton, on the south by Buxton, Macclesfield and Northwich, and on the west by the London and North Western Railway's main line 'which here runs almost due North'.

Fr Walter Sidgreaves SJ, FRAS became the first president of the Branch.[8] Alfred Brothers FRAS,[9] Samuel Okell and Thomas Thorp FRAS were elected vice-presidents.[10] Another famous member at that time was Mrs Sallie Proctor-Smyth.[11]

Independence for Manchester

Although within the first two years the Branch was to all intents and purposes flourishing, all was not well financially and things went from bad to worse. By the turn of the century it was apparent that the Branch could survive only if it became independent of the BAA. This did not happen until the end of 1902, when on 5 November members of the Branch met in the newly completed observatory atop the Manchester Technical College.[12]

Figure 1. The Godlee Observatory

The Godlee Observatory and its twin equatorial telescopes, an 8-inch (200-mm) refractor counterbalanced by a 12-inch (300-mm) Newtonian reflector on the same German equatorial mounting, by Grubb of Dublin, was a gift to the city from Francis Godlee, a local mill-owner and philanthropist.[13] Immediately it became apparent that, provided it had the Godlee Observatory as its new home, the Branch could set up as an independent society within the auspices of the Manchester Technical College.

On 18 September 1903, a group of former members of the North Western Branch of the BAA

gathered in the lower room of the Godlee Observatory and decided to form the Manchester Astronomical Society (MAS). Professor Thomas H. Core MA took the chair and was elected its first president; Samuel Okell the honorary treasurer; and William C. Jenkins, the director of the Godlee Observatory and already employed by the college, the honorary secretary. The Manchester AS blossomed. Within ten years it had over a hundred members and could later command lectures from the highest scientific authorities in the land, including Professor R.A. Sampson, Astronomer Royal for Scotland, and Professor Sir Arthur Eddington.

In late 1919, after a difference of opinion between the then vice-president, William Porthouse,[14] and the principal, J.C. Maxwell Garnett, MA, MAS moved out of the Technical College and into 65 George Street, the home of the Manchester Literary & Philosophical Society, and the former residence of John Dalton, the Manchester scientist and chemist. Shortly before the Second World War, MAS moved to the Central Library but its rooms were taken for war work. It was to be twenty-six years before MAS again called the Godlee Observatory its home, during which time the Manchester blitz not only destroyed 65 George Street, but forced MAS to suspend its activities, albeit temporarily, during 1941.

At the Council meeting held in the Milton Hall, Deansgate, on 19 May 1942, following the forced hiatus in the Society's proceedings during the blitz, Mr Porthouse noted that there was increased interest in the night skies, but 'the Society would have to be satisfied with the members it could get, and these were mainly of the "popular" type'. It is fascinating to conjecture what he meant by this odd statement. More than anything else, it shows that until 1939 the MAS had been a meeting place of academics and 'professionals', the well-to-do. Some had lived close to the city centre, and many of those had moved away at the onset of war. War was a leveller in more ways than one, and the Society, for its very survival, was obliged to welcome the average city-dweller who could not afford to leave the city during the blitz.

John Hindle

Two prominent members joined the society between the world wars. John H. Hindle joined in November 1917 and later became vice-president. By the 1930s he was internationally recognised as one of the leading optical experts of the time. Hindle built many large reflecting telescopes, including a 20½-inch (0.52-m) Newtonian–Cassegrain, 8 and 30 feet (2.4 and 9.1 m) in focal length, and a 30-inch (0.76-m) Newtonian. Both instruments were for his friend Dr William H. Stevenson, former president of the BAA and director of the Mars Section. The 30-inch was

Figure 2. 25 Inch Newtonian Reflector
by John H.Hindle

subsequently mounted at Cambridge University Observatory, by arrangement with Sir Arthur Eddington.[15]

Hindle frequently travelled abroad and always took the opportunity to visit major observatories. While in North America in 1931, he observed using the 72-inch (1.83-m) Brashear reflector at the Dominion Observatory, Victoria, British Columbia, but noted that he was 'very disappointed' with the star images. He had already described a new test for Cassegrain and Gregorian secondary mirrors,[16] and Professor Sampson, considering this test to be a great improvement on previous ones, commissioned Hindle to make a new 19.5-inch (0.5-m) convex secondary for the 72-inch telescope. Unfortunately, we do not know whether this secondary was ever finished.

On the same trip, in California, he met with Professor Ritchey, formerly of the Mount Wilson Observatory and the man largely responsible for figuring the 100-inch mirror of the Hooker Telescope. He later met George Ellery Hale, in Pasadena, and again suggested his new method of testing secondary mirrors. Hale later intimated that Hindle's test might indeed be profitably used to test the mirror of the 200-inch telescope, then under construction. Although Hindle had doubts that this

great telescope would ever be completed, he was invited to see the pouring of one of the 200-inch blanks in 1934. This he described enthusiastically and vividly to William Porthouse. It is tempting to think that, had he lived longer, Hindle would have been invited to Mt Palomar in 1948 to see the commissioning of the Hale Telescope.

During a two-day stopover at Mount Wilson Observatory, where he observed with the 60-inch reflector (whose star disks were 'quite in order'), he was given a guided tour of the Hooker Telescope, then the world's largest. On his way home, via Chicago, where lack of time prevented him from visiting Yerkes Observatory, he had a meeting in New York with Albert Ingalls, associate editor of *Scientific American*, who was primarily responsible for the great surge of interest in amateur telescope construction in America during the 1930s. The descriptions of John Hindle's work have, for many years, been read by generations of telescope-makers on both sides of the Atlantic in Ingalls' famous trilogy, *Amateur Telescope Making*, first published by *Scientific American* in 1935.

Hindle is best remembered for the invention of his ovoid-stroke mirror grinding and polishing machine and for multi-point mirror floatation systems designed to support, without flexure, large telescope mirrors. A Hindle mirror-grinding machine is still in use by Norwich Astronomical Society. Hindle's reputation as a telescope-maker encouraged others in MAS to make their own instruments, a tradition that is still very much alive.[17]

Eric Burgess

In October 1935, Eric Burgess (b.1920) became a junior member of the MAS. A year later, he formed the Manchester Interplanetary Society. As a member of both the fledgling British Interplanetary Society (formed in Liverpool by P.E. Cleator) and the MIS, Eric was Manchester's first 'rocket man'. One of the London venues for BIS meetings was the Mason's Arms – or The Spaceshippers' Arms, as the London members came to call it – in Maddox Street. This was the scenario used by Arthur C. Clarke in his science-fiction anthology *Tales from the White Hart*. Clarke was one of the most active of the London members, and although he was slightly older than Burgess, their interest in space research followed remarkably similar paths.

A breakaway group from the MIS, the Manchester Astronautical Association, lead by Burgess, was formed in 1937. It was to play a key role in holding together interest in UK astronautics during the second world war. As war loomed, all BIS activities were suspended and it remained for Manchester to carry the 'interplanetary torch' throughout the war years, during which Burgess printed and distributed a mimeographed quarterly journal, *Spacewards*. Although he kept in touch with Clarke and Cleator,

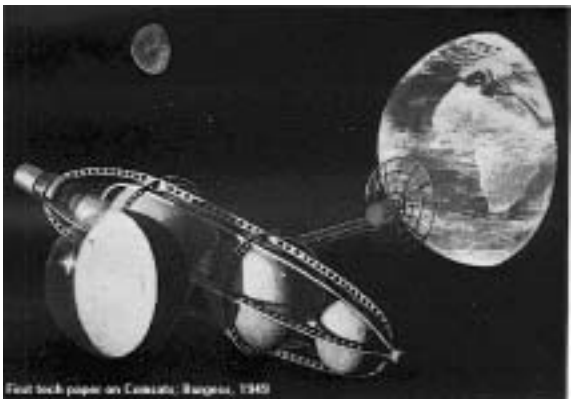

Figure 3. First technical paper on Comsats
Burgess 1949

he had no contact with the other BIS council members until the close of hostilities in Europe. By then, Eric had linked up with Kenneth Gatland to form the Combined British Astronautical Societies, which had about two hundred members and a printed journal, also with the title *Spacewards*. The Manchester Astronautical Association became its North Western Branch.

In 1944, Burgess and Gatland completely restructured the CBAS, and BIS members Cleator, Clarke and R.A. Smith, together with officials acting for the CBAS, circulated a policy document which contained plans for a post-war astronautical society. In September 1945, it was unanimously agreed that a new national society should be incorporated under the name of the British Interplanetary Society Ltd. Eric Burgess was the first to sign the new members' register and became chairman for the first post-war session, 1945/46, to be succeeded by Arthur C. Clarke in 1947.

In October 1945, Arthur C. Clarke published his seminal paper on the potential use of *manned* orbiting space stations to act as 'extra terrestrial relays' for radio and TV broadcasting.[18] The next year, Eric Burgess followed it with an article published in the November 1946 edition of *Aeronautics*, proposing to use *automatic* robotic satellites in geostationary orbits for the same reason and for meteorological and other purposes. Clearly, it is this technology,[19] first suggested by Burgess, that best describes modern global telecommunications.[20] Along with Charles A. Cross, NASA credits Eric Burgess[21] for the introduction of the term 'interplanetary *probe*', first used in a joint paper, 'The Martian probe'.[22] In September 1956, Eric and his wife Billie emigrated to California. He became a successful part-time science journalist and writer on space exploration.

Following the Apollo Moon flights, Burgess wrote or co-authored several very detailed books on NASA's exploration of the planets. In November 1971 Eric had dinner with Charles Cross and Carl Sagan, director of the Laboratory of Planetary

Studies at Cornell University. Sagan was visiting the Jet Propulsion Laboratory in Pasadena.[23] The topic of conversation centred on Pioneer 10, then nearing completion, and Burgess suggested to Sagan that a visual message should also accompany the vehicle. So was born the idea of fixing a plaque to the spacecraft.[24] Sagan was not at first optimistic that NASA would go along with it, but under extreme secrecy the plaque, depicting a man and a woman set against a diagram of the craft for scale and various other devices to show the origin of the probe, was designed by Carl Sagan and Frank Drake. A similar Burgess-inspired plaque was attached to Pioneer 11. Eric Burgess last visited Manchester in 1978 when he addressed the Manchester Astronomical Society at its 75th anniversary meeting. He was then in the UK as science adviser to the makers of the James Bond film *Moonraker*.

Postwar work

During the latter half of the twentieth century it has to be acknowledged that the MAS, like many amateur astronomical societies, can claim to have made only relatively minor contributions to the science in the light of burgeoning professional studies. Nevertheless, some individual contributions by its members are worthy of recognition. In 1946, the MAS returned to the Godlee Observatory and has enjoyed unrestricted access ever since. It is still one of the very few UK astronomical societies to meet weekly.

In 1952, Professor Zdenek Kopal was elected to the first chair of Astronomy at Manchester University. Kopal was a regular contributor to the MAS and became an honorary member. In 1954, Ken Brierley and Morris Marlowe were two of only a handful of observers to witness the total eclipse of the Sun from the British Isles, from the northernmost tip of Unst in the Shetland Islands. Other MAS members also went on to make significant contributions to astronomy and the sciences: Professor Wal Sargent was a student at Manchester University in the mid-1950s and subsequently, among other things, became director of the Mount Wilson and Palomar Observatories and Ira S. Bowen Professor of Astronomy at Caltech. His contemporary, also a former MAS member and now professor, Leon Lucy, devised the Lucy–Richardson deconvolution algorithm, used to correct the initial spherical aberration of the Hubble Space Telescope.

In 1969, MAS lunar observers John Bolton FRAS and Mike Duckworth FRAS, observed transient lunar phenomena (thought to be localised outgassing) in the vicinity of Aristarchus with the Godlee instruments that were apparently confirmed by the crew of Apollo 11.[25] Two years before, in January 1967, Duckworth and Kilburn observed a TLP in Gassendi. Patrick Moore and Terrance Moseley also saw it from Armagh, as did P. Sartory from southern England. This observation was recorded by NASA.[26] Nigel Longshaw is now another, internationally respected, MAS lunar observer.

In the 1970s, John Rustige and Allan Maudsley were regular contributors to the BAA Solar Section and among the ten leading solar observers in the UK. MAS members Rustige and Ken Bispham were among the first solar observers to make detailed observations of polar faculae.

In the 1980s, MAS member Dr David Whitehouse joined NASA and went on to become a senior BBC science correspondent and author. Former MAS president Dr Peter Mack became assistant professor of astronomy at the University of Oklahoma and manager of MIT instruments at Kitt Peak before setting up his own business making research-grade telescopes and instrumentation in Tucson, Arizona.

In the closing years of the century, Mike Oates FRAS has become the most prolific comet discoverer to date, with a tally of 142 mini-comets discovered by analysing data from the ESA–NASA SOHO satellite. Oates is also co-discoverer in November 1997, with Tony Cross and the present writer, of Manchester AS's greatest astronomical find, an almost perfect copy of a star atlas, *Atlas Celeste* (1786), which should have been published in 1750 as John Bevis's *Uranographia Britannica*.[27]

Manchester Astronomical Society is now only one of many dozens of such organisations in the UK, but as it enters its second century it looks forward to continuing its association with professional bodies in the UK and internationally in the pursuance of knowledge and the enjoyment of space to the benefit of its members and the public.

Notes and references

1. Allan Chapman, *The Victorian Amateur Astronomer* (Chichester, Wiley-Praxis, 1998).
2. K.J. Kilburn, *The Manchester Astronomical Society: A History* (Manchester, UMIST, 1992). New material is in preparation; see also http://www.mikeoates.org/mas/history/intro.htm.
3. A term coined by Allan Chapman.
4. The Manchester Literary and Philosophical Society was formed in 1781 and is one of the oldest learned societies in the UK.
5. Samuel Okell FRAS (1838–1932) was a manager of James Laing, Son & Co., Ltd of Manchester and London, and worked his way up to become a senior partner, retiring after seventy-five years with the company in 1931. The company were drysalters, supplying barrels of meat to ships re-victualling in the London docks and later in the Salford and Manchester docks complex. With the opening of the Manchester Ship Canal in 1895, and the immense amount of export trade to and from 'Cottonopolis' at the turn of the century, the business thrived and Okell became a wealthy man. He travelled widely, to South America, South Africa and to Jamaica, where he met and became friends with Professor William H. Pickering

at the outstation observatory of Harvard University. Other friends included E. Walter Maunder, the astronomical writer Richard A. Proctor, and the telescope-makers George Calver and Andrew Ainslie Common. Common's 36-inch (0.9-m) telescope, built for the Halifax textile manufacturer Edward Crossley, was donated to Lick Observatory and is still doing useful work more than a century after its construction. (Obituary notice, *MNRAS*, **93**, 231 (1933).)

