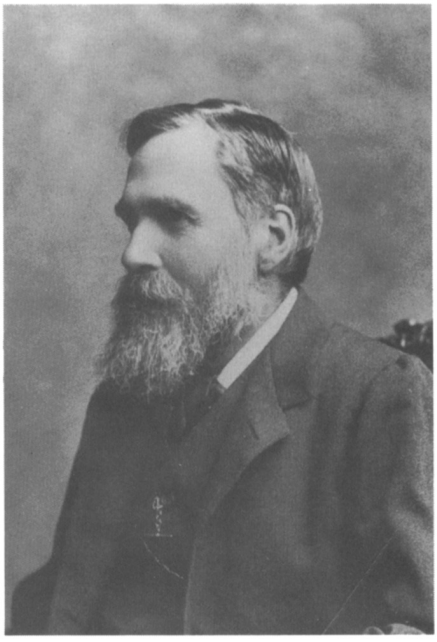
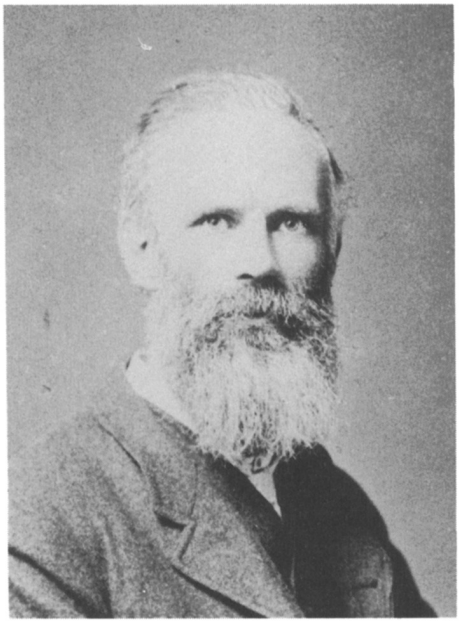
The History of Stellar Photometry

https://doi.org/10.1017/S0252921100007326 Published online by Cambridge University Press

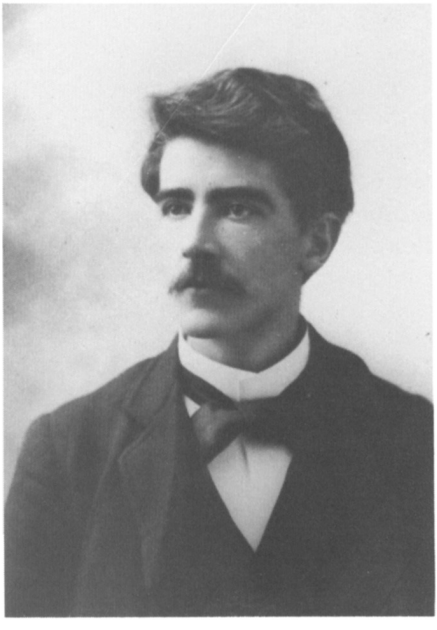
George M. Minchin, FRS (1845–1914)



William H.S. Monck (1839–1915)



George F. Fitzgerald, FRS (1851–1901)



Stephen M. Dixon (1866–1940)

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Biographical and Historical Notes on the Pioneers of Photometry in Ireland

The Editors

Introduction

As the circumstances of the early electrical measurements of starlight in Ireland are not widely known we wish to take this opportunity to set down the facts, as far as they are known to us. Corrections or new information will be welcomed.

The observations made in Dublin in 1892 were the result of a collaboration between four graduates of Trinity College: George M. Minchin, William H.S. Monck, Stephen M. Dixon and George F. Fitzgerald. The observations in 1895 were made at Daramona Observatory, Co. Westmeath with a 24-inch reflector by Minchin, Fitzgerald and the owner of the telescope, William E. Wilson. In 1875 Minchin was appointed Professor of Applied Mechanics at the Royal Indian Engineering College at Coopers Hill, near Staines in London. In 1877 he started a long series of investigations of photoelectricity using a small optical laboratory at Coopers Hill and the laboratories of University College London. His initial aim was to transmit images electrically but he became skilled in making photovoltaic cells of selenium.

