‘A man who has infinite capacity for making things go’: Sir Edmund Taylor Whittaker (1873–1956)

Alison Maidment

The Open University

Mark McCartney

Ulster University

Among the leading mathematicians of the nineteenth and twentieth centuries was British mathematician and astronomer, Sir Edmund Taylor Whittaker. Born in Southport, in the north of England, Whittaker’s career started at the University of Cambridge, before moving to Dunsink to become Royal Astronomer of Ireland and Andrews Professor of Astronomy at Trinity College, Dublin, and finishing in Scotland as Professor of Mathematics at the University of Edinburgh. Whittaker completed original work in a variety of fields, ranging from pure mathematics to mathematical physics and astronomy, as well as publishing on topics in philosophy, history, and theology. Whittaker is also noted as the first person to have opened a mathematical laboratory—with the focus on numerical analysis—in Great Britain. The purpose of this paper is to give an overview of Whittaker’s life, both as an academic and a person.

Keywords: Edmund Taylor Whittaker, Royal Astronomer of Ireland, Andrews Professor of Astronomy, Professor of Mathematics University of Edinburgh, Whittaker and Watson, mathematical laboratory, numerical analysis.

In the first half of the twentieth century, Edmund Taylor Whittaker was a major figure in British mathematics, forming a reputation that would outlive him. A man of wide interests, he wrote papers on pure mathematics in the areas of automorphic functions and special functions, and in applied mathematics in electromagnetism, general relativity, numerical analysis, and astronomy. His interests also encompassed biography, history, philosophy, and theology (Figure 1). Robert S Ball described the young Whittaker as 'a man who has infinite capacity for making things go' (Ball & Ball 1915, 152), but it is a description which could equally have been applied to his whole career.

Born in Birkdale, Lancashire (now Merseyside), Whittaker was an 'extremely delicate' child. As a result, he was educated at home by his mother until eleven years old when he was sent away to the Manchester Grammar School. At school, Whittaker 'was on the classical side', which meant that three-fifths of his time was devoted to Latin and Greek (Whittaker n.d.). In the upper school the concentration on poetry and drama caused a 'falling off' in his marks and he 'was glad to escape by electing to specialise in mathematics'. He was awarded a Langworthy Scholarship[1] in January 1890 and an entrance scholarship to Trinity College, Cambridge in 1891.

Whittaker entered Trinity as a 'minor scholar in mathematics' in October 1892. In 1894, whilst an undergraduate, he was awarded another scholarship, the Sheepshanks Astronomical Exhibition.[2] However, this was at a time when the key to success was to be

[1] The Langworthy Scholarship, bequeathed in the will of businessman and politician Edward Ryley Langworthy, was a £20 award 'open to general competition amongst the students at the [Manchester] Grammar School, to be tenable for one year, "as a reward for the proficiency in one or more of the following branches of study, namely:- classics, mathematics, physical science, and modern languages"' (Anon 1874, 5).

[2] The Sheepshanks Astronomical Exhibition was a three-year scholarship at £50 a year donated to the University in the name of astronomer Richard Sheepshanks, FRS, by his sister Anne after his death in 1855.

placed highly in the Mathematical Tripos examinations,[3] which usually meant spending extra time and money being tutored privately. The Tripos was extremely competitive, with those high in the order of merit—the high-ranking Wranglers—often becoming fellows of their college soon after graduating. However, not everyone could afford the luxury of a private tutor, making scholarships and monetary prizes particularly competitive. Whittaker had Robert Rumsey Webb (1850–1936) as his tutor. Webb was a lecturer and Fellow of St John's, who supplemented his income (as was not unusual at the time) by taking on private pupils. He had been Senior Wrangler in 1872 and by the 1890s had become the most successful private tutor in Cambridge, working sixty hours a week and coaching 37 of the 45 top nine Wranglers over the period 1890–1894 (Warwick 2003, 247). However, after two years Whittaker decided he did not like Webb's style of cramming students with Tripos questions and switched instead to Ernest William Hobson (1856–1933).[4]

In 1895, after three years of study, Whittaker was bracketed Second Wrangler, along with J H Grace.[5] The Tripos was considered so important that each year the top Wranglers would feature in both national and provincial news. In fact, in 1895, the news was covered as far north as the *Aberdeen Journal* (Anon 1895a) and as far south as the *Guernsey Star* (Anon 1895b). The *Huddersfield Daily Chronicle* even ran it twice (Anon 1895c).

---

[3] The Mathematical Tripos is the mathematical course at the University of Cambridge. Those graduating with first class honours degrees were referred to as 'Wranglers', with the Senior Wrangler being top of the class.

[4] Ernest William Hobson had been the coach of Philippa Fawcett who caused a sensation in the Mathematical Tripos of 1890 by scoring more marks than the Senior Wrangler. Although at that time women could sit the Tripos examinations, they were not ranked alongside the men. Hence Fawcett was described as 'above the Senior Wrangler'.

[5] The Senior Wrangler was Thomas J l'A Bromwich (1875–1929). There was also a rumour that Grace had been in the lead after the penultimate paper but celebrated a day too early, losing the title (Todd 1959, 113).

Although Whittaker missed out on the position of Senior Wrangler, his career was little affected. In 1896, he was made a Fellow of Trinity College, Cambridge, a year before Grace and the Senior Wrangler, Bromwich were made Fellows of their colleges.[6] Pupils at his old school, the Manchester Grammar School, were even given a half-day holiday to celebrate. Whittaker was then awarded the First Smith's Prize[7] in 1897 for a piece of work which was published as 'On the connexion of algebraic functions with automorphic functions' (Whittaker 1898). Whittaker stated that this paper was 'the definitive edition of my Trinity Fellowship thesis and Smith's Prize essay' (Whittaker n.d.).

