cometary neutral gas which leads to the set-up of an ambipolar electric field and a potential well. The solar-wind electrons fall into the potential well, are accelerated, and are able to ionize and excite the neutral gas. You have the energy of a solar-wind electron which is colour-coded in energy on the figure with blue as low energy and red as higher energy; as the electrons fall into the potential well they are accelerated. If they don't undergo collision then they get out of the potential well. If not they will deposit energy by ionizing and exciting the cometary gas; that is the source of the cometary aurora.

*Mr. Steven Cockcroft*. I love the idea of picking up a pristine comet. How do you know that it is pristine, and that it didn't pass 100 years ago and we just didn't spot it?

*Professor Galand*. Modelling the dynamical history we can look back at the evolution of comet orbits. Nearby stars, or massive planets such as Jupiter, can alter the cometary trajectory. For 67P, in the 19th Century and also in the 1920s and late 1950s, its orbit was perturbed which brought it ultimately into the inner Solar System where it has outgassed more significantly. There is an hemispherical asymmetry in the composition of the neutral gas in 67P and that may be due to evolutionary changes. For *Comet Interceptor*, we really want to have as pristine a comet as possible. When new candidates are detected, the dynamical history has to be modelled.

*The Chair*. A quick question about *Comet Interceptor*. You are at L2 waiting for your pristine comet to appear. How long can you wait and will you be operating your instruments there?

*Professor Galand*. *Comet Interceptor* can wait up to four years at the Lagrange point L2. It's a function of the amount of propellant. Currently ESA is not planning to allow science operation for L2 but let's see. There is already a Target Identification Working Group as part of *Comet Interceptor* and we have already started to look at candidates, in order to assess how many dynamically-new comets per year we could discover and are suitable candidates. We also have back-up candidates just in case. It will take between six months to three years to reach the comet; if you wait longer at L2 it will not be possible to go as far. Let's hope to find a very good target fast enough not to have to wait at L2 too long.

*The Chair*. Can I thank you again, Marina? [Applause.]

I'd like to remind you about the drinks reception after this meeting in the RAS Council Room and I give notice that the next A & G Highlights meeting will be on Friday, December 8th.

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## LATE-VICTORIAN LANCASHIRE ASTRONOMERS AND THE RAS 1871–1901

*By Steven Phillipps*

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A previous paper[1] outlined the contribution of Lancashire astronomers to the Royal Astronomical Society in the fifty years to 1870. For most of this time the RAS and its journals

were essentially the only specific vehicles through which serious participants could share their astronomical interests. As the century progressed, though, various developments spread the astronomical base more widely, in what Allan Chapman[2] has called "the rise of the leisured enthusiast". A new 'popular' journal, the *Astronomical Register*, appeared in 1863 and local astronomical societies began to establish themselves, notably in Liverpool in 1881, while the British Astronomical Society, later Association (BAA), followed in 1890, with a North-West Branch centred on Manchester. This article explores how these factors affected the involvement (or otherwise) of Lancashire astronomers in the RAS. As in the previous paper, 'Lancastrian' is taken to mean a resident of the traditional (pre-1974) county, counting only persons who became involved, or at least interested, in astronomy while living there (though a few born in Lancashire but living elsewhere rate a mention).

*1871–1880*

We should actually first note an extra pre-1870 FRAS inadvertently omitted from the previous paper[1]. Born in 1817, Rev. John Edwards trained at St Aidan's College in Birkenhead and was appointed rector in Bradford-cum-Beswick in Manchester in 1859, becoming expert in ecclesiastical history. Also interested in the history of astronomy, he was elected an FRAS in 1869[3].

Even though the RAS president was the Lancashire-born William Lassell[1,2] (by then resident in Kent), only one Lancastrian was elected a Fellow in 1871. This was Samuel Cottam of Wightwick House, Higher Broughton near Manchester, born in 1828, the son of the earlier Fellow, Samuel Elsworth Cottam[1]. Cottam Jnr. was a chartered accountant, becoming the head of the family firm, and was also a painter, a musician, and a photographer[4], but did not publish any astronomical results.

There was, though, a brief note in *Monthly Notices* (*MN*) in 1871 on the Zodiacal Light[5] from a non-member, Rev. W. A. Jevons of Liverpool. William Jevons was a Unitarian minister, born in Worcestershire in 1794 but brought up in Liverpool. He was educated at Manchester New College, a non-conformist academy (actually then sited in York), but left the ministry due to differences of views. He wrote a book for schools: *Elements of Astronomy illustrated by the more useful Problems on the Globes and adapted for the Use of Young Persons and those unversed in mathematics*. His nephew, W. Stanley Jevons, is generally considered to have been the first mathematical economist.

Also in 1871, *Nature* reported a paper[6] read at the Manchester Literary and Philosophical Society by Prof. Osborne Reynolds in which he suggested that the tails of comets, the solar corona, and the aurora were all electrical effects in the ether which filled space, specifically "comet's tails are an effect due to the medium through which it passes being heated and illuminated by the comet". Reynolds, born in Belfast in 1842, had been appointed professor of engineering at Owens College, the forerunner of the Victoria University of Manchester, in 1868. He subsequently became famous for his studies of fluid mechanics, particularly turbulent flow (the Reynolds number, *etc.*). He became an FRS in 1877 and won their Royal Medal in 1888[7]. However, despite writing on the

structure of the Universe, he appears never to have joined or communicated with the RAS.