By September 1891 Minchin had succeeded in making some working cells and he wished "to test them on the stars". He contacted his friend Monck who had recently set up an observatory in his back garden in Dublin. Monck in turn asked Fitzgerald for the loan of a galvanometer or electrometer and for advice in its use. As Fitzgerald did not have a suitable instrument, he ordered Clifton's form of Thomson's quadrant electrometer, which arrived near the end of the year. It seems that Minchin also sent some of his cells to Dr Boeddicker in the spring of 1892 for trials on the 72-inch telescope but no reports are available.

Minchin visited Dublin in August 1892 with some improved cells but on account of bad weather he had to return to England before a test could be made. However, the weather improved near the end of the month and a trial was carried out with Monck's telescope on the morning of the 28th. Monck was assisted by his 26-year old neighbour, Stephen Dixon and they succeeded in measuring the relative brightness of Jupiter and Venus. They failed to obtain 'certain' results from the stars on account of instrumental drift and other difficulties.

In December 1893 Minchin met Wilson in London and Wilson invited him to try his cells on the Daramona telescope. Minchin probably visited Daramona in January 1894 but there is no record of the visit. The first recorded observations at Daramona took place in April 1895. Wilson and Minchin operated the telescope and Fitzgerald attended to the electrometer in a room below the observing floor. Observations were possible on four nights and the results were published by Minchin in the *Proceedings*

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of the Royal Society. Minchin acknowledged that the first measurements of planets and stars were made with Monck's telescope to which he mistakenly attributed an aperture of nine inches; this error has been copied by several authors. Minchin visited Daramona again in September 1895 but Fitzgerald was not present and there is no report of observations being made. The second set of observations at Daramona was made in January 1896, despite bad weather. It seems that Minchin visited Daramona a year later but no more observations were reported.

G.M. Minchin (1845-1914)

George Minchin Minchin was born on 25 May 1845 at Valentia Island, Co. Kerry; for some reason his name on the baptismal certificate is recorded as 'George Minchin Smith'. His father George was an attorney and lived in Donnybrook, Dublin. His mother Alice died when he was about nine years old and he was put in the care of his uncle-in-law, Mr. David Bell, a schoolmaster and Shakespearean scholar.

Minchin entered Trinity College in 1862. He was awarded the first Scholarship in Mathematics in 1865 and in the following year he obtained a gold medal in mathematics and began to take an interest in experimental science. He was unsuccessful in the Fellowship examination in 1871 and 1872 but was awarded the Madden Premium, a consolation prize for unsuccessful candidates.

In 1875 he was appointed Professor of Applied Mechanics at the Royal Indian Engineering College at Coopers Hill, near Staines in London which is now part of Brunel University. The purpose of the College was to train engineers for service in India and by all accounts Minchin was a genial and inspiring teacher. He wrote several mathematical texts, the best known being his *Statics* which ran to seven editions. He was renowned for his clear reasoning and elegance of expression and it was said of him that he could never tolerate a slipshod argument or a carelessly written sentence. He was a notable correspondent, especially with Fitzgerald with whom he swapped mathematical problems. His letters bear testimony to his clear style and his logical mind. Apart from mathematical work he was a keen and skilful experimenter and he carried out investigations into wireless waves, X-rays and photoelectricity not only at Coopers Hill but also at the recently established laboratories of University College London. He invented and developed an absolute sine-electrometer for measuring voltage which was a modification of the gold-leaf electrometer. He was elected a Fellow of the Royal Society in 1895.

He maintained his links with Ireland, not only through letters but by visits to an aunt in Westmeath. In 1887 he married Emma Fawcett of Strand Hill, Co. Leitrim. While a bachelor and living in Coopers Hill he kept a collection of small birds in cages in his rooms. He was an early riser and his books were written mostly before breakfast. He was a keen athlete, being rated as one of the best lawn tennis players at Coopers Hill; in his younger days he had played cricket for the Gentlemen of Ireland.

Coopers Hill closed in 1906 and Minchin moved to New College Oxford where he still had access to telescopes and laboratories. He died on 23 March 1914 and was survived by his widow, a son and a daughter.

W.H.S. Monck (1839-1915)

William Henry Stanley Monck was born on 21 April 1839 and spent his childhood at Skeirke, near Borris-in-Ossory, Co. Laois where his father was curate from 1829 to 1850. Skeirke is about 30km from Birr (Parsonstown), the seat of the Rosse family in Co. Offally where William Parsons, the Third Earl of Rosse completed his great 72-inch (1.83m) speculum reflector in 1845. It seems likely that the boy Monck would have seen the great telescope and this may have inspired his lifelong interest in astronomy. In 1850 the family moved to Inistioge, Co. Kilkenny where William's father was rector until his death in 1858; his grandfather, the Rev. Thomas Stanley Monck, was an elder brother of Charles Stanley, the First Viscount Monck of Charleville, Enniskerry, Co. Wicklow. Charles, the Fourth Viscount Monck was Governor General of Canada from 1861 to 1868.

