Journal of Astronomical History and Heritage, 10(3), 198-210 (2007).

SIR ROBERT STAWELL BALL (1840–1913): ROYAL ASTRONOMER IN IRELAND AND ASTRONOMY'S PUBLIC VOICE

Allan Chapman
Wadham College, University of Oxford, Oxford, OX1 3PN, England, UK.

Abstract: Nineteenth-century Ireland, and especially Dublin, had a vibrant scientific tradition. And astronomy in particular was seriously cultivated, being part of an Irish tradition extending back to early medieval times. This paper examines principally the career of Sir Robert Stawell Ball, who, while holding three prestigious posts in Ireland, namely those of Andrews Professor at Trinity College, Dublin, Royal Astronomer of Ireland, and Director of the Dunsink Observatory, became famous for his genius as a popular astronomical interpreter, lecturer, and writer. The paper looks at Ball's wider career, the circumstances that provided a receptive market for astronomical information across the English-speaking world, and his massive outreach as both a lecturer and a writer.

Keywords: Irish astronomy, Dunsink Observatory, Armagh Observatory, Birr Castle, Robert Ball, biography, education and public outreach, nineteenth century astronomy

1 INTRODUCTION

Long before Dr Eric Lindsay became Director of Armagh Observatory, Ireland had a distinguished history in astronomy. It is all the more pity, therefore, that when modern scholars write on the history and achievements of Ireland, their attention invariably comes to focus upon only two, albeit high-profile, topics. One of these is literature, from the Bardic traditions to James Joyce and W. B. Yeats; the other is Ireland's long, complicated, and troubled political history, from Strongbow in the twelfth century down to Sinn Féin and the 'peace process' today. Yet unless an author is writing specifically upon the history of science, mention is rarely made of Irish scientific achievement, especially contributions to astronomy and its related sciences such as optics, physics, and telescope-making, and the communication of astronomical ideas to the general public.

2 THE FOUNDATIONS OF IRISH ASTRONOMY

Who was the first astronomical Irishman? It is hard to be certain, but it cannot be denied that the unknown individual or individuals who laid out the midwinter sunrise alignment at Newgrange around 3,200 BC must have been amongst the first (O'Kelly and O'Kelly, 1982). In more recent times, however, we know that Irish monks before AD 450 and during the following 'saints and scholars' period, were familiar with the elaborate processes by which one calculated the date of Easter for a given year from the spring equinox and the lunar cycle (see Croinin, 1995). This technique was largely regularised by the Venerable Bede of Jarrow in Northumbria around AD 700, and it came to be used across Europe, including Ireland (Ward, 1990: 27-34). What is more, the author of the most widely-read textbook on astronomy in medieval Europe was reputedly an Irishman (although some scholars have claimed that he was a native of Halifax, Yorkshire). He was John of the Holy Wood, Latinized to Johannes de Sacro Bosco, whose *De Sphaera Mundi* of ca. AD 1240 came to be universally known simply as 'Sacrobosco' and was still readily available, by now in printed form, until at least as late as 1647 (Pedersen, 2004).[1] Then in the late seventeenth century there was William Molyneux of Dublin, an astronomer and correspondent of both John Flamsteed and Edmond Halley, whose *Dioptrica Nova* (1693) was the first complete optical treatise to be written in the English language.

It was in the late eighteenth century, however, that Irish astronomy really began to develop. For while Ptolemaic astronomy would have been routinely taught to undergraduates at the early Trinity College, Dublin, after its foundation in 1591—perhaps from printed copies of Sacrobosco and more certainly from Ptolemy—it was the founding of two major observatories that firmly established modern research astronomy upon Irish soil. In 1783 Trinity College founded Dunsink Observatory, accommodated in elegant buildings and containing state-of-the-art research instruments, five miles north-west of Dublin (Ball, 1895: 233ff; Wayman, 1987). This was to be used by Trinity's Andrews Professor of Astronomy, and 91 years after its establishment, would come to be directed by Professor Sir Robert Stawell Ball. The other was Armagh Observatory, founded by Archbishop Robinson of Armagh in 1789-1791, though it only really became fit for major astronomical research after one of Robinson's successors, Archbishop Lord John Beresford, effectively re-endowed it in 1827. The formidable Revd Dr Thomas Romney Robinson (no relation of the founder), and himself a Trinity College man, would direct Armagh between 1823 and 1882, and would be succeeded by Eric Lindsay in 1937.

Indeed, it is interesting to note that Armagh Observatory was founded by, and effectively re-equipped by two Archbishops of Armagh, while both Dunsink and Armagh had Observatory Directors who were Church of Ireland clergymen: the Revd Dr Ussher at Dunsink and T.R. Robinson at Armagh (Ball, 1883; Bennett, 1990). For in the eighteenth and nineteenth centuries people saw astronomy as a theologically-potent subject, as the logical and mathematical mind of man observed, calculated, and thought its way towards an understanding of the logical and mathematical mind of God, to see astronomy as a truly sublime science.

Both Armagh and Dunsink, as well as several private observatories operated by independent gentlemen, were equipped with instruments for the undertaking of positional astronomy. Dunsink, for instance, had an 8-foot-diameter meridian circle built by Jesse Ramsden and Matthew Berge of London which, in 1808, was one of the most advanced astronomical instruments in Europe, while in 1827 Armagh obtained a fine mural circle and transit by Thomas Jones of London, as well as precision clocks and achromatic telescopes. In fact, in the decades immediately following their foundation,

both Dunsink and Armagh had better and more modern instruments than were available to the Astronomer Royal at Greenwich, for the great north- and south-facing quadrants at the Royal Observatory, which were built in 1725 and 1750 respectively, had become out of date—albeit venerable antiques—by the time they were replaced after 1813 (Howse, 1975: 25-26).

Positional astronomy reigned supreme in 1780. The angular positions of the fixed stars were mapped and tabulated, hopefully to within an arc-second of accuracy, in right ascension and declination, and against this stellar 'framework' the positions of the Sun, the Moon, the planets, comets and (after 1801) the minor planets, would be measured. It was all part of the wider process of quantifying the Newtonian Universe: before Newton's theories could be demonstrated as a fact of nature it was first necessary to obtain primary observational data of the highest quality to feed into the equations. Since ancient times, astronomy has earned—and has always retained—its credibility as the most advanced of the sciences, by first harvesting observational data of the highest accuracy before going on to use it to construct theories of the Universe.

Once Dunsink and Armagh Observatories led the way, nineteenth-century Ireland underwent a veritable blossoming in astronomy. At the academic collegiate level the Cork brewer, William Horatio Crawford, founded an astronomical observatory as part of Queen's College at Cork in 1878 (now University College Cork), an observatory, in fact, with a fascinating architecture in so far as the design was based on an ancient Irish church and cost £10,000. Its long lancet windows were really the slits for the transit instrument, and it was only the dome on the top of the central tower that disclosed its astronomical purpose. The Crawford Observatory comprised a wonderful fusion of modern-day scientific features and ecclesiastical and antiquarian elements (Dreyer, 1884; Grubb, 1880; *The Irish Builder*, 1879).[2]

Then, in addition to academic foundations, during the nineteenth century Ireland witnessed a flourishing of 'Grand Amateur' independently-funded serious research astronomy. Some of these astronomers were comparatively modest in their resources, whilst others were very wealthy. John Birmingham, for instance, was a moderately well-off country gentleman of Tuam in the west of Ireland, who owned a 4.5-inch Cooke refractor and some other relatively modest instruments (Mohr 2004). But Birmingham knew the night sky like the back of his hand, and in 1866 he shot to international fame in the scientific world when he discovered a nova in Corona Borealis. This achievement, in fact, would have been impossible for anyone who did not possess a detailed knowledge of the night sky and an intimate familiarity with star places and brightnesses.

And then there was John William Clerke, who managed the local bank in Skibbereen. He also owned a remarkably good set of scientific instruments, including a 4-inch refractor and, amongst other things, ran the local time service for the neighbourhood (Brück, 2002: 16-18). Clerke was a Protestant graduate of Trinity College, Dublin, but married into the Roman Catholic Deasy brewing family of Clonakilty. Indeed, this harmonious mixed marriage between two middle-class families itself suggests that we need perhaps to re-evaluate some popular misconceptions about Protestant-Catholic relations in Ireland, at least for the period before the Famine. But one of the astonishing astronomical fruits of the Clerke-Deasy marriage was the daughter, Agnes Clerke, who became in the 1880s (albeit then living in London) what might quite rightly be called the first proper historian of nineteenth-century astronomy, and in particular of astrophysics (Clerke, 1885; see, also, Brück, 2002, 2004).

Figure 1: The restored 72-inch reflecting telescope at Birr on 30 June 1997. Standing in front of the telescope (left to right) are Michael Hoskin, Sir Bernard Lovell and Patrick Wayman (photograph courtesy Mark Bailey).