Around this time, we get a glimpse into Whittaker's domestic life thanks to correspondence with his mother.[8] He would discuss various aspects of his life, from college affairs to the more trivial, like trying Hovis bread. He also gave his mother news about fellow students; their job applications, how much their jobs paid, their marital engagements, and the First Smith's Prize results of the year ahead of him. He discusses his own applications for the Isaac Newton Studentship,[9] which he didn't win, the award of his Fellowship, and his award of the Tyson medal.[10] When mentioning other students, he often includes where they were placed in the Tripos. One of Whittaker's lifelong hobbies, gardening, is another recurrent

---

[6] Grace was made Fellow of Peterhouse and Bromwich of St Johns in 1897.

[7] The Smith's Prize was established in 1768 at the bequest of Robert Smith. Originally, the prize was awarded via examination, but from 1885 it was awarded based on an essay, see (Barrow-Green 1999).

[8] Twenty-one of Whittaker's letters home to his mother, dating between 17 January and 11 December 1896, were found at a bookshop in Sheffield and are now available online, see (Whittaker 1896).

[9] The Isaac Newton studentship at the University of Cambridge was first awarded in 1891 for the encouragement of study and research in astronomy, open to Bachelor of Arts under the age of 25. Had Whittaker won it, he would have been awarded the sum of £250 a year for three years.

[10] The Tyson medal is an annual award for the best performance in astronomy related subjects at the University of Cambridge. It is named after its benefactor, Henry Tyson (d.1852) and was awarded for the first time in 1881.

theme as are religious matters. He writes about meetings of the University Temperance Council and helping at the Jesus Lane Sunday School Treat.

Of particular interest is a letter dated 31 January 1896, where Whittaker mentions that he went to ‘a lecture by Prof. Thomson explaining the new photography’. Thomson showed ‘a photograph of some coins inside a purse, the purse being closed when the photo was taken’. Here Whittaker is referring to the English Nobel prize winning physicist, J J Thomson (1856–1940), discoverer of the electron. The lecture would have been held at the Cavendish Laboratory, as Thomson was then Cavendish Professor of Physics. Wilhelm Röntgen had discovered X-rays only three months before, but the Scottish electrical engineer, Alan Archibald Campbell Swinton (1863–1930) managed to replicate Röntgen’s experiments very soon after, taking a ‘photograph’ of coins inside a purse. It seems likely that it was Swinton’s images that Thomson was using.

During the years 1897 to 1899, Whittaker spent a good portion of his time cataloguing and reading the memoirs of the preceding thirty years relating to the three-body problem.[11] This was on behalf of the British Association, who in 1897 had requested a report on planetary theory. This led to the publication of Whittaker’s ‘Report on the progress of the solution of the problem of three bodies’ (Whittaker 1899).

Whittaker remained deeply interested in astronomy but was first and foremost a mathematician and whilst an undergraduate had identified a need in Cambridge for the mathematical analysis being developed on the continent. Whittaker recalled how ‘the college lecturers could not read German, and did not read French’ and that, instead of Euler and Cauchy, ‘one of the most eminent of them in the eighteen-nineties used to speak of the

[11] The three-body problem of dynamical astronomy is the determination of the motion in space of three point masses which attract each other according to Newton’s law. Historically, the problem often related to the Sun, Moon, and Earth.

discoverer of the Gamma-function as “Yewler”, and the founder of the theory of functions as “Corky”’ (Whittaker 1942a, 217). This gap had been addressed to an extent by Whittaker’s college tutor, Andrew Russell Forsyth (1858–1942). Forsyth had published *Theory of functions of a complex variable* (Forsyth 1893) which Whittaker claimed ‘had a greater influence on British mathematics than any work since Newton's *Principia*’ (Whittaker 1942a, 218). However, Bottazzini & Gray (2013, 733–736) point out that although *Functions of a complex variable* was well received locally, where the subject matter was relatively new, the reception on the continent was ‘lukewarm’. By continental standards, it was not sufficiently rigorous, and it did not ‘truly bring together the three strands its author had hoped to interweave’ (p.735). Three-quarters of a century later, Leonard Roth wrote:

> The style of the book is magisterial, Johnsonian; the author's powers of assimilation are well-nigh incredible and yet, strange to say despite his intentions and his absorption of the material, he never comes within reach of comprehending what modern analysis is really about: indeed whole tracts of the book read as though they had been written by Euler (Roth 1971, 231).

But Roth’s review was written at a time when English speaking mathematicians were much more familiar with mathematical analysis, with a variety of treatises on the topic widely available. Whittaker’s own book *A course of modern analysis* (Whittaker 1902a) was published in 1902, with Hardy’s *Pure mathematics* and Bromwich’s *Infinite series* following six years later.

A course of modern analysis was based on Whittaker’s lecture course on analysis, which itself was an innovation. The treatment of complex function theory had not yet been introduced at an undergraduate level and *Modern Analysis* provided a comprehensive text for both his students and fellow academics. When describing the book, one of Whittaker’s obituarists wrote:

> British nineteenth-century mathematics was deplorably insular… AR Forsyth, whose pupil Whittaker was, had started the [reform] by introducing the general theory of functions to this country…But it remained to Whittaker in his *Modern Analysis* to bring the subject within the reach of the modern mathematician in much the same form in which it is still presented today. Also he was the first to make available in this country a comprehensive account of the special functions of analysis (McCrea 1957, 234).

For the second edition of the book Whittaker moved to joint authorship with George Neville Watson (1886–1965).[12] Watson had been a student at Trinity College, Cambridge while Whittaker was a Fellow. There had been only two years when both were together at Trinity, however it was long enough to form a fruitful collaboration. When the new edition came out in 1915, early chapters were revised, and new chapters added, increasing the page count from 378 to 560 pages. Part one concluded with a new chapter on the theory of integration and part two included new results such as the work of Mellin and Barnes, which 'enabled the authors to give a more brief and systematic account of the hypergeometric function and of its "confluent" form' (Anon 1916, 299). After the 1915 publication, *Modern Analysis* became more familiarly known as *Whittaker and Watson*. The treatise withstood the test of time, with two further editions (1920 and 1927) and many reprintings and although it was not deemed perfect,[13] it is still recognised and used by mathematicians today. Dutch-Australian number theorist, Alf van der Poorten, wrote that 'Notwithstanding its title,

---

[12] Watson is also well known for his *Treatise on the theory of Bessel Functions*, first published in 1922 (Watson 1922).