Returning to actual RAS members, John Alexander Bennion (born in Manchester in 1849) evidently developed his interests in astronomy while studying at Manchester Mechanics' Institute and Owens College in the late 1860s, obtaining certificates in both natural philosophy and engineering, and was elected an FRAS at an early age in 1872. Trained as an engineer, in 1869 he had won 1st prize of £5 for his performance on Principles of Mechanics in the final examinations of the Royal Society of Arts, Manufactures and Commerce. Matriculating at Cambridge in 1875[8] he was called to the bar in 1884 and described himself as barrister-at-law when voted vice-chairman of the Mathematical and Physical section of Manchester 'Lit and Phil' in 1888. He was later director of technical education for Lancashire County Council and lived in Blackpool.

Rev. Samuel Jenkins Johnson[9] also became an FRAS in 1872. Though by then a vicar in Devon, he was born in Atherton in Lancashire in 1845 and after obtaining his degree was a curate in nearby West Houghton. He sent observations of Mercury that he had made from Lancashire in the 1850s and 1860s to the *Astronomical Register*[10] in 1872 and had earlier[11] communicated observations of the aurora *via* W. F. Denning, founder (in 1869) and secretary of the fairly short-lived Observing Astronomical Society[12] (OAS), whose members were "gentlemen possessing astronomical instruments for the purpose of securing concerted observations". Johnson subsequently supplied 37 papers to *MN*, many on eclipses.

Denning[13] recorded in *Astronomische Nachrichten* in 1872 that the late Edmund Salter of Manchester had been able to see twelve stars in the Trapezium with his "12 inch reflector of superior quality". Despite this impressive instrumentation, Salter, though contributing to the OAS[20], did not join the RAS. Born in 1819 in Wiltshire[14], he lived in Hulme in Manchester and in Ashton-under-Lyne and was Inspector of Schools under the British and Foreign School Society. Unfortunately he was "the victim of a melancholy accident at the Peterborough Railway Station" in 1870.

Probably less surprisingly, a further OAS correspondent, and subscriber to the *Astronomical Register*, who provided details of a range of observations[15] around this time, Henry Ormesher of Patricroft, near Manchester, did not join the RAS either. He was a rare working man in our list of observers, a foreman boiler maker, born in nearby Eccles in 1829. One wonders if he might perhaps have worked at engineer/astronomer James Nasmyth's works which was sited in Patricroft[1].

Three additions to the RAS ranks appeared in 1873: Joseph Ridgway Bridson of Bolton and Belle Isle Windermere, John Berger Spence of Erlington Hall, Manchester, and Joseph Hough of Rossall School, Fleetwood. Bridson was born in Horwich in 1831 and went into the family bleaching and calico-printing company in nearby Bolton, the family residing at Bridge House adjacent to their works. (His father was mayor of Bolton.) A champion yachtsman, founder of Windermere Yacht Club in 1860, he later leased the whole of Belle Isle in Windermere as a country residence. He became a subscriber to the *Astronomical Register* in 1869, prior to joining the RAS. He was also president of Bolton Photographic Society[16]. His son of the same name became an admiral. He was also related to Mary Augusta Ridgway Bridson, former Prime Minister Tony Blair's grandmother.

Spence was born in Cumberland in 1839 and was a metal and chemicals

merchant in Manchester (his father, a leading chemicals manufacturer, was Justice of the Peace for the County of Lancaster). He was a member of the Royal Institution and a Fellow of the Geological Society, the Royal Geographical Society, the Chemical Society, and the Royal Society of Literature[17]. Born in Leeds in 1837, Hough was originally an engineer, then worked at Lord Wrottesley's private observatory[18], some of his observations being reported in *MN*[19]. Later graduating from Cambridge, in the 1870s he was assistant natural-science master at Rossall and then headmaster of Burnley Grammar School.

The Rev. James Pearson of Fleetwood joined the RAS in 1874. A native of Preston and attending the grammar school there before matriculating at Cambridge, he was 15th wrangler in 1848. A varied career saw him as a curate in Scarisbrick near Ormskirk, a maths master in Norwich, and professor at the Royal Military College, Sandhurst, before returning to clerical positions and becoming vicar of Workington and then Fleetwood in 1871[20]. He published one *MN* paper, in 1879[21], on the adjustment of 'equatoreal' telescopes, and wrote widely on tides. He also produced a paper for *L'Astronomie*, '*La Date du Commencement de l'Ere Chretienne*', which he suggested was out by three years.

George Russell Rogerson of Waterloo near Liverpool also joined in 1874. Born in Fazakerley, Walton-on-the-Hill, then a village outside Liverpool, in 1839, he was a solicitor, public notary, freemason, and captain in the 8th Lancashire Artillery Volunteer Corps. He was also a Fellow of the Royal Geographical Society and the Royal Society of Literature[22] but was apparently most noted as an early member, then chairman, of the National Dog Club, a forerunner of the Kennel Club[23]. He was an observing colleague of R. C. Johnson (below). He donated his observatory to his old school, Liverpool College, in 1886 and in the 1890s migrated to Australia.

David Winstanley, then resident at the Doctor's Cottage, Blackpool, was elected an FRAS in 1875, as was John Brise Colgrove, 'Head Master of the Modern Side' at Rossall School. The former was born in Manchester in 1846 and was initially a photographer in Newton Heath, but in 1881 he is recorded as an "inventor of scientific instruments", in Richmond, Surrey. His only contribution to the RAS appears to have been the donation of an unspecified item to the library in 1882[24]. However, he had sent an observation of a possible daylight aurora, seen from Blackpool, to *Nature* in 1871. Colgrove was born in Buckinghamshire in 1840 and taught in a prep school from an early age before entering Cambridge, being awarded his MA in 1872. He was later headmaster of Loughborough Grammar School and was a keen member of the Alpine Club, he and two colleagues from Rossall being the first to scale the Matterhorn without guides[25] in 1876. He was a member of the RAS for 56 years without contributing to *MN*.