In addition to these more modest amateurs, Ireland possessed three of the most outstanding 'Grand Amateurs' who flourished within Britain and Ireland in the nineteenth century. No one, of course, needs to be told of what Lord Rosse did, for his now-restored great 72-inch telescope is in itself an Irish national monument (see Figure 1). And then there was Edward Joshua Cooper of Markree Castle (County Sligo) who —with the assistance of his paid astronomer, Andrew Graham—compiled a major catalogue of more than 60,000 ecliptic stars (Cooper, 1851-1856) and between the late 1830s and 1860 undertook a long-term programme for the discovery of asteroids (Chapman, 1998: 48-50, 320-21; Glass, 1997: 13-16). Then at Daramona House (County Westmeath) in the 1880s and 1890s, William Edward Wilson (an uncle of Kenneth Essex Edgeworth) collaborated with scientists who included George Francis FitzGerald and George Minchin, and in the mid-1890s made some of the first photometric assessments of stellar brightnesses, although they had been preceded by earlier measure-

ments made in Dublin. He also made pioneering contributions to solar physics and celestial photography (Butler, 1986; Butler and Elliott, 1993; Elliott, 2004).

Victorian Dublin was also the home of one of the most outstanding firms of optical engineers: that of Thomas and his son Sir Howard Grubb. In the early 1830s Thomas Grubb was making his money as a manufacturer of iron-bed billiard tables and from general engineering work; in 1840 he became 'Engineer to the Bank of Ireland' where he designed machinery for engraving, printing, and numbering banknotes (Glass, 1997: 21-22). But in 1834 Cooper of Markree commissioned him to build an iron and stone equatorial mount for the 13.3-inch, 25 ft 3 inches focal length achromatic object glass which he had recently acquired from the eminent Parisian optician Robert Aglaé Cauchoix. The success of this instrument led to more astronomical commissions coming in, including an early one for a reflecting telescope from Thomas Romney Robinson of Armagh (Glass, 1997: 13-16). And after making a name for themselves as telescope engineers who mounted other people's optics, Thomas, and especially Sir Howard, went on to establish a major reputation for the manufacture in their own right of some of the finest-quality large-aperture achromatic lenses and mirrors of the age.

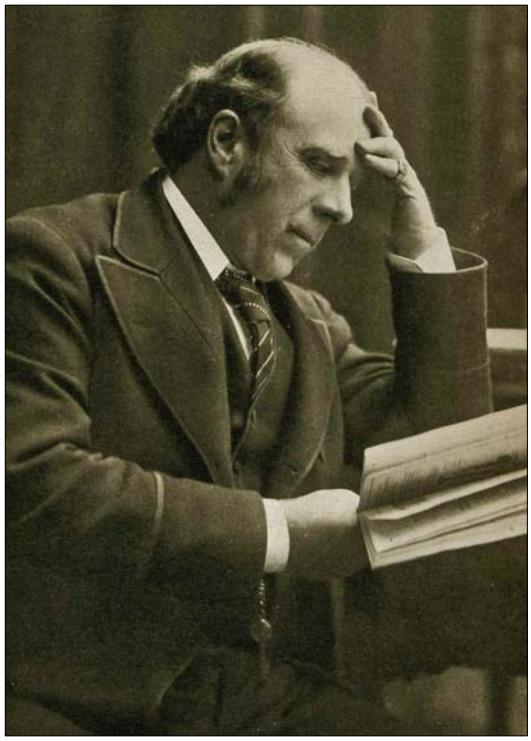

Figure 2: Portrait of Sir Robert Stawell Ball (after Ball, 1915: Frontispiece).

In addition to these above-mentioned Irish astronomers, scientists and precision engineers, there were many more, for it is important to realise that Sir Robert Stawell Ball (Figure 2) was not a 'one-off' so much as the product of a varied and vibrant tradition of Irish science, a tradition which, in Dublin in particular, comprised a rich assortment of figures—one of whom, in the medical world for instance, was the eminent surgeon Sir William Wilde, who was Oscar's father (McGeachie, 2004; Wilson, 1942).

3 SIR ROBERT STAWELL BALL[3]

One might argue that astronomy was in the ancestry of Sir Robert Stawell Ball. And while it is true that his father, Dr Robert Ball, owned a modest telescope, his real astronomical lineage had made its first public appearance in the 1660s when two of his ancestors, Dr Peter and William Ball, a pair of astronomical brothers from Mamhead, near Exeter, Devonshire, made important observations of Saturn and its rings with a long telescope and communicated them to the *Philosophical Transactions of the Royal Society* (Ball, 1915: 1, 2, 9; Ball and Ball, 1665). Indeed, Peter and William Ball were prominent early and original Fellows of the Royal Society, and were friends of Dr Robert Hooke. And as was the case with so many gentry families looking for opportunities, it was a later seventeenth-century Ball who emigrated to Ireland in the hope of making his fortune, settling in Youghal, and it was from this connection that Sir Robert sprang.

Sir Robert's father, Dr Robert Ball, had come up from Youghal to Dublin in 1827 to take up a post in Dublin Castle, becoming what might be called a civil servant. Yet as Sir Robert tells us, his father was not really suited to office work, being much more interested in science, and his wider contributions to Irish science and culture had been recognised by the bestowal of a doctorate from Trinity College in 1850 (Ball, 1915: 7-9; Ball, 1927). Indeed, from the 1830s to his sudden death in 1857, Dr Ball had been something of a driving force in Irish cultural life. He had, amongst other things, been the founding Secretary of the Dublin Zoo and Botanical Gardens, and seemed to know everybody who was anybody in Dublin, including scientists, professors, judges, medical men, and that redoubtable ecclesiastical eccentric, the Rt Revd Thomas Whateley, Archbishop of Dublin, with whom the Balls dined from time to time.

Sir Robert's parents had met at a British Association for the Advancement of Science meeting which took place in Bristol in 1836. On that occasion, the visiting Dr Ball had been entertained by a family living in Queen's Square, Bristol, where he had met his future wife, Amelia Gresley Helicar, who also had an interest in science. The couple subsequently married, settling in a large house at No. 3 Granby Row, Dublin, and their first son Robert (the astronomer) was born on 1 July 1840. Many decades later, when the British Association was again meeting in Bristol, he told a group of Association members that he was truly a child of the British Association (Ball, 1915: 8-9). Ball was descended, therefore, from a quite comfortably-off and well-known family, and following the sudden death of Dr Ball—whose interests were in natural history rather than physics—young Robert was proud to recall the names of those eminent men of science who had sent condolences to his mother. Sir Richard Owen, the illustrious comparative anatomist, in particular had drawn attention to Dr Ball's achievements, and had generally visited at 3 Granby Row whenever he was in Dublin.

Sir Robert Ball was, as a subsequent obituarist was to put it, "… the typical Irishman of convention, and his geniality and sense of humour, which were always combined with shrewdness, made him universally popular." (Ball, 1927). He was, amongst other things, a born raconteur, but he also possessed an acute eye

for human idiosyncracy. It is also clear that Dr Ball himself was no dour stick, and one senses from his son's subsequent recollections that he had a distinctly scatty sense of humour which his son inherited. Indeed, it seems that one rarely had to probe deeply to find a captivating strain of eccentricity in Victorian Dublin, from Archbishop Whateley's invitation of celebrity mediums to his Palace to try out theologically heterodox séances to a passion for 'charades' and parlour games in the houses of the great and good of Dublin (Ball, 1915: 43-61). It is important to understand a man's personality, background and driving forces if one wishes to make a balanced assessment of his achievements. Robert Stawell Ball was the child of a cultured family living in a world where colourful personal traits, firm friendships, intellectual rigour, courtesy—and fun—were both accepted and respected. And if his education and First Class Degree from Trinity College after 1857 helped to define him as a scientist, so his genial personality, love of telling stories and acute social sense were essential to his subsequent career, first as a tutor, then as a university teacher of brilliance, and by the 1880s as a mesmerising public lecturer.

As a boy and a youth, his mediocre performance as a classical scholar had failed to display his brilliance at Dr Brindley's private school, Tarvin Hall, near Chester, where he had been sent by his parents to obtain his secondary education. His conspicuous gifts for mathematics, mechanics, and experimental science, so it seemed, cut little ice there (Ball, 1915: 18-26). But upon his return to Ireland following his father's death, and his entrance into Trinity as an undergraduate, Ball began to find his intellectual feet. His gift for friendship stood him in good stead, not to mention the good intentions of several Trinity professors who had been friends of his father, and who provided help. But it was at Trinity that Ball's mathematical and scientific talents were properly recognised, while a formative event during his student years had been his reading of the Cincinnati Observatory Director, Ormsby MacKnight Mitchel's *The Orbs of Heaven* (English edition, 1853), which fired his astronomical imagination. Ball also won a series of prestigious scholarships—the Lloyd Exhibition, Gold Medallist in Mathematics, and University Student—which gave him a £100 *per annum* scholarship income for seven years, and enabled him to live without burdening his widowed mother. After completing his degree, he apparently continuing to live at home, at 3 Granby Row—which was a short walk from Trinity—and he was able to undertake independent 'postgraduate' studies (Ball, 1915: 31-32).

