BIOGRAPHICAL MEMOIRS OF FELLOWS OF THE ROYAL SOCIETY

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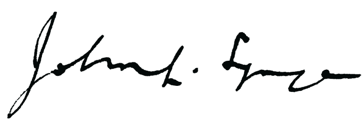

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Elected FRS 1943

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John Lighton Synge was arguably the greatest Irish mathematician and theoretical physicist since Sir William Rowan Hamilton (1806–65). He was a prolific researcher of great originality and versatility, and a writer of striking lucidity and 'clarity of expression'. He made outstanding contributions to a vast range of subjects, and particularly to Einstein's theory of relativity. His approach to relativity, and theoretical physics in general, is characterized by his extraordinary geometrical insight. In addition to bringing clarity and new insights to relativity, his geometrical approach profoundly influenced the development of the subject since the 1960s. His crusade in his long academic career was 'to make space–time a real workshop for physicists, and not a museum visited occasionally with a feeling of awe' (31)*.

Ancestry

J. L. Synge was born in Dublin on 23 March 1897, the youngest of a family of four, Ada Kathleen Frances, Edward Hutchinson and Victor Millington, in this order, being his siblings. For simplicity we shall call Synge's two brothers Hutchie and Millington, these being their names in the family circle; Synge himself was called Jack by his family and some colleagues (C. Synge Morawetz, personal communication, 2007). Synge was born with a growth on the cornea of his left eye, which, as a result of surgery, became useless thereafter. At that time the family lived at Rathe House on the estate of Lord Gormanston (1837–1907) in Kingscourt, Co. Cavan. Lord Gormanston was Ireland's senior viscount (the 14th Viscount Gormanston) and had served as Governor of the Leeward Islands (1885–87), British Guiana (1887–93) and Tasmania (1893–1900).

* Numbers in this form refer to the bibliography at the end of the text.

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J. L. Synge's father, Edward Synge (1859–1939), was the land agent for Lord Gormanston's estate and also for a number of other estates in County Mayo and County Wicklow. Of the Wicklow estates the most substantial one was Glanmore Castle and its extensive surrounding land. The castle, a 'Gothic monstrosity situated in a beautiful glen near Ashford' as J. L. Synge had described it, was built by Francis Synge (1761–1831), J. L. Synge's second-great-grandfather (that is, his great-great-grandfather) in the 1800s; it provided the tangible confirmation that, by this time, the Synges were firmly established as Irish gentry. During the Land War in the 1880s Edward Synge acquired a certain amount of notoriety for the harsh methods by which he was evicting the tenants from the estates he was managing.

J. L. Synge's mother was Ellen Frances Price (1861–1935), daughter of the distinguished Irish engineer James Price. Synge thought that, in so far as it was genetic, his interest in mathematics was inherited from this side of the family. The Price family can be traced back to the Stuarts of Scotland, and in particular to Sir William Stuart, who settled in Ireland in the early seventeenth century.

In the male line, Synge's family can be traced back to the sixteenth century, to Thomas Millington, 'Corruptly called Singe of Bridgnorth', Bridgnorth being a town in the county of Shropshire in central England. He was, by trade, a shoemaker and for many years he was a chorister in Chester Cathedral. The father of Thomas, Canon Millington, was also 'surnamed Singe in regard he was a Canon …', and his family can be traced back to Hugh de Mulneton in the time of Henry II (1133–89) (Synge 1937). Many of the early Synges were millers and tanners by profession. They took an active part in the governance of Bridgnorth as bailiffs, and one of them, Richard Synge (1566–1631), J. L. Synge's seventh-great-grandfather, was a Member of Parliament for Bridgnorth.

According to tradition, the changing of the name from Millington to Synge originated with Henry VIII (1491–1547), who commanded a Millington choirboy of particularly beautiful voice to 'Singe, Millington, Singe.' Originally the family name ranged over Synge, Syng, Singe and Sing, but the present form Synge was well established by 1600; it is always pronounced as 'sing'. It is remarkable that the name Millington has survived so widely as a first name to the present day.

The arrival in the 1620s, and permanent settlement, in Ireland of Edward Synge (1614–78), J. L. Synge's sixth-great-grandfather and the eighth son of the above-mentioned Richard Synge, formed the shoot that was to become the Irish branch of the family of Synges. Edward was brought to Ireland by his eldest brother George (1594–1652), senior to Edward by 20 years, who had been in Ireland since 1621 and who was responsible for Edward's education at Drogheda School and Trinity College Dublin (TCD). George became Bishop of Cloyne in 1638 but, after the 1641 rebellion in Ireland and the loss of almost his entire estate, he returned to England in the late 1640s without leaving any descendants behind; he died in 1652 and was buried at Bridgnorth. Edward Synge became Bishop of Cork, Cloyne and Ross in 1663.

J. L. Synge's family were members of the Church of Ireland, and a great number of his distant ancestors attained high office in the Church. We have already encountered the two bishops Edward and George. Pre-eminent among them, however, was Edward Synge (1659–1741), the son of Bishop Edward Synge and J. L. Synge's fifth-great-grandfather, who became Archbishop of Tuam in 1716. The two bishops and the archbishop were much admired and respected both as preachers and as scholars. The archbishop himself was the father of two bishops, Edward (1691–1762) and Nicholas (?–1771), the latter being the fourth-great-grandfather of J. L. Synge. The clustering of so many eminent churchmen in the same immediate family is probably unique.

The most distinguished distant ancestor of J. L. Synge was undoubtedly Hugh Hamilton (1729–1805) (no relation to Sir William Rowan Hamilton). His granddaughter Isabella

Hamilton married J. L. Synge's great-grandfather John Synge (1788–1845). J. L. Synge had some reservations as to the greatness of Hugh Hamilton as a mathematician, but he did praise his great-great-great-grandfather as being 'the most intellectual Irish bishop of the eighteenth century, a better mathematician than Berkeley, a better physicist, a better theologian, and in practical benevolence not behind' (34). Hamilton had a brilliant academic career, entering Trinity College at the age of 14 years, where he was subsequently elected a Fellow of the College at 22 years old and Erasmus Smith Professor of Natural Philosophy at 30 years of age. He was elected Fellow of the Royal Society of London in 1761, and Member of the Royal Irish Academy in 1785, the year in which the Academy was founded. On the ecclesiastical side of his career, he was appointed Dean of Armagh in 1768, consecrated Bishop of Clonfert in 1796, and translated to Ossory in County Kilkenny in 1798, where he died in 1805 (the year in which Sir William Rowan Hamilton was born).