[13] In the preface of the fourth edition, Whittaker thanked his son-in-law Edward Copson (1901–1980) for his 'trouble which he has taken in supplying us with a somewhat lengthy list [of corrections and minor errors]' (Whittaker & Watson 1940). Another of Whittaker's obituarists, Daniel Martin, who lectured in the mathematics department at the University of Glasgow for thirty-three years, pointed out that *Modern Analysis* had 'some inadequacies' including his treatment of Cauchy's integral theorem (Martin 1958, 1).

Whittaker and Watson is neither “modern” or “analysis”, as we now understand it. But it is the Bible of classical special functions’ (Poorten 1996, 128).

Modern Analysis also contained Whittaker’s general solution to Laplace’s equation, a result he had published in the *Monthly notices of the Royal Society* (Whittaker 1902b), and *Mathematische Annalen* (Whittaker 1903). The 1903 paper is a much-expanded form of the 1902 paper, giving a more detailed proof with interpretations of the solution as well as solutions in terms of Legendre and Bessel functions. In the same papers, for an encore he gives the ‘general’ solution of the wave equation. Though Whittaker and other authors use the term ‘general solution’, it would be more accurate to describe it as an integral representation of the solution. It was, according to George Temple, a very useful result, as it allowed the unification of results in spherical harmonics and opened avenues for research in Mathieu and Lame functions (Temple 1956, 306–307). In reference to this paper, G H Hardy wrote to James Jeans ‘I was really writing for a copy of your latest paper which seems to be rivalling Whittaker’s in notoriety’ (Milne 1952, 7–8). The ‘notoriety’ to which Hardy is referring is the fact that Whittaker’s result had made it to the local press. Whereas the *Yorkshire Evening Post* (Figure 2) confidently asserted on the 1 September 1902 that the work was ‘a very remarkable discovery’, and one that had previously defeated ‘the greatest mathematicians (Anon 1902a)’, a report in *The Manchester Courier* on the 11 October of a meeting of the Manchester Literary and Philosophical Society was more subdued. It was reported that in a discussion of ‘a general solution of the potential equation recently obtained by Mr E T Whittaker Professor Lamb said that the solution, in the form shewn, offered no new features, though it might be valuable for ulterior purposes’ (Anon 1902b). Professor Lamb was Horace Lamb (1849–1934) who, at that point, was Bayer Professor of Applied Mathematics at Owens College, Manchester.

In September 1904 an incident occurred which provides an insight into the nature of Whittaker's character. In 1902, the Education Act meant that Church schools (mostly Church of England, and some Roman Catholic) were funded by local taxation. At this stage about one-third of school children were educated in Church Schools. Non-conformists were not happy that their taxes were being used to fund Anglican and Catholic Schools and instigated passive resistance by not paying. Whittaker, who had been born into an Anglican family but had become a Presbyterian whilst at Cambridge was one such non-conformist, which lead to him being brought before the magistrate. Whittaker felt that the Act was a betrayal since it funded Roman Catholic schools. This led to him having to give up six silver forks to auction to make good the cost of the taxes (Anon 1904). In light of this incident, it is interesting to note that in 1930 Whittaker became Roman Catholic himself, being awarded the honour Pro Ecclesia et Pontifice in 1935 and elected to the Pontifical Academy of Sciences in 1936.

In 1906 came a new phase in Whittaker's life. That year the Royal Astronomer of Ireland, Charles Jasper Joly died prematurely at the age of forty-two. Before the year was out, Whittaker had succeeded him on the recommendation of previous Royal Astronomer of Ireland, Robert Stawell Ball (1840–1913). Whittaker had attended Ball's lectures at Cambridge, when Ball was Lowndean Professor of Astronomy and Geometry. Ball had made quite the impact on Whittaker, with Whittaker describing him as 'one of the two or three greatest British mathematicians of his generation' (Ball & Ball 1915, 396). This is perhaps a somewhat generous evaluation. Ball was well-known as an excellent expositor and it is possible that this is what impressed Whittaker. Ball's recommendation read:

> Now let me commend to your most special attention and careful consideration my very great friend Whittaker. He is the only man I know of who can properly succeed Joly. And the place will suit him in every way. He is a keen gardener and a man who has infinite capacity for making things go. Then as to his scientific attainments, he knows more of the mathematical part of astronomy than anyone else in Great Britain, or if you

> like to add Europe, Asia, Africa and America, I won't demur. A modest, charming man in every way. He has already made one discovery [the general solution to Laplace's equation] which the greatest mathematician of the last two centuries would be proud to have placed to his credit (Ball & Ball 1915, 152).

The Royal Astronomer of Ireland also held the post of Andrews Professor of Astronomy at Trinity College, Dublin, a post which Whittaker described as having the chief function of strengthening the school of mathematical physics at the University (Whittaker n.d.).

Whilst in Ireland, Whittaker compiled what has been referred to as his magnum opus, *A history of the theories of aether and electricity: from the age of Descartes to the close of the nineteenth century* (Whittaker 1910). It took Whittaker an immense amount of reading which was made possible by the free time his appointment in Ireland allowed.

Although Whittaker must have spent a good deal of time compiling *A history of the theories of aether and electricity*, he still managed to write another book, *The theory of optical instruments* (Whittaker 1907), publish eight papers, of which six are on astronomy, as well as publish work on the observation of variable stars. In 1911, 398 photographic plates of variable stars were taken by the Observatory. However, Charles Martin (1875–1936), Whittaker's assistant, probably did most of the observing.[14] The observatory was also responsible for the time signal service to Dublin Port. Yet the apparatus at the observatory was described by Whittaker as very poor, with no fund for purchasing new instruments and work on photographic observation of variable stars was hampered by light pollution from the 'brilliant lights of trespassing bicyclists' (Merdin 1988, 60).