Then in 1865, a job opportunity came his way, on the recommendation of his Trinity friend, Dr Johnstone Stoney. William Parsons, Third Earl of Rosse, was looking for a tutor for his youngest sons Randal, Clere, and Charles, and the 25-year-old Ball got the job. Moving to Birr, Ball soon made firm friends with the Earl, who also gave him pretty well full rein with the 72-inch telescope (Figure 3). What an inducement, indeed, to do serious astronomy—having the world's largest telescope at one's personal disposal whenever the Earl himself was not observing! And as the Earl and Countess Mary—herself an expert photographer with serious scientific interests—spent part of each year in London, mainly when Parliament was in session and the Earl was sitting as Irish Representative Peer in the House of Lords, Ball often travelled with them.

As a former President of the Royal Society, Lord Rosse knew everyone in British science, and made sure that Ball met everybody of note, especially in astronomy. It was in the company of Lord Rosse, for instance, that Ball visited the astrophysical observatory at Tulse Hill in South London, and met its owner, the famous [Sir] William Huggins. Lord Rosse also introduced Ball to their fellow Irish astronomer and nova discoverer, John Birmingham of Tuam (Ball, 1915: 62-79, especially 74; Mohr, 2004).

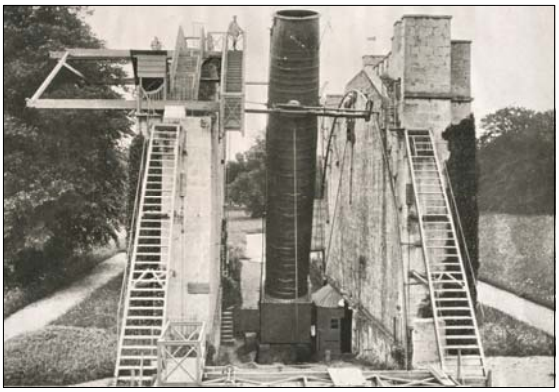

Figure 3: Lord Rosse's 72-inch telescope at Birr Castle (after Ball, 1915).

On the night of 13 November 1866, Ball kept watch for a hoped-for shower of meteors from the constellation of Leo. There had been impressive showers in 1833 and in 1800 (see Dick, 1998), and astronomers wondered, following the suggestion of the German astronomer, Heinrich Olbers, in 1833, if there would be another show in 1866 (Ball, 1915: 70-74; see, also, McCall et al., 2006). There was indeed, and it was spectacular. Ball left a vivid description of the meteor storm which developed as the night of 13 November progressed, and he was one of many astronomers who helped, thereafter, to advance the science of meteor studies, with the realisation that in addition to sporadics there were, perhaps, swarms of meteoroids orbiting around the Sun, and when these swarms crossed the Earth's orbit they would burn up in our upper atmosphere and produce spectacular meteor storms. In 1869 Ball's friend Johnstone Stoney delivered a lecture in which he discussed the possibility of meteor showers being caused by shoals of matter orbiting in space and entering the Earth's atmosphere, while Stoney and the Irish astronomer A.M.W. Downing would become the first, in principle, to use the Leonids as a way of predicting meteor storms (Ball, 1915: 70-72). And nearly two decades later, Ball (1885) would devote a 40-page chapter to 'Shooting Stars' in his best-selling book, *The Story of the Heavens*.

It was also at Birr Castle that Ball undertook his first original piece of research in that branch of mathematical astronomy which he most loved: geometry. From January 1866 to August 1867, he used the great Rosse telescope to observe and measure with a micrometer the exact position angles of numerous small nebulae. Because the telescope was mounted in the altazimuth and not in the equatorial plane, it was necessary to make corrections when reducing the

positions of these and other nebulae in order to establish their precise right ascensions and declinations.

Lord Rosse died (at Birr Castle) on 31 October 1867, following a surgical operation on his knee which seems to have gone wrong—as was not infrequent in that pre-antiseptic era of surgery. Lord Joseph Lister had only just published his preliminary researches into surgical sepsis prevention in March 1867, and it would take a good few years before his ideas about germ infection became generally accepted. Yet Ball's two years at Birr Castle had 'put him on the map' as an astronomer, not to mention his making long-standing friendships with his pupils. One of them, the Hon. Sir Charles Parsons, would go on to become one of the greatest mechanical engineers of his day, and invent the steam turbine engine. It was Parsons' steam launch, *Turbinia*, in fact, which out-raced every ship in the Royal Navy at the Spithead Review in 1897, and a decade later would lead to a revolution in marine engine design (Scaife, 2000).

Back in Dublin, Ball soon found opportunities opening up before him, and in 1867 he was appointed to the Chair of Mathematics and Mechanics at the newly-established Royal College of Science, Dublin. It was in this post that Ball's gifts as a public lecturer soon made themselves obvious, and won him students. But in this respect, Ball had much more than a ready tongue and a pleasing manner: he meticulously prepared his materials, using diagrams, drawings, and lantern slides to communicate concepts in physics and mathematics to his students. And having a permanent job, he now got married, to Miss Frances Elizabeth Steele, who came—like Ball himself—from learned public Dublin, for her father was Curator of the National Museum of Ireland. They enjoyed a long and a happy marriage, and just as Dr Valentine and Sir Charles amongst Ball's own brothers won knighthoods and Fellowships of the Royal Society, so his own children seem to have been successful; it was Robert's son, Valentine, who edited the papers and reminiscences of his father (Ball, 1915: 11).

4 EARLY ACADEMIC CAREER AND RESEARCHES

Although Ball's public academic career began when he was appointed to the Royal College of Science Chair in 1867, his rise to public prominence began in 1874 when he succeeded Dr Franz Friedrich Brünnow as the prestigious Andrews Professor of Astronomy at Trinity College. This was one of the great astronomical chairs, and the foremost astronomical professorship in Ireland, carrying with it the title 'Royal Astronomer of Ireland'. A year later, while still no more than 34 years old, Ball was elected a Fellow of the Royal Society and, in addition to teaching duties in Trinity, became Director of the Dunsink Observatory, which carried with it a fine residence, several acres of land, elegant gardens and stables, and all the necessary appurtenances whereby one might truly live like a gentleman.[4] But because research was becoming increasingly seen as a defining function of a university professor, Ball felt obliged to find suitable research projects on which to work and, hopefully, make original discoveries.

For six decades up to his death in 1882, Ball's 'opposite number' in Irish astronomy, Thomas Romney Robinson, had been assiduously observing at Armagh. Most of Robinson's work was devoted to astrometry, such as measuring the right ascensions and declinations of celestial objects and determining the elements of binary star systems. But by 1874, such work—ground-breaking though it might have been in 1830, and useful as it still was—had in many ways become routine.

During the 1860s, a revolution had taken place in astronomy, bringing into life the new sciences of solar physics and astrophysics, with their cascades of spectacular discoveries and their demand for new technologies such as large spectroscopes, photographic apparatus and adjacent chemical laboratories to maintain the research momentum. But in this 'new astronomy' it was the independently-wealthy and therefore administratively-unencumbered 'Grand Amateurs' who had staked out the original territory and had already stolen the lead, and not the academically-accountable public and university observatories. For people like William Huggins (whose private Tulse Hill Observatory in London was visited by Lord Rosse and Ball, probably in 1866), the Americans Lewis Rutherfurd and Henry Draper, and to some extent the Italian Jesuit Father Angelo Secchi (whose Vatican Observatory stellar spectroscopic researches were funded by the Roman Catholic Church), were all independent scientists, accountable to no Boards of Governors for their time and provision of resources. Indeed, it was not until astrophysics had already proved itself as an awe-inspiring branch of science that any institution (other than the Vatican) was established for its further study, and this came about with the founding of the Potsdam Astrophysical Observatory, in Germany, in 1874.

Robert Ball knew that his professorial resources at Dunsink would not enable him to work in the new science of astrophysics, for Dunsink's instrumentation (just like that of Armagh), excellent as it was in its way, was designed for meridian and astrometric research, and the money was not available to equip the Observatory for astrophysical work. Ball therefore endeavoured to find a serious branch of astronomical research which was firmly within the resources of his institution, and in which he could make a major contribution to the knowledge of the Universe.