He wrote extensively on mathematics, physics and chemistry, and theology. His greatest contribution to mathematics was the publication of his *De Sectionibus Conicis* in 1758; it contained many original contributions, and it was perhaps the last major book on conic sections to be written in the strictly Euclidean mode. It won considerable acclaim at the time, and the great Euler described it as a perfect book. Would it be unreasonable to suggest that in Hugh Hamilton we may have another ancestor from whom Synge had inherited his interest in mathematics?

Interestingly, in Hugh Hamilton's granddaughter Isabella we find a Gaelic strain in the ancestry of J. L. Synge. Synge's daughter, Professor Cathleen Synge Morawetz, traced Synge's great-grandmother Isabella, through her mother Juliana Trisdall, back to the time of Henry VIII, to the McCrossains of the sept of Leix (County Laois) called O'More (or O'Moore) (C. Synge Morawetz, personal communication, 2007).

Of Synge's more immediate relatives, the most distinguished ones are undoubtedly his uncle John Millington Synge (1871–1909), his distant cousin Richard Lawrence Millington Synge (1914–94) FRS, and his daughter Cathleen Synge Morawetz (1923–).

John Millington Synge (JMS) is the world-renowned playwright and poetic dramatist who portrayed so vividly and beautifully the primitive life of the Aran Islands and the western seaboard of Ireland. He was also an accomplished violinist and ornithologist, with cycling and hill-walking his greatest hobbies. Despite his strict religious upbringing, though more likely *because* of it, JMS became, by the age of 18 years, a complete atheist, abandoning at the same time his Ascendancy background to become a staunch Nationalist. In his own words (Greene & Stephens 1959, p. 19):

> Soon after I had relinquished the Kingdom of God I began to take a real interest in the Kingdom of Ireland. My patriotism went round from a rigorous and unreasoning loyalty to a temperate nationalism, and everything Irish became sacred.

As we shall see below, JMS's transformed attitudes filtered down in various degrees to J. L. Synge. JMS died on 24 March 1909, leaving the bulk of his estate to his nephews Edward Millington Stephen and Hutchie, Synge's eldest brother.

Richard Lawrence Millington Synge (Gordon 1966) was a distinguished chemist who in 1941, in collaboration with Dr Archer John Porter Martin (FRS 1950), developed a quick and inexpensive method, called paper partition chromatography, for separating the components of complex chemical mixtures. They shared the 1952 Nobel Prize in Chemistry for their work.

Cathleen Synge Morawetz was born in Toronto on 5 May 1923. She is an eminent mathematician and has made pioneering contributions to partial differential equations and wave propagation. She has the unique distinction of having been the first woman to hold, from 1984 to 1988, the directorship of the famous Courant Institute of the University of New York. She is also the first woman to have been elected to the Applied Mathematics Section of the United States National Academy of Sciences (in 1990), and only the second woman to have been elected President of the American Mathematical Society (from 1995 to 1997). She was awarded the National Medal of Science in 1998 and, as the referee of this memoir kindly pointed out, in 2001 she was elected an Honorary Member of the London Mathematical Society; again, the first woman to be so honoured.

Childhood and early education

It has already been mentioned that at the time when J. L. Synge was born his family lived in Rathe House in Co. Cavan. Befitting their Ascendancy background, the Synges were sufficiently well off to employ, in addition to the usual domestic servants, a nurse for Synge junior, a general factotum, gardener-cum-coachman, and a live-in tutor for the education of their children.

In 1903, when Synge was six years old, the family moved closer to Dublin, primarily for the formal education of their children but also because of the isolation and loneliness that his mother felt at remote Rathe House. They first moved to Bray, in County Wicklow, some 19 kilometres south of Dublin, then a favourite seaside resort. In his short autobiography Synge remembers vividly the Coons and Pierrots on the Esplanade, 'fantastically attired …, amusing the crowd with their songs and passing round the hat …'. The autobiography was written in about 1986 and it will be referred to as SAB in what follows.

In 1905 the family moved to Sandycove, halfway between Bray and Dublin, to a rented terrace house at 3 Bayswater Terrace, and finally, in 1913, to their permanent residence at Knockroe, Sydenham Road, in Dundrum, then a suburb of Dublin.

Synge's formal education began soon after the family settled in Sandycove. He spent two years in a nearby very small dame school (four pupils in all) run by two sisters, and then three years at Tudor House School, a small preparatory school in the nearby Dalkey village. The school was run by an Englishman, Mr Rootham, and there were about 20 pupils, probably screened socially. There was a very British atmosphere in the school.

It was at Tudor School that Synge first mastered the elements of geometry and algebra, and some Greek and Latin. In his three years at the school Synge gained considerable confidence in his academic ability, especially in mathematics. But this confidence received a shock when, shortly before leaving Tudor House, Rootham decided to teach his class permutations and combinations. 'I could not master them. The reason was … that I have a visual mind, good for geometry or formal algebra, but definitely not combinatorial' (SAB, p. 6). He would refer to the visual quality of his mind throughout his life.

It was while in Sandycove, in 1909, that J. L. Synge acquired his first bicycle, 'a most important event in my life', as he put it. On the death of his uncle (the playwright) JMS that year, Synge's brother Millington acquired JMS's much-used bicycle; Synge himself got Millington's old, dilapidated bicycle with no free-wheeling and no effective braking mechanism. This was a dangerous machine to cycle, especially downhill, and it was not long before Synge persuaded his father to replace it with a brand-new bicycle, 'sent from Gamage's of London, price £3-19-9, a bargain price' (SAB, p. 7).

Figure 1. J. L. Synge's painting 'Schrödinger in the Hand of God'. (Reproduced by courtesy of the Dublin Institute for Advanced Studies.) (Online version in colour.)

Cycling, walking, swimming and sailing were the main hobbies that Synge was to pursue passionately throughout his life. Cycling, especially, formed an integral part of his life, both as a form of recreation and as an object of dynamical investigation. Later on in his life he took up painting with some considerable success (figure 1). Well after retirement he tried his hands on the mandolin, but without much success.