[14] Charles Martin, M. A. transferred from Greenwich Observatory to become an assistant to the Royal Astronomer of Ireland, Dr A A Rambaut, in around 1895 and remained at Dunsink until his death in 1936. Martin became Acting Director of the Observatory in 1921, after the position of Royal Astronomer of Ireland was left vacant (Anon 1936, 4) (Hutchins 2008, 402–403).

At Trinity College, Dublin, Whittaker gave advanced lecture courses on spectroscopy, astrophysics, and electro-optics, as well as public lectures at the Royal Dublin Society. One of the attendees at these public lectures was the future Irish political leader, Éamon de Valera (1882–1975). De Valera was so influenced by Whittaker that they stayed in contact and when in 1940 de Valera opened the Dublin Institute of Advanced Studies, he sought Whittaker's advice (McCrea 1957, 238).

Whittaker enjoyed life at Dunsink, partly as the house came with large gardens, but partly because his working arrangements were not too demanding, leaving him time to write. Whilst there he took time to reorganise the library and assemble a collection of portraits of his predecessors. He also held sufficient stature as Royal Astronomer to be interviewed by the *Dublin Daily Express* about the appearance of Halley's Comet in 1910 (Anon 1910, 8). The paper seemed somewhat disappointed that 'speculation as to probable disaster to the earth is now satisfactorily settled' and the comet had done no damage. Whittaker dampened their enthusiasm even more by stating that the most interesting thing about the comet is that it is possible to accurately predict when it will come back.

The last and longest phase in Whittaker's career came in 1912, when he was appointed Professor of Mathematics at the University of Edinburgh, a post he held until his retirement in 1946. He had planned to retire back to Dublin, but by the end of the Second World War he had changed his mind. A year after taking the appointment, Whittaker opened the Edinburgh Mathematical Laboratory, the first of its kind in Great Britain. Apart from being the first such 'laboratory' at a British university, it was also the first time in Britain that the field later known as numerical analysis was taught systematically. The idea for the laboratory likely came from a combination of Whittaker's experience of numerical problems as an astronomer and from his actuarial friends in Edinburgh, a city which in 1912 was one of the chief centres of life assurance. He was also probably aware of the work of German mathematician Carl Runge (1856–1927) who had been promoting numerical computation at the 1912 International Congress of Mathematicians in Cambridge, which Whittaker attended.[15]

According to Arthur Erdélyi[16], a colleague of Whittaker's at the University of Edinburgh, '[Whittaker] regarded the introduction of the Mathematical Laboratory course as his most notable contribution to mathematical education' (Erdélyi 1957, 53). In furthering the practice of computation, the Mathematical Laboratory made use of some of the most modern calculating machines. At an exhibition in Edinburgh as part of the celebrations of the tercentenary of Napier's *Mirifici Logarithmorum Canonis Descriptio* the Laboratory displayed an Archimedes, Brunsvigas (ordinary and miniature), a Burroughs adding and listing, two Comptometers, a Mercedes-Euklid, a Millionaire, and a Tate's Arithmometer (Horsburgh 1914, 75).

During August 1913, the first Edinburgh Mathematical Society Colloquium was held (Figure 3). The idea for the first colloquium came from the demand for a summer course in the Mathematical Laboratory. According to Cargill Gilston Knott, in his report of the Colloquium for *The Mathematical Gazette* 'several correspondents had expressed the hope

[15] Further details on the development and influence of Whittaker's mathematical laboratory will be given in a forthcoming paper by Maidment which is in preparation.

[16] Arthur Erdélyi (1908–1977) was a Hungarian-Jewish mathematician who had to flee Prague, where he was studying at the University, due to the Nazi invasion. As Erdélyi had been working on hypergeometric functions, on which Whittaker was one of the leading experts, Erdélyi wrote to Whittaker requesting help. Whittaker was able to find Erdélyi a position and helped him with travel expenses. After a successful career at both Edinburgh and Caltech, Erdélyi returned to Edinburgh in 1964 where he was appointed to the chair of mathematics.

that vacation courses in this line of study might be established' (Knott 1913, 165).[17] Whittaker decided that it would be a good idea to include lectures on other areas of mathematics too. Thus Professor Arthur W Conway, from the National University of Ireland and Dr Duncan MacLaren Young Sommerville from the University of St Andrews also gave lectures. Conway lectured on 'The theory of relativity and new physical ideas of space and time' and Sommerville on 'Non-Euclidean geometry and the foundations of geometry'. For Whittaker's part, he lectured on 'Practical harmonic analysis and periodogram analysis: an illustration of Mathematical Laboratory practice', guiding his 'students' (who were mostly university professors and secondary school teachers) with a lecture each day during the week long Colloquium. Whittaker, who became President of the Edinburgh Mathematical Society the following year, was also a driving force in changing the Society from a society for teachers to effectively an academic/research society (Rankin 1983).

Whittaker's efforts helped spread the importance of teaching computational mathematics across the English-speaking world. Louis Rosenhead—who for forty years headed the department of mathematics at the University of Liverpool—suggested that Whittaker's initiative with the laboratory led to the institution of similar courses at the University of Leeds and Imperial College, London (Rosenhead 1954, 426). American mathematician, Norbert Wiener in his obituary of Joseph Lipka, Associate Professor of Mathematics at Massachusetts Institute of Technology wrote that in the summer of 1914:

> [Lipka] stayed some time in Edinburgh in contact with Whittaker. It was Whittaker's influence which turned his attention to the study of graphical and numerical methods in computation, to which Lipka's *Graphical and Mechanical Computation*…constitutes one

[17] Cargill Gilston Knott (1856–1922) was one of the founding members of the Edinburgh Mathematical Society. A mathematician and physicist, by 1913 Knott was a reader in applied mathematics at the University of Edinburgh and went on to carry out pioneering research in seismology (Whittaker 1924, 237–248).