One might suggest that his chosen line of research was made in accordance with two factors. One was the instrumental strength of the Dunsink Observatory, and the other was his own natural turn of mind as a scientist. Instrumentally speaking, Dunsink had an excellent 11.75-inch refractor, the object glass of which had been made in Paris 40 years before by the renowned Cauchoix (Figure 4). Having been owned originally by the cantankerous Sir James South, and subsequently presented by him to Trinity College, Dublin, in 1863, it had been beautifully re-mounted soon after in a fine clock-driven iron equatorial mount by Thomas Grubb (Ball, 1897: 12-14; Glass, 1997: 29-32). So Ball had at his disposal a fine old lens which still gave crisp star images, and was set in a beautifully-engineered mount of the latest design. The telescope is still in full working order at Dunsink,[5] and Ball (1885) supplied a pair of detailed engravings of the interior and exterior of the dome and telescope in his *Story of the Heavens*.

And this chimed in nicely with Ball's scientific interests, for at heart he was a geometer and a theoretical mathematician, with a love of fine technology, who enjoyed the business of astronomical observation. He was not by instinct an experimental physicist, as the new breed of astrophysicists tended to be. Indeed, when he was in Canada and in the United States in 1884, being genuinely impressed by the wonders of multiplex telegraphy and other electromagnetic demonstrations at American scientific institutions, he often lamented his ignorance of electrical physics and its related science and technologies, and, in his travel diary, he noted the need, upon returning to Ireland, to read up on these fascinating subjects (Wayman, 1986).

Considering these factors, therefore, one can understand why Ball decided to pursue astrometric research at Dunsink, where the 11.75-inch refractor—in conjunction with precision micrometers—could be used to detect and to quantify tiny positional changes between the fixed stars. Central to these researches was his project to re-determine several important stellar parallaxes, and most notably that of 61 Cygni (which was first determined by Friedrich Wilhelm Bessel in 1838). But what in many ways must have been more exhausting, from the sheer range and routine of the measurements that had to be made, was the determination of the relative positions, over time, of 368 small red stars (F.W.D. and G.T.B., 1915: xviii; Knobel, 1915: 231-233).

The measurement of the positions of the small red stars promised, in 1874, to be cosmologically significant, for the Italian astronomer, Giovanni Schiaparelli,[6] had suggested that the small red stars might well form part of a local star cluster to which the Sun could also belong. And if we and this local cluster were moving through space as a gravitational 'family', as it were, then the 368 red stars should display no parallaxes, or else very similar ones as observed against non-red stars that were not part of the cloud. Yet after a decade of meticulous measurement, it became clear that the 368 small red stars did not appear to form part of a cluster. Of course—as Ball was aware—*disproving* a theory also constituted an advancement of knowledge, although his negative results must have been deeply discouraging.

The rest of Ball's career as an observational astronomer at Dunsink, and between 1892 and 1913 as Lowndean Professor at Cambridge, was largely devoted to the meticulous measurement of the parallaxes of a wide variety of stars, for it was from such measurements that astronomers could discover their distances. But this work was seriously affected by the deterioration of his right eye after 1883, the increasingly painful state of which required its surgical removal in 1897. And by the time that he was working at the much better-equipped Cambridge University Observatory,[7] he was able to use photography as a faster, more time-saving and more accurate method to determine stellar parallaxes than the older 'eye at the micrometer eyepiece' visual technique. By using photography, a star field could be photographed exactly with a 20- or 30-minute guided exposure, and the resulting plate could then be measured at leisure during daylight hours on a specially-devised plate-measuring machine. At Cambridge, however, Ball seems to have done relatively little observing himself, leaving much of the parallax work, for instance, to his junior colleagues, Arthur Robert Hinks and Henry Norris Russell (F.W.D. and G.T.B., 1915: xix). By the late 1890s, with impaired eyesight and an established international reputation as a writer and lecturer on astronomy, it seems to have been teaching that had the greatest claim upon his time and energies. In this context, his *A Treatise on Spherical Astronomy* (Ball, 1908) was written especially for the use of university students.

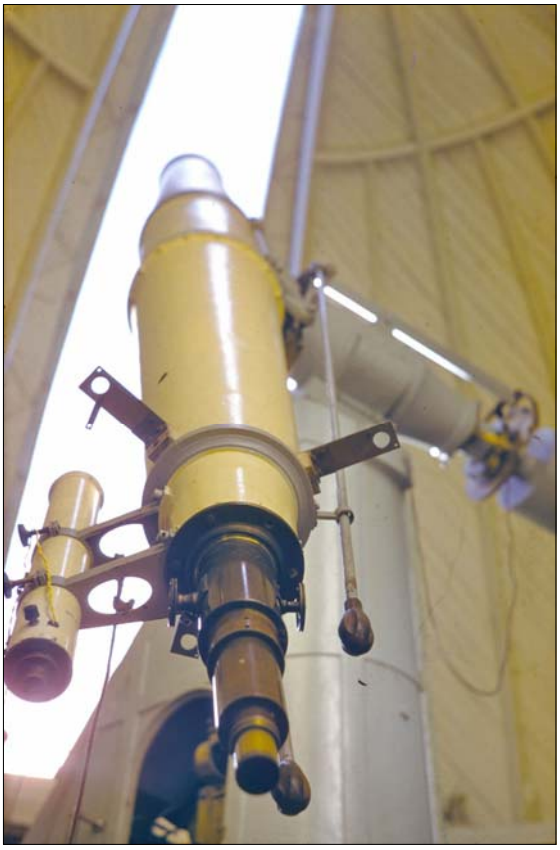

Figure 4: The 11.75-inch refractor at Dunsink Observatory, known as the 'South Telescope' after Sir James South who in 1863 presented the lens, made by Cauchoix of Paris in 1829, to Dublin University. It was installed by Thomas Grubb of Dublin in 1868, and was a favourite instrument of Robert Ball. It is still in place. When it was made, the lens was the largest object glass in existence and was used in 1830 by Sir John Herschel to discover the sixth star in the Trapezium in the Orion Nebula. This photograph was taken in the 1950s by Hermann Brück (courtesy of Mary Brück).

5 SIR ROBERT BALL, THE ASTRONOMICAL COMMUNICATOR

Ball's contemporary and enduring historical reputation lies not in his achievements as an observational astronomer, observatory director or theoretical geometer, but as a teacher and interpreter of astronomy. Of course, the appellation 'populariser' springs to mind, and while Sir Robert himself would have eagerly embraced this title, we must not forget that in the century and more since he was active, the term 'populariser' has slid down-market somewhat, and now often carries the overtone of professional 'presenter' rather than front-rank expert discussing state-of-the-art learning, as it did in Victorian times. An indication of this change of usage, indeed, is that when the Irish astronomical historian Agnes Clerke (1885) published her *Popular*

History of Astronomy during the Nineteenth Century she was not averse to using the word *'Popular'* in the title of a major and quite monumental work of scholarship that described, interpreted and argued its way through the momentous intellectual and technical changes through which astronomy had passed since 1800, and was aimed at a cultivated and literate audience.

But terminology apart, it is clear that Robert Ball was a natural communicator (Figure 5) who was at pains to constantly perfect his art, both as a way of communicating the subject to the wider world and of making a very substantial additional income.

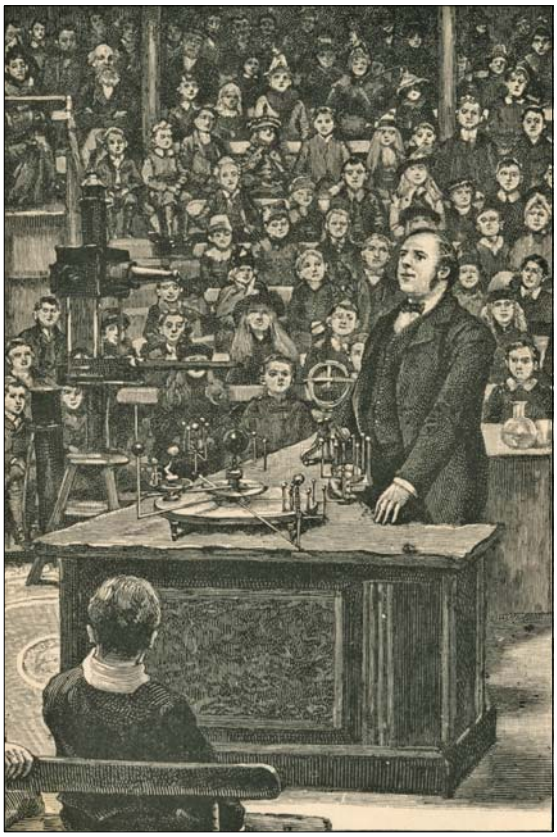

Figure 5: Sir Robert Stawell Ball lecturing to young people at the Royal Institution, London (after Ball, 1889a: Frontispiece; courtesy B. Bartlett).