Synge left Tudor House School in 1910 and, after being taught at home by a tutor for several months, he joined his brother Millington at St Andrew's College after Easter in 1911. The College then occupied a fine old building on the north side of St Stephen's Green in the heart of Dublin. It was in St Andrew's that Synge's mathematical ability surfaced. In 1913 he won three medals in the mathematical subjects in Middle Grade of the (Irish) Intermediate Examination, and in 1914 one medal in Senior Grade. He also won a number of exhibitions in cash, spending some of the money on one of the best bicycles available at the time. He was a keen footballer and took an active part in the literary and political activities of the College. He and his brother were members at the foundation, in 1911, of the popular Literary and Debating Society of the College, and Synge was to serve as the chairman of the society two years later. It is recorded (Fitzpatrick 1994) that, during a debate on 20 February 1914, Synge assaulted a fellow student on account of displaying a British flag; was this a sign of uncle J. M. Synge's influence?

Religion

It was mentioned earlier that J. L. Synge's family were members of the Church of Ireland. Synge and his siblings were all baptized, and in due course his sister and two brothers were confirmed in the Church of Ireland. His sister remained a conforming Christian, but both his brothers lapsed soon afterwards, almost certainly under the influence of their atheist uncle JMS. At the advanced age of 89 years Synge wrote, 'This infected me to such an obvious extent that my parents never, to my recollection, suggested that I should be confirmed. I never was' (SAB, p. 11).

In stark contrast to the illustrious religious careers of so many of his ancestors, Synge became, and remained throughout his life, 'an atheist, with no belief whatsoever in a God or gods of any kind.' In his book *Kandelman's Krim* (34), he states in his characteristic style, and in no uncertain terms:

> … I am a Protestant to the marrow of my bones, holding the essence of Protestantism to consist, not in the recitation of this creed or that, but in the assertion of the right of the individual to hold his own views on all matters and express them as he thinks fit, with the prudential reservation that one does not preach vegetarianism (at least not too violently) in the lion's den.

This was no idle talk. Synge lived as he preached, as the following story kindly related to me in 2006 by his daughter Cathleen indicates. As children, Cathleen and her older sister Margaret (Pegeen) took piano lessons with a Miss Capp. At the end of each lesson, Miss Capp would give the girls sheets of music to take home for practice (and pay for them at the following lesson). Close to one Christmas Miss Capp gave the girls Christmas carols for practice. Synge objected, but Miss Capp insisted, saying that 'no practice of the pieces she handed out, no lessons.' Synge capitulated! Cathleen referred, most affectionately, to her father as a 'Hellfire Atheist.'

Trinity College Dublin

J. L. Synge entered TCD in 1915, and by the end of his first year he won a Foundation Scholarship in mathematics. This was an extraordinary achievement for, in those days, the Foundation Scholarship examinations were normally taken at the end of the third year. This achievement was made possible with the help of his old school, St Andrew's College. His former mathematics teacher, A. E. Dowds, thought that it would be a good advertisement for the school were Synge to win a Foundation Scholarship in his first year. Dowds was able to persuade St Andrew's to pay for extra tuition for the Scholarship examinations. St Andrew's certainly got their money's worth!

Besides the great honour attached to the Foundation Scholarships, Scholars were entitled, as they still are, to free evening meals (Commons) and free rooms in College. Synge duly moved into rooms in College, at the top of number 26 (and later in the much better rooms in number 16) in the oldest building on the campus, called the Rubrics, as it was built of red brick. Conditions were rather primitive by modern standards but, free from all family restrictions for the first time in his life, Synge enjoyed his new-found freedom immensely. He formed close and lasting friendships, particularly with his fellow mathematics students, C. H. Rowe and T. S. Broderick, who later on were to become professors of pure mathematics in TCD. Mention must also be made of John (Seán) Beaumont (1893–1959), who, more than anybody else, influenced Synge's early politics.

Beaumont, like Synge, came of a Protestant background, and he had been some three years senior to Synge at St Andrew's College. He seems to have pursued several parallel courses in Trinity College, taking a degree in Celtic Studies in 1915 and a Foundation Scholarship in mathematics in the same year, while pursuing courses necessary to qualify in law (D. Ó Mathúna, personal communication, 2007); he was a staunch Nationalist and a rebel, and exerted a strong influence on Synge in this regard.

The Easter Rising, so crucial to the emergence of the modern Irish State, started on Easter Monday, 24 April 1916, just days before Synge's Scholarship examinations. It consisted in taking over several prominent buildings, most notably the General Post Office, from the steps of which the Proclamation of Independence was read at 12 noon on 24 April. Within a week or so the rebellion was crushed, and most of its leaders were executed. Public opinion, at first apathetic and suspicious of a German connection, turned into widespread sympathy. The executions had produced a considerable emotional effect on Synge and, under the influence of Beaumont, he was prepared to call himself a Sinn Feiner, although he never became a member of Sinn Fein. He joined the Gaelic League, founded in 1893 by Douglas Hyde (1860–1949) (who was destined to become Ireland's first President) to ensure the survival of the Irish language and culture. Synge accepted Beaumont's suggestion to go with him to learn the Irish language at the Irish College, run by the Gaelic League, at the village of Ballingeary in Co. Cork. He was to stay there for two months, cycling back all the way to Dublin at the end. In his autobiography (pp. 14 and 15) he wrote:

> For the first time in my life I lived among Catholics, and I realised that this was much more the real Ireland than what I experienced. The Protestant conscience was absent, and there was an atmosphere much freer and more natural. … And I had discovered a new Ireland, breaking out of my Ascendancy cocoon.

The story of how Beaumont and a reluctant Synge stole a rifle (presumably left behind by the British Army after one of the occupations of the College) from the rooms of one of their fellow students, smuggled it out of College and handed it to the rebels, is vividly recorded in SAB (p. 21). Synge described his relationship with Beaumont 'as that between an elder and a younger brother. … He remains in my mind as one of the most mysterious people I have met.'

It was in Trinity College, too, and more specifically at the Gaelic League, that Synge met Elizabeth Eleanor Mabel Allen (1896–1985), who was shortly to become his wife. She was a history student a year older than Synge, but two years ahead of him at the university. She came of a Protestant background (her father, Robert Allen, was a Church of Ireland teacher) but, like Synge, she abandoned her religion and became a staunch Nationalist. In addition to sharing their religious and political beliefs, Synge and Elizabeth shared their love for mathematics. Indeed, as their daughter Cathleen pointed out to me recently, Elizabeth entered Trinity with the intention of studying mathematics, changing to history only after being discouraged by her older brother. The legacy from her father, who died when she was four years old, had been exhausted towards the end of her studies, and she was forced to leave College sometime after her third year without a degree.

