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SIR ROBERT STAWELL BALL.

SIR ROBERT STAWELL BALL, the late Lowndean Professor of Astronomy and Geometry at Cambridge, was the son of Dr. Robert Ball, a distinguished Irish naturalist, and was born in Dublin on July 1, 1840. Robert Stawell was the eldest of three brothers, all conspicuous figures in Dublin Society, the others being Dr. Valentine Ball, Director of the Science and Art Museum in Dublin, and Sir Charles Ball, the well-known Dublin surgeon.

Robert Stawell Ball was educated at Abbott's Grange, Chester, and Trinity College, Dublin, which he entered in 1857 At the first Honour Examination in Mathematics, which took place in January of the following year, he did not specially distinguish himself; but three months later, on a wider mathematical course, he shot into the front rank, and from that time onwards was regarded as one of the three leading mathematicians of his year. His rivals were Dr. F. A. Tarleton, now Senior Fellow of Trinity College, lately Professor of Natural Philosophy at Dublin, and Dr. T. E. Little, for many years University Anatomist.

At the examination for University Science Scholarship in 1860 these three names appear in the order: Tarleton (1), Ball (2), and Little (4). A year and a half later, at the final examination for Mathematical Moderatorship, the order was Tarleton (2), Ball (3), and Little (4)—W. S. Burnside (afterwards Erasmus Smith's Professor of Mathematics in the University) having dropped down from the year above and carried off the first place. The principal prize of the year, however—the University Studentship,—was awarded to Ball, his answering in a second course of Experimental and Natural Science having been remarkably high.

Two years later, we find Ball and Tarleton competing for Fellowship in Trinity College. In the years 1863, 1864, and 1865 Ball's name appeared fifth, fourth, and third respectively in the list of competitors; but in the latter year an affection of the eye (which in later life necessitated a surgical operation), brought on by the heavy strain of reading required for this severe

of a Professor was not wholly devoid of difficulty, and in the summer of 1874, when Dr. Francis Brünnow resigned the post of Royal Astronomer of Ireland and Andrews' Professor of Astronomy in the University of Dublin, Ball applied for the post and was duly elected.

At the time of Ball's appointment, the Dunsink Observatory was furnished with an excellent telescope containing a Cauchoix objective of 12-inches aperture, presented to Trinity College by Sir James South, mounted equatorially by Grubb of Dublin, and a fine transit-circle by Pistor & Martins of Berlin. The former had been employed very successfully by Brünnow in the investigation of stellar parallax. In this he was indeed but following the traditions of the Observatory, Dr. Brinkley, more than half a century earlier, having devoted fourteen years of arduous labour to that exacting branch of astronomy.

Dr. Ball determined to carry on the traditions of the Chair, and devoted himself to the same line of investigation. The first object to which he directed his attention was the well-known star 61 Cygni. His researches on the parallax of this star are contained in the third and fifth parts of the 'Astronomical Observations and Researches made at Dunsink,' and display the same care and thoroughness by which all his scientific work was characterised. The parallax which he found, viz. 0″·466, is larger than the now accepted value, but it agreed well with the results obtained up to that time by Bessel, Johnson, Struve, Auwers, and Peters.

At the time of Dr. Brünnow's resignation, the "South" equatorial was in the maker's hands for the purpose of effecting certain alterations which Dr. Brünnow's experience had suggested. These were not finished till the following year, and from a combination of causes Ball was unable to commence systematic work with this instrument until July 1876, but from that date onwards for the next few years the telescope was seldom idle. During the years 1877–1881 he displayed the greatest activity as an observer, often prolonging his observations far into the morning hours. In later years, whether in consequence of renewed trouble from his eye or as the result of increasing demands upon his time from outside, his energy in this direction slackened a good deal until towards the end of his tenure of the post of Royal Astronomer it almost entirely ceased.

Perhaps the most important contribution made by Ball to the observational side of astronomy is to be found in his carefully thought out and systematic hunt for stars with large parallaxes. These "reconnoitring observations," as he called them, and the discussion of the results deduced from them, are given in the Third and Fifth Parts of the Dunsink Publications. The importance attaching to them does not lie in the success of the scheme, for it must indeed be admitted that the direct result of the search was almost entirely negative. He cast his net widely, but the mesh employed by him was too large to catch the minute parallactic displacement in the case of the vast majority of the stars.