Ball's gift as a communicator first seems to have manifested itself around 1859, when, as a Trinity College undergraduate, he delivered an impressive talk on "The Gulf Stream" to a meeting of the Dublin Philosophical Society (Ball, 1915: 118). And then, of course, he became a skilled and confident tutor to the three younger Rosse sons, and had a lifelong effect upon them. Thereafter, both as Professor at the Royal College of Science and as Andrews Professor at Trinity, he became noted not only for the verbal clarity of his lectures, but for the extent to which he would go to devise visual aids to get across complex ideas. These included working models, lantern slides, and even lantern slides with moving parts which simulated—let us say—planetary motion when projected onto the screen. But perhaps even more than all of these things, Robert Ball very clearly *enjoyed* lecturing, and seems to have loved it more and more as the years went by and he became a stunning master of his art.

His first paid lecture—which did little more than cover his expenses with its 14 shillings payment—was given at the Belfast Athenaeum on 4 February 1869 (Ball, 1915: 118). Then, in 1874, he received an invitation to lecture to the Birmingham and Midland Institute. And as he had just taken up his Andrews Professorship at Trinity, he felt it only right that he should speak on an astronomical event, instead of the talk on mechanics which he had been originally requested to deliver, and so he lectured very successfully on the transit of Venus of that year.

But Ball's enduring career as a lecturer to non-academic audiences really blossomed after 1879, when Richard Anthony Proctor (see Hutchins, 2004) left England to embark on a world lecture tour and needed a replacement for the Gilchrist Trust Lectures, which he was due to deliver. Proctor, who was only three years older than Ball, already enjoyed an illustrious reputation as a serious popular lecturer, although unlike the genial Irishman, he had a difficult and prickly side which won him many enemies in the Royal Astronomical Society and elsewhere. So his world tour of 1879 was something of an escape from the scientific controversies in which he was enmeshed in London. The Gilchrist Trust was a charity that aimed to put on lectures directed mainly at working-class audiences, operating through Mechanics' Institutions, chapels and other venues. The first of Ball's Gilchrist Lectures was delivered in Rochdale on 27 January 1880 (Ball, 1915: 216-217), with succeeding lectures in Blackburn and other towns in Lancashire, Yorkshire and elsewhere. The Gilchrist Lectures drew huge crowds, and on one occasion, Ball later recorded, a lecture started 20 minutes before the scheduled time because at that time the hall was already so tightly packed that the chairman declared "Not a single human being can get in, so why delay?" (Ball, 1915: 216). Thus it soon became obvious that in addition to being engaged by what was a charitable body, Ball could also attract serious paying audiences, and his career as a lecturer was born.

In Victorian times, the public lecture—like the sermon—was not only a major instrument of communicating ideas but was a popular social occasion as well (e.g. see Inkster, 1978, 1980). Lectures on all manner of topics were on offer on the commercial circuit, and just like TV agents today, profit-making lecture agencies abounded, especially across the English-speaking world. Explorers, missionaries, military heroes and scientists all offered their wares, and in a major city, such as Manchester or Belfast, a person might choose whether he or she wanted to listen to a lecture on the Solar System, the life of Nelson, ancient Egypt or travels in China. And crucial to this lecture industry was a burgeoning communication system, and a society which had more leisure and more spare cash in its pocket to spend on stimulating nights out. Nor would Ball or any of his fellow-lecturers have got anywhere without a fast and reliable railway system, cheap newspapers and magazines, and the electric telegraph to publicise impending performances, not to mention a host of spacious and comfortable venues (town halls, Free Trade Halls, theatres, institutes, chapels and such) which could seat 1,000 or more people. And by 1884, when Ball embarked upon his first lecture tour of Canada and the USA, fast and luxurious ocean liners and a parallel infrastructure in

the New World and Australia meant that one could comfortably and profitably lecture one's way around the world if one had the standing to attract paying audiences. Indeed, it had been Charles Dickens who led the way with his American tours of 1842 and 1867, where he read selections from his novels, and was mobbed in the streets by ecstatic fans (Ackroyd, 1991). Then two years before Ball, in 1882, Oscar Wilde had embarked upon his own outrageous American tour in the wake of Gilbert and Sullivan's box-office success, *Patience*, lecturing on poetry and aesthetics, resplendent in a get-up somewhat resembling a Little Lord Fauntleroy suit, complete with knee breeches and velvet jacket, with long hair and carrying lilies (Ellmann, 1987).

By 1884, America was fully geared up to mass entertainment of all kinds, with an abundance of comforts and novelties. Some American cities had electric lighting and telephones, while the Madison Square Theatre in New York, even had an ice-blower-cooled air-conditioning system to provide relief from the fierce summer heat (Wayman, 1986: 188). Sir Robert comments on these and other novelties (such as receiving invitations by telephone) in his travel diaries, not to mention details of luxury liners, hotels and restaurants, for he very much enjoyed the luxuries of life.

Over the years, Ball built up a repertoire of lectures which could pack a large theatre, and in his son's *Reminiscences* in particular one learns much about his lecturing circuit. "A Glimpse Through the Corridors of Time", for instance, given to inaugurate the new Lecture Hall at the Birmingham Midland Institute on 24 October 1881, became a perennially popular component of his repertoire. Dealing with the history of the Solar System as it was then understood in terms of gravitational physics, it brought the audience face to face with big concepts regarding time and space. Subsequent lectures on the Moon, the Earth as an astronomical body, volcanoes, the physics and chemistry of the stars, and many more besides indicated that he possessed a formidable armoury of material.

But what was Ball really like as a lecturer? An early glimpse is to be found in some of the reviews published following his first American lectures in 1884. The *Boston Herald* for 15 October 1884, for instance, described him in a recent performance in that city as having hesitant speech, and being "… sometimes clergymanic." On 21 October, on the same lecture tour, he admitted in his diary "I know I stammered and hesitated horribly." These are interesting comments to read about a man who was already reckoned to be a skilled lecturer, although he had to admit that his lecture topic (21 October) on the "Conservation and Dissipation of Energy" was an "… uphill task …", and no doubt much more demanding on his audience than a well-presented tour of the Solar System (Wayman, 1986: 193).

But what always strikes one is Ball's genuine modesty and willingness to learn from his critics. For Sir Robert was no flouncing celebrity, given to sulking or crying if criticised, but an honest-to-goodness practical man who recognised that the audience paid and that he was the piper, whose tune must be sweet if he was to stay in business. Indeed, taking recent newspaper criticism on board, on 25 October he resolved upon four points of technique to observe in future lectures. They were: (1) write out lectures and do not improvise; (2) do not speculate, but concentrate on maximum clarity; (3) avoid digressions; and (4) do not make jokes if the joke serves no purpose, otherwise it will only detract from a clear exposition (Wayman, 1986: 194). Indeed, these guidelines are just as good for a lecturer to follow today as they were over 120 years ago, because they are about common sense, and clarity as against showiness.

In that pre-microphone age, Ball took it for granted that clarity of diction and a good, clear, projected delivery were fundamental. And while he eschewed improvised or *ex tempore* lectures, he admitted that, by practice and by sheer repetition, he came to know his various lectures off by heart, so that he often *could* lecture without notes. Across a public lecture career that spans from the 1870s through to 1910, it has been estimated that Ball delivered more than 2,500 lectures (Jones, 2005: 35); we do know that he gave 700 alone between 1874 and 1884 (Ball, 1915: 224). And during the 30-odd years of his career, it has been estimated that around one million people, on both sides of the Atlantic, heard him lecture (Jones, 2005: 35).

Why did he do it, and considering the fact that he was a full-time academic astronomer, in Dublin and, after 1892, in Cambridge—and not a professional lecturer—how did he find the time to lecture so often away from his formal academic bases? Yet in the much more leisurely world of Victorian academe, he seems to have experienced no special difficulty in dividing his year between university teaching and lecture tours. It is notable that after completing his parallax measures of 61 Cygni and other stars in the mid-1880s, he does not seem to have done any more serious astronomical research, which is all the more remarkable, indeed, since he had gravitated to Great Britain's premier university observatory directorship upon becoming Lowndean Professor at Cambridge. But in Cambridge observational research was conducted under Ball's direction, rather than by him personally. In this respect, there were some parallels to Sir George Biddell Airy's management of the Royal Observatory, Greenwich, between 1835 and 1881, for Airy himself hardly ever touched a telescope, although he managed a highly-efficient team of observers.[8]

One reason why Ball lectured so much was because he enjoyed it, for once an art has become second nature to its practitioner it becomes an aspect of one's self-expression. As he once told an enquirer into his mastery of his art, he no more tired of lecturing than a skilled golfer (and Sir Robert loved golf) got tired of potting balls, or 'W.G.' (Dr William Grace, the legendary cricketer) got bored with scoring centuries. So lecturing became a part of his personal expression (Ball, 1915: 220).