Synge and Miss Allen became engaged in 1917, and were married on 29 July 1918. Thinking that their parents would disapprove of marriage, they got married clandestinely in a registry office, 'certainly not in a church'. His brother Millington, who had recently graduated from medical school, and his friend Broderick were their witnesses. They had a 'wedding feast of scrambled eggs' (SAB, p. 18) in Synge's rooms and then a cycling honeymoon in Co. Donegal.

To return to his studies proper, Synge was aiming for a degree with honours (Senior Moderatorship), taking, as was the custom then, two subjects, in his case mathematics and experimental science. Of the mathematics courses then taught in Trinity, he found mechanics, hydrodynamics and elasticity particularly attractive and very much to his liking. The advanced courses in these subjects were taught by Professor M. W. J. Fry, with whom Synge established long and friendly relations. Synge could not enthuse about algebraic geometry, so well established in College by the great geometer George Salmon (1819–1904) FRS, and found the textbooks used confusing. This was not true of differential geometry, which was his favourite subject and fitted so well with his study of dynamics; it also formed a good foundation for his study of relativity in later years.

He studied closely the monumental and demanding treatise *Analytical dynamics* by E. T. (later Sir Edmund) Whittaker FRS (Whittaker 1904). Synge found an error in the section of the book dealing with small oscillations, on p. 176, which he duly communicated to Whittaker (1873–1956). Whittaker very politely acknowledged this and made the necessary correction in the subsequent editions of the book. Indeed, when Whittaker brought out the third edition of his book in 1927, he invited Synge to contribute a piece of his work on the geometry of dynamics, which Synge published in 1926 (8). Synge had thus ‘gained a patron’ who was to promote his election to the Fellowship of the Royal Society in 1943.

Synge graduated in October 1919 with a Double Moderatorship in Mathematics and Experimental Physics. He was also awarded a Large Gold Medal which, for financial reasons, he later sold. On graduation he was given a temporary job in Trinity teaching mathematics to ex-soldiers who were being rehabilitated, and in January 1920 he was appointed a College lecturer with a salary of £150 per annum. At about this time Synge had a few lessons in German and, with the help of a dictionary, he was able to ‘stumble’ through Einstein’s papers on relativity. It may be recalled that 1919 was one of the most exciting years in the history of relativity, it being the year in which the bending of light was verified observationally. Such a momentous event could hardly have left Synge unmoved.

In 1920, TCD announced that it would elect a new Fellow in mathematics, not on the basis of an examination as was then the normal practice, but on the basis of a thesis. Synge used his considerable expertise in analytical dynamics to investigate ‘The stability of [what else?] the bicycle’; this was not an easy problem because, on account of the rolling of the wheels, the system is non-holonomic. A thesis was duly submitted, but was unsuccessful: ‘I hardly expected to receive the Fellowship and was not unduly disappointed when it went to my friend Charles Rowe’ (SAB, p. 19).

In the late summer of 1920 Synge learned that the University of Toronto was looking for a lecturer in mathematics. He duly presented himself (at the Standard Hotel in Dublin) for an interview with Professor A. T. DeLury, the head of the Mathematics Department at Toronto. DeLury was of Irish extraction and a devotee of Irish literature. It was not long before Synge realized ‘that it was useful to be a nephew of J. M. Synge [the playwright].’ The interview ended with DeLury offering Synge, not a lectureship, but an assistant professorship at ‘the princely salary of $2500 per annum’, which was later raised to $2700.

Toronto, 1920–25

After a long delay in securing berths for the transatlantic journey, Synge and his wife arrived in Toronto in November 1920; they were to stay there until 1925. After Dublin the Synges found Toronto rather crude, but everyone was very kind to them, and Synge liked his academic work. The only well-known mathematician in the department was J. C. Fields (1863–1932) FRS, but by the time Synge had arrived his research activity was at an end. However, an event took place in Toronto during that time that turned out to be of immense significance to Synge: the meeting of the American Mathematical Society (AMS) at the end of 1921. For the first time Synge came in touch with some of the leading mathematicians of North America 'who actually published papers and books' (SAB, p. 24). In particular he established good and lasting relations with the University of Princeton mathematicians O. Veblen (1880–1960) and L. P. Eisenhart (1876–1965), who at that time were turning their attention to Einstein's theory of relativity. So was Synge, whose interest in relativity was considerably enhanced by the course of lectures given by Dr Ludwik Silberstein at the University of Toronto in 1920–21 (there, presumably, on a visiting lectureship). In his approach to relativity Synge adopted, right from the start, the elegant geometrical and visual approach initiated by Herman Minkowski (1864–1909) in 1908. This geometrical approach was to become the most distinct characteristic of his subsequent work in theoretical physics.

It was in Toronto that the Synges' first two daughters, Margaret (always called Pegeen) (1921–63) and Cathleen (1923–), were born.

Synge's first two major research papers (2, 3) were on the various types of principal directions (like the principal axes of the inertial tensor of a solid in Newtonian mechanics) in a general Riemannian space of any dimensionality. They were communicated to the *Proceedings of the National Academy of Sciences* by Veblen after a conversation that he and Synge had during the aforementioned meeting of the AMS.

Synge's first-ever publication (1) was a letter to *Nature* in 1921, entitled 'A system of space-time co-ordinates'. The remarkable thing about this short and insignificant looking paper is that it laid down an approach to relativity that Synge was to follow consistently throughout his life. Unlike the common approach, then, to the coordination of physical events by means of rigid bars and clocks, Synge proposed a coordination based entirely on clocks and light-rays. For Synge distance measured by a rigid bar is a derived concept, and 'the word *rigid* must be avoided like poison until properly defined in space–time terms' (37). He introduced the name 'chronometry' (36) for that part of science that deals with the concept of time. Had it not been for the fact that the name 'relativity' was so well established, Synge would have replaced it by 'chronometry'.

Synge was actively involved in another major event that took place in Toronto in 1924, namely the International Congress of Mathematicians. The prime mover in bringing the Congress to Toronto was Professor Fields. Fields was a well-to-do bachelor who was familiar with many mathematicians in Europe, having studied with some of the best mathematicians of the time, including K. T. W. Weierstrass and F. G. Frobenius. Fields was able to secure sufficient funds from the government of Canada to invite a large number of European mathematicians; indeed, there was a substantial amount of money left over, which, as we shall see later, in part funded the establishment of the Fields Medals in 1932. One of the participants of the congress was Professor A. W. Conway (1875–1950) FRS, of University College Dublin. An Organizing Committee was set up and Synge was appointed its secretary. It was not an easy job, and Synge felt quite relieved when the Congress was over.