Although he was not yet an FRAS (he did not join until 1891), 1875 saw the first published work[26] from Father Walter Sidgreaves, S.J., from the observatory at Stonyhurst College, a Jesuit boarding school near Clitheroe. Stonyhurst was the primary observatory in Lancashire for many years with annual reports in the major journals[27]. Father Sidgreaves was from Grimsargh near Preston (born 1837) and attended Stonyhurst as a pupil before becoming a teacher there. He was temporary director of the observatory from 1863 to 1868, in the absence of Father Perry, and was then Perry's assistant, taking part in the Venus transit expeditions to Kerguelen Island and Madagascar. He took over the directorship after Perry's unfortunate demise in 1889[1]. Originally most interested in meteorology and terrestrial magnetism, he later undertook the spectroscopy of stars, particularly novae, producing numerous papers for *MN*[28].

Another assistant to Father Perry at that time was William Carlisle. Born in London in 1842, he became a brother at the seminary at Stonyhurst in the 1860s and in the 1871 census was recorded as "astronomer/domestic servant"(as was colleague Joseph Hostage). He travelled to Belgium with Perry that year to help with magnetic-survey observations and accompanied Perry and Sidgreaves to Madagascar in 1882. His telescopic observations were also acknowledged in a number of Perry's *Monthly Notices* papers[29] on Jupiter's satellites and occultations, and in one by the Rev. W. J. Crofton, S.J., on Barnard's Comet of 1888[30]. By 1881, he had the more formal appellation of 'clerk to the director' and was now Father Carlisle, S.J. (William Crofton only appears to have been briefly at Stonyhurst; by 1891 he was at St. Bueno's College in St. Asaph before becoming headmaster of Wimbledon College.)

Next actually to join the RAS, in 1876, was Richard Coward Johnson of Blundellsands, near Liverpool, who had already sent an observation of the crater Archimedes to the *Astronomical Register* (signed as "rcj") in 1868. He was born in Liverpool in 1840 and was initially an accountant for the family coal-merchant's business, later recording himself as "coal proprietor", living at The Hall, Higher Bebington on the Wirral, where he had his observatory[31]. He owned a 9¼-inch telescope, being one of the first amateurs to use silver on glass mirrors, and in due course contributed two papers to *MN*[32] (28 years apart). He also helped to form the Liverpool Astronomical Society, being president in 1882, and was a long-time member of the Liverpool Literary and Philosophical Society from 1863[33]. He travelled extensively in the near east in the 1870s with cleric–explorer–naturalist Henry Baker Tristram, contributing appendices of astronomical observations to one of Tristram's books.

In 1877, we find Thomas Gregory, assistant master at Merchant's College, Blackpool, joining the RAS[34]. Born in 1849 in Manchester, he was the son of the principal of the school for the sons of merchants. The following year, two more Lancashire schoolmasters joined, Benjamin Templar of Birkdale, Southport[35], and William Hobson from Whalley Range in Manchester[36]. Templar, born in Bristol in 1829, ran a school in Salford before moving to Southport where he died a year after joining the RAS. Hobson was born in Armagh in 1843 and studied, then taught, at a Quaker training college in Yorkshire, before becoming proprietor of a school in Manchester. He later returned to Ireland as a tutor.

Sir Franz Arthur Friedrich (known as Arthur) Schuster was born in Frankfurt in 1851 but made his name in Manchester where his father's textile business was located. After working briefly for the family firm he became a student at Owens College and subsequently carried out research into spectra at Cambridge (spending a year with Kirchoff in Heidelberg). He was invited by the Royal Society to lead an expedition to Siam (now Thailand) to photograph the spectra of the corona during an eclipse in 1875. He was elected an FRAS in 1877, FRS in 1879, became professor of applied mathematics at Owens (by then part of the Victoria University) in 1881, and succeeded Balfour Stewart as professor of physics in 1888. He became its first Dean of Science when the independent Manchester University was created[37]. Along with extensive work in other areas, he had five papers in *MN* on the Sun[38] and later published a key paper for the study of stellar atmospheres, 'Radiation through a Foggy Atmosphere', in *Astrophysical Journal* in 1905.

Arthur Edward Nevins of Liverpool (born 1853) became an FRAS in 1879, publishing the same year[39] his views 'On the practical Advantages of Hartnup's Method of testing Chronometers' as determined during numerous long-distance voyages. Originally in the navy, he then followed in the footsteps of his father, the distinguished John Birkbeck Nevins, by training in Edinburgh as a

medical doctor and becoming a member of the Royal College of Surgeons. He practised in Stoke before joining his father's practice back in Liverpool[40] along with his brother.

A perhaps unlikely, but well-known, name gave an astronomical talk (on damping oscillations of his own telescope) at the Manchester Literary and Philosophical Society in 1879, as reported in *The Observatory*[41] — its president James Prescott Joule FRS, already famous for his studies of heat. Joule was born in Salford in 1818 and worked in the family brewery business there before concentrating on his scientific experiments[42], particularly after building his own laboratory at his father's home in Whalley Range.

There was only one addition to the RAS in 1880, Rev. William Smith of Chorley. Born in Cheshire (1844) but brought up in Lancashire, he started out as a boiler maker like his father before becoming a well-travelled Primitive Methodist minister who also gave lectures on astronomy[43].