William never attended school but was for a short time educated at home by tutors. He distinguished himself on entry to Trinity College Dublin and in 1861 he obtained the first Scholarship in Science with a gold medal and a senior moderatorship in logic and ethics besides the Wray Prize for the encouragement of metaphysical studies. He studied divinity with distinction for several years but instead of following his father and grandfather into the Church, he turned to Law and was called to the Bar in 1873, being later appointed Chief Registrar in Bankruptcy in the High Court. In 1878 he returned to academic life and was Professor of Moral Philosophy in Trinity (the chair formerly occupied by George Berkeley) until 1882. He wrote *An Introduction to Kant's Philosophy* and a well-received *Introduction to Logic.*

Astronomical questions always interested him. In 1886 he became a Fellow of the Royal Astronomical Society and a member of the Liverpool Astronomical Society. On 12 July 1890 he wrote a letter to the *English Mechanic* advocating the formation of an association of amateur astronomers to cater for those who found the R.A.S. subscription too high, or its papers too technical, or who, being women, were excluded. Moves towards setting up such a society had already been made by E.W. Maunder and at a meeting on 24 October 1890 the British Astronomical Association was established. Monck was a prolific writer and many of his letters and articles appeared in the early volumes of the *Publications of the Astronomical Society of the Pacific*, *The Sidereal Messenger* and *Astronomy and Astro-Physics* (the forerunner of the *Astrophysical Journal*) as well as the *Journal of the British Astronomical Society* and the *English Mechanic.* In 1899 he published an *Introduction to Stellar Astronomy.*

About 1888 he took up residence at 16 Earlsfort Terrace and in 1891 he bought the $7\frac{1}{2}$-inch Alvan Clark refractor which had been owned by Dawes and Erck and set up a small observatory in his back garden. While the observations made in August 1892 are significant in retrospect, they represent only one facet of his many astronomical interests. Meteors interested him greatly and he corresponded for many years with W.F. Denning. In 1894 Monck suggested that there were probably two distinct classes of yellow stars — one being dull and near, the other being bright and remote. This

clue to the existence of dwarf and giant stars was taken up by J.E. Gore of Sligo who estimated the size of Arcturus. If better data had been available to Monck, his discussion of proper motions and spectra might have led him to the relationship between luminosity and colour later discovered by Hertzsprung and Russell.

Monck was quiet and reserved in manner. He was an authority on economics, church history and legal matters. He was a formidable chess opponent but took more pleasure in solving problems than in the cut and thrust of games. He died on 24 June 1915 at the age of 76, leaving no children. His widow survived him by only a few months.

S.M. Dixon (1866-1940)

Stephen Mitchell Dixon was born in Dublin in 1866, the seventh of nine children of George Dixon and his wife Rebecca, who was the daughter of George Yeates, Dublin's leading instrument maker. His father died when he was five but his mother brought up her large family with loving care and all her seven sons had successful careers, the best known being Henry H. Dixon, F.R.S. and Andrew F. Dixon who became professors of Botany and Anatomy respectively in Trinity College (they were fondly known as 'Botany Dick' and 'Anatomy Dick'). The Dixon family lived at 17 Earlsfort Terrace from 1889 to 1894.

In Trinity College Stephen was a Senior Moderator and Gold Medalist in experimental science. For two years he was demonstrator to Dr W.A. Trail, the professor of Applied Mechanics in the Engineering School. After Trinity he spent two years as a civil engineer on railway construction in England and six months with the Portrush Electric Railway Company — a narrow gauge tramway constructed by Trail and his brother in 1883. The tramway connected Portrush with the Giant's Causeway and it was the first in the world to be powered by hydro-electricity.