He refused to be involved in any way with the publication of the proceedings of the Congress for, in the meantime, he learned that his Alma Mater, TCD, would elect a new Fellow (by examination this time) in 1925; furthermore, his former professor, M. W. J. Fry, would vacate the Erasmus Smith Professorship of Natural Philosophy. By this time (1924) Synge had had

Figure 2. J. L. Synge (right) with his former students A. J. McConnell (centre) and E. T. S. Walton at Synge's 90th birthday. (Online version in colour.)

nine papers published, the first seven on differential geometry and relativity, one on the theory of elasticity (4) and one in classical mechanics (5). He wanted to return to Ireland and he felt that a few more papers would enhance his chance of winning the Fellowship.

Dublin, 1925–30

Synge resigned his assistant professorship in Toronto at the end of the academic year 1924/25 and returned to Dublin with his wife and two daughters. He was the only candidate for the Fellowship and, with A. W. Conway as external examiner and M. W. J. Fry as the internal one, the examination was a mere formality; Synge was duly elected to Junior Fellowship on 8 June 1925. Eighteen days later he was appointed Professor of Natural Philosophy.

A year later, in 1926, he got his ScD from Trinity and was elected a Member of the Royal Irish Academy. The similarity between Synge's career, thus far, and that of his distant ancestor Hugh Hamilton is very striking indeed; Synge followed, almost exactly, the same steps that Hamilton had in his academic career more than 150 years earlier.

In his first year in Trinity, 1925/26, Synge felt privileged to have in his class two brilliant students, A. J. McConnell (1903–93), who was to become the Professor of Natural Philosophy and Provost of Trinity College, and E. T. S. Walton (1903–95) (figure 2), who was to become the Professor of Physics in Trinity and share the Nobel Prize for Physics with Sir John Cockcroft FRS in 1951.

In 1926 Synge published, as mentioned above, his important paper 'On the geometry of dynamics' in *Philosophical Transactions of the Royal Society of London* series A (8). It was a substantial paper in which he regarded the configuration space of a dynamical system as a

Riemannian manifold with two important types of *positive definite* metric. Tensor calculus formed the backbone of the paper.

A by-product of this work was the derivation of the all-important equation of *geodesic deviation*, an equation that gives, in dynamics, the relative acceleration of two neighbouring particles in terms of the curvature tensor—that is, the fourth-order Riemann tensor—of the manifold. At the very same time, the Italian geometer and relativist Tullio Levi-Civita (1873–1941) published the derivation of the same formula that also holds for a Riemannian manifold with an *indefinite* metric; it holds, in particular, for the space-time manifold of the general theory of relativity. The importance of this formula in general relativity cannot be overemphasized; the interpretation, in general relativity, that the curvature tensor constitutes the gravitational field, is based on this formula.

The most important undertaking by Synge during the years 1925–30 was the editing, with A. W. Conway, of the first volume of the mathematical papers of Sir William Rowan Hamilton. This volume, the first of four, contained Hamilton's work on geometrical optics and it was published, with generous support from TCD and University College Dublin, by the Royal Irish Academy (RIA) in 1931.

It is not sufficiently acknowledged that the prime mover of this project was Synge's eldest brother, Hutchie (1890–1957), senior to Synge by seven years. Hutchie entered TCD in 1908 to read mathematics and Old Irish. He was a brilliant student, winning several prizes and a Foundation Scholarship in mathematics in 1910. He read extensively and widely and, as Synge put it, 'I never met anyone who gave me such an impression of omniscience' (SAB, p. 28). Because of this, and because of the age difference, Hutchie had considerable dominance over his youngest brother, which was not unlike the dominance of John Beaumont.

Hutchie never graduated because, after inheriting the legacy from his uncle J. M. Synge, referred to above, he abandoned Trinity College after completing his third year and lived a life of leisure, travelling in mainland Europe or living with the family. Some 10 years later he undertook research work in physics with Synge's encouragement. Two of his papers, one on the design of a multiple-mirror telescope in 1930, and the other on the design of a microscope that can measure lengths less than the wavelength of light in 1928, both published in *Philosophical Magazine*, ensured Hutchie's place in the history of science.

Early in the 1920s Hutchie became interested in Hamilton, the greatest mathematician that Ireland had produced. He developed a somewhat mystical reverence for him as a genius and thought that the publication of Hamilton's collected papers was long overdue. He sought the support of Albert Einstein for this project in a letter to him on 16 April 1922. Einstein gave his enthusiastic and wholehearted support in a letter to Hutchie on 4 May 1922. However, without any academic standing himself, he could not get very far. So he turned to his brother, J. L. Synge, and pressed him to get the RIA to publish Hamilton's papers.

When Synge became a Member of the RIA in 1926, and a member of its Council in 1927, he was able to persuade an initially reluctant Academy to undertake the publication of Hamilton's works; Synge and Conway were appointed editors of the first volume. As a preparation for this work Synge produced an annotated catalogue of Hamilton's manuscripts and of 200 or so notebooks. It was an arduous undertaking but Synge was fascinated at coming into intimate contact with a great mind.

More importantly, the expertise in Hamilton's work that Synge gained in editing this volume had a profound influence on many of his subsequent researches. His two books *Geometrical optics; an introduction to Hamilton's method* (13) and *Geometrical mechanics* *and de Broglie waves* (28) are a direct result of this undertaking. No fewer than 10 papers dealt exclusively with, or were applications of, Hamilton's method. It was a source of great satisfaction for Synge to have been able to apply the very same method to the study of water waves in 1963 (44).

Between 1925 and 1930 Synge published 11 papers, mostly on differential geometry, hydrodynamics and relativity, and one on the steering gear of a four-wheel vehicle (7). We mention, in particular, his paper (6) on the first and second variations of the length-integral along a geodesic in a Riemannian manifold. The most important result in the paper is the formula giving the second variation in terms of the Riemannian curvature; it is now known as Synge's formula (Frankel 2004, p. 324). Eleven years later, in 1936, Synge used his formula to establish a theorem on the relationship between the sectional curvature and the connectedness of even-dimensional Riemannian manifolds (11), now known as Synge's theorem. In its simplest form the theorem states that

> Any compact even-dimensional orientable manifold with strictly positive sectional curvature is simply connected.

This theorem is acclaimed as 'one of the most beautiful results in global differential geometry of the twentieth century' (Frankel 2004, p. 329).