6. Solar observer at the Royal Observatory, Greenwich.
7. The early membership records of Manchester Literary & Philosophical Society have been lost, possibly during the bombing in 1941–42.
8. Director of Stonyhurst College, having succeeded the late Fr Stephen Perry.
9. Pioneer photographer and the first to take portraits by the light of burning magnesium ribbon. Brothers was also the first to take pictures underground, in the Blue John Mines, Castleton, Derbyshire.
10. A skilled instrument-maker and inventor. Thorp's company specialised in making scientific apparatus, recording instruments, gas meters and regulators. He is credited with the invention of the coin-in-the-slot gas meter. His advertisements in scientific publications such as the BAA journal included a range of replica gratings used in spectroscopy that formed the basis of a series of spectroscopes that he made and sold.
11. Sallie Duffield Proctor-Smyth FRAS (1856–1941) was born Sallie Thomson, at St Joseph, Missouri. Her first marriage was to R.J Crawley of Belfast, with whom she went to Australia. A year after Crawley's death in 1880, she returned to Missouri and became the second wife of Richard Anthony Proctor, the writer of many popular astronomical books, and stepmother to his six children by his previous marriage. The family moved to England and lived at Kew, London, before moving to Orange Lake, Florida, in 1884. Four years later, intending to move back to England, Richard Proctor fell ill en route to England via New York and died, apparently of a chill on top of malaria. Sallie Proctor hurried to New York and determined to fulfil the lecture tour of England that her late husband had arranged. This she did, reading from his prepared notes. By Richard Proctor she had two sons who both died in childhood. Sallie Proctor-Smyth became a member of the Branch when she moved to Altrincham, Cheshire, after marrying in 1890 her third husband, Dr J.C. Smyth (d.1905) of Belfast. She was a professional astronomical lecturer and gave at least three talks to the Manchester Astronomical Society after being elected to its Council in 1905. Her stepdaughter Mary Proctor (1862–1957), Richard Proctor's daughter by his first marriage and only six years younger than her stepmother, was also a regular attendee of the society. (Obituary notice, *MNRAS*, **102**, 73, 74 (1942).)
12. Now UMIST, the University of Manchester Institute of Science and Technology.
13. K.J. Kilburn, 'The Godlee Observatory in Manchester, England', *Journal of the Antique Telescope Society*, Issue 23, 19–24 (2002).
14. Porthouse was a lunar observer and in 1946 had a crater in Mare Imbrium named after him, in H.P. Wilkins' great 300-inch map of the Moon.
15. *Scientific American*, September 1939.
16. *MNRAS*, **91**, 592 (1931).
17. In November 2000, MAS members visited Telescope Technologies Ltd at Birkenhead and were shown three partly completed 2-m robotic telescopes, the first large instruments to be constructed in the UK since the demise of Grubb-Parsons Ltd in the mid-1980s. The wide-field Ritchey–Chrétien optics of these new telescopes were being tested by the same Hindle null test devised by John Hindle seventy years before.
18. A.C. Clarke, ' Extra terrestrial relays', *Wireless World*, October 1945, pp. 305–308.
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23. R.O. Fimmel, J. Van Allen and E. Burgess, *Pioneer: First to Jupiter, Saturn, and Beyond*, NASA SP-446 (1980).
24. Carl Sagan, in an interview about the plaque, *Washington Post*, 25 February 1972.
25. Telegram from NASA to J. Bolton, 23:40, 19 July 1969. (Photocopy in the possession of K.J. Kiburn.)
26. 'Chronological catalog of reported lunar events', NASA Technical Report TR R-277, July 1968.
27. K.J. Kilburn, J. Pasachoff and O. Gingerich, 'The forgotten star atlas', *Journal of the History of Astronomy*, **34**, 125–134. (2003).

The Early Indian Mercury-Period

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This paper considers the several meanings of the word 'sidereal' as it pertains to early Indian planetary periods, and focuses upon that of Mercury. It compares Indian periods with planetary periods in the Western tradition from Ptolemy to Newton, and with modern values. The distinctive 'fingerprint' of the early Indian sidereal planetary periods is the marked degree to which their accuracy progressively increased from Saturn through to Mercury. The Indian sidereal Mercury-orbit period had an error of ten or twenty seconds, at a time (sixth century AD) when European astronomers hardly knew that any such period existed.

Planetary orbit-periods were given in two canonical mediaeval Indian astronomy texts: the most commonly used such text, the *Surya-Siddhanta*, which gradually came into a recognisable form around the 8th or 9th century, of unknown authorship; and the *Brahmasphuta*, compiled by Brahmagupta in Rajastan at a definite date, AD 628.[1] The former text is regarded as having evolved, from what may have originally been an oral tradition, between the fifth and the ninth century: 'The date of its commentator Ranganatha is AD 1602, when it was made safe from the hands of its interpolators.'[2] An eminent early Indian astronomer was Aryabhata, born in 476, to whom some hints of heliocentrism, or at least that the Earth rotates on its own axis, are attributed.[3] Tables in these texts give what must be regarded as absurdly large periods of time: the Brahmasphuta cites the planetary rotations per 4.3 billion solar years! In what follows, I shall prefer to express these ratios as decimals, i.e. the mean period of a single rotation.

The 'sidereal' period of a planet signifies, for us, its orbit-period, i.e. its time of revolution around the Sun with respect to the fixed stars; and this is often contrasted with its 'tropical' period, which means its year, i.e. its rotation-period around the Sun with respect to zero degrees – the first point of Aries, or the vernal equinox. For the Earth, these periods are 365.256 and 365.242 days, respectively. But equally, the concept of a 'sidereal' period contrasts with the synodic period, which is what is experienced or seen from Earth, for example that for Venus is 18–19 months, the interval between its periods of maximum brightness, or from one appearance to the next as the Evening Star. The same, reciprocal equation always links the synodic and sidereal periods: for the lunar months, e.g.

$$\frac{1}{29.5}\left(\text{synodic period}\right) = \frac{1}{27.3}(\text{sidereal}) - \frac{1}{365}\text{days(year)}$$

In discussing early use of sidereal planetary periods, one has to guard against imputing a heliocentric theory to the early Indian astronomers (although there is, as mentioned, the shadow of a suggestion of this in the Indian tradition). It is helpful to compare use of such periods both with use of tropical planetary periods and with synodic periods, at least for the inner planets, which one finds more in Western astronomy. A further and unexpected meaning of the term 'sidereal' appears, in that Indian planetary periods were measured with respect to sidereal and not tropical Earth-years. The problematic meaning or significance of sidereal periods for the inner planets is not here of central relevance, although clearly it is important: the primary concern here is merely to assess the accuracy of these periods.

Thurston has observed that, 'The main parameter in the mediaeval Indian theory of the motion of the planets is the *sidereal* period ... even for the inner planets,'[4] echoing the earlier view of Van der Waerden.[5] Other scholars have emphasised this distinctive feature,[6] while at the same time arguing that these Indian texts had derived their parameters from non-Ptolemaic Greek sources.[7] Non-Ptolemaic ancient Greek astronomical sources are, it has to be said, scant.

Thurston added that the *Brahmasphuta* tables of these periods were 'extraordinarily precise'. These tables used huge integer values of sidereal-orbit; so for the Sun and Jupiter, for example, the figures given are Sun, 4,320,000,000 sidereal years, and Jupiter, 364,226,455 rotations.[8] Dividing one by the other gives what we recognise as a sidereal orbit period, and inserting a value for the sidereal year in days then will give that period in days. Thus, the years which they used 'are in fact sidereal revolutions of the Earth about the Sun',[9] this being a key feature of the Indian astronomical tradition.

By way of contrast, Claudius Ptolemy of Alexandria (*c*. AD 120–180) in his *Almagest* gave no such orbit-periods for the inner planets. In a thorough discussion of Ptolemy's treatment of the inner-planet orbits, Swerdlow made no allusion to this concept.[10] For Ptolemy's geocentric cosmology, his inner-planet epicycles would lack anything resem-

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bling the meaning they later acquired in a heliocentric context. One can extract them, as angular velocities around an epicycle, and earlier authors such as Biot did done so, in order to compare with the Indian values.[11] No Western astronomer before Copernicus ever gave a list of sidereal planetary orbits. 'Sidereal' here is, of course, contrasted with 'synodic'.

As an example of how Ptolemy defined his planetary periods, he wrote that Jupiter, in 71 solar years less $4\,^{9}/_{10}$ days, would complete six revolutions less $4\,^{5}/_{6}$ days, 'from a solstice back to the same solstice'.[12] Thereby it can be shown that his orbit-period was too short by somewhat less than two days;[13] Copernicus retained a similar format for defining his sidereal planetary periods:

Ptolemy	$(71\ \text{y} - 4\,^{9}/_{10}\text{d})/(6 - 4\,^{5}/_{6}) =$ 4331.0 days, error 1 day, 15 hours
Surya-Siddhanta[14]	(4,320,000 × 365.256)/364,226 = 4332.2 days, error 9 hours
Modern value	4332.6 days

It is evident that Ptolemy's measurements are in tropical space and time, so that he was not using sidereal periods as such. I would have thought that this applied to most ancient Greek astronomy that we know about, which is a problem for any claim that the Indian parameters derive from the West.

The Indian Mercury-value requires all seven figures of the modern estimate to discern its error:

Surya-Siddhanta	(4,320,000 × 365.2564)/ 17,937,060 = 87.96913 days, error 11 seconds
Newton	1726 87.9692 days, error 5 seconds
Modern value	87.96926 days

The 'impossible' eleven-second error in the sidereal orbit mean period of Mercury here was not improved upon until Newton in eighteenth-century Europe. The most modern NASA parameters are required for an adequate accuracy, finally to calibrate the ancient Indian data. NASA websites give sidereal planetary orbit-periods to seven-figure accuracy, expressed as a fraction of the Julian year (just 365.25 days).[15] Earth's sidereal year has no secular component, i.e. its mean orbit-period does not appreciably change over the centuries: it was then 7 seconds longer, only in the sense that Earth was then revolving slightly faster, so that the days were shorter, making it then 365.25644 days.[16]

Did Indian astronomers derive their orbit-periods from non-Ptolemaic Hellenistic sources[17]? After all, did they not lack either astronomical tradition or observational records for deriving such periods? This thesis encounters problems:

1. There are no comparable values for the inner planets given by Western astronomers before Copernicus. One can perform arithmetic computations to extract equivalent values from the text, but that is hardly the same thing.
2. For the thirty-year Saturn period, Ptolemy's value is *too short* by nine days, whereas the Indian values are *in excess* by six days.[18] It is not easy to see how one error could have derived from the other.
3. For all three outer planets, the Indian sources are more precise than Ptolemy.
4. The Indian periods were measured in sidereal years. The Western astronomical tradition measured the flow of time in tropical solar years.

In Figure 1, error-values of the Indian sidereal planetary periods in minutes have been plotted against solar distance, on a log–log scale.[19] Venus's orbit was known within minutes, the error for Mars was under an hour and Jupiter's more, while Saturn's orbit had a huge error of several days. The two astronomical texts compared here appear as closely similar. The figure highlights a characteristic feature of this Indian tradition: the increase of planet-orbit error-values with solar distance. The slope of the line connecting the error-values appears greater than that for Western sources. Thus the large error in the Saturn and Jupiter-periods could be viewed as just as remarkable as the small errors for Venus and Mercury. Little by way of difference is discernible between the *Brahmasphuta* and *Surya-Siddhanta* values. The figure compares these Indian error-values with those of Ptolemy and Copernicus.[20] Ptolemy's Mars-orbit sidereal period, we may note, is as accurate as Copernicus', but neither of these is as precise as the Indian values. Copernicus was *less* accurate than the Indian astronomers for the Mars, Venus and Mercury periods.

With the arrival of heliocentrism in Europe, there begin to appear lists of planetary sidereal periods– in the sense of being neither synodic nor tropical – and we find them in the great books by Copernicus, Kepler and Newton. Kepler (in his *Harmonice mundi*) was the first astronomer to give sidereal heliocentric planetary periods in a modern format, viz. as time per revolution[21]; before then, relations between planetary and solar periods were given as above. Newton, in the third edition of his *Principia* (1726), gives these in his section on Kepler's third law, where it becomes clear that it is the sidereal, heliocentric periods that he is discussing, although (as the graph shows) his were in general *less* accurate than Kepler's![22] We can compare error-values for Venus' mean sidereal orbit-period (224.701 days):

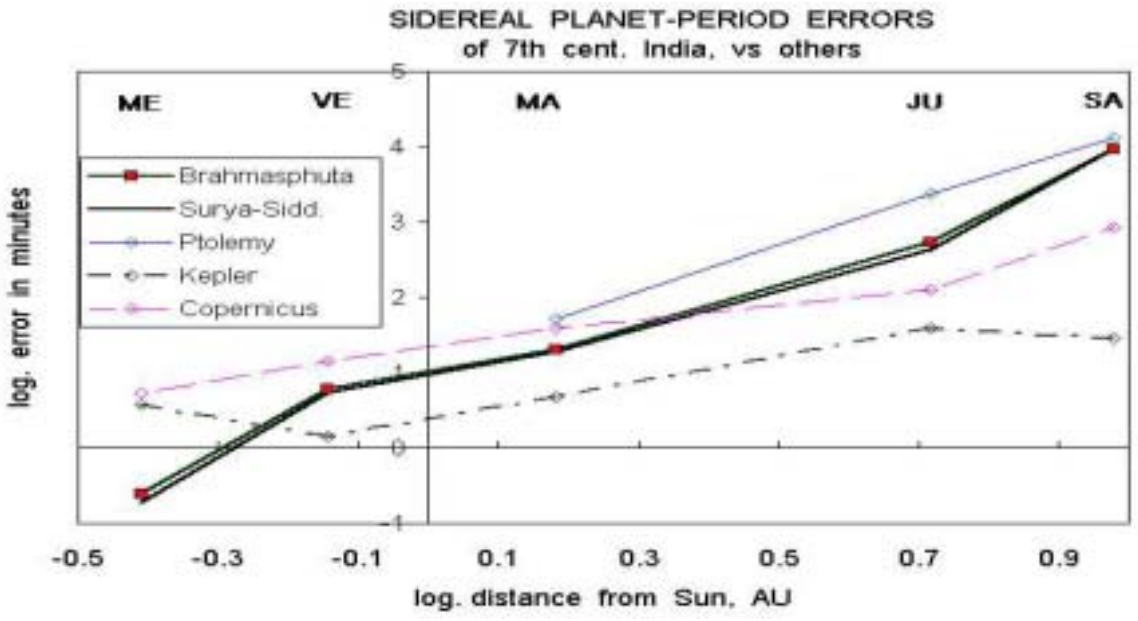

Figure 1. Errors in the sidereal periods of planets, from seventh-century India and Western sources.