> of the most valuable contributions in the English language. In 1914 he commenced his Mathematical Laboratory course, which was enthusiastically received at the Institute (Wiener 1924, 63).

Several books resulted from work in the Laboratory. Four of the six books in the *Edinburgh Mathematical Tracts* series of 1915 are based on the teaching which took place there. However, the Laboratory's most successful book, *The calculus of observations: a treatise on numerical mathematics*, by Whittaker and his colleague George Robinson, derived from courses of lectures given by Whittaker between 1913 and 1923 (Whittaker & Robinson 1924). When the book was published in 1924, it received glowing reviews. The reviewer for *Nature* wrote that 'no previous book in any language contains the matter collected here after ten years' experience of dealing with numerical data' and that 'the authors are to be heartily congratulated on successfully producing a book that gives the result of such pioneering work' (B 1924, 378). The book ran into four editions, the final edition appearing in 1944.[18]

In 1953, at the age of 80, Whittaker had the second volume of his *History of the Theory of Aether and Electricity* published, which covered the years 1900–1926 (Whittaker 1953). It was less well regarded than the first volume as it was felt that Whittaker, in his chapter entitled 'The Relativity Theory of Poincaré and Lorentz', wrongly minimized Einstein's role in forming the special theory of relativity. One of those who disagreed with Whittaker was his friend and colleague Max Born.[19] In a letter to Einstein in 1953, Born wrote about the volume:

---

[18] A reprint of the fourth edition was published by Dover in 1967. In 1969, the reprint was reviewed alongside two other books on numerical analysis and unsurprisingly–given developments in the field–it didn't stand up against them (Howlett 1969, 108).

[19] Max Born (1882–1970) was a German physicist and mathematician known for his work in quantum theory. From 1936 he was the Tait Professor of Applied Mathematics at the University of Edinburgh. Born went on to win the 1954 Nobel Prize in Physics for his statistical studies of wave functions.

> Among other things it contains a history of the theory of relativity which is peculiar in that Lorentz and Poincaré are credited with its discovery while your papers are treated as less important. Although the book originated in Edinburgh, I am not really afraid you will think that I could be behind it. As a matter of fact I have done everything I could during the last three years to dissuade Whittaker from carrying out his plan… (Born 1971, 197).

However, Whittaker was not the only one to believe that Einstein was wrongly credited. It is a debate that has received much attention, although the consensus remains strongly in favour of Einstein. Canadian historian of science, Jeffrey Crelinsten, in his book *Einstein's jury: the race to test relativity,* wrote that Whittaker was reconstructing history to suit his own beliefs and that 'there is evidence that Whittaker was motivated by a distaste for relativity, in particular the cosmological interpretation of Einstein's general relativity theory postulating that the universe is expanding' (Crelinsten 2006, 35). Historian of mathematics, Jeremy Gray agrees that Whittaker was mistaken and like Crelinsten, questions how such an eminent mathematician could be so misled. He points out that 'the answer is not likely to lie in a failure to understand the intellectual issues; Whittaker was one of a number of British mathematicians well versed in mathematical physics' and 'it may simply be that, writing in his seventies, Whittaker was attracted to a position just because it was startling and, if correct, would debunk a modern myth' (Gray 1995, 67). By the 1950s, Whittaker may have become stubborn in his beliefs, but genuinely believed an injustice had occurred. In a letter from Whittaker to astronomer George McVittie, Whittaker claims that his latest volume will '…blast some reputations. The 20th century is quite as bad as any preceding age in attributing discoveries to the wrong people' (Crelinsten 2006, 36). Whittaker wrote to his son, John

Macnaghten Whittaker,[20] of a third volume he had planned to write to cover the post 1926 era, but he died before it came to fruition (Whittaker 1952a).

As mentioned earlier, Whittaker had a lifelong commitment to the Christian faith. His daughter Beatrice Copson wrote, ‘My father’s two great interests apart from mathematics were theology and gardening. At one time, before he married, he even thought of going as a missionary to China and indeed started to learn Chinese’ (Wayman 1987, 190). It is therefore not surprising that he wrote on two occasions at book length on matters religious and theological in *The beginning and end of the world*, the Riddell Memorial Lectures at Durham in 1942 (Whittaker 1942b) and *Space and spirit*, the Donnellan Lectures at Trinity College, Dublin, 1946 (Whittaker 1947a). According to the historian of physics, Helge Kragh, in these two books Whittaker was the ‘the only physical scientist of the first rank’, (Kragh 2008, 215) to defend the strong entropic creation argument, that is the idea that since the entropy of the universe is always increasing this points to a moment of creation (of minimum entropy), and hence to a creator God.

Amongst Whittaker’s popular output are three articles which were published in 1947, 1950 and 1952 in the BBC weekly Magazine *The Listener*. All of them make connections to a greater or lesser degree between science, philosophy and theism and in each case, as a respected academic, he made the front cover as a contributor.

His 1950 piece found him responding to Fred Hoyle, then a young and energetic Cambridge astrophysicist. Fred Hoyle had given a five-part radio series, which was also printed in *The Listener* and was then produced as a book (Hoyle 1950). The talks are remembered for it being the first public occurrence of the phrase ‘big bang’, a term which Hoyle used pejoratively. At the end of the fifth part of the series, Hoyle suggested that people

[20] John Macnaghten Whittaker (1905–1984) was himself a successful mathematician. He went on to become Vice-Chancellor of the University of Sheffield.

held religious beliefs for 'security' reasons, but he did not see there any use in 'deceiving myself' for comfort. Further, if life after death existed, he reckoned that after 300 years he would be bored! In his response, Whittaker agreed with Hoyle in the sense that 'the religious man asserts that religion cannot be accepted for any other ground than it is true; it must be justified in the first instance at the bar of reason'. On Hoyle's second point Whittaker quipped that 'Mr Hoyle …is evidently under the impression that there are clocks in heaven' (Whittaker 1950). Whittaker's response was published on the 1 June, and by the end of the month *American Vogue* was asking Whittaker how much he would accept as a fee for republication. An edited version (removing the specific reference to Hoyle's piece) was published on the 15 October, making Whittaker a rare, if not unique, example of a man whose published work not only crossed disciplinary boundaries, but was published everywhere from *Nature* to *Vogue.*

During his long career Whittaker's contributions to mathematics were recognised by numerous bodies. He was elected Fellow of the Royal Society in 1905, Fellow of the Royal Society of Edinburgh in 1912, won awards such as the Sylvester and Copley Medals of the Royal Society and the De Morgan Medal of the London Mathematical Society. He was President of the Mathematical Association 1920–1921, the Mathematical and Physical Section of the British Association in 1927, the London Mathematical Society 1928–1929 and the Royal Society of Edinburgh for the period 1939–1944 as well as being knighted in 1945.