In 1892 Dixon was appointed professor of civil engineering at the University of New Brunswick in Nova Scotia where he was a popular teacher and an effective administrator. He was largely responsible for the modernisation of the engineering course and for the design of a new Science and Engineering Building which was erected in 1900–1901. He directed the plays at the annual concerts of the university Glee Club. In 1894 he married Aline Harrison, the daughter of the Chancellor of the University; in order to outwit the students the marriage ceremony was held at 5 a.m. on the day before the announced date. They had one daughter, Sibyl who was born in 1899. Dixon held the chairs of civil engineering in the Universities of Dalhousie in Halifax (1902–05), and Birmingham (1905–13) and at Imperial College London (1913–33). He was Dean of the City and Guilds Engineering College (1930–33). During the First World War he had an important post in the Ministry of Munitions and he served with the Royal Engineers in France. He was awarded the O.B.E. in 1937.

After the death of his first wife in 1934 he married Josephine Jud in 1936 and lived in the south of France. He died on 25 March 1940 in Nice at the age of 74.

G.F. Fitzgerald (1851–1901)

George Francis Fitzgerald was born on 3 August 1851 and spent his childhood in Monkstown, Co. Dublin where his father was rector of Kill-o'-the-Grange parish. His mother was a sister of George Johnstone Stoney who proposed the name of 'electron' for the particle of electricity in 1891. George with his brothers and sisters were tutored at home by the sister of George Boole, the logician and Professor of Mathematics in the Queen's College at Cork.

Fitzgerald had a most distinguished academic record in Trinity and became a Fellow of the College at the age of 26. Four years later he was appointed Erasmus Smith Professor of Natural and Experimental Philosophy in the College. While the volume of his published work is comparatively modest, he had a great influence on his contemporaries and was noted for his generosity of time and ideas. He was a champion of Clerk Maxwell's electromagnetic theory and he did much to make it understood. When Hertz succeeded in generating electromagnetic waves, Fitzgerald brought his work to the attention of the British Association for the Advancement of Science at its meeting in Bath in 1888 and ensured that its significance was appreciated. By suggesting a suitable means of producing radio waves he helped to lay the foundation of wireless telegraphy.

Fitzgerald is probably best remembered for the theory which bears his name — the Fitzgerald-Lorentz Contraction. After the failure of the Michelson-Morley experiment to detect the existence of the ether, Fitzgerald proposed in 1892 that the explanation lay in the contraction of a moving body in the direction of its motion. The mathematical basis of the theory was developed by the Dutch physicist, H.A. Lorentz. Though the concept of the ether was later abandoned, the Fitzgerald-Lorentz Contraction was a significant milestone towards Einstein's Theory of Relativity.

When Fitzgerald was appointed to the chair of natural and experimental philosophy, there was no teaching of practical physics in Dublin so he obtained a disused chemical laboratory and began classes in experimental physics. He took an active part in general educational matters and was concerned with improving the general level of education in the country. It was largely through his efforts that technical education was established in Ireland, including the foundation of Kevin Street College of Technology. In 1895 he bought a Lilienthal glider and he attempted to fly it in Trinity College Park.

In 1885 he married Harriette, the second daughter of the Rev. J.H. Jellett, Provost of Trinity. They had five daughters and three sons. He served as secretary to the Royal Dublin Society from 1881 to 1889 and took an active part in its meetings and in the annual meetings of the British Association. Among distinctions awarded to him were Fellowship of the Royal Society in 1883 and the award of its Royal Medal in 1899.

His generosity and willingness brought him many tasks and continuous overwork undermined his health. Fitzgerald died after an operation for a digestive complaint

on 22 February 1901, at the age of 49 and his death was a great blow to the College and to the wider scientific community. Oliver J. Lodge wrote: "...it may be doubted whether there ever was a man of equal scientific power, agility of thought and selflessness combined".

W.E. Wilson (1851-1908)

William Edward Wilson was born on 19 July 1851, just two weeks before G.F. Fitzgerald. Wilson's father owned a large estate in County Westmeath at Daramona which lies north-east of the road between Mullingar and Longford. Due to delicate health he was educated at home. He showed a keen interest in astronomy and in 1870, at the age of nineteen, he took part in a total eclipse expedition to Iran. The following year he set up an observatory equipped with a 12-inch Grubb reflector in the garden at Daramona.

In 1881 Wilson bought a 24-inch mirror and tube from Grubb and installed them in a new dome which adjoined Daramona House. Wilson carried out three main projects: a determination of the temperature of the solar photosphere, the electrical measurement of the brightnesses of stars and photography of the Sun and stars.