	Indian	Coper-nicus (1543)	Kepler (1618)	Newton (1726)
224 days +	0.697 days	0.691 days	$^{42}/_{60}$ days	0.618 days
Error	6 min-utes	14 min-utes	3 min-utes	2 hours

Only Kepler's *Harmonice mundi* appears as more accurate than the Indian source, while Newton's *Principia* gave a two-hour error in the 224.7-day Venus-period. None of these clearly improved upon the Indian texts for their inner planet orbit-periods.

Conclusion

With the advent of heliocentric theory in the sixteenth century, Western astronomers give lists of planetary periods that were both heliocentric and sidereal, before which time these periods were given as geocentric and tropical. The Indian tradition lacks these categories and needs to be judged on its own merits. One strand of its tradition believed that Earth rotated upon its axis and that time was to be measured in sidereal days. Whether or not this is evidence of a heliocentric framework, the claim that the tradition of Indian planetary periods had a Greek origin is more problematic than is generally supposed.

Indian planetary periods were thoroughly sidereal, using the several meanings of that term that we have discussed, in a way that is distinctive, applying to no other tradition. Earlier Western astronomers following Ptolemy had separate definitions and concepts for the inner versus the outer planets. It may not be easy for us to comprehend how the early Indian astronomers could have had sets of planetary periods that made no such distinction if their world-view was geocentric, as was apparently the case. When Europe started to produce its own lists of sidereal planetary periods, those of Copernicus, Kepler and Newton, they were measured using tropical, and never sidereal, years.

Acknowledgement

I am most grateful to Hugh Thurston for helpful advice.

Notes and references

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2. E. Burgess, *Translation of the Surya-Siddhanta: A text book of Hindu Astronomy* (University of Calcutta, 1860, 1935), p. ix.
3. Hugh Thurston, *Early Astronomy* (Springer, 1994), p. 188: 'Not only did Aryabhata believe that the Earth rotates, but there are glimmerings in his system (and other similar Indian systems) of a possible underlying theory in which the Earth (and the planets) orbits the Sun, rather than the Sun orbiting the Earth. The evidence is that the basic planetary periods are relative to the Sun.'
4. Hugh Thurston, 'Mediaeval Indians and the planets', *Dio*, **8**(1-2), 18 (1988).
5. B. Van der Waerden, *Heliozentrische Systeme in griechiste, persische und indische Astronomie* (Zurich, 1970).
6. See e.g. David Pingree 'The recovery of early Greek astronomy from India', *Journal for the History of Astronomy*, **7**, 109–123 (1976), here p. 112: 'since the fifth century AD the normal Indian year has been

sidereal rather than tropical'.

7. J.B. Biot, *Etudes sur 1'astronomie indienne et sur 1'astronomie chinoise* (Paris, 1862).
8. H. Thurston, 'Planetary revolutions in Indian astronomy', *Indian Journal of History of Science*, **35**(4), 311–318 (2000), here p. 313; D. Pingree, *Astral and Mathematical Literature* ... (Weisbaden, 1981), p. 15.
9. Burgess, *Translation of the Surya-Siddhanta*, p. 17; see also Brennand, *Hindu Astronomy*, p. 176.
10. Noel Swerdlow, 'Ptolemy's theory of the inferior planets', *Journal for the History of Astronomy*, **20**, 29–56 (1989).
11. A comment from Hugh Thurston may here be helpful. Questioned as to whether Ptolemy had used sidereal periods for the inner planets, he replied (to the author), 'For the inner planets he found the rate of revolution round the epicycle which gives us (though presumably not him) the heliocentric sidereal period.'
12. Ptolemy, *Almagest*, IX 3 (G.J. Toomer (trans.), (Springer-Verlag, 1984), p. 424.
13. Ptolemy's solar year of 365.246 days (365:14:48) was used in estimating this error-value: Ibid., p. 424, n. 26.
14. E. Burgess, 'Translation of the Surya-Siddhanta, a text-book of Hindu astronomy', *Journal of the American Oriental Society*, **6**, 141–498 (1860); see also Pingree, 'The recovery of early Greek astronomy from India', p. 191, for *Surya-Siddhanta* periods.
15. See http://home.earthlink.net/~mrob/pub/planets.html I am grateful to Miles Standish for explaining the Julian year measure.
16. F.R. Stephenson and L.V. Morrison, 'Long-term fluctuations in the Earth's rotation 700 BC to AD 1980', *Philosphical Transactions of the Royal Society of London* A, **313**, 47–70 (1984). I am grateful to Jean Meeus for explaining this.
17. D. Pingree, 'History of mathematical astronomy in India', in *Dictionary of Scientific Biography*, Vol. 15, ed. C. Gillespie (New York, Scribner's, 1980), pp. 533–580, here p. 555; Pingree, 'The recovery of early Greek astronomy from India', p. 109.
18. Saturn's mean orbit-period is 10,759 days.
19. K.R. Laing, *Astrophysical Data* (Springer-Verlag, 1992), p. 29; only for Mercury's orbit did these values require supplementing (with an extra decimal place).
20. Ptolemy, *Almagest*, p. 424; Copernicus, *De revolutionibus*, Book V, pp. 235–6.
21. Johannes Kepler, *The Harmony of the World*, trans. E. Aiton *et al*. (American Philosphical Society, 1997), p. 418.
22. A. Motte (trans.), *Newton's Principia,* Vol. II (University of California Press, 1934), p. 404.

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

Paul Mohr

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

ROYAL IRISH ACADEMY.

"CUNNINGHAM MEMOIRS."

No. V.

THE RED STARS:

OBSERVATIONS AND CATALOGUE

By J. BIRMINGHAM.

2nd Edition

By REV. T. E. ESPIN, B.A., F.R.A.S.

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PART I.

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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

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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 *Misure 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 Σ.	Star's Name.	Σ.'s Colours.	Secchi's Colours.
60	η Cassiopeiæ.	Major, flava; minor, purpurea.	1866·722; maj. alb.; min. rub. ,, ·845; maj. flav.; min. rub. ,, ·928; maj. alb.; min. fla. ,, ·964; maj. fla.; min. alb.
941	. . . . .	Maj. albacærulea; min. albasubpurpurea.	Maj. cærulea; min. rubra.
1110	Castor.	Maj. min. subvirides. [H. called both white.]	Maj. alba; min. aurea.
1116	. . . . .	Maj. min. albæ.	Maj. alba; min. rubra.
1273	. . . . .	Maj. fla. min. cærulea.	Maj. alba; min. flava.
1365	. . . . .	Maj. subfl. min. albasubcærulea.	Maj. flava; min. rubra.
1888	. . . . .	Maj. fla. min. rubro-purpurea; colores insignes.	Maj. alba; min. aurea.
2114	. . . . .	Maj. min. albæ.	Maj. flava; min. cærulea.
2218	. . . . .	Maj. alba; min. cinerea.	Maj. min. flavæ.
2264	95 Herculis.	1828·71; maj. flava-subviridis; min. flavasubrubra. 1828·76; maj. subviridi.; min. subflava. 1829·62; maj. viridiflava; min. egregie rubra.	1873·529; maj. rubra; min. viridis.
2272	70 p 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.
2545	. . . . .	Maj. alb. min. cærulea.	Maj. flava; min. cærulea.
2822	μ Cygni.	Maj. alb. min. albasubcærulea.	Maj. alba; 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	5·5	5·1	—	—	—	5·2
5·7	5·7	6·2	5·7	—	6·1	5·8	5·6
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	7·8	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	8·5	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	210	281	69	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).

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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No.	No. in Schj.	No. in Schm.	Star's Name.	Right Ascension. 1880.	Annual Precession in R. A.	Declination. 1880.	Annual Precession in Declination.	Magnitude.
				h m s	s	° ′	″	
328	169	—	. . . .	14 18 47	+ 2·69	+ 26 15·0	− 0·28	8·0
329	170	—	. . . .	14 23 24	3·19	− 5 26·8	0·27	8·0†
330	171	75	ρ Bootis.	14 26 40	+ 2·60	+ 30 53·9	0·27	4·0
331	173a	—	R Camelopardalis.	14 26 41	− 5·31	+ 84 22·5	0·27	var.
332	—	76	δ Ursæ Minoris.	14 27 46	− 0·21*	+ 76 13·7	0·27	5·0
333	172	—	. . . .	14 28 10	+ 3·80	− 42 59·7	0·27	9·0†
334	173	—	. . . .	14 29 44	2·46	+ 37 9·2	0·27	6·2
335	173b	—	a Centauri.	14 31 29	4·03	− 60 20·4	0·26	1·0†
336	173c	—	R Bootis.	14 31 54	2·65	+ 27 15·6	0·26	var.
337	173d	77	34 Bootis.	14 38 9	2·64	+ 27 2·4	0·26	5·8
338	—	—	54 Hydræ.	14 39 4	3·47*	− 24 55·9	0·26	5·5†
339	—	78	ε Bootis.	14 39 44	2·62	+ 27 34·9	0·26	2·3
340	—	79	σ Libræ.	14 43 15	+ 3·52	− 27 27·5	0·25	5·0†
341	—	80	β Ursæ Minoris.	14 51 4	− 0·24*	+ 74 28·7	0·24	2·1
342	—	—	. . . .	14 55 41	+ 0·95*	+ 66 24·6	0·24	4·5
343	—	81	20 Libræ.	14 57 3	3·50	− 24 48·5	0·24	3–4†
344	—	82	γ Libræ.	14 59 56	3·24	− 15 47·3	0·24	8·0
345	174	—	. . . .	15 2 50	3·61	− 69 37·6	0·24	6·0†
346	175	—	δ Lupi.	15 10 32	3·63	− 39 42·4	0·23	4·7†
347	176	—	. . . .	15 12 54	6·86	− 75 20·7	0·23	7·0†
348	176a	—	S Libræ.	15 14 30	3·43	− 19 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	+ 2·44	+ 31 48·0	0·22	var.
351	—	84	11 Ursæ Minoris.	15 17 13	− 0·06*	+ 72 15·6	0·22	5·5
352	—	85	ε Draconis.	15 22 16	+ 1·39	+ 69 23·2	0·21	3·0
353	—	86	γ Libræ.	15 28 49	3·34	− 14 29·2	0·21	4–5
354	—	—	α Coronæ.	15 29 37	2·53	+ 27 7·2	0·20	10·0†
355	—	87	39 Libræ.	15 29 45	3·63	− 27 44·1	0·20	4–5†
356	178	—	. . . .	15 30 54	+ 2·77	+ 15 30·0	0·20	6·7
357	—	88	θ Ursæ Minoris.	15 35 0	− 1·93	+ 77 44·9	0·20	5·0
358	—	89	α Serpentis.	15 43 20	+ 2·70	+ 18 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).

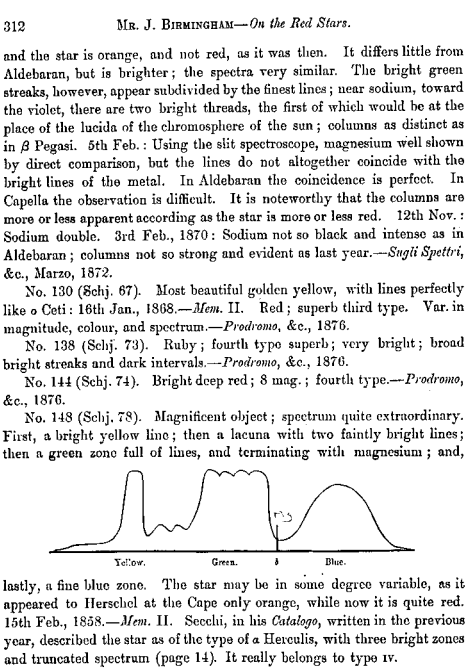
Type II. Fine-line spectra, characteristic of pale yellow stars such as the Sun, Arcturus and Pollux.

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.—*Sngli Spettri*, &c., Marzo, 1872.

No. 130 (Schj. 67). Most beautiful golden yellow, with lines perfectly like o Ceti: 16th Jan., 1868.—*Mem.* II. Red; superb third type. Var. in magnitude, colour, and spectrum.—*Prodromo*, &c., 1876.

No. 138 (Schj. 73). Ruby; fourth type superb; very bright; broad bright streaks and dark intervals.—*Prodromo*, &c., 1876.

No. 144 (Schj. 74). Bright deep red; 8 mag.; fourth type.—*Prodromo*, &c., 1876.

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 α 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 ...

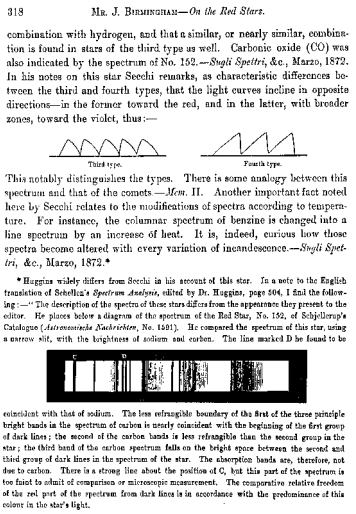
The spectral observations in John Birmingham's Catalogue were presented in four parts:

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.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combination with hydrogen, and that a similar, or nearly similar, combination is found in stars of the third type as well. Carbonic oxide (CO) was also indicated by the spectrum of No. 152.—*Sugli Spettri*, &c., Marzo, 1872. In his notes on this star Secchi remarks, as characteristic differences between the third and fourth types, that the light curves incline in opposite directions—in the former toward the red, and in the latter, with broader zones, toward the violet, thus:—

Third type. Fourth type.