His enterprise was, however, of great value, as indicating to future investigators the necessity of employing a more refined method even in reconnoitring observations. Up to Ball's time astronomers had, no doubt, devoted the most elaborate care to a few selected objects, but, so far as the writer of this notice is aware, Ball's was the first attempt made to collect parallaxes wholesale, and in this respect may be regarded in some sense as the forerunner of Kapteyn's more accurate method, rendered possible by the introduction of photography, which in recent years has been fruitful of results. His aim in undertaking this research is well expressed in the opening paragraph of his first memoir on the subject: "It is, of course, well known that up to the present no parallax of a star has been detected which exceeds a single second of arc. In the great majority of cases the parallax is very much less, even if it be appreciable. But when we reflect that not one star out of every ten thousand has yet been regularly examined for parallax, it is obvious that it would be rash to conclude that there are no stars nearer to us than any of those of which we already know the distance."

In 1879 Ball published his observations of 42 objects, of which he was able to say, as the result of his researches, that in every case the parallax is certainly less than one second of arc and most probably does not exceed half a second. These researches continued to engage Ball's attention until about the year 1884, when the Fifth Part of the Dunsink Publications appeared, containing the results of observations of 368 separate stars. This work is a model of system and organization. The methods employed for saving time and labour, both in taking the observations and in reducing them, while sacrificing as little as possible in essential accuracy, are fully set forth in the introduction, and, although the general conclusion is again a negative one, subsequent investigators may derive much advantage from a study of this memoir. In the case of only two of the 368 stars observed was there any suggestion of a large parallax. These two objects were accordingly submitted to a longer and more minute scrutiny. For the first of these, Gr. 1618, as the result of 106 observations spread over the years 1878–1880, Ball found a parallax of $0''\cdot32$. This conclusion has been in the main confirmed by Kayteyn and Peter, although their results point to a value of the parallax considerably smaller than that found by Ball. The second of the two cases to which Ball points in his Preface as the positive fruits of his labours was 6 Cygni (B) (a double star, very similar in many respects to its neighbour 61 in the same constellation), for which he deduced a parallax of $+0''\cdot48$. Subsequent researches, however, by Asaph Hall, Neander, Kostinsky, and Chase have not confirmed this result.

As a mathematician, Ball will be chiefly remembered for his Theory of Screws. This theory, dealing in a general manner with the dynamics of a rigid body, was first sketched by the author in a paper communicated to the Royal Irish Academy on

the 13th November, 1871, and was developed in a series of papers, contributed for the most part to the same learned Society, extending over more than thirty years. The subject was entirely revised by the author and appeared in 1876 in a single volume entitled 'The Theory of Screws, a Study in the Dynamics of a Rigid Body.' In 1889 the work appeared in a German form under the title 'Theoretische Mechanik starrer Systeme,' by Dr. Harry Gravelius. In 1898 Ball contributed to the *Transactions of the Royal Irish Academy* a paper which he called "Twelfth and *Concluding* Memoir on the Theory of Screws," and in 1900 the whole work was published by the Cambridge University Press in a single treatise of 544 pages. But the author's inventiveness was not yet exhausted, and, in spite of the title of the twelfth memoir, fresh papers continued to appear on the same subject. These were, "Further Developments of the Geometrical Theory of Screws" (1901), "On the Reflection of Screw Systems and allied Questions" (1902), and "Some Extensions of the Theory of Screws" (1903, 4).

A notice of Sir Robert Ball's life would be incomplete without some reference to his activity as a popular writer and lecturer on Astronomy. While still Professor at the Royal College of Science, Ball inaugurated a series of popular evening lectures at the College, which proved a brilliant success and demonstrated the remarkable gifts with which he was endowed as a popular exponent of science. He threw himself into the scheme with all his usual energy and zeal. After he became Royal Astronomer he continued from time to time to appear on the lecture platform. A discourse which he delivered at the Midland Institute in Birmingham, at the opening of the winter session of 1881, attracted particular attention. This lecture, entitled "A Glimpse through the Corridors of Time," gave in popular language an outline of the Theory of the Tidal Evolution of the Moon, a subject of the utmost complexity, which had shortly before been developed by Mr. (afterwards Sir George) Darwin in a series of elaborate mathematical memoirs published in the *Philosophical Transactions of the Royal Society*. From this time forward Ball continued to enjoy an undisputed pre-eminence as a popular lecturer in Astronomy, and he became a familiar figure to large audiences in every part of the kingdom. As a lecturer he was distinguished by the wonderful lucidity with which he was able to treat the most abstruse subjects and by a delightful sense of humour which never failed to enlighten them. He had a peculiar faculty of quickly establishing a bond of sympathy between himself and his audience, and seemed to enjoy his lectures as much as did the crowds that applauded him.

His popular works on Astronomy, the outcome for the most part of these lectures, enjoy a wide popularity. These include 'The Story of the Heavens,' 'Starland,' 'In the High Heavens,' 'In Starry Realms,' 'Time and Tide, A Romance of the Moon,' 'The Cause of an Ice Age,' 'The Story of the Sun,' &c. In 1892

he brought out a useful Atlas of Astronomy, intended to meet the needs of the amateur furnished with a small telescope in his study of the sky. This work possessed many interesting and novel features. A second edition of the book, published in 1905, appeared under the title 'A Popular Guide to the Heavens.' The last work issuing from his pen was 'A Treatise on Spherical Astronomy,' published in 1908 at the Cambridge University Press. It is intended chiefly for the use of University students, and is marked throughout by the author's usual lucidity and suggestiveness.