But perhaps the real driving force was financial profit, for Ball did not generally lecture gratis, knowing full well how to argue with agents or impressarios in order to obtain the highest fee. When chided about being mercenary, he replied that he lectured "… on behalf of a certain married lady with five children who is solely dependent upon her husband for support …", since he had a wife and family to maintain (Ball, 1915: 224). He did, however, deliver lectures to charitable bodies for which he claimed no fee. And as he clearly

enjoyed life's luxuries, one can understand how he found a bare professorial salary inadequate and in need of augmentation from elsewhere. Fond of lecturing as he was, Sir Robert would not board a train to cross the country to a lecture venue until his fee and expenses had been agreed upon. And he was not always cheap. In 1908, for example, the Manchester Astronomical Society (1903-1909) minute books record that an attempt to bring him to the City to deliver a public lecture had to be abandoned because the Society could not meet the high fee which he was demanding. Sadly, the exact sum that he asked for is not recorded, but there are several other occasions when explicit sums were discussed. On the other hand, in 1901 Sir Robert lectured gratis in Cardiff, probably to the Astronomical Society of Wales (*The Cambrian Natural Observer*, 1901), and he returned to London by the night train.

Even at the outset of his public lecturing career, on 28 August 1884, Sir Robert certainly knew how to charge. Having recently arrived in Montreal as part of the delegation of scientists attending the British Association for the Advancement of Science meeting in Canada, on that day he was approached by a Boston lecture agent. Ball said that he was willing to lecture at £40 a time, with the agent receiving a 10% commission. However, the tour was a little slow in getting off the ground—understandably so, perhaps, for Ball planned on earning in one hour almost as much as a British labourer would earn in a year—but things eventually took off and by 31 October, when he was preparing to sail home to Ireland, he noted: "… after the lecture [in Boston] I was handed a cheque for 1,000 dollars. I believe that this is the largest sum I have ever received at once." (Wayman, 1986: 195). This would have been equivalent to about £250 sterling. Teething troubles over, the amiable and amenable Ball soon adapted to his American audiences, and on 27 October, towards the end of his tour, he wrote: "I believe I would make £100 a week if I stayed here." (Wayman, 1986: 194-195).

Quite apart from the very lucrative lecture circuit, Ball clearly appreciated the Americans and the Canadians, and he met and socialised with numerous scientists, including Asaph Hall (the discoverer of the Martian satellites) and Charles Young (the spectroscopist who confirmed the presence of the 'reversing layer' in the solar atmosphere). Indeed, he styled the company of his new American friends "… perhaps the most intellectual society I have ever had the good fortune of meeting." (Wayman, 1986: 190). He was also struck by the engaging modesty of these individuals, for when one was dining or talking with a group of American *savants* there seemed to be no one-upmanship or desire to dominate the conversation. Quite simply, they got on well together and discussed ideas in a fair manner. One also wonders to what extent Ball's own jovial personality may have contributed to the merriness of these gatherings. Indeed, Ball was to make return visits to Canada and the USA in 1887 and 1901, and it is apparent that in addition to the dollars, he clearly liked the Americans and felt comfortable with them. In this context, on 14 January 1902 he remarked to a friend as the ship *S.S. Saxonia* approached Ireland after what must have been an exhausting eleven-week tour,[9] that although he had delivered 48 lectures, shaken hundreds of hands and "… spoken to many thousands …", he had not seen a single '*American*'. "The American I have *not* seen is the tall, swaggering, tobacco-chewing Uncle Sam of the stage and fiction. I have met scores of the most charming, well-bred, well-educated and cultivated people that this earth can show, but of the dollar-worshipping vulgarian that the American is reputed to be at home I know nothing." (Ball, 1915: 352-353).

Ball lectured at all the great venues of the Victorian and subsequent ages. He regularly addressed the British Association at its annual meetings around Britain, gave Friday Night Discourses at the Royal Institution (see Figure 5), and in 1907 even gave a lecture to 950 prisoners in Dartmoor Gaol. As he amusingly told his son Bill (William Valentine Ball) beforehand, he was going to address a distinguished audience, containing lawyers, clergymen, and other professionals, for as the Governor had mentioned to him, men from such backgrounds would be included amongst his jailbird listeners! (Ball, 1915: 238-239). He was also a gifted lecturer to children, and gave no less than three sets of the celebrated Royal Institution Lectures to young people, in 1881, 1887, and 1898. His best-selling book, *Star-Land* (Ball, 1889a), was the written-up version of his 1887 Children's Lectures, while his very last public lecture, in November 1910, was delivered for the N.S.P.C.C. charity, with tickets selling at 7/6 each (Ball, 1915: 225; Jones, 2005).

Ball kept lecturing because, as he frankly admitted, it was a reliable—and pleasant—way of generating money. But having captivated his audiences on the lecture platform, he realised that he could both acquire further funds and educate a wider public by writing books. He was as facile a writer as he was a lecturer, and from 1885 produced a dozen popular books, in addition to his academic works. As one might expect, when an author feels obliged to generate new popular texts on what is, after all, a very technical subject, there is inevitably a good deal of reworking of familiar material intended for different readerships. His most famous book, *The Story of the Heavens* (Ball, 1885, and subsequent editions), in many ways says it all, with a masterly, equation-free and anecdotal text that teaches the reader pretty well all there was then to know about the Sun, the Earth, the Solar System, stars, nebulae, and deep space, along with an historically-valuable chapter on telescopes and observatories.

He also covered similar ground in his extremely successful *Star-Land* … (Ball, 1889a), but this was aimed at a younger readership in the wake of his Royal Institution Childrens' Lectures of 1887—which he admits were in themselves a virtual repeat of the lecture series of 1881 (see Ball, 1889a: Preface). A lot of familiar material about the Solar System and gravity also appears in *The Story of the Sun* (Ball, 1893b), plus a new and state-of-the-art treatment of solar physics and spectroscopy, while his *In Starry Realms* (Ball, 1892b) reprints a collection of papers on a wide variety of astronomical topics which he had previously published in magazines such as the *Contemporary Review*, *MacMillan's Magazine*, *Good Words* and *Girls' Own Paper*. And his last Royal Institution Childrens' Lecture Series provided the material for *The Earth's Beginning* (Ball, 1901), which dealt with the origins of the Universe as then understood, spiral nebulae, the Sun, the Solar System, the Earth, earthquakes, and volcanoes. The explosion of the Indo-

nesian island Krakatoa in 1883 had clearly galvanised British public attention, and several of Ball's books deal with the explosion in varying degrees of detail. *In Starry Realms*, for instance, devotes an entire 23-page chapter to the subject of Krakatoa before progressing to a chapter dealing with a wholly different subject: "Darwinism and its Relation to Other Branches of Science".

A Popular Guide to the Heavens, A Series of Eighty-three Plates (Ball, 1905) was in many respects a valedictory work, as the 1910 edition was published within three years of Ball's death. And while confessedly derivative in character, and acknowledging the published works of many of his contemporaries, it was nonetheless an invaluable and sumptuously-produced 'guide to the study of the sky', with detailed regional star charts and photographs which could be used by the aspiring student to find his or her way around the night sky, recognise its principal features, and learn something about the latest discoveries and ideas.

Ball even ventured into the realm of astronomical biography in *Great Astronomers* (1895), where in nineteen chapters he looked at a succession of astronomers starting with Ptolemy, and concluding with John Couch Adams. Though most of the material would have already been fairly well known—at least on an academic level—the book is especially insightful when dealing with Irish astronomers such as John Brinkley (an Englishman by birth) and Sir William Rowan Hamilton (both of whom had preceded Ball both as Andrews Professor and Dunsink Observatory Director), Lord Rosse, who had been his patron and encourager and Adams, whom he succeeded in Cambridge.[10]

From an examination of the above, one can come to understand the wider dynamics of Ball's career. His Andrews Chair, Dunsink Directorship, title as Royal Astronomer [*not* Astronomer Royal] of Ireland, and later his Lowndean Chair and Cambridge University Directorship, not to mention his acknowledged brilliance as a university teacher, gave him impeccable academic credentials, but only a modest professional income. It was, however, his popular books that brought both international fame and profit, especially as a given body of research and preparation could be easily made to yield multiple profits. For first of all, Ball would put together a lecture which in itself might go on generating hundreds of pounds by regular repeats as the years went by. Secondly, that lecture could be given a further lease of life in a popular periodical, such as *Macmillan's Magazine*. And thirdly, its contents could be rounded up into a volume of popular essays such as *In Starry Realms*. The Sun, the Moon, the planets, nebulae, Krakatoa and many other topics received this threefold treatment, generating fresh money at each turn. Fortunately, late Victorian Britain had a sufficiently economically, intellectually and regionally diverse population as to enable a popular topic to be addressed to a fourfold paying audience: in lectures, magazines, handsome hard-backed books, and to children.