This notably distinguishes the types. There is some analogy between this spectrum and that of the comets.—*Mem.* II. Another important fact noted here by Secchi relates to the modifications of spectra according to temperature. For instance, the columnar spectrum of benzine is changed into a line spectrum by an increase of heat. It is, indeed, curious how those spectra become altered with every variation of incandescence.—*Sugli Spettri*, &c., Marzo, 1872.*

* Huggins widely differs from Secchi in his account of this star. In a note to the English translation of Schellen's *Spectrum Analysis*, edited by Dr. Huggins, page 504, I find the following:—"The description of the spectra of these stars differs from the appearance they present to the editor. He places below a diagram of the spectrum of the Red Star, No. 152, of Schjellerup's Catalogue (*Astronomische Nachrichten*, No. 1931). He compared the spectrum of this star, using a narrow slit, with the brightness of sodium and carbon. The line marked D he found to be

coincident with that of sodium. The less refrangible boundary of the first of the three principle bright bands in the spectrum of carbon is nearly coincident with the beginning of the first group of dark lines; the second of the carbon bands is less refrangible than the second group in the star; the third band of the carbon spectrum falls on the bright space between the second and third group of dark lines in the spectrum of the star. The absorption bands are, therefore, not due to carbon. There is a strong line about the position of C, but this part of the spectrum is too faint to admit of comparison or microscopic measurement. The comparative relative freedom of the red part of the spectrum from dark lines is in accordance with the predominance of this colour in the star's light.

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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Astronomy and its Audiences: Robert Ball and Popular Astronomy in Victorian Britain*

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Popular science writing has been viewed as a way to obtain economic and social support for science, to legitimise scientific research, as part of the scientific culture and as a scientific mediator. This paper explores the popularisation of astronomy undertaken by the one-time Royal Astronomer of Ireland Sir Robert Ball during the second half of the nineteenth century. The complex interactions between popular science and other elements of scientific culture are examined by looking at the different audiences for astronomy and the strategy adopted by Ball.

The figure of Robert Ball

Sir Robert Stawell Ball (1840–1913) was a prominent and well-respected figure in Victorian society. Born in Dublin on 1 July 1840, Ball entered Trinity College Dublin in 1857, where he distinguished himself, finishing his studies in 1865 – having worked on Brinkley's *Astronomy*, Newton's *Principia* and Laplace's *Mécanique Célèste*, among other texts. His first contact with practical astronomy was at Birr Castle, Parsonstown. There, from 1865 to 1867, Ball combined his job as tutor to the sons of the third Earl of Rosse with regular micrometric observations of nebulae. He then moved back to Dublin on being appointed Professor of Applied Mathematics and Mechanics at the Royal College of Science. During this period, Ball's prestige as a scientist able to bring abstruse subjects within the comprehension of his audiences led to his election, in 1873, as a Fellow of the Royal Society.

One year later Ball was appointed Astronomer Royal of Ireland and Andrews Professor of Astronomy at the University of Dublin, and director of the observatory at Dunsink. His role as populariser of science, which had started years before, now developed strongly, and the lectures he delivered opened to him the doors to an appealing career. It was as a popular lecturer that he would come in contact with the widest circles.[1]

Ball moved to Cambridge in 1892 to take up the Lowndean Professorship of Astronomy and Geometry, and the next year he was appointed director of the Observatory of Cambridge – posts he held until his death in 1913. At a time when the application of the spectroscope in astronomy was making great headway, Ball's geometrical knowledge had led him instead to focus on observational astronomy, in particular on measuring stellar parallax. But the rapid rise of astronomical photography led him to completely abandon visual observations in his field.[2] It is tempting to present Ball as a scientist displaced by the rise of astrophysics: although interested in it, Ball did not take an active part in the new astronomy.

Nevertheless, many astronomers continued to make visual observations during this period. The main problem for Ball could have been his serious limitations as an observer. From 1883 his right eye began to deteriorate, and it was finally removed in 1897. After the publication of his research at Dunsink in 1884, he seems to have done very little observing. It seems plausible that Ball made a voluntary shift in his career, focusing on popular astronomy topics, where his eye trouble was not an impediment. From 1877 to 1906 he published many works in this field. This was a consequence of his success as a lecturer, an activity that took him to several towns and cities of Britain and Ireland. He also visited America for lecturing tours in 1884, 1887 and 1901. His prestige as a scientist and populariser gained him positions in academies, associations and societies, as well as acting as adviser to official bodies such as the Irish Lights Boards.

The rise of popular science

During the second half of the nineteenth century, along with the creation of the modern concept of technology, a new role of science in education and the economy, and the gradual professionalisation of science from its amateur origins, there was a marked rise of popular science as a mass phenomenon. It had begun during the first half of the century by popularisers who disseminated science because it was 'useful knowledge, an instrument of self-improvement, an aid to profitable, rational, and usually individualistic economic activity, and a pillar of natural religion'.[3]

The success of popular science was linked to social and economic factors such as the growth of an educated middle class and the invention of a cheaper steam-powered printing technology. Public science became more and more important in the

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social context. An example of this is the foundation in Britain of the University Extension Movement in the late 1860s.[4] Popular lectures became fashionable, not only in Britain but also on the continent, generally linked to the growth of liberalism. They were held in town halls, public libraries, Mechanics Institutes,[5] village schoolrooms, Co-operative Societies and even chapels.[6] This programme of bringing education to the masses helped to open up the universities to religious nonconformists, women and poorer men.[7] Changes in the popularisation of science also came about through the direct intervention of governments, such as scientific education through the foundation of science museums.[8]

Astronomy, like engineering, became a very popular subject during the nineteenth century. The studies of the stars made by William Herschel (1738–1822) and his son John Frederick William Herschel (1792–1871) with large reflecting telescopes had changed the character of astronomy. Popular lecturers translated to wondering audiences the Herschels' discoveries, which opened up 'new physical and intellectual horizons that captured the public imagination'.[9] The rise of science popularisation can also be linked to the need to create publics for science. Social diversity required different audiences. Popularisers addressed and adapted their rhetoric to these audiences, and at the same time redefined them.

Controversy: professional scientists *v.* popularisers of science

Ball was rated by his contemporaries as 'one of the two or three greatest British mathematicians of his generation'.[10] Famous is his theory of screws, based on his researches on screw motions[11] – a topic that could have, in some aspects, links with his first observations of many faint nebulae. He was also described as a master of practical astronomy and as one of the 'highest authorities in speculative astronomy'.[12] In his popular books he presented professional scientists as the right people to analyse and interpret scientific knowledge, 'as those competent to judge'.[13] Particularly interesting is the way he presented his own professional activity, the 'wondrous alliance between mathematics and astronomy',[14] and the role of mathematical reasoning in astronomy.[15]

Ball enjoyed a considerable vogue as a public lecturer and author. His lectures were delivered in a language appealing to the public, without any specific or exclusive terms. This way of addressing an audience has been identified in particular with the popularisers of science, non-professional scientists, of the late Victorian period. In fact, the second half of the nineteenth century has been traditionally seen as a time of increasing tension between amateurs (including journalists) and professional scientists (who tried to exclude amateurs from scientific activity). Robert Ball, however, was an individual astride both cultures. We can use his example to take a different approach to this traditional picture: to study the interactions between several expressions of public and popular science, and provide a way of studying the mediatory role of popular science. Ball is what one could call a bridge point between these two *cultures* that have been said to compete during the nineteenth century in the field of popular science.

One can sense this tension in some of Ball's pronouncements on controversial issues, such as the existence of Martian canals. He discussed the canals in his lectures, often at the request of a curious audience who wanted to know whether there was life on Mars. In 1892 and 1893 Ball wrote at least two articles supporting the existence of Martian canals and the possibility of finding (non-intelligent) life there.[16] He adopted a similar but even stronger attitude in the 1898/99 Royal Institution Christmas Lectures.[17] This position was in close agreement with those of Percival Lowell (1855–1916) and Camille Flammarion (1842–1925), two of the most respected popularisers of astronomy of the period. However, Ball supported the conclusions of the prestigious astronomer Edward Emerson Barnard (1857–1923), who questioned the existence of Martian canals, at two meetings of the Royal Astronomical Society in the mid-1890s.[18] This uncharacteristic vacillation seems to be related to how Ball performed for different audiences.

When they were addressed to the professional community, Ball's works were very descriptive, full of data. Professional scientists had a different way of communicating and presenting the results of their researches –a mode that Ball was as competent in as when he was speaking to the public. For his public lectures, though, he wove a coherent and convincing story that explained the truths of the real world, a tale full of anecdotes and other elements to catch the audience's attention and exercise their imagination. Ball, as a populariser, explained in an easily digestible way how the world worked, and justified the activities of professional scientists.[19] Popular science was also a scientific mediator, creating an interchange between the ideas discussed in the scientific community and the ones presented at popular lectures: each fed on the other.

Ball's programme to popularise astronomy

Ball consolidated his position in the world of science popularisation during the late 1870s and early 1880s. One is tempted to suggest that economic reasons were behind his decision to pursue a career in this field. In fact, he always charged a fee

for attending to his courses and seminars.[20] Whatever the reasons, my opinion is that Ball carefully planned the development of his career as a populariser of astronomy. The first stages of Ball as a popular lecturer saw him visit several Mechanics Institutes.[21] Later, in November 1880, he offered himself to the Royal Institution to deliver one of the Friday evening lectures. As Ball himself pointed out, in lecturing at the Royal Institution he was now in exalted company: 'all the most distinguished men of learning, past and present, who have being called into being since the days when these lectures were first started'; it was 'to receive the blue ribbon of the lecturer'.[22]

After his entrance into the pantheon of popularisers, with a lecture delivered at the Royal Institution on 11 February 1881, based on his work at Dunsink and entitled 'The distances of the stars', Ball received invitations to lecture at various institutions. He received one that same year from the Royal Institution to give the 1881/1882 Christmas Lectures.[23] By 1884 he had delivered around seven hundred public lectures, and he probably lectured to more than a million people during his entire life.[24] Ball's lectures became a mass phenomenon, regularly delivered to audiences of five hundred to a thousand. The Gilchrist Lectures, intended for the working classes, brought him to more than two hundred towns of England, Scotland, Wales, Ireland and the Channel Islands.[25] The lecture series for the Gilchrist Trust became of crucial importance for Ball's career, while they were an exceptional trampoline for developing his vocation as a populariser of science and gaining prestige both in the fields of popular and academic astronomy.

Characteristics and success of Ball's popular work

Ball worked hard to develop visual aids for his audiences to demonstrate the heavenly bodies, their sizes and their distances. A good example is the large india-rubber ball he used to suspend by a string and illuminate with a beam of electric light, in order to explain to his audience the phases of the Moon. He also used devices to illustrate the appearance of lunar craters, a Foucault's pendulum to demonstrate the rotation of the Earth, 'a model of Saturn with his rings, an arrangement to illustrate an eclipse, a comet which gradually extended a splendid tail and then disappeared, a nebulous-looking object which, when shown on the screen, was made to transform into a cluster of stars; and smoke rings which were shown in illustration of the annular nebulae'.[26] Models, slides and other kinds of apparatus helped him not only to illustrate and better explain the subject of his lectures, but were also used in delivering the same lecture as many times as he could. At the same time, his capacity for improvisation and his techniques and skills made Robert Ball an expert on the stage.[27]

He usually delivered public lectures only by invitation, and only if his terms and requirements were accepted. There is no doubt that, although he acted as someone interested in the dissemination of scientific knowledge, he was also guided by his own financial interests. Tickets for the lecture were usually distributed long before Ball arrived at the place. Once there, Ball was introduced by the chairman to the audience. Making use of his characteristic and loud voice, Ball presented during his lectures his theories of how climatic changes were caused by long-term variations in the Earth's orbit; his nebular hypothesis, which was based on his explanation of the solar system's origin; and other such theories. He always used an accessible language and made use of his 'delightful gift of humour … to enliven any dull parts of a lecture and retain the attention of his hearers'.[28]

Ball's success as a populariser of science came not only from his lectures, but also from several written works. This approach, frequently used during the nineteenth century, not only allowed a broader audience to be reached, but also involved little additional effort for the author, who gained the reputation of publication.[29] The most prolific years of Ball's career as an author were from 1880 to 1900. He published not only pure scientific papers dealing with astronomy, but also many popular books, as well as contributions to popular science journals such as *Nature*, *Science* or the French *L'Astronomie*. These works, many of them mere transcriptions of lectures, were described by his contemporaries as written in a pleasant, clear and concise style.[30] Good examples are Ball's most widely known lecture of his early period as a public speaker, 'A glimpse through the corridors of time',[31] and his popular book *Starland*, based on his 1887 Christmas Lectures at the Royal Institution.[32]

Astronomy and its audiences

As we have seen, Robert Ball, like other popularisers of science, adapted his rhetoric to match his audience. It seems to me clear that this was a very important part of their success. Ball, one of the most prestigious and best-known popularisers of science in the Victorian period, carefully cultivated this ability. His activity as a populariser opened to him the doors of fame, and provided him not only with the opportunity to make many different and important contacts, but also to gain personal prestige, both as socially and as a scientist.

I have mentioned the different ways of communicating knowledge that professional scientists used when addressing their colleagues and when talking to the public. Let me focus now on a more subtle and particular case: the transcription of the first of

Ball's Friday Lectures at the Royal Institution, 'The distances of the stars'. In this lecture, Ball addressed members of this scientific society and their friends – in other words, people acquainted with the rudiments of astronomy and scientific knowledge in general. The lectures were to enlighten them about recent discoveries and the results of astronomical research.[33] He explained the annual parallax of 61 Cygni with the aid of a diagram:[34]

> On a review of the whole question there seems no doubt that the annual parallax of 61 Cygni is nearer to the half second found by Struve, than to the third of a second found by Bessel. To exhibit the nature of the evidence which is available for the solution of such a problem, a diagram has been prepared. The abscissae are the dates of the second series of observations made at Dunsink. The ordinates indicate the observed effect of parallax on the difference of declinations between 61(B) Cygni [i.e. 61 Cygni B] and the comparison star. Each dot represents the result of the observations made on the corresponding night. The curve indicates where the observations should have been with a parallax of 0″.47, the effect of the parallax in declination being only 0″.40.