In 1884 Ball became Scientific Adviser to the Commissioners of Irish Lights, and the annual cruise with the Commissioners round Ireland for the purpose of inspecting the various light-houses along the coast was always a source of the keenest enjoyment to him. He was never tired of talking of the beauties of the scenery along the west coast of the island. The Skelligs especially used to excite his enthusiasm, and he was wont in his humorous way to divide the world into two classes: those who had seen the Skelligs and those who had not.

In February 1892, on the death of Prof. J. C. Adams, Ball was elected to the Lowndean Chair of Astronomy and Geometry at Cambridge and Director of the University Observatory, a post which he held till his death. With regard to this portion of his life a Cambridge correspondent communicates the following notes:—

"His work on the Council of the Senate, of which body he was a member from 1902 to 1910, and his other administrative duties do not here concern us, but we must note the growing activity of the Cambridge Observatory under his direction. The Sheepshanks telescope, designed to carry on Ball's parallax work by photographic methods, was erected during his tenure of office. Investigators came from outside to work at the Cambridge Observatory, notably Prof. H. N. Russell, of Princeton. The recent developments at Cambridge only took effect after the commencement of his illness, but the changes met with a full measure of support from him. As a lecturer on the mathematical side of Astronomy he showed the same lucid qualities which made him so effective in a more popular sphere. He gave the young student an insight into the methods of the classical writers in celestial mechanics and prepared the way for the study of the later advances. His textbook on 'Spherical Astronomy' indicates the lines of his teaching in that subject. Other academic duties which fell to his lot included the Isaac Newton Studentship elections and the Smith's Prize awards. The cheerful encouragement which he offered to the students and his valuable advice will be remembered by many who must look back with feelings of pleasure to their intercourse with him."

In 1868 Sir Robert Ball married Frances Elizabeth, elder daughter of the late Dr. W. E. Steele, Director of the Science and Art Museum in Dublin. He leaves also four sons and two

daughters. In 1886 the honour of Knighthood was conferred upon him by the Lord Lieutenant of Ireland. He was President of the Royal Astronomical Society, 1897–1899, also of the Mathematical Association, of the Royal Zoological Society of Ireland, and served on the Council of the Royal Society 1897–98. In 1879 he received the Cunningham Medal of the Royal Irish Academy for his mathematical researches.

Sir Robert Ball was one of the most warm-hearted and cordial of men, and was loved and admired by a large circle of friends. He had, indeed, a genius for friendship. Nothing could resist his hearty manner, his ready sympathy, his humour, and his enthusiasm. After a long illness, extending over the greater part of two years, he died on November 25th, 1913, and is buried in the quiet little churchyard of St. Giles' Church, near the Observatory, where also lie the remains of his illustrious predecessor.

A. A. Rambaut.

MEETING OF THE ROYAL ASTRONOMICAL SOCIETY.

Friday, 1913 December 12.

Major E. H. Hills, C.M.G., F.R.S., *President,* in the Chair.

Secretaries: Prof. A. S. Eddington, M.A., M.Sc.
Prof. A. Fowler, F.R.S.

The Minutes of the previous Ordinary Meeting were read and confirmed.

Prof. Fowler. Fifty-four presents have been received since the last Meeting, including, amongst others:—Tycho Brahe, Omnia Opera, edidit J. L. E. Dreyer, Tomus I. presented by Dr. Dreyer; Birkeland (Kr.), The Norwegian Aurora Polaris Expedition, 1902–3; Cause of Magnetic Storms and Origin of Terrestrial Magnetism, 2 vols., presented by the author; Perth Observatory, Western Australia, Astrographic Catalogue, Perth Section, Vols. 2, 3, presented by the Observatory.

The President. I will ask you to return your thanks to these donors. It will interest Fellows if I add that Lady Huggins has written offering a photogravure reproduction of the well-known Royal Society portrait of Sir William Huggins. I have no doubt that the gift will be received with enthusiasm.

Mr. W. B. Gibbs and *Mr. R. A. Gregory* seconded the appointment of Dr. J. W. Capstick, Mr. H. P. Hollis, and Mr. R. Inwards as Auditors of the Society's accounts. The resolution was carried.

The President. I will ask Mr. Maunder to give an account of his paper on the Distribution of Sun-spots.

Mr. Maunder. In the years 1903–4 four papers appeared in the 'Monthly Notices' on the subject of the distribution of Sun-