The estimation of the temperature of the Sun's surface was carried out in collaboration with Mr. P.L. Gray of Mason College in Birmingham and later with Dr Arthur A. Rambaut who was Director of Dunsink Observatory from 1892 to 1897. Wilson benefitted also from discussions with Fitzgerald with whom he corresponded regularly. The detector was a differential radiomicrometer, invented by C.V. Boys, which combined the functions of a bolometer and a galvanometer; it was constructed by Yeates of Dublin. A null method was used to compare the solar radiation with that from an electrically heated strip of platinum. The first estimate of 7073K was made in 1894 but after a revised determination of the absorption of the Earth's atmosphere the value was corrected in 1901 to 6863K which compares favourably with modern estimates. A large siderostat was loaned by the Royal Society for this investigation.

Apart from the electrical measurement of starlight, the other major achievement of Wilson was in celestial photography. From 1893 onwards the 24-inch telescope was used for photographing nebulae and clusters and his results equal the best obtained elsewhere at that time. Eleven stellar photographs appear in his collected papers and although Wilson claimed that the collotype process used was unable to reproduce the delicate nebulosities in the original negatives, the results are impressive. Photographs of the solar disk were taken regularly with a 4-inch Grubb refractor for the purpose of studying sunspots. In August 1898 a large sunspot was photographed on cine film for four hours at the rate of about 100 exposures an hour. Although Wilson reported that the spot did not show much change, this may have been one of the earliest applications of time-lapse photography to the study of solar phenomena.

A number of other investigations were carried out and are mentioned in the annual reports which appeared in the *Monthly Notices* of the Royal Astronomical Society in 1883 and from 1892 to 1908. These include observation of the transit of Venus in 1882 and a photographic search for a planet beyond Neptune in 1901/1902. In May

1900 Wilson, Rambaut, H. Grubb, C.J. Joly and Bergin took part in the successful joint Royal Irish Academy — Royal Dublin Society eclipse expedition to Plasencia in Spain.

In 1886 Wilson married Carolina Ada, the third daughter of Capt. R.C. Granville of Biarritz and the family visited there from time to time. He was elected a Fellow of the Royal Society in 1896 and was awarded an honorary D.Sc. by Trinity College Dublin in 1901. He died on 8 March 1908 at the age of 57 and was survived by his widow, one son and two daughters.

Monck's Telescope

The $7\frac{1}{2}$-inch lens of Monck's telescope was made by Alvan Clark and had an eventful history which is worth recounting.

Alvan Clark lived in Boston and was by profession an inventor and portrait painter. He had two sons — George and Alvan Graham — and two daughters. George, while a student at Andover College, attempted to build a small reflecting telescope. This led to his father becoming interested in optics and eventually to the founding of the firm of Alvan Clark and Sons in 1850. Five times the firm made the world's largest telescope with apertures ranging from 18.5 inches for Dearborn Observatory in 1862 to 40 inches for Yerkes Observatory in 1897. The Yerkes instrument is still the largest refractor in the world.

One of Clark's earliest customers was the Rev. William Rutter Dawes (1799-1868), the experienced English observer of double stars. After completing the $7\frac{1}{2}$-inch objective in 1853, Clark used it to discover the faint companion of 95 Ceti. When Dawes learnt about this discovery he asked Clark to carry out further tests on other close binaries and then asked if he could buy the telescope. Clark reluctantly agreed and sold it to Dawes in March 1854 for $950. Dawes was very pleased with its quality and used it for two years, mostly for observing Saturn. Between 1855 and 1859 Dawes bought four more Clark telescopes and thus helped to establish Clark's reputation as a telescope maker.

In 1856 Dawes sold the $7\frac{1}{2}$-inch lens only to Frederick Brodie who remounted it at Eastbourne. By 1869 the lens had been bought and remounted again by Dr Wentworth Erck of Sherrington House at Shankill, 16km south of Dublin. Erck made regular observations of sunspots from 1869 to 1888 and carried out more than 1900 measurements of 40 selected binaries between 1873 and 1880. In 1872 Charles E. Burton compared the optical performance of the $7\frac{1}{2}$-inch objective with a 9-inch mirror of silvered glass. At the opposition of Mars in 1877 Erck was one of the first in the British Isles to observe the moons of Mars which had been discovered a few weeks previously by Asaph Hall with the 26-inch Clark refractor of the U.S. Naval Observatory in Washington. He also observed Jupiter and Saturn and, according to A.A. Rambaut, he was one of the first, if not the very first, to notice the proper motion of Jupiter's Red Spot. Burton, shortly before his death at the age of 35, used Erck's telescope to take photographs of the Moon.