In his most popular work, *The Story of the Heavens*, the *Nature* article from which the above quote is taken became Chapter XXI. Of course, he did not use here the same words employed to address the audience of the Royal Institution and the readers of the journal:[35]

> It is desirable to give the reader the means of forming his own opinion as to the quality of the evidence which is available in such researches. The diagram has been constructed with this object. It is intended to illustrate the second series of observations of difference of declination which I made in Dunsink. Each of the dots represents one night's observations. The height of the dot is the observed difference of declination between 61(B) Cygni and the comparison star. The distance along the horizontal line – or the abscissa, as a mathematician would call it – represents the date. These observations are grouped more or less regularly in the vicinity of a certain curve. That curve expresses where the observation should have been, had they been absolutely perfect. The distances between the dots and the curve may be regarded as the errors which have been committed in making the observations.

Ball thus related the wonders and mysteries of the universe to the public using appropriate language, adapting his speech and his presentation for the particular audience. In the words of a letter he received at Dunsink, he almost made people believe that the *Story of the Heavens* was so simple that a child could understand it.[36] This was perhaps the reason for Ball's success: he learned to address different audiences in the appropriate way. However, he was also part of the creation of a scientifically aware public, and his programme to popularise astronomy became an element of what one might call a general scientific culture, a mediator between the scientific community to which he belonged and his contemporary society.

Notes and references

1. 'Ball, Sir Robert Stawell 1840–1913', *The Dictionary of National Biography*, Vol. 1912–1913 (Oxford University Press, 1927), pp. 19–20.
2. J.L.E. Dreyer, 'Sir Robert Ball, F.R.S.', *Nature*, **92**, 403–404 (1913).
3. Frank M. Turner, 'Public science in Britain, 1880–1919', *Isis*, **71**, 589–608 (1980), here p. 590.
4. This movement was strongly linked to the name of James Stuart (1843–1913). His first course, delivered in autumn 1867 in Liverpool, Manchester, Leeds and Sheffield, was on astronomy.
5. Adult education colleges established for the benefit of workers who wanted to improve themselves, often founded by wealthy industrialists.
6. Exactly the kind of places where Robert Ball delivered his lectures and courses when he visited towns such as Rochdale, Accrington, Huddersfield, Preston and Bury – towns that were part of his first tour as a lecturer for the Gilchrist Trust. For a complete study of the information we have about these lectures, including a brief history of the Gilchrist Trust, see W. Valentine Ball (ed.), *Reminiscences and Letters of Sir Robert Ball* (London: Cassell, 1915), pp. 214–219.
7. In Oxford, for instance, the Reverend Arthur Henry Johnson (1845–1927) delivered in Birmingham, in 1878, the first of the Oxford extension lectures, 'The history of England in the seventeenth century' – see Lawrence Goldman, *Dons and Workers: Oxford and Adult Education Since 1850* (Oxford, Clarendon Press, 1995).
8. Of many books dealing with the foundation of science museums, a good introductory one is T. Bennett, *The Birth of the Museum: History, Theory, Politics* (London and New York, Routledge, 1995).
9. H.C. King, *Geared to the Stars* (Bristol, Adam Hilger, 1978), p. xiv.
10. Cited in James Moseley, 'Sir Robert Stawell Ball F.R.S.', *Journal of the British Interplanetary Society*, **32**, 157 (1979).
11. A brief summary of his geometrical method can be found in Susan McKenna-Lawlor, 'Robert Stawell Ball: Mathematician and astronomer' in C. Mollan *et al.* (eds), *Some People and Places in Irish Science and Technology* (Dublin, Royal Irish Academy, 1985), pp. 56–57.
12. H. MacPherson, *Astronomers of Today* (London and Edinburgh, Gall & Inglis, 1905).
13. W.V. Ball, *Reminiscences and Letters*, p. 189.
14. Robert S. Ball, 'Comets', *Nature*, **30**, 454–457 (1884), here p. 454.
15. Robert S. Ball, 'A glimpse through the corridors of

time', *Nature*, **24**, 79–82 (1881), here p. 80.

16. See N. Whyte, *Sir Robert Stawell Ball (1840–1913)* (http://explorers.whyte.com/ball.htm, August 2002); and R. Jones, *Sir Robert Ball: Victorian Astronomer, 1840–1913* (http://www.geocities.com/ziksby2/Sir_Robert_Ball.html, January 2005). Whyte cites the *Fortnightly Review*, **52**, 288 (1892); Jones cites a Goldthwaite's *Geographical Magazine* published in 1893.
17. Whyte, *Sir Robert Stawell Ball*, mentions articles in *The Times* on 28 December 1898, 30 December 1898, 2 January 1899, 4 January 1899, 6 January 1899 and 9 January 1899.
18. Whyte, *Sir Robert Stawell Ball*. This conclusion is said to be based on reports in the *Monthly Notices of the Royal Astronomical Society*, **56**, 163 (1896) and *The Observatory*, **19**, 72 (1896); **20**, 152 (1897).
19. Scientists were used to discussing scientific controversies. However, Ball's interest in presenting science, and in particular astronomy, as a legitimate activity, as well as his ambition of becoming a well-recognised figure, led him to rarely mention in his lectures alternative arguments to the ones he put forward.
20. 'I cannot afford the time to give lectures unless I am well paid for them,' he wrote to a lady in 1880 – see W.V. Ball, *Reminiscences and Letters*, p. 224. Ball would deliver the same lecture as many times as he could so as to obtain more money for less intellectual effort. He did, however, give some free lectures, on behalf of the Missions to Seamen, in his later years.
21. This was on his first lecturing tour, when he visited Birmingham, Hanley and Gloucester.
22. W.V. Ball, *Reminiscences and Letters*, pp. 202–203.
23. He would also deliver the Christmas Lectures in 1887 and 1891.
24. F.W.D. and G.T.B., 'Sir Robert Stawell Ball, 1840–1913', *Proceedings of the Royal Society*, Series A, Vol. 91 (London, Harrison & Sons, 1915).
25. It was through the secretary of the Trust in 1879, his friend William Benjamin Carpenter (1813–1885), that Ball first undertook lectures for the Gilchrist Trust. This was because Richard Anthony Proctor (1837–1888), a well-known writer and lecturer on astronomy linked to the Trust, was about to embark on a world lecture tour.
26. W.V. Ball, *Reminiscences and Letters*, p. 208.
27. There are several curious and interesting anecdotes that show Robert Ball's capacity for solving unexpected problems when lecturing. One of the most famous relates to his lecture 'Krakatoa: The mighty volcano' that he had to deliver with the wrong slides (he used the ones for his lecture 'The Moon') and a crashed terrestrial globe. See W.V. Ball, *Reminiscences and Letters*, pp. 196–197; see also http://www.geocities.com/ziksby2/Lecturer.html.
28. F.W.D. and G.T.B., 'Sir Robert Stawell Ball'. There is also some valuable information about Ball's methods as a lecturer in W.V. Ball, *Reminiscences and Letters*, pp. 219–230.
29. D.A. Hinton, 'Popular science in Britain, 1830–1870', Ph.D. thesis, University of Bath (1979), pp. 170–197.
30. F.W.D. and G.T.B., 'Sir Robert Stawell Ball'; and Dreyer, 'Sir Robert Ball, F.R.S.', pp. 403–404.
31. This was the inaugural lecture at the new hall built by the Midland Institute, delivered on 24 October 1881. See W.V. Ball, *Reminiscences and Letters*, p.193. The lecture, unusually written before it was delivered, was subsequently printed in *Nature* (published in two parts: **24**, 79–82 (1881) and **25**, 103–107 (1882)) and in pamphlet form by Macmillan a year later.
32. It was the publisher who sought Ball's permission to transcribe his spoken lectures. They were recorded at the lectures by a reporter and later rewritten by Ball. The book, which appeared in 1889, was a great success.
33. In this case the lecture dealt with recent investigations by the Astronomer Royal of Ireland at Dunsink.
34. Robert S. Ball, 'The distances of the stars', *Nature*, **24**, 91–92 (1881).
35. Robert S.Ball, *The Story of the Heavens* (London, Cassell, 1985), pp. 449–450.
36. Letter signed in Aberdeen, 5 June 1889, probably by the Surgeon J. Farquhar. See the correspondence relating to Dunsink Observatory, Dublin, 1885–1900, at the Museum of the History of Science, Oxford (MS Museum 54).

Appendix: Robert Ball's popular scientific texts

Note that the distinction between scientific and popular works is not always clearly delimited.

Books

The place of publication is stated only if different from London.

Experimental Mechanics, a Course of Lectures (1871).
Elementary Lessons on Applied Mechanics (1872).
Astronomy (1877).
Mechanics (1879).
Elements of Astronomy (1880).
A Glimpse Through the Corridors of Time (1882).
The Story of the Heavens (1885).
Time and Tide: A Romance of the Moon (2 lectures) (1889).
The Cause of an Ice Age (1891).
An Atlas of Astronomy: A Series of Seventy-two Plates, with Introduction and Index (1892). [Later published as *A Popular Guide to the Heavens*.]
In the High Heavens (1893).
The Story of the Sun (1893).
Starland: Being Talks with Young People About the Wonders of the Heavens (1895).
Great Astronomers (1895).
A Primer of Astronomy (Cambridge, 1900).
The Earth's Beginning (1901).
The Latest Achievement in Astronomy (1904).
A Treatise on Spherical Astronomy (Cambridge, 1908).

Articles

'Speculations on the source of meteorites', *Nature*, **19**, 493–495 (1879). [27 March, read at the Royal

Irish Academy on 13 January.]
'The distances of the stars', *Nature*, **24**, 91–92 (1881). [26 May, lecture at the Royal Institution of Great Britain on 11 February.]
'A glimpse through the corridors of time, I', *Nature*, **24**, 79–82 (1881).
'A glimpse through the corridors of time, II', *Nature*, **25**, 103–107 (1882).
'On the occurrence of great tides since the commencement of the geological epoch', *Nature*, **27**, 201–203 (1882). [28 December, extract from a lecture delivered at the Midland Institute of Birmingham on 20 November.]
'Comets', *Nature*, **30**, 454–457 (1884). [4 September, lecture at the Montreal meeting of the British Association.]
'L'Origine des étoiles filantes', *L'Astronomie*, 331–337 (1886).
'A dynamical parable', Address to the Mathematical Section of the British Association, 1887.
'The absence of air from the Moon', *Science*, **21**, 99 (1893).

Astronomical Observations on the River Niger Exploration

Brian Spencer

Expeditions to deepest Africa by Mungo Park and the Lander brothers included observations of the Sun and the moons of Jupiter to determine latitude and longitude. Their observations and commentary from their Journals provides an interesting insight into exploration in the early 19th Century.

Towards the end of the eighteenth century in London, a very small group of wealthy influential gentlemen formed an Association for Promoting the Discovery of the Interior Parts of Africa – the 'African Association' – and a subscription was levied on members which was to be used where possible to maintain at least one explorer in the field undertaking scientific studies. The Association was particularly keen to get an explorer to reach Timbuktu in central Africa, a city reputedly paved with gold, and to discover the course of a great river, the Niger, about which almost nothing was known. The first expeditions sent out by the Association were not entirely successful, and as they had all started either in the north or the east of the continent it was decided to begin the next exploration on the west coast. The man chosen to undertake this approach was Mungo Park, a young Scottish surgeon who had been befriended by Sir Joseph Banks, the Association's pre-eminent member. Park had already forsaken medicine for the greater excitement promised by exploration – and the greater financial reward.

Park went to Africa in 1795 and began his journey by travelling up the River Gambia for about 200 miles, then striking eastwards across unknown territory hoping that he would reach the Niger, which he did at Segou, in present-day Mali. Somewhat to his surprise, he immediately noticed that the river flowed from west to east, and not in the opposite direction, as had been thought, even by Park himself. Park followed the river for a few miles downstream, but then realised that he was not going to get much further; he was weak and had exhausted his provisions. He returned to Gambia, and arrived back in London in 1797. Park's expedition had only limited success, and the map-makers were disappointed that accurate determinations of latitude and longitude had not been made.

Park was keen to go back to Africa, but the Association had no immediate plans for him, so he returned to Scotland, married, had children, and practised as a doctor. Then, in 1803, a major expedition to the Niger was proposed with the primary aim of opening up trade routes; purely scientific exploration was to be a secondary consideration. Park was to lead the expedition, which would be about fifty strong, including a detachment of thirty soldiers. The cost of such a large party was too much for the pockets of the Association members, so the government agreed to foot the bill. However, when Park was almost ready to leave there was a change in government and the expedition was delayed. The Association suggested that Park should take the opportunity to study Arabic and familiarise himself with astronomical calculations that he could use to determine his position. Park had acquired some knowledge of Mandingo, the language he had found to be most prevalent during his first expedition, but he had noted a fairly widespread use of Arabic, and it was thought that knowledge of Arabic would be of significant advantage. Arabic had been introduced into the area by Moorish traders, who, as Park noted, also introduced 'Mahomedanism', which had become widespread.

The expedition finally got under way in 1805, and the plan was for the party to follow a similar route to that taken by Park on his first expedition. On reaching the Niger, the carpenters in the party were to build boats in which they would all sail down the river to its unknown end. Park believed that they would eventually join the Congo, while others believed that the Niger ran into the Nile, and some thought that it ended in a lake. Of course, they were all wrong.

In the surviving journal of the first part of the expedition, published posthumously, Park records twenty-five astronomical observations made between 15 May and 17 September. His instruments included a sextant, watch, compass and telescope, and he had a copy of the *Nautical Almanac.* He observed the Sun, the Moon and Jupiter to find his latitude, and Jupiter's satellites to correct his watch; Jupiter's satellites were easy to see with a telescope, and the times of their immersions and emersions were tabulated in his Almanac. The majority of the observations recorded in the journal are of the meridional altitude of the Sun, for which he used a Troughton's pocket sextant, and very early in the

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expedition he had this to say about the instrument:

> [E]ndeavoured to take the meridional altitude of the Sun, by the back observation with Troughton's pocket sextant; and after carefully examining his rise and fall, with the intervals betwixt each observation, I was convinced that it can be done with great accuracy, requiring only a steady hand and proper attention. This was a great relief to me; I had been plagued watching the passage of the fixed stars, and often fell asleep when they were in the meridian.

Park and his party left Gambia on 27 April, and it was almost a month before he began to record observations. A typical calculation of the latitude involved determination of the meridional altitude of the Sun, incorporating a value of 32 minutes for the Sun's diameter. The zenith distance was thus obtained, and this value was subtracted from the declination given in the *Almanac* to determine latitude. The first calculation came up with a latitude of 14° 4′ 51″ N, and the numerous calculations that were recorded in succeeding weeks all resulted in a value between 13 and 14 degrees north. The expedition was heading almost due east.