Sir Edmund Taylor Whittaker died on Saturday 24 March 1956 and was buried the following Tuesday in Mount Vernon Cemetery in Edinburgh. As a man whose daughter remembered him as being 'a brilliant raconteur and very witty' (Wayman 1987, 190) he may well have been amused by the fact that the cemetery register states that he was buried with due mathematical precision at a depth of 6 ft 6 inches.

Acknowledgments

The authors would like to thank Jennifer Toews, from the Thomas Fisher Rare Book Library at the University of Toronto and Professor June Barrow-Green, for her continued help in writing this paper.

Bibliography

Anon., 'Munificent bequests of the late Mr. E. R. Langworthy', *The Manchester Guardian*, 17 April, (1874), 5.

Anon., 'Cambridge Mathematical Tripos', *Aberdeen Journal*, 12 June, (1895a), 8.

Anon., 'To-day's Telegrams', *Guernsey Star*, 11 June, (1895b), 2.

Anon., 'The Mathematical Tripos', *The Huddersfield Daily Chronicle*, 12, 15 June, (1895c), 3.

Anon., 'A discovery in pure mathematics', *The Yorkshire Evening Post*, 1 September, (1902a), 2.

Anon., 'Manchester Literary and Philosophical Society', *Supplement to the Manchester Courier*, 11 October, (1902b), 6.

Anon., 'Passive resistance', *Cambridge Independent Press*, 30 September, (1904), 5.

Anon., 'Halley's Comet statement by Astronomer Royal', *Dublin Daily Express*, 20 May, (1910), 8.

Anon., 'University and educational intelligence', *Nature*, (1913), 205.

Anon., 'A course of modern analysis', *Nature*, 8th June, (1916), 298–299.

Anon., 'Mr Charles Martin', *Weekly Irish Times*, 13 June, (1936), 4.

Anon., 'A course of modern analysis by Edmund Taylor Whittaker'. [Online] Available at: https://www.goodreads.com/book/show/1185685.A_Course_of_Modern_Analysis. (n.d.) Accessed on 15 March 2019.

B, W E H, 'Co-ordination of numerical data', *Nature*, 114 (1924), 377–378.

Ball, R S & Ball, W V, *Reminiscences and letters of Sir Robert Ball*, London: Cassell, 1st edition, 1915.

Barrow-Green, J, '"A corrective to the Spirit of too exclusively pure mathematics": Robert Smith (1689–1768) and his prizes at Cambridge University', *Annals of Science*, 56/3 (1999), 271–316.

Bell, H, *A course in the solution of spherical triangles for the Mathematical Laboratory,* London: G Bell and Sons, Ltd, 1st edition, 1915.

Born, M, *The Born Einstein letters, 1916–1955,* London and Basingstoke: Macmillan, 1st edition, 1971.

Bottazzini, U & Gray, J, *Hidden harmony—geometric fantasies,* New York: Springer, 1st edition, 2013.

Bromwich, T J I, *An introduction to the theory of infinite series,* London: Macmillan and Co., Limited, 1st edition, 1908.

Crelinsten, J , *Einstein's jury: the race to test relativity,* New Jersey: Princeton University Press, 1st edition, 2006.

Croarken, M, 'The centralization of scientific computation in Britain 1925–1955', Ph.D thesis, University of Warwick, Coventry, (1985).

Echols, W. H., 'Forsyth's Theory of functions of a complex variable', *Annals of Mathematics,* 7/1/5 (1892–1893), 143–144.

Erdelyi, A, 'Sir Edmund Whittaker, 1873–1956', *Mathematics of Computation American Mathematical Society,* (1957), 53.

Forsyth, A R, *Theory of functions of a complex variable,* Cambridge: Cambridge University Press, 1st edition, 1893.

Gibb, D, *A course in interpolation and numerical integration for the Mathematical Laboratory,* London: G Bell and Sons, Ltd, 1st edition, 1915.

Gray, J, 'Poincaré, Einstein, and the theory of special relativity'. *The Mathematical Intelligencer,* 17/1 (1995), 65–67.

Hardy, G H, *A course of pure mathematics.* Cambridge: Cambridge University Press, 1st edtion, 1908.

Horsburgh, E M, *Handbook of the Napier Tercentenary Celebration or modern instruments and methods of calculation.* London: Tomash Publishers, 1st edition, 1914.

Howlett, J, 'Review', *The Mathematical Gazette*, (1969), 107–108.

Hoyle, F, *The nature of the universe: a series of broadcast lectures.* Oxford: Basil Blackwell, 1st edtion, 1950.

Hutchins, R, *British university observatories 1772–1939.* Aldershot: Ashgate Publishing Limited, 1st edition, 2008.

Ince, E, *A course in descriptive geometry and photogrammetry for the Mathematical Laboratory,* London: G Bell and Sons, Ltd, 1st edition, 1915.

Knott, C G, 'The Edinburgh Mathematical Colloquium', *The Mathematical Gazette*, October, (1913), 165–167.

Kragh, H S, *Entropic creation: religious contexts of thermodynamics and cosmology,* Aldershot: Ashgate Publishing Limited, 1st edtion, 2008.