*1881–1889*

The Liverpool Astronomical Society (LAS) came into being in 1881[44], catering at first for amateur astronomers in the vicinity of the city, "a kind of halfway resting-place between the amateur public and the Royal Astronomical Society", but thanks to its energetic first secretary William Henry Davies[45] it soon became a national and even international entity. (There was a branch in Pernambuco, of which the Emperor of Brazil was an honorary member.) At its peak importance in the late 1880s it had more than 600 members, but only a small minority actually lived in and around Liverpool (56 within 12 miles in 1886), and many of these were on the other side of the Mersey, in Cheshire, including its early president and major observer, Rev. T. H. E. C. Espin[46].

Born in Hertfordshire in 1831, Davies ran a business in Liverpool making pianos. (Indeed, he published a series of articles in the *English Mechanic* on 'How to make a pianoforte'.) He contributed numerous papers to LAS meetings and in 1884 joined the RAS. His son of the same name (born in Liverpool 1857) was also active on the council of the LAS and was a piano teacher. Only a few of the other local members contributed papers to the Society's journal or its meetings, though, and like Davies senior these were generally also in the RAS, as below. (A few later joined the BAA rather than the RAS, including council member Walter Sang, a civil and mechanical engineer from Edinburgh (born 1836) who lived in Sefton Park in Liverpool and was a variable-star observer[47], and the LAS librarian[48] Charles Albert Defieux, a New York-born (*c.* 1850) restaurant manager in Liverpool who later became a mechanical and electrical engineer before emigrating to Canada.)

The splendidly named Squire Thornton Stratford Lecky joined the RAS in 1881 while living in Bootle. He was a master mariner and lieutenant in the Royal Naval Reserve (later retiring as Honorary Commander RNR)[49]. Born in County Down in 1838, he ran away to sea when he was 14, was subsequently second mate on a China clipper sailing out of Liverpool, and then joined the Indian Navy. Rejoining the merchant marine, at one point he attempted to run the blockade of Charleston harbour during the American Civil War. He became an authority on navigating the Pacific Ocean and the coasts of South America, and his book *Wrinkles on Practical Navigation* ran to fifteen editions. He later worked as marine superintendent for the Great Western Railway in Milford Haven, overseeing their ferry services. His son was also a Lieutenant in the RN.

James Cook of Preston had been one of the original committee of the OAS and supplied observations of Jupiter[11] to Denning, but did not join the RAS

until 1881. Cook built his own refracting telescopes and was one of the group Denning organized to carry out a systematic search for the hypothetical inner planet Vulcan. Born in Lancaster in 1829 (his RAS obituary incorrectly says 1839), he is listed[50] in 1869 as a "coal proprietor and merchant". He moved to the University of Sydney in 1884 and worked there building equipment for the next 25 years[51].

The next Lancastrian FRAS, in 1882, was actually a Welshman[52]. Isaac Roberts was born in Denbighshire in 1829 but was apprenticed to a firm in Liverpool when he was 15, eventually becoming its manager. Setting up on his own as a building contractor in Liverpool, he became one of the most prominent master builders in the area and accumulated a substantial fortune. By 1878, he had his own observatory, at first in Rock Ferry on the Wirral, then from 1883 in Maghull outside Liverpool[53]. An early member of the LAS, he was its president in 1885–1886. He became interested in the possibilities of astrophotography and in 1888 sent to the RAS what is reckoned to be the first ever photograph of a galaxy (M31 with its companions)[54]. He also published the first book of astronomical photographs, in 1893, by which point he had sold his business and relocated his observatory ('Starfield') to Sussex. In all, he made around a hundred contributions to astronomical journals, 79 of them in *MN*. He was elected an FRS in 1890 and won the RAS gold medal in 1895. His second wife was American/French astronomer Dorothea Klumpke.

John Wilson Appleton of Toxteth Park also joined the RAS in 1882. He was another early member and Secretary of the LAS, reports of whose meetings were carried by *The Observatory* from 1883[55]. He had been born in Liverpool in 1835 and was originally an accountant, recorded as having a "counting house and works" in Toxteth. Later he was a schoolmaster and he was also a Wesleyan preacher.

Though not yet in the RAS — he joined in 1887 — Rev. John Bone from Lancaster had a letter to the *English Mechanic* concerning a lunar crater commented on in the *Astronomical Register* in 1882[56]. He was on the provisional committee for the proposed British Astronomical Society (subsequently Association) in 1890[57]. Born in Southwark in 1835, he was a curate in Southport from 1865 before becoming a vicar in Lancaster[58]. He was also involved in the Lancashire Philosophical Society and founded the Lancaster Astronomical and Scientific Association in 1903[59].

Frederick Charles Green from Breightmet near Bolton (where he was born in 1853) was elected an FRAS in January 1883[60] but died of consumption on the Isle of Man four months later at the age of only 29. Educated at Bolton School, he had originally been a clerk in the shipping trade and had a great interest in sailing, but became a master cotton bleacher at his brother's works.

An intriguing inclusion in *The Observatory*[61] that year was a review of 'A New Mechanical Sky-Map', "a handy and useful contrivance", made by Theodore Grosse of Manchester. From the description it is evidently a variant of what is now referred to as a planisphere. Grosse was a civil engineer born in Dresden, Saxony, in 1851, but was living in Manchester by 1875 and was also in the machinery-export business.

Next to join the RAS, in 1885, was another LAS member, the Rev. Canon James Hardy Honeyburne, who, in his own words[62], had "a 3¼-inch telescope, in a little back yard in Liverpool". Born locally in 1845, he was a Wrangler at Cambridge[63] and taught at a grammar school before being ordained. He was the incumbent of parishes in Everton and Toxteth Park and later a vicar in Southport. He also served as an Honorary Canon of Liverpool and Rural

Dean of Southport. The same year saw Captain Benjamin Thomson RNR of St. Helens join the RAS[64]. Born in Dumfries in 1845, he went to sea when he was 15 and obtained his master's certificate in Liverpool in 1869. He was a freemason, recorded as being with the Hong Kong Lodge in 1889, later retiring to Sussex.