The first recorded use of the telescope was on 16 May, when Park observed an immersion of Jupiter's first satellite, Io. He noted the time of the immersion by his watch, found the predicted time in the *Almanac,* and subtracted the equation of time to obtain the mean time at Greenwich. Subtracting this time from his watch time he arrived at the result that his watch was 3 minutes 35 seconds fast. He commented: 'it is difficult to account for such a difference in the rate of going of the watch in the course of one month, but the excessive heat and the motion of riding may perhaps have contributed to it; I think my observation of the immersion was correct.'

The telescope was used again on a few occasions, as Park records:

> 26 May. During the night got the telescope ready in order to set the watch to Greenwich time by observing an emersion of the second satellite of Jupiter. Mr. Anderson took the time, and I was seated at the telescope half an hour before it happened, in order to be sure of observing it. The satellite emerged by
>
> | | H | M | S |
> |---|---|---|---|
> | Watch | 11 | 49 | 16 |
> | Mean time at Greenwich | 11 | 46 | 30 |
> | (Almanac time – equation) | | | |
> | Watch too fast | 0 | 2 | 46 |
>
> Observations of the Sun taken with artificial horizon the same evening to determine the apparent time.

(He does not record what the time was, or what he did with it, but he presumably used it to compare it with Greenwich time and so obtain his longitude).

> 26 June. Observed the emersion of the first satellite of Jupiter.
>
> | | H | M | S |
> |---|---|---|---|
> | Watch | 9 | 26 | 20 |
> | Mean time at Greenwich | 9 | 27 | 8 |
> | (Almanac time – equation) | | | |
> | Watch too slow | 0 | 0 | 48 |

(Park again took altitudes of the Sun for the time, and quotes a longitude of 8° 6′ W, but does not give his method of derivation.)

> 27 June. We could not sleep with the noise of the hippopotami, which came close to the bank and kept snorting and blowing all night. The night being clear, observed the emersion of Jupiter's second satellite. Calculated the watch to be 38 seconds slow.
>
> 2 July. Neglected to wind up the watch.
>
> 19 July. Observed the following emersion of Jupiter's satellites:
>
> | | H | M | S |
> |---|---|---|---|
> | Third satellite emerged by watch | 9 | 25 | 18 |
> | Watch too slow | 0 | 1 | 55 |
> | | | | |
> | First satellite emerged by watch | 9 | 36 | 10 |
> | Watch too slow | 0 | 2 | 34 |

(Altitudes of the Sun for the time were again taken, and a derived longitude of 5° 0′ 13″ W calculated.)

These were the last observations of Jupiter's satellites recorded in the journal, and Park does not comment on the fact that in 11 minutes his watch had apparently lost 39 seconds. The reason for this discrepancy is clearly the difficulty in exactly timing the emersion, or immersion, of the satellites.

Park continued to derive his latitude by observations of the Sun until the last recorded entry on 17 September, and at the very end of the surviving

journal he notes:

> In case any one should be inclined to doubt the accuracy of the latitudes taken by the back observation with Troughton's pocket sextant; I think it proper to mention that I have observed at Sansanding alternately with the horizon of the river, and the back observation in water, and the artificial horizon; and never found them to vary more than four minutes, but generally much nearer.

Park had reached Segou on his first expedition, and he arrived there again on 17 September with very few members of his party left. Malaria and dysentery were the great killers. It was 16 November before they were ready to continue downstream, and before leaving Park asked one member of the party to take his journal back to Gambia. That left just eight surviving members who took to the water. Details of subsequent events rely on the eye-witness account of a local interpreter who was in the canoe. He notes that they travelled several hundred miles, apparently antagonising all the local inhabitants, and when they reached Boussa, where the river narrowed, they were attacked. Park and five others were killed or drowned in early 1806. The interpreter and one slave survived. All of Park's possessions were thrown into the river, and only one or two items were ever recovered; journals written by Park after he left Segou were never found.

Park did not solve the mystery of the Niger, and it was not solved until another quarter of a century had elapsed. Richard Lander was the man chosen to determine finally the course of the Niger. He was the obvious choice because he was the only surviving explorer with experience of travelling in that part of central Africa.

He was also a good choice as far as the Colonial Office was concerned. The Colonial Office had taken over the financing of expeditions, and sending Lander out on his own was not going to cost very much. Unlike Park, Lander had no friends in high places; he was of humble origin, and although he did receive a small sum for his services, his brother John – who, it was agreed, could join the expedition – received nothing. It was one of the cheapest expeditions to leave these shores, and it was one of the most successful.

The brothers began their journey at Badagri, near present-day Lagos. They travelled north-eastwards to Boussa, then canoed down the Niger to the sea. However, it was not quite as simple as that: they had to overcome the usual dreadful illnesses, and many life-threatening hazards on the way. The only instruments they took with them were a watch, a compass and a thermometer, so they made no astronomical observations; but on the night of 2 September 1830 an astronomical event occurred which was recorded as follows by John Lander in his journal:

> About ten o'clock at night, when we were sleeping on our mats, we were suddenly awoke by a great cry of distress from innumerable voices, attended by a horrid clashing and clattering noise, which the hour of the night tended to make more terrific. Before we had time to recover from our surprise, our interpreter rushed breathless into our hut, and informed us with a trembling voice that 'the Sun was dragging the Moon across the heavens'. Wondering what could be the meaning of so strange and ridiculous a story, we ran out of the hut half dressed, and we discovered that the Moon was totally eclipsed. A number of people were gathered together in our yard, in dreadful apprehension that the world was at an end, and that this was but the 'beginning of sorrows'. We learnt from them that the Mohammedan priests residing in the city, having personified the Sun and Moon, had told the king and the people that the eclipse was occasioned through the obstinacy and disobedience of the latter luminary. They said that for a long time previously the Moon had been displeased with the path she had been compelled to take through the heavens, because it was filled with thorns and briers, and obstructed with a thousand other difficulties; and therefore that, having watched for a favourable opportunity, she had this evening deserted her usual track, and entered into that of the Sun. She had not, however, travelled far up the sky, on the forbidden road, before the circumstance was discovered by the Sun, who immediately hastened to her in his anger, and punished her dereliction by clothing her in darkness, forcing her back to her own territories, and forbidding her to shed her light upon the earth. This story, whimsical as it may seem, was received with implicit confidence in its truth by the king and queen, and most of the people of Boussa; and the cause of the noises which we had heard, and which were still continuing with renewed vehemence, was explained to us by the fact that they were all 'assembled together in the hope of being able to frighten away the Sun to his proper sphere, and leave the moon to enlighten the world as at other times'. The king observed that neither himself nor the oldest of his subjects recollected seeing but one eclipse of the Moon besides the one he was gazing at.

The Lander brothers arrived back in England in 1831, but despite their great achievement they initially received only rather grudging recognition. Eventually their exploits became more widely known; they were invited to Windsor Castle to meet

King William IV, and Richard was awarded the first Gold Medal of the newly formed Royal Geographical Society. John received the medal on behalf of Richard, who was once more travelling on the Niger, where unfortunately he was shot and died from his wounds.

Almost a century later a monument was erected at Jebba, south of Boussa. It was inscribed:

> To Mungo Park and Richard Lander who traced the Niger from near the source to the sea. Both died in Africa for Africa.

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W. Henry Robinson: Popularising astronomy in Victorian Walsall and Birmingham

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William Henry Robinson was one of the most prominent citizens of Walsall, then part of Staffordshire, in the Victorian and Edwardian periods. An influential businessman, he managed to combine printing, publishing, editing a newspaper, writing books and poetry, maintaining a library and retail trading with founding the town's literary institute, and bringing the scientists, explorers, authors and cultural pursuits of the day to his home town. An amateur astronomer in his own right, Robinson was instrumental in setting up the BAA's Midland Branch.

William Henry Robinson is little known today among the people of Walsall, in the West Midlands, where he lived for most of his life, yet they have much to thank him for. If it were not for Robinson, we might not know nearly as much as we do about the history of the area, for it was he, and his father before him, who published many of the books, and one of the newspapers, that tell us so much about Walsall and many other parts of the borough. True to the tradition of his time, Robinson, who became a printer, publisher, journalist, author, historian, amateur astronomer and cyclist, spent many hours in the pursuit of knowledge, both for his own edification and for the benefit of others. He styled himself W. Henry Robinson, and so here I shall call him Henry, his personal preference.

Figure 1. W. Henry Robinson, *Walsall Red Book, 1912*
(Walsall Local History Centre)

Birth of a businessman

Henry's father, John Russell Robinson, brought him to Walsall, then in Staffordshire, from his home at The Hollies in Cannock, Staffordshire, after his birth in 1847.[1] J.R. Robinson founded a printing, publishing, stationery and retail business on The Bridge, Walsall, the headquarters of the Walsall Steam Printing Works and the original *Walsall Advertiser* newspaper, founded in 1857.[2] Following his education at Mr Jackson's Grammar School in Aldridge, Henry entered the family business.

After his father died in 1869, Henry took the helm of the business at the age of twenty-one, and made a great success of it, running and expanding the premises on The Bridge, at No.8, roughly where Milletts now stands. This fine Victorian emporium was not only a shop selling stationery, medicines and of course printing services – it was also the local Stamp Office, where government stamps were issued and official stamp duties were received, as well as issuing licences for guns, carriages, male servants, horses, armorial bearings and dogs![3]

Figure 2. No.8, The Bridge, Walsall, *c.1900*
(Walsall LHC)

In addition, Mr Robinson's premises housed the Walsall Library & Philosophical Institution, established in 1801, which at one time was the only

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library in the town, originally housed at St Matthew's Hall, now The Old Court House.[4] While the Walsall Free Library was by now in operation, Robinson still maintained this original subscription library and took the majority of reviews, magazines and literary periodicals available. Above the shop were the offices of the *Walsall Advertiser,* of which Robinson was the editor and publisher.

It was as the printer and publisher of the *Walsall Red Book* directory that Robinson perhaps left his greatest legacy to his adopted town. This now rare series of books remains a rich source of information for both family and local historians, and is housed in the Local Studies Library at Walsall Local History Centre. The *Red Books* were launched in 1872, and over many years they were to become the indispensable guide to local events, a directory and a local 'Who's Who' par excellence.[5]

Marriage and residences

On 7 January 1874, at the age of twenty-seven, Henry married Lydie Agnes Elizabeth Schnabel, aged twenty-one, a young lady of German extraction. She was the daughter of Frederick Robert Michael Schnabel, a professor of languages, and they were both naturalised British citizens, hailing originally from Hamburg.[6] At the time, Lydie was living in Birmingham Road, and Robinson on The Bridge, presumably 'over the shop'.[7]

The Robinson's fortunes were on the up, and business was obviously good, as by 1881 they had moved into a substantial residence in one of the most prosperous parts of Walsall.[8] 'Offendene' was a fine, large Victorian detached house in its own grounds, situated on the corner of Princes Avenue and Sutton Road.[9] Robinson was now well placed to socialise with the cream of Walsall society, and he made many useful connections which were later to benefit the town as well as his business. In 1894 the property was extended, as the lighter character of the brick shows in the only surviving photograph, to provide for servants quarters. Sadly, 'Offendene' was demolished in the late 1960s to make way for a small block of flats.

'Offendene', Sutton Road, Walsall, 1964
(Walsall LHC)

By the time of the 1881 Census, Robinson was a prosperous businessman listed as employing eleven men, three women, six boys and two girls.[10] Henry and Lydie's children were John, Ida and Agnes, and also residing at 'Offendene' were Lydie's sister Theresa (aged fourteen), a governess, a cook and a house servant. The couple eventually had three sons, six daughters (one of them being Margaret, who would become Henry's constant companion in old age) and ten grandchildren.[11]

The Robinsons eventually moved, around 1904,[12] to The Lindens (now demolished) in Lichfield Road, and by 1909 the family was living at 63 Highgate Road.[13] The change of house, possibly to raise funds for Henry's new offices and printing works at 133 Lichfield Street, which he had occupied by 1906,[14] did not affect Henry's movement in the higher Walsall social circles. During my research I discovered a previously unknown photograph of him, at a garden party for the Canadian Trade Mission which visited the town in 1906, in a collection of prints from nitrate negatives by William 'Billy' Meikle, a local amateur photographer. The party was held at The Shrubbery, a short distance from 'Offendene' and the home of S.B. Wheway, JP.[15]

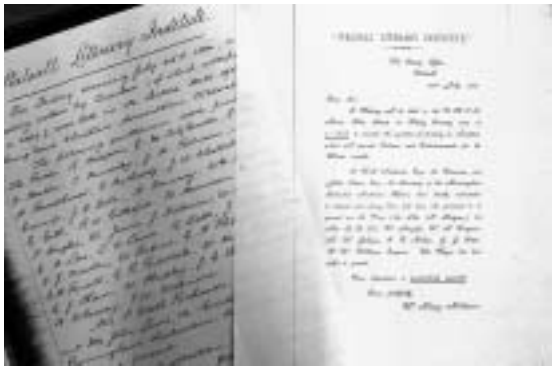
W. Henry Robinson (right) at The Shrubbery,
photograph by W. Meikle, 1906. (Walsall LHC)

Robinson's premises at 133 Lichfield Street, Walsall,
1906 (Walsall Red Book, 1907, Walsall LHC)

The Walsall Literary Institute

Henry Robinson was not just a printer and publisher. He was also a self-taught author, journalist and editor. Under his leadership the original *Walsall Advertiser,* one of the three main local newspapers of the day, became a great success, and he published many books including seminal local history works such as those written by Frederick W. Willmore. The Advertiser Office, built in the 1840s, still survives opposite Walsall's Central Library, now used by other businesses.

As well as publishing books by others, Henry wrote several of his own, both prose and poetry, some under the pseudonym of Maurice Grindon. Their contents reveal a man of both literary and philosophical bent, with a romantic and religious soul, who was also steeped in the practical and scientific reason of the age.[16]



The formation of Walsall Literary Institute (Acc 107/2, Walsall LHC)

One might well wonder how Robinson would have found the time to do anything other than run his multifarious businesses and raise his family, yet in the manner typical of his time he still managed both to relax with his hobbies and to turn his talents to the edification of the local populace.