Lipka, J, *Graphical and mechanical computation.* New York: John Wiley & Sons, Inc., 1st edition, 1918.

Martin, D, 'Sir Edmund Taylor Whittaker, F. R. S.', *Proceedings of the Edinburgh Mathematical Society,* (1958), 1–9.

McCrea, W H, 'Edmund Taylor Whittaker', *Journal of the London Mathematical Society,* (1957), 234–256.

Merdin, P, 'Review of Quaternions, the aether and the Taoiseach: Dunsink Obervatory 1785–1985 by Patrick A. Wayman', *New Scientist,* 1596 (1988), 60–61.

Milne, E A, *Sir James Jeans: a biography,* Cambridge: Cambridge University Press, 1st edtion, 1952.

Poorten, A v d, *Notes on Fermat's Last Theorem,* New York: John Wiley & Sons, Inc., 1st edtion, 1996.

Rankin, R., *The Edinburgh Mathematical Society: the first hundred years (1883–1983).* [Online]
Available at: http://www-history.mcs.st-and.ac.uk/ems/EMS_centenary_1.html, (1983). Accessed on 15 March 2019.

Rosenhead, L, 'Society and the calculating machine', In: *Proceedings of the British Society for the Advancement of Science,* (1954), 421–433.

Roth, L, 'Old Cambridge days', *American Mathematical Monthly*, 78 (1971), 223–236.

Runge, C, 'The mathematical training of the physicist in the university', In *Proceedings of the Fifth International Congress of Mathematicians Volume 2,* (1913), 598–607.

Shearer, G & Carse, G, *A course in Fourier's analysis and periodogram analysis for the Mathematical Laboratory,* London: G Bell and Sons, Ltd, 1st edition, 1915.

Temple, G, 'Edmund Taylor Whittaker 1873–1956', *Biographical Memoirs of Fellows of the Royal Society,* 2 (1956), 299–325.

Todd, J A, 'John Hilton Grace', *Journal of the London Mathematical Society,* (1959), 113–117.

Warwick, A, *Masters of theory: Cambridge and the rise of mathematical physics*. Chicago: University of Chicago Press, 1st edtion, 2003, p. 247.

Watson, G N, *A treatise on the theory of Bessel functions.* Cambridge: University Press, 1st edition, 1922.

Wayman, P A, *Dunsink Observatory 1785–1985.* Dublin: Royal Dublin Society, 1st edition, 1987.

Whittaker, E T, *Letters home 1: E. T. Whittaker at Trinity College in 1896. Transcribed by R. J. Cook, University of Sheffield.* [Online]
Available at: https://www.maths.ed.ac.uk/~v1ranick/whittakertrin.pdf. (1896). Accessed on 15 March 2019.

Whittaker, E T, 'On the connexion of algebraic functions with automorphic functions', *Philosophical Transactions of the Royal Society A,* 192 (1898), 1–32.

Whittaker, E T, 'Report on the progress of the solution of the problem of three bodies', *British Association Report,* (1899), 121–159.

Whittaker, E T, *A course of modern analysis.* Cambridge: Cambridge University Press, 1st edition, 1902a.

Whittaker, E T, 'On the general solution of Laplace's equation and the equation of wave motions, and on an undulatory explanation of gravity', *Monthly notices of the Royal Astronomical Society,* 62 (1902b), 617–620.

Whittaker, E T, 'On the partial differential equations of mathematical physics', *Mathematische Annalen,* 57 (1903), 333–355.

Whittaker, E T, *The theory of optical instruments.* Cambridge: Cambridge University Press, 1st edition, 1907.

Whittaker, E T, *A history of the theories of aether and electricity: from the age of Descartes to the close of the nineteenth century.* London: Longmans, Green, and Co., 1st edition, 1910.

Whittaker, E T, A catalogue raisonne of Sir Robert Ball's mathematical papers. In: W V Ball, *Reminiscences and letters of Sir Robert Ball.* London: London Cassell, 1st edition, 1915, 388–396.

Whittaker, E T, 'Cargill Gilston Knott, LL.D., F.R.S., General Secretary', *Proceedings of the Royal Society of Edinburgh,* 43 (1924), 237–248.

Whittaker, E T, 'Andrew Russell Forsyth', *Obituary notices of Fellows of the Royal Society,* 4/11 (1942a), 208–227.

Whittaker, E T, *The beginning and end of the world.* Oxford: Oxford University Press, 1st edition, 1942b.

Whittaker, E T, *Space and Spirit.* London: Thomas Nelson and Sons Ltd., 1st edition, 1947a.

Whittaker, E T, 'The mind behind material nature', *The Listener*, 24 April, (1947b), 626–627.

Whittaker, E T, 'Religion and the nature of the universe', *The Listener*, 1 June, (1950), 943–944.

Whittaker, E T, *Whittaker collection, Manuscript Collection 219, Box 5, Correspondence 24th May 1952, University of Toronto Rare Book Library.* Toronto, (1952a).

Whittaker, E T, 'Are there eternal truths?' *The Listener*, 21 August, (1952b), pp. 283–284.

Whittaker, E T, *A history of the theories of aether and electricity: Vol II, the modern theories 1900–1926,* London: Thomas Nelson and Sons Ltd., 1st edition, 1953.

Whittaker, E T, *Whittaker collection, Manuscript Collection 219, Box 11, Autobiography, University of Toronto Rare Book Library.* Toronto. (n.d.).

Whittaker, E T & Robinson, G, *The calculus of observations: a treatise on numerical mathematics,* Glasgow: Blackie and Son Limited., 1st edition, 1924.

Whittaker, E T & Watson, G, *A course of modern analysis,* Cambridge: Cambridge University Press, 4th edition, 1940.

Wiener, N, 'In memory of Joseph Lipka', *Studies in Applied Mathematics,* 3/2 (1924), 63–65.