We can note that by the end of the 1884–85 session, there were 28 RAS Fellows with an address in Lancashire[65], including Rev. William Owen Williams of Liverpool who had been elected in 1868 when living in Pwllheli[52] in what was then Carnarvonshire. He was born on Anglesey in 1817 and was a 'Welsh Calvinistic Methodist minister' in Toxteth Park. He was a lunar observer whose work was noted in the *Register*[66]. (The number of Lancastrian Fellows reached 31 in 1895, then remained about the same for the rest of our time period.)

Next, later in the year, was Richard Wilding of Fulwood, Preston, already an LAS member, who was the 'curator' of Preston Observatory and owned a 19-inch reflector. He appears to have been initially interested in double stars but became director of the Photography Section of the BAA from 1898[67]. Born in 1842 in Preston, he was a cotton manufacturer "employing 377 adults and 147 children" in 1881. He later moved to Kent.

Elected an FRAS in 1886 while at Cambridge reading mathematics and law, John David McClure (eventually Sir John, LL.D.) gave his address in 1890 as his home town of Wigan (born 1860). He had previously been a grammar-school assistant master and obtained a degree in music at Owens College. He worked as a University Extension Lecturer, then became professor of astronomy at Queen's College, London. Later Headmaster at Mill Hill School, raising it to be "one of the chief Nonconformist public schools in the country", he was knighted in 1913[68].

Rev. Samuel Hickling Parkes of Swinton Industrial School, Manchester, was elected an FRAS in 1887[69]. (The school was for pauper children, being seen as a more productive alternative to the workhouse.) His uncle, of the same name, an optical instrument maker in Birmingham, had joined the RAS in 1882. The Reverend was born in 1849 in Staffordshire and in 1871 was recorded as a "student of theology". A Wesleyan minister, he was living in Bolton in 1891 but unlike his uncle is, for some reason, not in the 1890 list of RAS Fellows.

A further LAS stalwart and sometime president, James Gill, was elected to the RAS in 1888 and later also joined the BAA. Born on the Isle of Man in 1840, he trained sailors in navigation and seamanship in Liverpool. He was Principal of the Navigation School at the Sailor's Home and then headmaster of Liverpool Corporation's Nautical College[70]. He wrote *A Text Book of Navigation and Nautical Astronomy*.

Rev. (Thomas) Joseph Walshe was another Liverpool resident elected in 1888[71]. Born in 1862 in Ireland, and trained at Ushaw College in Durham, he was a Catholic priest (eventually Right Reverend Monsignor) and an 'officer' at a college for theological and humanities students. He was also noted for his support of the women's suffrage movement and was awarded an honorary master's degree by Liverpool University in 1920.

Yet another clergyman, the Rev. George Burgess, was proposed for the RAS by Fellow Wesleyan Methodist preacher (and one might guess relative) the Rev. John Burgess, at the end of 1889, while living in Urmston, just outside Manchester[72]. Born in Leicestershire in 1844, he had been in Lancashire since the 1870s but in 1893 he emigrated to New Zealand as a Congregationalist parson. Robert Lethbridge Tapscott gave his affiliation as Owens College when proposed at the same meeting as Burgess, but was a civil engineer in Liverpool by the time he was elected after the usual two-month gap[73]. Born in Liverpool

in 1857 and graduating at King's College London in 1876, he worked for the Lancashire and Yorkshire Railway. He was also a member of the Institution of Civil Engineers (contributing a paper 'Railways in India' to Liverpool Engineering Society[74]), a Fellow of the Geological and Meteorological Societies, and a member of the Society of Arts. He held a patent for a "machine for cleaning and polishing boots or shoes". He appears to have emigrated to the USA in 1897.

*1890–1901*

The intriguing character George Higgs was next to sign up in the RAS. George Daniel Sutton Higgs (born Daniel Sutton in Devon in 1841), the son of an agricultural labourer, somehow acquired a significant and surprisingly broad education[75] and by 1861 was a watchmaker's apprentice. A few years, and name changes, later he moved north, setting up business in Liverpool where he was listed as "George Higgs, watchmaker". He used his technical skills to construct a remarkable high-quality solar spectrograph and by the late 1880s was supplying photographic spectra to the RAS[76]. In 1893 he published a notable *Photographic Atlas of the Normal Solar Spectrum*. His work was considered as good as any from professional observatories[77] and George Ellery Hale visited the laboratory at his home. Higgs was a prominent member of the LAS from 1886 (later becoming its president), the BAA, and Liverpool Physical Society[78].

Thomas William Brownell, then of Moss Side, Manchester, also joined the RAS in 1890[79] and a couple of years later was one of the early members of the BAA. Born in 1856 in Hulme, Manchester, he was an 'inspector of board schools' there for many years. Another to join was (Lawrence) Neville Holden. Born in Lancaster in 1864 and educated at the local grammar school, he was a solicitor there and succeeded his father as Coroner for the district and then Registrar for the county court. Scientifically, he was honorary director of the Greg Observatory at Escobeck near Lancaster[1], mainly collecting meteorological records, and a founder member of the Lancaster Astronomical and Scientific Society[80].

The end of 1890 saw the arrival on the scene of the British Astronomical Society, almost immediately renamed the British Astronomical Association, which took over from the now rather ailing Liverpool society as the primary national 'amateur' organisation. (The RAS was considered more for 'professionals' though of course most of its members were themselves amateurs, in the normal sense.)