Synge had settled down to the idea of spending the rest of his life in Dublin when he received a letter from Professor DeLury informing him that they were thinking of establishing a Department of Applied Mathematics in Toronto and inviting him to set it up and head it. After endless discussions with his wife Synge decided, for various reasons, to accept the invitation. He resigned his professorship and Fellowship of Trinity on 5 July 1930 and returned, with his family (which now included their third daughter, Isabel, born on 18 March 1930), to Toronto in the late summer of 1930.

Toronto, 1930–43

On his arrival in Toronto, Synge set to work to plan the new curriculum in the newly established Department of Applied Mathematics. His first two members of staff were A. F. C. Stevenson and B. A. Griffith, both of whom transferred from the Department of Mathematics. Synge was quite disappointed by the latent hostility among some senior members of the Department of Mathematics, in particular between DeLury and Fields, but he managed to maintain friendly relations with both of them at all times.

Later on, in 1938, the distinguished Polish mathematical physicist Leopold Infeld (1898–1968) was appointed lecturer in the department. Infeld was Einstein's collaborator at the Princeton Institute for Advanced Study for two years, in 1936 and 1937, but having no permanent post to offer him the Institute approached Synge to ask whether a post could be created at Toronto. Synge took the matter to the president of the university, Canon Cody, who, though impressed by Infeld, could only offer him a lectureship. Infeld accepted, bringing with him 'something new into a rather stuffy academic atmosphere' (SAB, p. 32). Synge and Infeld became good friends, and remained so well after they both left Toronto. Although they both had relativity as one of their main fields of research, the only collaboration between them concerned the projects related to World War II (20, 32). Towards the end of 1939 Synge received permission to add another lecturer to his department. This led to the appointment of Alexander Weinstein (1897–1979), the distinguished Russian mathematical physicist who became famous for his work on a variety of boundary-value problems.

Synge's involvement in the establishment of the Fields Medals in mathematics was crucial and, because of their importance to the mathematics community, is worth recounting briefly. Early in 1932 Professor Fields, now 69 years old, fell seriously ill. He sent for Synge and explained that he wanted to endow international medals in mathematics. As mentioned above, the medals would be funded in part by the residue of the government grant for the 1924 International Congress of Mathematicians, and the rest by Fields's estate. Fields dictated letters concerning the medals and Synge had them typed for him. Some time later Synge had a telephone call from Fields's nurse–housekeeper saying that his condition was critical. Synge arrived to find him trying to get his will in order with the help of, among others, a representative of the Toronto General Trusts. 'But he could hardly speak, and to my surprise seemed to have forgotten about the medals. … So I reminded him…' (SAB, p. 35) and the medals got into his will.

It was Fields's intention to launch the medals at the 1932 International Congress of Mathematicians in Zurich, but in view of his illness he passed on the responsibility to Synge. Synge travelled to Zurich, presented Fields's proposal to the Congress, the Council of the Congress duly approved of the medals, and the 'International Medal for Outstanding Discoveries in Mathematics', universally known as the Fields Medal, came into being. Fields died soon afterwards in the same year.

Apart from a visiting lectureship at Princeton University during the second half of the academic year 1938/39 and weekly visits to Brown University in Providence, Rhode Island, in 1941, Synge was to remain in Toronto until 1943. One of his brightest students was Alfred E. Schild (1921–77), with whom he wrote *Tensor calculus* (21) in 1949, a book very much in use to this day.

Synge continued his prolific research in many different fields, now including hydrodynamics, elasticity and electromagnetic theory. Responding to a question by Dr H. K. Box, a Toronto dentist, early in 1931, Synge applied the theory of elasticity to investigate the problem of 'traumatic occlusion' which concerns the thin (periodontal) membrane connecting the tooth and the bony socket. This investigation led to a series of six papers, the most important of these being a 42-page-long paper (9) published in 1933; it was entitled 'The tightness of the teeth, considered as a problem concerning the equilibrium of a thin incompressible elastic membrane' and was a supreme example of mathematical modelling. When Synge's old friend Charles Rowe, then professor of mathematics at Trinity, heard the title of this paper he remarked, 'His dentures must be troubling him.'

Of Synge's many contributions to hydrodynamics (of which (10), (15) and (30) are examples), the most important and influential paper, 'Relativistic hydrodynamics' (12), published in 1937, became a classic. It was recently reproduced in *Journal of General Relativity and Gravitation* (**34**, 2171–2216 (2002)) as one of the 'golden oldies' of relativity. It was the first systematic attempt to develop a hydrodynamical theory in general relativity and, as Jürgen Ehlers, the Editor of this 'oldie', stated:

> He does this in his characteristic style, using spacetime diagrams to illustrate the contents of the theorems as well as the proofs. … It is a pleasure to read this exposition ….

Another publication from his Toronto years, with his colleague B. A. Griffith, which influenced generations of students, is *Principles of mechanics* (14), an undergraduate textbook used to this day.

Brief mention was made above of Synge's visiting lectureship to Princeton University early in 1939. Much as he was looking forward to meeting Einstein, then at the Princeton Institute for Advanced Study, Synge was disappointed that he met him only once; even then the conversation was confined to a discussion of a refugee physicist looking for a post. The man Synge liked best at Princeton was the relativist and cosmologist H. P. Robertson (1903–61), who, Synge believed, was the first to see that the so-called 'Schwarzschild singularity' is not really a singularity.

With the advent of World War II in 1939, Synge felt that his Department of Applied Mathematics could do some research useful to the war effort. He contacted General (Andrew George) McNaughton, the head of the National Research Council of Canada, who during World War I had been the head of the Canadian Armed Forces. The general responded by giving Synge some old data on artillery errors that he himself collected during World War I, and asked for a mathematical analysis of the material. Synge and Infeld, and other members of the department, set to work; after several months a report was sent to General McNaughton. The general thought very highly of it and told Infeld a few years later that 'by our work we had saved many lives' (Infeld 1978, p. 18), a remark that neither Synge nor Infeld took seriously. With this work over, they were allowed to work on radar waveguides about which they received classified reports. This marks the beginning of Synge's interest in waveguides and antenna theory. After the war this work was declassified and a number of papers appeared in scientific journals: (18) with G. E. Albert and (19) on antenna radiation, and (20) with Infeld and others on waveguides. Synge also became keenly interested in ballistics, studying in particular the standard papers by the Cambridge (UK) group led by R. H. (later Sir Ralph) Fowler (FRS 1925) on the motion of a spinning shell (Fowler *et al*. 1920; Fowler & Lock 1922).