In July 1884, with the support of friends and other local worthies and enthusiasts, he set out to found the Walsall Literary Institute.[17] On the evening of 25 July, at a meeting in the YMCA Room in Freer Street, everyone from the local vicar and the Mayor of Walsall to the town's businessmen and men of letters was present to propose the launch of the new institute, in conjunction with the Birmingham Suburban Institutes Union. It was perhaps inevitable that Henry Robinson would be elected as its first – and only – honorary secretary, and with the help of his friends he set to with a will to make it a tremendous success, which was to lead eventually to his other great passion – astronomy. Thanks to the hard work of Robinson, the Institute was to thrive over the years, lasting until 1911.[18]

Robinson was an early member of the Cyclists Touring Club,[19] and thought nothing of trekking fifty miles or more on his Beeston 'Cripper' tricycle. In between long distance tricycling runs around the UK with his great friend and mentor W.H. Duignan, a local solicitor, politician and historian,[20] some twenty years his senior, and sitting on the local Cottage Hospital Executive with Sister Dora (Dorothy Pattison), Walsall's much-loved Victorian nursing pioneer,[21] Henry Robinson was also a keen amateur astronomer and promoter of public interest in science.

Sir Robert Ball

It seems likely that Robinson's astronomical interest developed at least partly as a result of his work with Walsall Literary Institute, for their programmes over the years were regularly populated with scientific, especially astronomical, lectures as well as presentations by such literary giants as Charles Dickens, Oscar Wilde and Bram Stoker.[22] Robinson enthusiastically brought the wonders of the universe and the scientific and literary talents of the day to Walsall, for the benefit of local people.

Sir Robert S. Ball at Walsall, 1898 (Programme of Walsall Literary Institute, Walsall LHC)

However, it was perhaps in introducing Robert Stawell Ball – the Victorian equivalent of Sir Patrick Moore – to the people of late-nineteenth-century Walsall that Henry Robinson made his greatest contribution to promoting public interest in science in the Midlands. Sir Robert, who had worked with the Earl of Rosse on the world's largest telescope – the Leviathan of Parsonstown, now Birr – and had been Astronomer Royal for Ireland at Dunsink Observatory, was Lowndean Professor of Astronomy at the University of Cambridge and director of the observatory there. He

was to become a regular lecturer at the Walsall Literary Institute over many years, and appeared both at the Temperance Hall and at the Agricultural Hall, Darwall Street – later the Imperial Theatre, and now a public house of the same name.[23]

Sir Robert was, by the time of his first appearance at Walsall in 1897, a phenomenally popular speaker and author. His son recorded that by 1884 he had delivered over 700 public lectures, and in 1885 his first and most successful book, *The Story of the Heavens*, was published to popular acclaim.[24]

The parallel with Sir Patrick Moore here is striking, with the lecture hall and theatre being the Victorian and Edwardian equivalent of the television. If an astronomer were to popularise his science, it was in such venues, speaking to the public, that he would be found. So it was that Sir Robert came to Walsall on many occasions, and struck up a friendship with Henry Robinson, who in 1898, on behalf of the Committee, invited Sir Robert to become President of the Walsall Literary Institute.[25] He accepted, and his first lecture as President was 'The lances of heaven', given on 18 January 1899.[26]

Sir Robert was a prolific writer, publishing several books (some with an impressive print run of more than 50,000 copies) each year based on his research and his lectures, with which he travelled the nation and the globe, as *Time and Tide – a Romance of the Moon,* a volume I acquired from a dealer in Australia, proves. It is based on the theory of tidal evolution on which he lectured to the London Institute on 19 and 26 November 1888. Interestingly, he gave a lecture of very similar title at the Walsall Literary Institute on 14 November 1888, 'Time and tide – the romance of modern science', which may have been a lecture along similar lines.[27]

As time went on, through soirées, conversaziones, smoking-concerts and dances, lectures both literary and scientific, visits from explorers and diplomats, and outings aplenty, the Walsall Literary Institute grew remarkably, and must have been one of the most active in the land. As any club secretary will tell you, the amount of work involved in running any successful group is enormous, and the task often thankless. Yet in this regard Henry Robinson did not go unthanked, for on Wednesday 30 October 1895, at a lecture by Sir Robert Ball on 'Recent discoveries in the Sun', he received a just reward and timely recognition of his efforts, for the membership had since 1884 been upwards of 1,000 on the register, and the past year had been the Institute's most successful yet, with 1,100 members, as is recorded by detailed reports of the evening in the local newspapers.[28]

This event, appropriately, was made the occasion for a presentation by Mr G. Gill, JP to Mr Robinson of the substantial sum of 100 guineas from the funds of the prosperous institute, 'in recognition of the services gratuitously rendered by him'.[29]

A subscription by the members had also raised £33 3s 6d, which had been used to purchase a telescope which, from the description given in a report on p. 5 of the *Walsall Advertiser* dated 2 November 1895, I believe to have been a traditional Victorian brass refractor of perhaps between 3 and 6 inches aperture. It had 'a solid base, an equatorial mounting' and what Sir Robert Ball described on the night as a 'neat little finder'. The great man said that he looked 'with some degree of envy, on that very beautiful telescope' and that he 'wished Mr. Robinson might have plenty of fine nights to use it, and that he might make some great discoveries by its means'. Mr Gill presented the telescope 'in the hope that it would often serve to remind him of his many friends who wished him well, and that when gazing through it at the celestial bodies he might not be too unmindful of sublunary matters'. After an amusing speech of acceptance, Henry Robinson concluded with an invitation to the members to 'come and look through the instrument, whenever convenient, but hoped that they would not all come at once' –at which point the audience broke into spontaneous laughter and loud applause, which was followed by Sir Robert Ball's lecture in his inimitable style.

The BAA Midland Branch

Henry Robinson's astronomical interests obviously waxed from this point, as in June 1896 he became a member of the British Astronomical Association, which membership he held until September 1915,[30] when it presumably lapsed, though he was still interested in astronomy (as I will show). Significantly, Robinson was also proposed as a Fellow of the Royal Astronomical Society, on 8 December 1899,[31] by his friends Sir Robert Ball and the Revd. John M. Bacon, plus Nevil Maskelyne, a descendant and namesake of the famous Astronomer Royal. Elected an FRAS on 9 February 1900, Robinson joined forces a year later with other like-minded friends, F.W. Nash and J.H. Reynolds, at a meeting held on 14 February 1901 in the library of the Birmingham Natural History & Philosophical Society, 'for the purpose of considering a proposition to form a Midland Branch of the British Astronomical Association, with Birmingham as the centre.' Robinson chaired the meeting, at which it was proposed to form a branch embracing the counties of Warwickshire, Staffordshire and Worcestershire.[32]

Surprisingly, Henry Robinson did not become the secretary of the new BAA Midland Branch, perhaps due to other commitments. He did however take up the position of vice-president,[33] and a letter dated 30 December 1901 sent to Robinson by his friend John

Bacon, suggests that once again Henry was a prime mover in this Midlands organisation, the clergyman referring to 'proof of the flourishing existence of the Branch which, like all else you take in hand, is sure to go ahead.'[34]

The proof to which he was referring was, in this case, a slim volume printed by Robinson following the last BAA Midland Branch meeting for 1901. The meeting took place on 12 December 1901, and the BAA Journal 'Reports' describe that evening's presentation as being 'devoted to a very able and philosophical treatise by Mr. W.H. Robinson, F.R.A.S., on the problem of life-conditions and possibilities from an astronomical standpoint'.[35] The title of this treatise was *Life in Other Worlds,* and fortunately for posterity Robinson printed and circulated a copy of his paper as a booklet at the request of the members of the Midland Branch.[36] This booklet, donated personally by Robinson, survives in the Local Studies Library at Walsall Local History Centre.

Life in Other Worlds (Walsall LHC)

Life in Other Worlds is an elegant look at how impossible it is to discover anything definite about the existence of life on our nearest neighbours in space by use of the telescope. It demonstrates that (at that time at least) we could only reason by analogy in comparison with the evolution of our own Earth. It pokes a little fun at the wilder excesses of both the English and American press in suggesting that there was life on Mars, and ends philosophically with some of Henry Robinson's religious musings on the situation of humanity in the universe.

Robinson's astronomical interests continued, especially in observing the planet Mars, as a report on his observations of the Red Planet given by him at the Midland Branch on 23 April 1902 shows,[37] but by the end of the 1902 season there were signs that the BAA Midland Branch was floundering.[38] Most of the meetings of the past session had been, with one or two notable exceptions, of an informal character, and by the end of the year the BAA Journal was reporting that the Branch Committee regretfully had to report 'a general lack of astronomical interest in the Midlands, which makes it difficult to carry on the work of the branch successfully'.[39]

As the Association's own history, *BAA – the First 50 Years,* says, there is no record of any further report from the Midland Branch after the 1902/03 season. They concluded that 'the difficulties were apparently insurmountable, and the Branch ceased its activities'.[40] There is no other evidence for the demise of the Branch – possibly if Mr Robinson had been secretary, the story might have been different, and it is possible that the public had other things on their mind, such as the Boer War and the rise of Germany in Europe.

The later years

In 1906 Henry Robinson relaunched *The Walsall Advertiser* under the control of a separate company: it began to be published by the Walsall Advertiser Co. Ltd, at 133 Lichfield Street.[41] By 1908 he had moved home to 63 Highgate Road,[42] and at the age of sixty-one was probably looking forward to a well-earned retirement in which to enjoy the then relatively dark, albeit gaslit, skies of the Walsall area. By 1911,[43] although still running his printing business, The Walsall Press, he had sold the *Walsall Red Book* franchise to his main competitors, T. Kirby & Sons, who continued to print the town directories until 1939. In 1911 the Walsall Literary Institute was disbanded after suffering a gradual fall in membership over a number of years.[44] In 1914, of course, the Great War broke out, and the following year the *Walsall Advertiser* ceased publication, perhaps a victim of the war.

85 Highgate Road, Walsall, 2002
(Stuart Williams, FRAS)

In 1916, Robinson, now almost seventy, moved to his final address, 85 Highgate Road,[45] which today is split into two flats. He was still operating his business from home, presumably on a much smaller scale since he no longer advertised from the offices at 133 Lichfield Road, and it is probably around this time that his daughter Margaret moved in as his faithful companion in old age.[46]

Both the astronomer and the journalist in Robinson were still active, however, and he tried to lift the spirits of his countrymen in a small way by penning both historical and astronomical articles for newspapers, such as 'Astronomy – A respite for the times',[47] Robinson's personal copy of which is preserved in the Local Studies Library at Walsall Local History Centre. At this time – 25 June 1915 – he was still a Fellow of the Royal Astronomical Society, and wrote a column for the *Stamford Mercury*. He used his first column to express his anguish at the 'greatest and most barbarous war the world has ever known', and over several months offered the night sky as a small respite from the 'rightly absorbing anxieties of the war'.

By 1916, Robinson was writing a similar column for his home town of Walsall.[48] As the first article, dated 21 October 1916, reveals, he was still a Fellow of the Royal Astronomical Society, and he continued to be well known in local circles as an astronomer, since he had been persuaded by 'several townsmen' to write a series of articles on astronomy. His old arch-rivals on the *Walsall Observer* newspaper kindly accepted his offer, and so in his twilight years he was able to occupy himself in astronomical writings. By 1920, it is probable that Henry Robinson was completely retired from the printing trade, as he had ceased advertising locally, and so came the end of an era in Walsall.

W. Henry Robinson, c.1920
(Walsall LHC)

Still occupied with astronomy and his other hobby of gardening as late as 1924, William Henry Robinson passed away, aged seventy-nine, early in the morning of Wednesday 17 February 1926.[49] His wife Lydie had died in 1901, and he was survived by his three sons, six daughters and ten grandchildren. His funeral took place on Saturday 20 February, the service at St Matthew's being followed by cremation at Perry Barr and interment at Rushall.

At the end, the *Walsall Observer,* his greatest competitor, had this to say of William Henry Robinson:

> Born a journalist, as it were, the late Mr. Robinson's biggest contribution was undoubtedly to the literary life of the town ... his pen was prolific and informative. 'Til the Sun Grows Cold' and 'Kathleen O'Leovan' are novels he produced, and he was the author of a volume of poems, some of which had real beauty and merit, but he will be remembered more for his occasional articles, many of which have appeared in the 'Observer' ... [A]stronomy and history were among the subjects on which he wrote, always with painstaking care and illuminating detail.[50]

Some monuments to Robinson remain in Walsall: the family grave, at St Michael's Church, Rushall, Walsall; the old Advertiser Offices at 133 Lichfield Street, now given over to other uses; and of course Robinson's lasting literary legacy, including the *Walsall Red Books,* his many newspaper articles, and those few astronomical works that survive.

From what little information I have been able to find, William Henry Robinson – known to friends as Henry – stands out as a man to admire. He deserves to be recognised for his remarkable local contribution to history, to literature and to the public understanding of science, as well as for his business acumen. I do not doubt that, were he alive today, he would be just as active, and delighted with the giant strides that science has made since his own times. I am sure that he would even now be taking advantage of computers, robotic telescopes and the Internet to expand his knowledge and to inspire the people of his home town of Walsall, which despite his great success he never left. Yet he too lived in exciting times, and he made the most of them with the tools at hand, a keen mind, boundless enthusiasm and a formidable capacity for hard work.

'The Late Mr. W.H. Robinson', *Walsall Red Book, 1926*
(Walsall LHC)

Acknowledgements

I should like to thank Walsall Local History Centre for access to local research material and permission to use photographs and other material from their collections; Miss P. M. Barber, Assistant Secretary of The British Astronomical Association, for extracts from the BAA Journal and *BAA – the First 50 Years;* Mr P.D. Hingley, Librarian of The Royal Astronomical Society, for details of Robinson's Fellowship proposal and election; Mr Roger Jones of Walsall, for drawing my attention to the report of Mr Robinson's presentation and telescope; and Dr Allan Chapman, of Wadham College, Oxford, for his inspiration to continue my research.

Notes and references

All sources quoted in the notes are at Walsall Local History Centre, Essex Street, Walsall, West Midlands, WS2 7AS; tel: 01922 721305, website: http://www.walsall.gov.uk/localhistorycentre. The Centre is the archives service and local studies library for Walsall Metropolitan Borough.

Of general interest, in relation to the history of the BAA Midland Branch: *Journal of the British Astronomical Association* Vol. **11**, pp. 239–240, 271, 311, 383; Vol. **12**, pp. 17–18, 116, 163, 237, 357; Vol. **13**, pp. 109, 160–161, 268.