Thomas Weir was a founder member of the BAA in 1890 and the original secretary of the North-West Branch of the Association two years later. He became an FRAS in 1899[81]. After financial problems in the North-West Branch, he defected to the new Manchester Astronomical Society (MAS) in 1903. He travelled to the solar eclipses in Norway in 1896 and Spain in 1900. An engineer, born in Scotland in 1843, he moved to England and worked for many years for the Vulcan Boiler and General Insurance Company in Manchester.

The first Lancashire resident elected to the RAS in 1891 (apart from Rev. Sidgreaves, see earlier) was George Price Blackwood Hallowes[82] of Didsbury. He was born in Cumberland in 1867 and educated in the Isle of Man and worked for the Surveying Branch of the Post Office. After his time in Lancashire, he was later based in various other parts of the country. He had supplied an observation of a bright meteor seen from Manchester in 1887[83] and also became a member of the BAA. He had been involved in astronomy from the age of 17 and was a regular observer of the Moon and variable stars with a 12½-inch

Calver reflector.

Father Sidgreaves' Stonyhurst colleague Rev. Aloysius Laurence Cortie, S.J., also joined in 1891, though he was then at St. Bueno's College in North Wales, where he was ordained. He was later president of the North-West Branch of the BAA. Born in London in 1859, and a pupil at Stonyhurst, he had become a teacher there in 1885 and returned to this post in 1895. He became director of the observatory in 1919[84]. He travelled to several solar eclipses and produced numerous papers in *MN* on sunspots and their magnetic effects[85] as well as on the spectroscopy of novae. In total he made 141 contributions to various publications and was a delegate at the first General Assembly of the IAU in 1922.

A further new Fellow in 1891 was John Billington Booth JP. Born in Preston in 1821, Billington Booth and his widowed mother became partners in a spindle-making business[86] and by the age of 50 he had risen to "magistrate, landowner, merchant (machinery), spindle and fly maker (master employing 31 men and 38 boys)", and staff at his Overleigh House included a butler. He was also chairman of Preston Gas Company, patenting an ignition device, and was a member of the Historic Society of Lancashire and Cheshire and of the Society of Arts[87].

Also elected in 1891, but more eminent scientifically, was Oliver Joseph Lodge D.Sc., LL.D., FRS, professor of physics in University College Liverpool (our first entry from that establishment, which had been established in 1881). A key early player in the field of practical electromagnetism[88], in 1894 Lodge made what is considered the first ever radio transmission. He was a keen defender of the idea of the all-pervading ether, even after the advent of General Relativity; his only appearance in *MN* is his part in an argument with Eddington and Jeans at the RAS meeting where the results from the 1919 eclipse results were discussed[89], though he did regularly communicate to *Nature* on astronomical topics. He had been born in Staffordshire in 1851 and worked in the family pottery business before obtaining a degree in physics. (He had a letter in the *Astronomical Register* in 1872[90].) He moved to Liverpool in the university's inaugural year and left to become the first Principal of the University of Birmingham in 1900. He was knighted in 1902. He was a president of the British Association, an active member of the Fabian Society, and also a spiritualist with a committed belief in life after death. Another of the new RAS Fellows in 1891 was Arthur Laidlaw Selby. He was born in Atherton (1861) but worked at the Clarendon after graduating in Oxford, and from 1890 spent the rest of his career as assistant professor and then professor of physics at the University College of South Wales and Monmouthshire in Cardiff[52]. His RAS obituary does not reference any astronomical work[91].

Rev. James Barnes Brearley of Oldham and Thomas Torrens Knowles M.A. were elected in 1892. Also a Fellow of the Royal Geographical Society, Brearley was born in Manchester in 1862 and attended Manchester Grammar School. He was a 'clerk in holy orders' and gave his address as St. James' Church in Oldham, though he shortly afterwards removed to Leicestershire and then Somerset. (He is not in the list of Fellows for 1896.) He matriculated at Cambridge[92] in 1900 but isn't recorded as graduating (he died in 1909). A 19th Wrangler at Peterhouse[93], Knowles (born 1857, in County Antrim) was a Cambridge Extension lecturer in chemistry, Lancashire County Council lecturer in physics, and science master at the Royal Grammar School, Lancaster, when he joined the RAS. (He too is missing from the 1896 list of Fellows.) He was later vice-principal of Liverpool College.

The year 1892 had also seen the formation of a North-West Branch of the

BAA, centred on Manchester. Of the eighteen members who turned up at its first meeting, at most eleven were from Lancashire, including four current or future FRAS — Banks, Brothers[1], Hallowes, and Weir — but the numbers quickly expanded. Another early member was Thomas Thorp. Born in Besses o' th' Barn between Manchester and Bury in 1850, he later lived in nearby Whitefield. Originally an architect, he was engineer to the local council and had a business manufacturing his own patented inventions, such as 'penny-in-the-slot' and rotary gas meters. He built his own telescopes for observatories at his home and at a cottage in Prestatyn in North Wales and was an expert on spectroscopic gratings[94] but did not join the RAS until 1902[95].

The next RAS Fellow, in 1893, was John Spencer[96] of Crawshawbooth, a village in the Rossendale Valley on the edge of the Pennines. Born there in 1823, in 1891 he was recorded as a "retired stone traveller"; he had earlier been a quarry master, and appropriately, was a Fellow of the Geological Society (and lived at Rock House, at the end of Rock Terrace). Joining him was Edward Turner Whitelow[97], a civil engineer of Deansgate, Manchester. Originally from Yorkshire (born in 1854), though his family moved to Salford while he was young, he worked for an engineering firm involved with railway and iron-making companies. By 1891 he had become a "consulting engineer and patent agent", with a business in Manchester trading in textile machinery, particularly to the Far East. He built an observatory at his home in Birkdale, Southport[98], and installed a telescope originally owned by Rev. Dawes[1]. At first making double-star observations, he became expert in photographing sunspots, collaborating with Janssen at Meudon. He eventually donated his instruments to Stonyhurst College. As well as the RAS and the Institution of Civil Engineers, he was also a member of the LAS, was on the council of the North-West Branch of the BAA, and later became president of the MAS.