There is ample evidence that the $7\frac{1}{2}$-inch Clark lens had a remarkable optical

quality. The noted amateur, William Lassell, was "astonished" by its performance. Rambaut wrote about the lens as follows:

> "It is in some respects a remarkable glass, being so full of bubbles that to one versed in such matters it might have appeared almost worthless for the delicate purpose for which it was intended; whereas it is remarkable for the exquisite definition it is capable of affording, as was proved on more than one occasion by the work done with it in the hands of Mr. Dawes and Dr. Erck".

According to Erck, Dawes considered the $7\frac{1}{2}$-inch telescope "more perfect than any of its successors".

After Erck's death in 1890, the telescope was acquired by Sir Howard Grubb who sold it to Monck for use from his residence at 16 Earlsfort Terrace where it was used for the pioneering measurements in August 1892. In 1912 Monck presented his complete telescope to the Queen's College Belfast (now Queen's University). According to Prof. K.G. Emeleus the lens was incorporated into a Littrow spectrograph by R.C. Johnson about 1921. As the spectrograph did not perform well, Emeleus sent the lens to Hilger's for testing; the two components were found to be off-centre but the main source of imperfection was eventually traced to a cheap prism. Although the spectrograph was still in existence in the mid-1960s, the subsequent fate of the lens is not known.

Wilson's Telescope

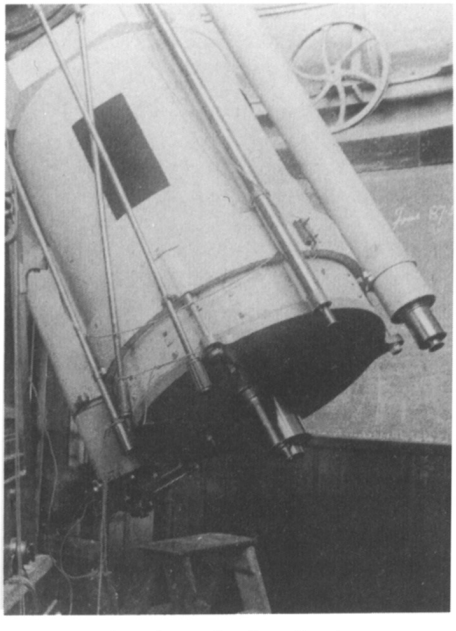
In 1871 Wilson built a small observatory in the garden of Daramona House for a 12-inch reflector made by Sir Howard Grubb in Dublin. There was attached a small room for photography and it also contained a small transit instrument made by Wilson himself and a sidereal clock. It was used for lunar photography on wet plates and for experiments on solar radiation with thermopiles.

In 1881 Wilson bought a 24-inch mirror and tube from Grubb and installed it on the old equatorial mount in a new dome which adjoined Daramona House. However, the original mounting proved unsatisfactory and the tube was remounted in 1892 and fitted with an electrically-controlled clock drive from Grubb. A laboratory and darkroom were added to the observatory in 1889. There was also a well-equipped workshop with a 6-inch Whitworth screw-cutting lathe, a shaping machine and a drilling machine. The tools were driven by a $1\frac{1}{2}$H.P. Crossley gas engine.

After Wilson's death in 1908, the telescope was scarcely used and in 1925 it was offered to the University of London by Wilson's son, J.G. Wilson, on condition that a dome was built to house it. A site was obtained at Mill Hill and the Observatory was opened in 1929 and used for spectroscopic research. From 1951 to 1974 it was used for practical instruction of astronomy students at University College. The telescope is now in the custody of Merseyside County Museum in Liverpool.

Daramona House, Streete, County Westmeath

Willaim E. Wilson, FRS (1851–1908)



Wilson's 24-inch reflector

https://doi.org/10.1017/S0252921100007326 Published online by Cambridge University Press

Acknowledgements

Many people have helped in the search for information but we are particularly grateful to Prof. Denis Weaire of Trinity College for drawing our attention to the astronomical work mentioned in the Fitzgerald correspondence in the archives of the Royal Dublin Society. We thank the following for supplying photographs: Richard Morris of Brunel University, the Mary Lee Shane Archives of Lick Observatory, the University of New Brunswick at Fredericton, Trinity College Dublin, John McConnell and William Dumpleton.

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