1. Obituary of W.H. Robinson, *Walsall Observer, 20 February 1926, p. 9.*
2. The original *Walsall Advertiser* newspaper was established by J.R. Robinson in 1857 (*Walsall Red Book, 1907, p. xxxix),* but no copies are known to have survived. It changed its title to the *Walsall Advertiser & Newspaper* with the issue of 22 November 1862, with which issue it broadened its content to include more news and comment. W.H. Robinson became editor and publisher of the newspaper in April 1869 following the death of his father, J.R. Robinson, on 8 April (*Walsall Advertiser, 10 April 1869, p. 4),* and first appeared in the editorial column in the issue of 1 May 1869. In 1906, W.H. Robinson relaunched *The Walsall Advertiser* under the control of a separate company, The Walsall Advertiser Co. Ltd, at 133 Lichfield Street. The newspaper ceased publication in December 1915.
3. *Walsall Red Book* 1872, p. 23.
4. Ibid., p. 26.
5. The *Walsall Red Books* were published from 1872 to 1939, from 1911 under the imprint of T. Kirby & Sons.
6. Marriage Register of St Matthew's Parish Church, Walsall, 7 January 1874.
7. 1871 Census for Walsall.
8. 1881 Census for Walsall.
9. Ordnance Survey maps, County Series Sheet 63.11, 1887, 1:2500.
10. 1881 Census for Walsall.
11. Obituary of W.H. Robinson.
12. *Walsall Red Book,* 1905, p. 123.
13. Ibid., 1909, p. 155.
14. Ibid., 1907, p. 40.
15. Meikle Collections, Accessions 63 and 195.
16. Various volumes in the Local Studies Library and Pamphlet Collection, especially *Man Immortable* by W.H. Robinson, FRAS. (The Walsall Press, 1902); *Kathleen O'Leovan* by 'Maurice Grindon' (pseudonym of W.H. Robinson) (Simpkin, Marshall, Hamilton, Kent & Co., London, 1896).
17. Minutes of Walsall Literary Institute, Accession 107/2.
18. Obituary of W.H. Robinson.
19. Ibid.
20. Travel diaries of W.H. Duignan, Accession 48/1.
21. Autograph Letter Book of W.H. Robinson, 1888–1902, Accession 160.
22. Programmes of Walsall Literary Institute, 1884–1907 (bound, 4 vols).
23. Ibid.
24. W. Valentine Ball (ed.), *Reminiscences and Letters of Sir Robert Ball* (London, Cassell & Co., 1915).
25. Minutes of Walsall Literary Institute, Accession 107/2.
26. Programmes of Walsall Literary Institute, 1884–1907 (bound, 4 vols).
27. Ibid.
28. *Walsall Observer, p. 6; Walsall Advertiser, p. 5;* reports of Walsall Literary Institute meeting, published 2 November 1895.
29. *Walsall Advertiser,* 2 November 1895, p. 5.
30. Letter from Miss P.M. Barber, Assistant Secretary, British Astronomical Association, dated 25 March 1996, plus photocopy of *Journal of the British Astronomical Association,* **6,** 400, 455, both in Accession 985 (original at the British Astronomical Association library).
31. Proposal for Fellowship of the Royal Astronomical Society of W.H. Robinson (photocopy in Accession 985, original at the Library of the Royal Astronomical Society). Proposed 8 December 1899, elected 9 February 1900.
32. *Journal of the British Astronomical Association,* **11,** 186–187 (Photocopy in Accession 985, originals at the British Astronomical Association library).
33. *Journal of the British Astronomical Association,* **12,** 163.
34. Autograph Letter Book of W.H. Robinson, 1888–1902, Accession 160.
35. *Journal of the British Astronomical Association,* **12,** 163.
36. 'Life in other worlds', paper read by W.H. Robinson to the BAA Midland Branch at Birmingham, 12 December 1901.
37. *BAA – The First 50 Years, pp. 64–65.*
38. *Journal of the British Astronomical Association,* **13,** 381.
39. Ibid.
40. *BAA – The First 50 Years,* pp. 64–65.
41. *Walsall Red Book,* 1907, p. 133.
42. Ibid., p. 155.
43. Ibid., 1912.
44. Obituary of W.H. Robinson; Minutes of Walsall Literary Institute, Accession 107/2.
45. Obituary of W.H. Robinson; *Walsall Red Book,* 1917, p. 483.

46. Obituary of W.H. Robinson.
47. 'Astronomy: A respite for the times'. Collected newspaper articles by W.H. Robinson, FRAS, from the *Stamford Mercury*, 1915.
48. 'Astronomy'. Collected newspaper articles by W.H. Robinson, FRAS, from the *Walsall Observer*, 1916.
49. Obituary of W.H. Robinson.
50. Ibid.

Book Reviews

The History of Astronomy A Very Short Introduction

Michael Hoskin. Published 2003 by Oxford University Press.
ISBN 0-19-280306-9

Hoskins' work is the latest in a series of more than 100 Very Short Introduction titles published since 1995. It is intended, so OUP helpfully tells us within the fly cover and on its web site, 'for anyone wanting a stimulating and accessible way in to a new subject'.

As it covers Pre-History Astronomy to the discovery of the spiral nature of nebulae by Lord Ross in 105 pages, one cannot but expect the book to be composed of short 'data bursts' of information. However, Hoskin, in his eloquent style, has managed to capture the salient points of the evolution of astronomical thinking and endeavour most succinctly. Within those few pages room has been also found for 20 half tone illustrations without sacrificing continuity, and it is perhaps arguable that it really is possible to fit the proverbial quart into a pint pot!

Whilst I would not recommend this book to anyone with a serious enough interest in the history of astronomy to have already joined the SHA, I certainly do commend it to anyone with a passing or latent interest in the subject who may be considering joining us. The very next time somebody tells me they would like to know more about our favourite subject, I shan't hesitate to advise them to obtain a copy. Pocket sized and nicely printed without any apparent typos, if one may adapt an advertising slogan – the book does exactly what is says on the cover!

Kenneth J Goward, FRAS

Latitude: How American Astronomers Solved the Mystery of Variation

Bill Carter and Merri Sue Carter. Naval Institute Press. 2002. ISBN 1-55750-016-9.

This was a book that aroused immediate curiosity, bearing an obvious word play title affiliation to Dava Sobel's, 'Longitude'. Apart from that, the two books are quite different, in more ways than their 90 degree, geographical dissimilarity.

The Carters write an interesting account of how, since the 17th century, there was an unidentified anomaly in the positions of stars. Measurements from Greenwich differed slightly from those made in Paris and Berlin. Experimental error was blamed. When at last, in the 19th century, American observatories became sufficiently well equipped the effect was even more pronounced, either the stars were in the wrong place or the latitudes of American observatories were downright wrong. In reality, European observatories were too close together and it was not until geographically more widespread observatories were founded that the dual twelve month and fourteen month periods of polar motion could be resolved.

The effect was slight, amounting to a fraction of a second of arc in latitude. In 1888, the German astronomer, Karl Küstner, proposed that a variation in latitude existed but it was not until about four years later, in 1892, that the American amateur astronomer, Seth Carlo Chandler, concluded that there were in fact two simultaneous variations in latitude, with periods of twelve and fourteen months that accounted for the variation. Chandler spent more than twenty years on his quest, battling against his academic superior, Simon Newcomb. Chandler was proved correct, on the basis of altitude measurements taken with an instrument of his own design, the almucantar. For his work he was awarded the Gold Medal of the Royal Astronomical Society in 1896 and Küstner in 1910.

The variation in latitude is now a proven phenomenon (polar motion), wherein the slight imbalance of the earth due to the variable effect of tides, seasonal air mass movement and even the variable mass of tree foliage in the northern hemisphere causes the earth's spin axis to move around the geographical poles within a radius of about 20 feet (6 metres). Even this is important to geodetisists, as it affects global positioning to a small but measurable degree.

The Carters elucidate an obscure subject of which the majority of us are unaware. Nevertheless, it was, as they say, the first contribution to world astronomy that Americans were able to make. Their insight into 19th century American astronomy and its infighting is interesting and informative and I recommend their book.

There are two main criticisms. From the outset, the Carters insist on comparing measurements in Imperial and Metric. I don't know if this was left to the publisher, but we have measurements in inches (centimeters) and yards (meters), back and forth that have little correlation. After a few pages this becomes irritating…and it goes on throughout the book getting progressively sillier, with feet (meters) and so on. Secondly, 'Astronomer Royal' is a title and deserves capital letters, and Edmond Halley has two 'l's. I understand that the Carter's did originally

use capital letters for Astronomer Royal but the publisher changed this. The spelling mistake has been corrected in the latest printing.

Kevin J Kilburn FRAS.

THE HERSCHEL PARTNERSHIP as viewed by Caroline

Michael Hoskin. Science History Publications Ltd.
ISBN 0-905193-05-9

Most people interested in the history of science in general, and astronomy in particular, will be aware of the extraordinary achievements of William Herschel and his sister, Caroline. William: probably the greatest astronomical observer of all time and author of a quantum leap in telescope design and construction. Caroline: his tireless, indispensable and obsessively faithful assistant.

So does this new book by acknowledged Herschel expert, Michael Hoskin, add to what is generally available regarding this remarkable story? Most definitely. Many will be accustomed to the odd paragraph or two in general astronomical history books. Some will have delved deeper and enjoyed *The Herschel Chronicles* by Constance A. Lubbock and *Memoir and Correspondence of Caroline Herschel* by Mrs. John Herschel, and will have assumed that these hold the last word. They do not. It turns out that the published version of the former volume is substantially abridged. As Dr Hoskin points out, *The Herschel Chronicles* that most of us are familiar with may make for easier reading than the unabridged version, but as a historical source it is emasculated nevertheless.

The Herschel Partnership fills many gaps. It fleshes out the characters, and not just the major ones. After reading this book, William seems to me to be a bit more selfish – but pioneers usually are. Caroline, perhaps a bit more irascible – but the author invites our sympathies. The somewhat enigmatic brother - the musician and mechanic, Alexander - suddenly comes into sharper focus as a real human being. Of the other siblings, the oldest brother, Jacob, comes across as not quite the ogre we are used to. The youngest, Dietrich, is not such a self-serving wimp. One of the most admirable characters in this fascinating family, of course, is the father, Isaac. His love, support, and encouragement of his children, especially little Caroline, are made abundantly clear. On the other hand there is Anna, the hard-nosed mother, who had a different agenda for her youngest daughter.

Michael Hoskin also gives us succinct but ample details of the state of northern Europe during those turbulent times, especially during the early years in Hanover. Then there are the great years after the move to England of William, Alexander, then Caroline. First the music, and then astronomy, and more astronomy. What leaps from the pages is the sheer industry of these people, particularly those first twenty years after Caroline's arrival in England. The dogged application of mind plus hard work to achieve [William's] ambitions and overcome every obstacle is amazing. Again, the book contains many fascinating details of these momentous years.

Then, the slowing down as old age creeps in. Yet the author makes this just as interesting. Now, William's son, John, appears and begins to carry the standard. Alexander dies. William dies. Caroline returns to Hanover, even though by now she has spent most of her life in England. Her demeanour is not improved by years spent regretting the move, expecting to die at any moment, yet living on for another quarter of a century. But even in this "Hanoverian Twilight" she carries William's torch as high as ever.

The author's smooth narrative, not without its moments of dry humour, makes this a very enjoyable book. So much so that one can imagine re-reading it from time to time like a favourite novel. Yet it also works easily and excellently as a reference book. There are no unfounded speculations. What, for instance, caused Caroline's estrangement from William's household after his marriage? There are no guesses – and rightly so, because Caroline herself ensured that no one should ever know. A useful chronological list of all the children of Isaac and Anna Herschel begins the book. At the end come comprehensive notes on sources, detailed notes and references on the main text [a rewarding read in their own right], and two indexes: one for Herschel family members and a second general one. If I had to find a gripe, it would be that some of the pictures – a few of them new to this reader – have a very low contrast on the printed page. But this is a minor quibble.

Michael Hoskin's *The Herschel Partnership* may not be a huge tome, but its unassuming size belies the wealth of information and entertainment between its covers. Highly recommended.

Les Jepson

The first Asteroid: Ceres 1801-2001. Historical Studies in Asteroid Research Volume 1.

Clifford J Cuningham. Star Lab Press Florida ISBN 0-9708162-2-7

This opus is a delightful cornucopia of everything you ever wanted to know about Ceres, and more. It

is replete with many colour illustrations from ancient mythology and modern science. It starts with astronomers pondering the gap between Mars and Jupiter, for example Kepler in his preface to *Mysterium Cosmographicum* (1596) wrote, 'Between Jupiter and Mars I placed a new planet' but at the conclusion of his preface decided this went too far: 'I do not favour this piece of audacity.' Titius first formulated the arithmetic progression linking planetary distances in 1766, in an insertion into a book by a Swiss naturalist. Then Bode in 1772 plagiarised it, only admitting that he had done so in 1784, by which time it was his! This involved Bode in postulating that 'this chief planet between Mars and Jupiter must complete its revolution around the Sun in 4 ½ years.' Hegel reasoned that no planet existed between Mars and Jupiter, publishing this unhappy treatise in the year of Ceres' discovery. In 1800 astronomers formed the 'celestial police' in Gotha and decided to hunt for it. They were pipped at the post by a monk in Palermo, Giuseppe Piazzi. While other were making merry in the last night of the century, 31 December 1800, he trundled up to his meridian-telescope, watching each star for two minutes as it crossed over his line. At 8.43 p.m. that night Ceres appeared in Taurus. The harvest-goddess Ceres was especially associated with Sicily, and so he conferred her name upon it. Piazzi wrote some letters announcing his discovery, and why it probably wasn't a comet. However his letters mis-cited its declination. Being a little secretive over its whereabouts, he soon lost it. In September 1801 Carl Freidrich Gauss showed how to re-find it, by an obscure orbit-theory. He found it, he explained, 'when all hopes of discovering in the heavens this planetary atom, among innumerable small stars after the lapse of nearly a year, rested solely upon a sufficiently approximate knowledge of its orbit to b based upon these very few observations.' Its discovery announced in the Monthly Notices of the RAS in the summer of 1801 established the notion of a beautiful order in the solar system. Sir William Herschel proposed in 1802 that Ceres (and Pallas) should be called 'asteriods.' The dispute over whether or not they were planets finds an echo in our time, when astronomers are unsure whether Pluto should so be designated. This work contains much citation of primary-source material, and is assuredly the definitive book about Ceres and its discovery.

Dr Nicholas Kollerstrom

The Antiquarian Astronomer

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