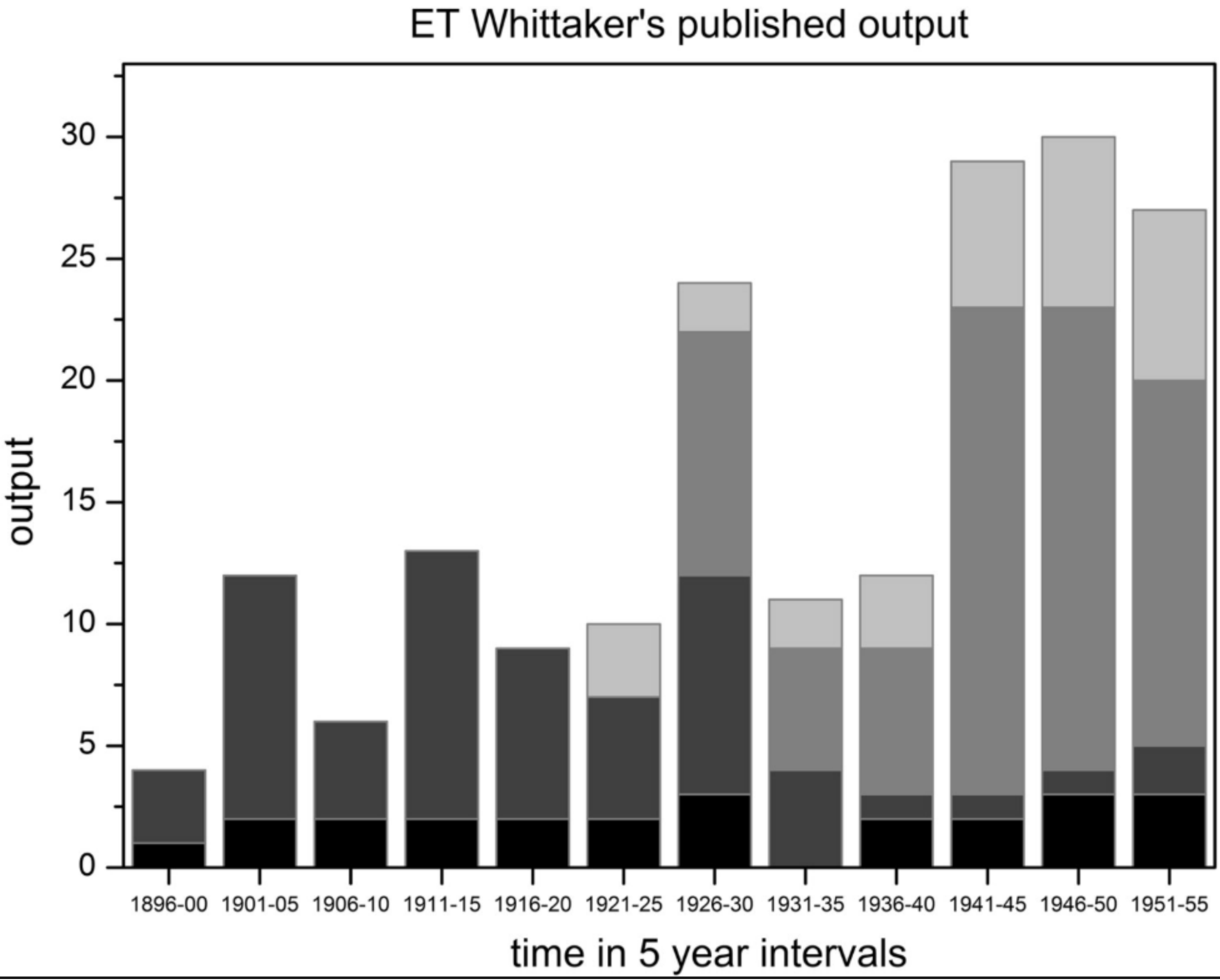

Figure 1 Whittaker’s published works.

Black: books and monographs (with revised editions counted as separate publications). Dark grey: papers in mathematics and mathematical physics. Grey: philosophical and historical papers. Light grey: biography. The division of the material into these four categories is Whittaker’s own, as given in his autobiography (Whittaker, n.d.).

THE YORKSHIRE EVENING POST.

MONDAY, SEPTEMBER 1, 1902.

A DISCOVERY IN PURE MATHEMATICS.

A former pupil of the Manchester Grammar School, Mr. Edmund T. Whittaker (says the "Manchester Guardian" to-day), has achieved a very remarkable discovery in pure mathematics. It is described in a paper which Mr. Whittaker has recently communicated to the Royal Society. The discovery lies in the region of pure mathematics, but its importance is greatly increased by its bearing on some of the profoundest problems in electricity, light, and other branches of physics involving undulatory phenomena. It opens a new door for the mathematical physicist.

THE EQUATION THAT HAS BEEN SOLVED AT LAST.

There is one differential equation which is of great historic interest. It is this:—

$$\frac{d^2V}{dx^2} \times \frac{d^2V}{dy^2} \times \frac{d^2}{dzV} = 0.$$

This equation first makes its appearance in Laplace's memoir on the rings of Saturn, printed in 1789. But Laplace was unable to solve it. The challenge has been before the world ever since. The greatest mathematicians have had their tries at the solution. The most notable contributors to the theory of the equation, after Laplace, were Gauss, Green, Poisson, Lord Kelvin, Riemann, and Neumann, for a discovery of this kind is not made at one bound. But Mr. Whittaker has discovered the general solution of this historic equation, and has earned a place in the history of mathematics.

Figure 2

The announcement in the Yorkshire Evening Post of Whittaker's 'discovery'. Note that the equation is given incorrectly, with multiplication signs instead of addition, and V dropping to the bottom line on the third term. It seems the reporter was badly out of their depth!

Figure 3

The EMS Colloquium, 4–9 August 1913. Front row L to R: Whittaker, Arthur Conway, Alexander Burgess, (President of the EMS), Duncan Sommerville and Peter Comrie, (Secretary of the EMS).