And just as Ball could demand hefty fees for his lectures, so his books sold not only well, but expensively. The revised 1893 edition of *The Story of the Heavens*, for instance, was sold by Cassell and Company for 12/6 [65p]; the sumptuous *The Story of the Sun*, with its gorgeous full colour plates, for 21/- (£1.05); while by 1893 *Star-Land* had already sold 20,000 copies and was still going for 6 shillings (30p) a copy.[11] I have not been able to discover the royalties that Ball was able to negotiate with Cassells, Isbister, George Phillips and his other publishers, but knowing what we do about his hard-nosed dealings with lecture agents, one suspects that they were very favourable.

In some ways, therefore, it is rather surprising that at his death in 1913 Ball's estate was valued at only £12,045 (Wayman, 2004), although we do not know what monies might have been apportioned beforehand. And while £12,045 was a very handsome sum at that time, one might have expected a larger *post mortem* estate considering his high earning capacity over nearly 30 years. But then again, as he always pointed out, he had a wife and family to maintain and one suspects that he adopted a very high standard of living as a necessary reflection of his status.

6 SUBSEQUENT CAREER

It is not without irony that a man who was so much devoted to a clear, popular understanding of science should have given over his original creative research energies to a branch of mathematical learning which was virtually incomprehensible to all but academic mathematicians. This was his famous 'Theory of Screws'. His ideas in this field were first stimulated in 1869 by Dr Johnstone Stoney in Dublin, and over the years came to be explored in a series of erudite mathematical papers and books that were a million miles away from the works of his popular fame (Ball, 1915: 83-84).

I could not begin to give an account of his Theory of Screws (see Ball, 1900b), although it is important to make it clear that the 'Screws' in question were not of the woodworking variety. They were, rather, mathematical expressions of the torques, vibrations, and wrenches that could pass through a solid extended body that was itself at rest. For this was pure analytical geometry, with no ostensible application to anything, and so abstruse that he told his son Valentine, who was no mathematician, "If I were to begin speaking now, and continued to expound the subject for about six months without interruption, you might have some faint glimmering of what it means." (Ball, 1915: 245). Yet this is what, so he tells us, occupied his mind when it was not devoted to more practical or didactic subjects, for Ball had a sustained and deeply serious commitment to pure mathematics of the most abstract and 'useless' kind. Was his Theory of Screws, along with those other branches of pure mathematics in which he delighted, a sort of intellectual sanctuary into which he retreated when all the talking, handshaking, and public adulation were over for the day? I find this contrast between his outer and inner intellectual lives truly fascinating.

The public Sir Robert, however, was very much of an affable performer. And when not performing before an audience, he loved golf and photography, at both of which he excelled. In 1885, when he succeeded John Tyndall on the Commission of Irish Lights, one of his annual delights was the round-Ireland cruise of the Commissioners (Ball, 1915: 246-266), as it was their job to visit, inspect, and report on each of the many lighthouses around the Irish coast. The cruise, in the luxuriously-appointed Commissioners' steam

yacht *Princess Alexandra* always took place around midsummer, to maximise the natural daylight, and was clearly a pleasant social affair in the ambiance of what seems like a floating gentlemen's club (Figure 6). Not only would visits be made to dangerous outlying lighthouses, but the vessel would often pull into the many small ports around the Irish coast, where the Commissioners would be entertained by the local gentry. One gets the feeling that much was eaten and drunk during the *Princess Alexandra* cruises, and that they also served to supply Ball with a growing fund of humorous and instructive stories about Irish life. Ball continued to cross the Irish Sea to join the Lights Commissioners even after he had moved to Cambridge, and he made his last cruise in 1912.

Figure 6: Sir Robert Ball in holiday mood on the Irish Lights Board steam yacht, *Princess Alexandra*, around 1890 (after Ball, 1915).

Jolly as the Lights Cruises no doubt were, we must not forget that their purpose and business were in deadly earnest, for as everyone knew, sailors' lives depended on lighthouses and their reliability. And as Ball made clear, the late nineteenth century was a time of rapid development in lighthouse technology, as different illuminants, such as oil, coal gas and electricity, were being experimented with, while complementary innovations in lighthouse optics were being made, with the aim of sending out the life-saving beams of light across the greatest possible sea distance (Ball, 1915: 246-248).

Although he spent the last 23 years of his life as a Cambridge don, Ball never ceased to be—as shown above—the archetypal genial, silver-tongued Irishman, and nowhere is this caught better than in the 'Spy' cartoon entitled 'Popular Astronomy' (Figure 7). Here we see the portly Sir Robert, immaculately dressed in a grey morning suit with frock coat, his ample corporation matching the curve of a large celestial globe standing slightly behind him, and with a broad smile extending across his somewhat flushed cheeks. And although he had lost an eye through disease, his life seems to have been a very happy one, with a good marriage, and children who were themselves successful.

Sir Robert Stawell Ball died in Cambridge on 25 November 1913. And as he had been a Fellow of King's College and a worshipper in its Chapel, his funeral was held there on the 29th, with his favourite hymn, 'Rock of Ages', being sung by the College Choir. He was buried in St. Giles' Churchyard, Cambridge, close to his professorial predecessor, John Couch Adams (Ball, 1915: 286).

7 NOTES

1. The author of the original *Dictionary of National Biography* (Oxford, 1880s) thinks that Sacrobosco was a Yorkshire man, but Olaf Pedersen (2004) says that there is no clear pre-sixteenth century source for Sacrobosco's place of birth.
2. I am indebted to Tony Ryan and Dr Ian Elliott for this information.
3. For the details of Ball's career see Ball, 1915: 80-135; Ball, 1927; Chapman, 2006; F.W.D. and G.T.B., 1915; Jones, 2005; Knobel, 1915; Ruis-Castell, 2004; and Wayman, 2004.
4. For the description of the Astronomer's elegant residence I am indebted to Dr Mary Brück, who told me in a private communication (29 September, 2007) that when her late husband, Professor Hermann Brück, became Director, his onetime predecessor, Sir Edmund Whittaker, extoled the Observatory as a place where one "… lived like a gentleman."
5. I had the pleasure of examining this historic telescope in 2004, although on that occasion clouds made it impossible to observe.
6. In 1877 Schiaparelli would amaze astronomers and popularisers when they misinterpreted the meaning of the word *canali*, the lines he claimed to have discovered on Mars.
7. Ball succeeded John Couch Adams, who had first computed the position of the then unknown planet Neptune in 1845-1846.
8. Airy never claimed to be a working observer himself (seeing practical observation as a skill rather than an intellectual activity) so much as the meticulous manager and coordinator of a team of efficient and disciplined observers at Greenwich. Indeed, in 1847 Sir James South complained to the Admiralty that the Astronomer Royal did not observe.
9. During this long voyage, 61-year-old Sir Robert Ball was found to be suffering from diabetes.
10. In addition to the aforementioned titles, Ball also wrote the following popular books: *Astronomy* (Ball, 1877), *Elements of Astronomy* (Ball, 1880), *Time and Tide: A Romance of the Moon* (Ball, 1889b), *The Cause of an Ice Age* (Ball, 1891), *An Atlas of Astronomy* (Ball, 1892a; from 1895 this was titled *The Wonders of the Heavens*), *In the High Heavens* (Ball, 1893a), and *A Primer of Astronomy* (Ball, 1900a).
11. These prices were extracted from the advertisement sheets that followed the Index in the new and revised 1893 edition of *The Story of the Heavens*.

12. *Note added in proofs:* I am indebted to Ian Elliott and David Spearman, who have found from Trinity College Dublin records that whilst he was Andrews Professor of Astronomy at TCD Ball received £700 per year for the support of himself, his Assistant and the gardener, the Assistant also receiving a further sum up to £110 per year from College funds.

8 ACKNOWLEDGEMENTS

I wish to express my appreciation to the following, who have, in various ways, provided me with valuable insight and assistance in the writing of this paper: Ian Elliott, Mary Brück, John Butler, Peter Hingley, Mary Chibnall, and Mark Hurn. I also express my appreciation to the editors, Mark Bailey, Hilmar Duerbeck and Wayne Orchiston, for their tolerance and their support.

Figure 7: The cartoon by 'Spy' of Sir Robert Ball that appeared in the magazine *Vanity Fair* in 1904 (courtesy Gerry Morris).

9 REFERENCES

Ackroyd, Peter, 1991. *Dickens.* London, Minerva.

Ball, Peter, and Ball, William, 1666. Of an observation, not long since, made in England, of Saturn. *Philosophical Transactions of the Royal Society*, 1, 9, 152-153.