Existing Fellow William Benjamin Hutchinson moved to Southport in 1894. He had been an FRAS since 1888, when he gave his address as The Observatory, Liversedge, in Yorkshire, and was president of the LAS in 1890–91. Born in London in 1863 and educated at Eton, he had spent time exploring in Africa before following his father into engineering. Adept at building his own instruments he was mainly an observer of the Moon and Saturn; he unfortunately died at the age of 35[99].

Though not a Fellow of the RAS, Davis Edmonson Benson (born in Moss Side in 1860) seems to have been a member of almost everything else. A civil engineer in Southport[100], he joined the Institution of Civil Engineers in 1886 and was subsequently in the Southport Society for Natural Science (president in 1900), the Royal Photographic Society of Great Britain, the LAS and, from 1894, the BAA. Writing extensively on mirror making, he was noted for his photographs of the Moon, and travelled to Spain in 1905 (with the Rev. Killip, see below) to photograph the eclipse of the Sun. Despite not being a member, he did attend RAS meetings and some of his work was referenced in *MN*[101].

Moving on to 1895, the next Lancashire resident to be elected FRAS was Charles Josephus Green[102]. (He used the style M.R.C.S., though his name is not apparent in the records of the Royal College of Surgeons[103].) He had been born in Melbourne, Australia, in 1846 but trained at Bart's in 1865–66. He was a house surgeon in Huntingdonshire County Hospital and by 1878 resided in Preston, with a surgery next door to his house.

Also in 1895, Professor Thomas Hamilton Core became president of the North-West Branch of the BAA[104]. He was later the first president of the MAS, which effectively replaced the North-West Branch in 1903. A Scot (born in

Lanarkshire, 1836), he had been one of the first professors of natural philosophy (along with Balfour Stewart) at Owens College in 1870 and lived in Fallowfield. Although he lectured on astronomical topics, he does not appear to have worked in the field. A much more active member of the North-West Branch from 1895 was Albert Alfred Buss who made around 60 contributions, mainly on magnetic and solar phenomena, to the *JBAA*, *The Observatory*, *MN*, and *Nature* between 1900 and 1932[105]. He also ran the Lee Observatory in Chorlton-cum-Hardy, Manchester[106], and eventually joined the RAS in 1908 while living in Ashton-on-Mersey. Born Frederic Albert Hermann Alfred Buss in the Grand Duchy of Baden in 1860, but a Swiss subject, he was a civil engineer.

Proposed by the RAS president Sir R. S. Ball, no less, Rev. Robert Killip was elected an FRAS the following year while living in Sale in Cheshire. From a Manx family, he had been born in Liverpool in 1853 and worked in a shipping house there before training as a Wesleyan minister. This led to various moves around the northern counties, though he was back in Liverpool by 1901 and subsequently resided in Southport. A member of the BAA and secretary of the LAS from 1902, he was a noted planetary observer[107]. He successfully photographed the solar eclipse of 1905 in Spain, along with his Southport neighbour D. E. Benson (above).

He was followed by William Banks from Bolton. Born in the nearby village of Egerton in 1850, he was the proprietor of William Banks and Co., who were manufacturers of optical and photographic equipment. He later specialised in telescopes[108] and published *Telescopes: Their Construction, Adjustment, and Use, with plans and details of Observatories; also full instructions for grinding, figuring and silvering Newtonian Mirrors*, which was in part an advertisement for his 'Popular Equatorial Mount for Telescopes' and the 'Banks Focimeter'.

Additions to the list of Fellows in 1897 were the Rev. Edward Spry Leverton, John Sisson Slater M.A. LL.D., and John Watson. Leverton was at the time headmaster at the grammar school in Kirkham, in the Fylde. Born in Cornwall in 1859 and educated at Marlborough and Oxford[109] (M.A. 1886), he was previously in holy orders in Sussex and was later rector of a church in Northampton before returning to Cornwall as vicar of Menheniot and canon of Truro cathedral. Another to be proposed by R. S. Ball, Dr. Slater was a barrister with chambers in Temple who otherwise lived in Lytham St. Annes where he had been a master at Seafield House School[110] from the 1870s, subsequently doubling up as lawyer and school principal. Born John Sisson in 1855, he was originally from a small village in Westmorland. Watson was then living in Sheffield but shortly afterwards moved to Blackburn. A Scot, born in 1844, he was chief engineer of an iron works in Warrington (then in Lancashire). He had travelled widely, including to India and Australia, and visited numerous observatories. He was involved with the North-West Branch of the BAA, was a vice-president of the LAS, and from 1907 to 1910 was president of the MAS[111].