In 1941 R. G. D. Richardson, the dean of the Graduate School of Brown University, set up a special programme of Advanced Instruction and Research in Mechanics (which was to become the graduate Division of Applied Mathematics in 1946), with the noted German applied mathematician William Prager (an exile in Turkey at the time) appointed to lead the programme. Prager's arrival from Europe having been delayed, Richardson asked Synge to help out. Synge was unable to leave Toronto at that time, so an elaborate plan was worked out, whereby Synge would fly to Brown every week, lecture for a few days, and fly back to Toronto to his normal duties. It was an exhausting undertaking but Synge found the lectures enjoyable and stimulating.

In particular with K. L. Nielsen, who was attending his lectures, he re-examined the motion of a spinning shell. Contrary to the long-held view, which originated in the above-mentioned work of Fowler, that there are only five forces acting on the shell, they discovered a sixth force. A note to this effect was sent to the National Research Council in Ottawa, which in turn sent it to the Aberdeen Proving Ground, an institution of the US Army. This work was published after the war (16).

Not long afterwards Synge was appointed as a (civilian) consultant, with the official title Ballistic Mathematician, at Aberdeen. It was in this capacity that he travelled to London early in 1944 attached as scientific assistant to Colonel Schwarz, the Armament Officer for the US Army Air Force in Europe; as we shall see below, Synge was at that time the head of the Mathematics Department of the Ohio State University, having left Toronto in 1943. With Rawdon Smith, Schwarz's other scientific advisor in Europe, Synge investigated the trail of a bomb dropped by an airplane flying horizontally on a straight course; that is, the difference between the horizontal range of the bomb (on hitting the ground) when the air resistance is neglected, and the horizontal range when the air resistance is taken into account. Having written a memo on this he was allowed to return to the USA on VE Day. In the meantime, back in the Aberdeen Proving Ground, the existence of Synge's sixth force, although very small compared with the others, was verified experimentally.

INTO THE AMERICAN ORBIT, 1943–48

'On account of my visits to Brown University and my connection with Aberdeen Proving Ground, I found myself drawn into the American orbit' (SAB, p. 41). In 1943 Synge accepted an invitation to head the Mathematics Department of the Ohio State University (OSU). He was to stay at OSU from 1943 to 1946. He found the collegiate atmosphere at OSU very much to his liking and he enjoyed, in particular, the company of Alfred Landé, the Professor of Theoretical Physics.

With many of his administrative duties taken off his shoulders by his colleague F. R. Bamforth, he was able to accept, early in 1944, the brief appointment as Ballistics Mathematician referred to above. He also developed a close collaboration with Professor Prager, whom Synge met during his visits to Brown University in 1941. This fruitful collaboration led to the development of the method of the hypercircle, a precursor of today's Finite Element Method, for the approximate solution of certain boundary-value problems. The first paper with Prager (17) was published in 1947. It was followed by seven papers by Synge, culminating in the publication of his book *The hypercircle in mathematical physics* (33) in 1957. For an authoritative account of the method and its history, and Synge's role in its development, the reader is directed to the recent paper by Synge's student, Vincent Hart, who contributed significantly to chapter 5 of the above book (Hart 2007).

In 1946, three years after his appointment at OSU, Synge accepted an invitation to build up and head the Mathematics Department of the Carnegie Institute of Technology (now Carnegie-Mellon University) in the industrial city of Pittsburgh. His most brilliant students at the Institute were Raoul Bott (1923–2005) (ForMemRS 2005) and John Nash (1923–); they were to become two of the most renowned mathematicians of the twentieth century. They attended a course on tensor calculus given by Synge, Bott as a postgraduate and Nash as an undergraduate, and both did excellently at the final examination. On a visit to Dublin in 1985 Bott, then a professor at Harvard University, recalled that Synge often wore a nose mask to combat the polluted atmosphere; occasionally he would wear an eyepatch over his left (bad) eye also, with the result that he was often referred to as a 'pretty fierce-looking chap'.

Nash went on to win the 1994 Nobel Prize in Economics. The much-acclaimed book *A beautiful mind* by Sylvia Nazar (Nazar 1998) and the (2001) Academy Award-winning film with the same title are based on his life. In 2005 he gave a moving public lecture in TCD in honour of his former professor; it was based entirely on Synge's course of lectures on tensor calculus that he had attended 60 years earlier.

THE HOMECOMING, DUBLIN, 1948–95

Synge's stay at Carnegie Institute of Technology was a brief one, from 1946 to 1948. His return to Dublin came about in a curious way. The Dublin Institute for Advanced Studies (DIAS) had been established in 1939 by Eamon de Valera (FRS 1968) (1882–1975), then Prime Minister of Ireland (48, 56); he was a keen mathematician and astronomer in his own right, and, quite literally, worshipped the great William Rowan Hamilton. Erwin Schrödinger (ForMemRS 1949), Nobel laureate, was the first Director of the Institute's School of Theoretical Physics (STP).

Towards the end of the 1940s Schrödinger was developing his own Unified Field Theory at the Dublin Institute, and Einstein was continuing with the development of his own Unified Field Theory at the Princeton Institute for Advanced Study. This subject attracted the attention of the mass media and, in particular, of *Time* magazine, which commented, on 10 February 1947, that 'Last week, from nonscientific Dublin, of all places, came news of a man who …'. This made Synge furious or, as he put it, 'This got my goat.' On 3 March he sent them a letter stating that 'For a few misleading words—"non-scientific Dublin of all places"—in an otherwise excellent account, your reporter on Schrödinger needs a swift kick in the pants.' He went on to say, 'Schrödinger bases his theory on Hamilton's Principle …; who was this Hamilton? Born, lived and worked (1805–1865) in "non-scientific Dublin, of all places"!'

Synge's letter attracted attention in Dublin and he got a letter from a friend on the Board of the STP of the DIAS asking him if he would consider returning to Dublin. This created a dilemma for Synge: did he *want* to return to Ireland? On the one hand, he liked America, and he was widely known and highly esteemed there. On the other hand there is, as he put it, a natural inclination to return to the land of one's birth. According to his daughter Cathleen, another deciding factor for leaving America was that her father suffered severely from hay-fever induced by ragweed pollen.