Ball, R.S., 1877. *Astronomy*. London, Longmans, Green & Co.

Ball, R.S., 1880. *Elements of Astronomy*. London, Longmans, Green & Co.

Ball, R.S., 1883. Thomas Romney Robinson (obituary). *Monthly Notices of the Royal Astronomical Society*, 43, 181-183.

Ball, R.S., 1885. *The Story of the Heavens*. London, Cassell.

Ball, R.S., 1889a. *Star-Land, Being Talks with Young People about the Wonders of the Heavens.* London, Cassell.

Ball, R.S., 1889b. *Time and Tide: A Romance of the Moon*. London, S.P.C.K.

Ball, R.S., 1891. *The Cause of an Ice Age*. [Modern Science Volume 1]. London, Kegan Paul & Co.

Ball, R.S., 1892a. *An Atlas of Astronomy* … London, Philip (From 1895 this was published as *A Popular Guide to the Heavens*.)

Ball, R.S., 1892b. *In Starry Realms.* London, Isbister.

Ball, R.S., 1893a. *In the High Heavens*. London, Isbister.

Ball, R.S., 1893b. *The Story of the Sun*. London, Cassell & Co.

Ball, R.S. 1895. *Great Astronomers.* London, Isbister.

Ball, R.S., 1900a. *A Primer of Astronomy*. Cambridge, Cambridge University Press.

Ball, R.S., 1900b. *A Treatise on the Theory of Screws*. Cambridge, Cambridge University Press.

Ball, R.S., 1901. *The Earth's Beginning*. London, Cassell & Co.

Ball, R.S., 1905. *A Popular Guide to the Heavens*. London, G. Philip & Co.

Ball, R.S., 1908. *A Treatise on Spherical Astronomy*. Cambridge, Cambridge University Press.

Ball, W. Valentine, 1915. *Reminiscences and Letters of Sir Robert Ball.* London, Cassell.

Ball, W. Valentine (?), 1927. Robert Stawell Ball. In *Dictionary of National Biography 1912-1921*. London, University Press, Humphrey Milford.

Bennett, J.A. 1990. *Church, State and Astronomy in Ireland: 200 Years of Armagh Observatory.* Belfast, Armagh Observatory.

Brück, M., 2002. *Agnes Mary Clerke and the Rise of Astrophysics.* Cambridge, Cambridge University Press.

Brück, M., 2004. Agnes Mary Clerke: ever-popular historian of astronomy. *The Antiquarian Astronomer*, 1, 2-4.

Butler, C.J., 1986. Early photoelectric photometry in Dublin and Daramona. *The Irish Astronomical Journal*, 17, 373-377.

Butler, C.J., and Elliott, I., 1993. Biographical and historical notes on the pioneers of photometry in Ireland. In *Stellar Photometry: Current Techniques and Future Developments* (Proceedings IAU. Colloquium No. 136). Cambridge, Cambridge University Press. Pp. 3-12.

Chapman, A., 1998. *The Victorian Amateur Astronomer. Independent Astronomical Research in Britain, 1820-1920.* Chichester, Praxis-Wiley.

Chapman, A., 2006. Ireland's astronomical muse: Sir Robert Stawell Ball and the Victorian world of astronomy. In Moore, Sir Patrick, and Mason, John (eds.). *2007 Yearbook of Astronomy*. London, Macmillan. Pp. 253-264.

Clerke, A.M., 1885. *A Popular History of Astronomy during the Nineteenth Century.* Edinburgh, Adam and Charles Black.

Cooper, E.J., 1851-1856. *Catalogue of Stars near the Ecliptic observed at Markree during the Years 1848, 1849 and 1850* ... 4 volumes. Dublin, A. Thom.

Croinin, D.O., 1995. *Early Medieval Ireland, 400-1200*. London, Longman History of Ireland.

Dick, S.J., 1998. Observation and interpretation of the Leonid meteors over the last millennium. *Journal of Astronomical History and Heritage*, 1, 1-20.

Dreyer, J.L.E., 1884. Observatory. In *Encyclopaedia Britannica. Volume 17 (Ninth Edition)*. Edinburgh, Adam and Charles Black. Pp. 710-711.

Elliot, Ian, 2004. William E. Wilson and his contemporaries. *The Antiquarian Astronomer*, 1, 11-12.

Ellmann, R., 1987. *Oscar Wilde.* London, Penguin.

F.W.D., and G.T.B., 1915. Sir Robert S. Ball (obituary). *Proceedings of the Royal Society of London*, Series A, 91, xvii-xxi.

Glass, I.S., 1997. *Victorian Telescope Makers. The Lives and*

Letters of Thomas and Howard Grubb. London, Institute of Physics.

Grubb, H., 1880. On the equatorial telescope and on the new observatory of the Queen's College, Cork. *Scientific Proceedings of the Royal Dublin Society*, 2, 347-369.

Howse, D., 1975. *Greenwich Observatory, Volume 3: The Buildings and Instruments*. London, Taylor and Francis.

Hutchins, R., 2004. Richard A. Proctor. In *Oxford Dictionary of National Biography*. Oxford, Oxford University Press.

Inkster, I., 1978. Robert Goodacre's astronomy lectures (1823-1825), and the structure of scientific culture in Philadelphia. *Annals of Science*, 35, 353-363.

Inkster, I., 1980. Robert Goodacre (1777–1835) and popular astronomy. *Journal of the British Astronomical Association*, 90, 245-252.

Jones, R., 2005. Sir Robert Ball: Victorian astronomer and lecturer par excellence. *The Antiquarian Astronomer*, 2, 27-36.

Knobel, E.B., 1915. R.S. Ball (obituary). *Monthly Notices of the Royal Astronomical Society*, 75, 230-236.

McCall, G.J.H., Bowden, A.J., and Howarth, R.J. (eds.), 2006. *The History of Meteoritics and Key Meteorite Collections: Fireballs, Falls and Finds*. London, Geological Society.

McGeachie, J., 2004. Sir William Robert Wills Wilde (1815-76). In *Oxford Dictionary of National Biography*. Oxford, Oxford University Press.

Manchester Astronomical Society, 'Minute Book 1903-1909'. Account of meeting on 18 September 1908. Original in the Manchester City Library, AS. 472.

Mitchell, O.M., 1853. *The Orbs of Heaven*. London, Ingram, Cooke & Co.

Mohr, P., 2004. A star of the western sky: John Birmingham, astronomer and poet. *The Antiquarian Astronomer*, 1, 23-33.

Molyneux, William, 1693. *Dioptrica Nova: A Treatise of Dioptricks*. London, Benj. Tooke.

O'Kelly, M.J., and O'Kelly, C., 1982. *Newgrange – Archaeology, Art and Legend*. London, Thames and Hudson.

Pedersen, O., 2004. Sacrobosco. In *Oxford Dictionary of National Biography*. Oxford, Oxford University Press.

Ruiz-Castell, P., 2004. Astronomy and its audiences: Robert Ball and popular astronomy in Victorian Britain. *The Antiquarian Astronomer*, 1, 34-39.

Scaife, W.G., 2000. *From Galaxies to Turbines: Science, Technology and the Parsons Family*. Bristol and Philadelphia, Institute of Physics.

South, Sir James, 1847. Letter to the Admiralty, dated 12 March. Original in the Royal Greenwich Observatory: (RGO) 6, 2/251-258.

The Cambrian Natural Observer, IV, New Series 2, May 1901, pp. 39-40.

The Irish Builder, 1 May, 130, and 1 December, 376 (1879).

Ward, B., S.L.G., 1990. *The Venerable Bede*. London, Geoffrey Chapman, Cassells.

Wayman, P.A., 1986. A visit to Canada in 1884 by Sir Robert Ball. *The Irish Astronomical Journal*, 17, 185-196.

Wayman, P.A., 1987. *Dunsink Observatory, 1785-1985: A Bicentennial History*. Dublin, Dublin Institute of Advanced Studies; Royal Dublin Society.

Wayman, P.A., 2004. Robert Stawell Ball. In *Oxford Dictionary of National Biography*. Oxford, Oxford University Press.

Wilson, T.G., 1942. *Victorian Doctor: Being the Life of Sir William Wilde*. London, Methuen.

Allan Chapman is an historian of science at Oxford University. His main area of research lies in the history of astronomy and instrumentation. The seventeenth and nineteenth centuries are his principal periods of study, and in the latter, the development of the self-funded, or 'Grand Amateur', tradition of astronomical research in particular. He is a former Professor of Gresham College, London, and since 2002 has been proud to serve as Inaugural Honorary President of the Society for the History of Astronomy. He is also Honorary Vice-President of the William Herschel Society (Bath) and is on the Editorial Board of the *Journal of Astronomical History and Heritage*.