Lancashire-born academic Sir Edmund Taylor Whittaker FRS was elected an FRAS in 1898, though his inclusion is a little ambiguous as it is not obvious whether he already had astronomical interests while still in Lancashire. He was born in Southport in 1873 and went up to Cambridge from Manchester Grammar School, graduating as Second Wrangler in 1895 and becoming a Fellow of Trinity College. He served as RAS Secretary from 1901 and became an FRS in 1905. He was appointed Royal Astronomer of Ireland at Dunsink Observatory and professor of astronomy in Dublin the following year, publishing seven *MN*[112] papers on variable stars and orbits. Primarily a mathematician, though, he wrote numerous books, starting with *A Course of*

*Modern Analysis* in 1902 and *Analytical Dynamics* in 1904. He was appointed professor of mathematics in Edinburgh in 1912 and was knighted in 1945[113]. Whittaker's Cambridge students included future astronomical greats Sir James Hopwood Jeans[46] and Sir Arthur Stanley Eddington[46], both of whom had Lancashire connections. Jeans was born in Ormskirk in 1877, but his family moved away when he was young, while Eddington, though born in Westmorland in 1882 and brought up in the south of England, attended Owens College in Manchester, residing at Dalton Hall from 1898 to 1902.

In 1899 Samuel Chatwood was added to the RAS list. An engineer born in 1833 in Edenfield, a village in the Rossendale Valley, he built up a business in Bolton, Chatwood's Patent Safe and Lock Co., making bank safes (employing 123 men and 26 boys in 1881). He also opened offices in London and took out various patents, not just on lock mechanisms but also bicycles. He was a member of the Institutions of Civil Engineers and of Mechanical Engineers, and of the Iron and Steel Institute[114], as well as the Society of Arts. When elected to the RAS he lived in Worsley, outside Salford, where he had a 9½-inch Cooke refractor (which is now in Wanganui, New Zealand[115]). His son Arthur Brunel Chatwood (born in Birkdale 1862) worked for his father's company, managing the London office, before becoming Astronomer at the Nizam of Hyderabad's Government Observatory in 1908[116].

Moving on to 1900 and 1901 (we take the end of the RAS 'year' in July as the endpoint for inclusion), we have three further FRAS. William Harrison Pearsall was a master at the Higher Grade School, Dalton-in-Furness (the Furness peninsular then being part of Lancashire). He had been born in Worcestershire in 1860 and was a schoolmaster there until moving to Dalton in the 1890s. Beyond his interest in astronomy, he was secretary of the Botanical Society and edited their journal[117]. His son, William Harold Pearsall FRS, was professor of botany at Sheffield University and then UCL. Thomas Marginson Nightingale from Bolton had recently obtained a B.Sc. from the Victoria University in Manchester[118]; he was only 28 when he joined the RAS. He remained in Bolton and was a master at the Municipal Secondary School throughout his career. Finally, there is the Rev. George Vickars-Gaskell[119]. Born in Kent in 1857, he was actually trained as a civil engineer before becoming a long-serving vicar in Grange-over-Sands. He had joined the BAA in 1899. We should, though, note one further Lancashire-based Fellow in the 1900 list, the Rev. Henry Glanville Barnacle[120]. A Church of England clergyman, born in London in 1849, he was the head of St. John's College in Grimsargh near Preston. A Cambridge graduate, he had started out as an assistant at the Royal Observatory, becoming an FRAS in 1874 and the same year travelling to observe the Transit of Venus from the Sandwich Islands[121]. He was ordained in 1879, becoming a curate in Yorkshire and a vicar in Cheshire before arriving in Lancashire. In 1911 he emigrated to Australia and was a founder member of the West Australian Astronomical Society.

In summary, it is evident from the above that there were few successors to the earlier Lancashire based 'grand amateurs' such as Lassell, Nasmyth, Dawes, or Baxendell. Isaac Roberts and George Higgs were certainly major players, though, along with Fathers Sidgreaves and Cortie at Stonyhurst, while the Rev. Johnson and A. A. Buss were the most productive of the others. Indeed, few of the RAS Fellows ever contributed any observations to their society. In terms of any additional recruitment through the more widespread opportunities offered by 'amateur' societies and journals, the effect seems to have been small.

The few active members of the LAS based in Lancashire were often already RAS Fellows, with only half a dozen or so subsequently moving into the senior organization. Similarly, despite the large enrolment into the BAA, especially after the formation of the North-West Branch (almost fifty with addresses in Lancashire signed up in 1892 alone), only two early members went on to join the RAS (though four others joined both almost simultaneously). Nevertheless, there were about 60 new FRAS with Lancashire connections in the thirty years covered here, compared to 50 in the previous fifty years. Socially, the Lancashire RAS Fellows were much like their predecessors in the earlier part of the century, with a preponderance of clergymen, business and factory owners, school masters, and engineers.

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# REDISCUSSION OF ECLIPSING BINARIES. PAPER 18: THE A-TYPE SYSTEM OO PEGASI

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OO Peg is a detached eclipsing binary system containing two late-A-type stars in a circular orbit with a period of 2·985 d. Using published spectroscopic results and a light-curve from the *Transiting Exoplanet Survey Satellite* (*TESS*) we determine their masses to be $1{\cdot}69 \pm 0{\cdot}09$ and $1{\cdot}74 \pm 0{\cdot}06\ M_{\odot}$ and their radii to be $2{\cdot}12 \pm 0{\cdot}03$ and $1{\cdot}91 \pm 0{\cdot}03\ R_{\odot}$. The *TESS* data are of high quality, but discrepancies in the radial velocities from two sources prevent a precise mass measurement. The primary star is definitively hotter, larger, and more luminous than its companion, but its mass is lower (albeit to a significance of only $1{\cdot}1\sigma$). Using published apparent magnitudes and temperatures, we find a distance of $238{\cdot}8 \pm 6{\cdot}1$ pc, in agreement with the *Gaia* DR3 parallax. Although both components are in the δ Scuti instability strip, we find no evidence of pulsations. More extensive spectroscopy is needed to improve our understanding of the system.

## *Introduction*

In this series of papers[1] we have been systematically reanalysing known detached eclipsing binaries (dEBs) in order to determine their physical