Be that as it may, in 1948 Synge bade a final farewell to North America to return to his native Dublin, having accepted a senior professorship at the STP of the DIAS. The Synges settled at 'Torfan', 8 Stillorgan Park, Blackrock, Co. Dublin; it was the first and only house that they ever owned. Colleagues and scholars from the Institute were often graciously entertained by the Synges. On the mantelpiece in their living room, written in Greek, were Archimedes' famous words, 'δός μοι ποῦ στῶ καί τάν γᾶν κινάσω' ('Give me a place to stand on and I can move the Earth'), an indication of Synge's highest regard for Archimedes.

Synge was a senior professor at the Institute from 1948 to 1972, and served as the director of the STP from 1956 to 1969. He officially retired at the age of 75 years, in 1972, but continued his research, and his association with the Institute, with the title Professor Emeritus, for another 20 years or so. At first he had as fellow Senior Professors Erwin Schrödinger (1887–1961) and Walter Heitler FRS (1904–81), and later Cornelius Lanczos (1893–1974), J. R. McConnell (1915–99), L. O'Reifeartaigh (1933–2000) and J. T. Lewis (1932–2004).

For Synge one of the main attractions in joining the Institute in 1948 was the prospect of having Schrödinger as a colleague. Synge found him a 'most interesting and many-sided man' (SAB, p. 49), but no collaboration seems to have developed. As an explanation of this, Synge says, 'I was all too conscious of my complete ignorance of quantum theory …' (SAB, p. 49). Schrödinger referred to Synge as 'My friend Professor John Synge, who is a very amusing conversationalist as well as a mathematician …' (Schrödinger 1964); this was no small compliment coming from a man such as Schrödinger. Throughout his stay at the Institute, Synge collaborated almost exclusively with (mostly) young postdoctoral research scholars of the Institute who chose to work with him.

During his Institute years (figure 3), Synge focused his attention mainly, but not entirely, on Einstein's theory of relativity, venturing occasionally into A. N. Whitehead's theory of relativity (24, 26, 29). His reputation as a relativist attracted research scholars, collaborators

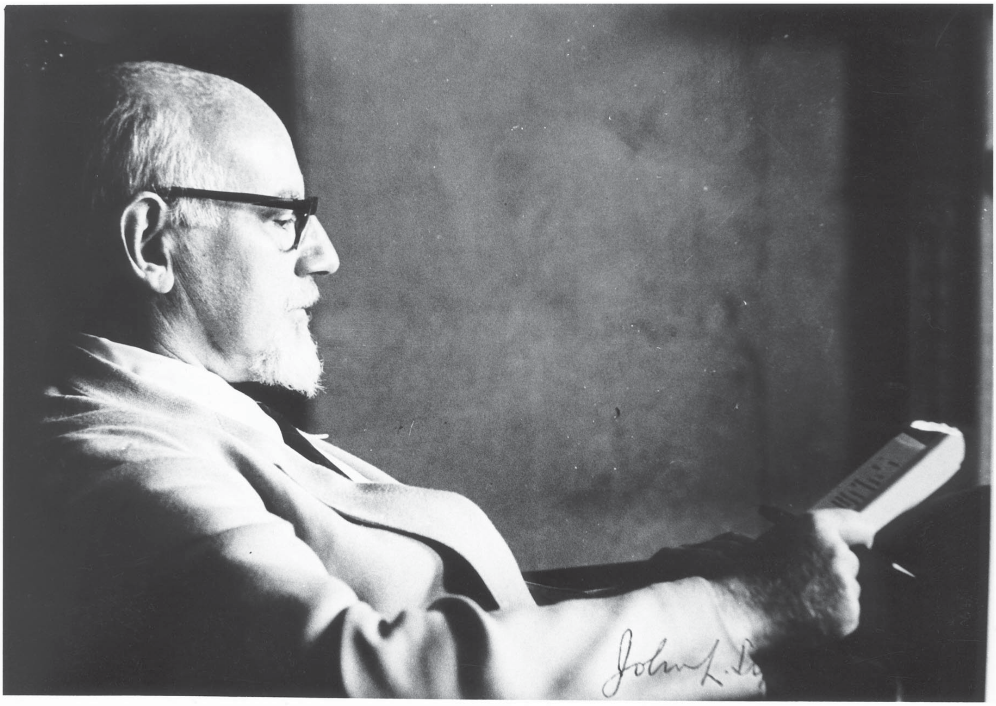

Figure 3. J. L. Synge in 1957 (Reproduced by courtesy of *The Irish Times*.)

and eminent visitors from all over the world, making the Institute one of the great centres in relativity theory. It is reckoned that up to the mid 1960s about 12% of the world's relativists passed, physically, through the DIAS. He encouraged and helped generations of students, many of whom distinguished themselves in the field of relativity.

We have already mentioned that Synge's approach to relativity, and indeed to theoretical physics in general, is characterized by his extraordinary geometrical insight. He felt just as much at home in the four-dimensional space-time of relativity as in the three-dimensional Euclidean space. Right from the beginning, he viewed relativity from the grandstand erected by Minkowski in 1908 and he was inviting his readers to do the same: 'I have sat in this grandstand for forty years and it hasn't creaked yet. It will not let you down, never, and in it you will not experience that dizzy nausea which the word "relativity" so often induces' (35).

What must be one of Synge's most remarkable achievements during his Institute years is his 1950 paper 'The gravitational field of a particle' (22). In it he was able, for the first time, to penetrate and explore fully the region inside the so-called Schwarzschild radius, what we now call a black hole. At a time when many relativists, including Einstein, thought that it did not even make sense to talk about this region, this work is very remarkable indeed. The paper was, in mathematical terms, the first maximal analytic extension of the Schwarzschild solution.

In the decade 1960–70 Synge devoted much time and energy, either on his own or in collaborations with several scholars, on systematic approximation methods for solving Einstein's field equations (40–43, 45–47, 49) and on the fundamental problem of the equations of motion in general relativity (50, 55).

Of the many other papers and books on relativity and many other topics that Synge published during his Institute years, mention must be made of the 1951 paper with S. O'Brien (25); it deals with the tricky problem of the junction conditions across a hypersurface of discontinuity in general relativity and it is frequently cited to this day. Of his non-relativistic contributions one must mention his book-size article 'Classical mechanics' in *Handbuch der Physik* (38); it is probably the most thorough, and definitive, survey on the subject to this day.

Synge made outstanding contributions to widely varied fields: classical mechanics and geometrical optics, relativistic gas dynamics, elasticity, electrical networks and antenna theory, mathematical methods and, above all, differential geometry and relativity theory. He published 11 books, including the three absolutely fascinating and delightful semi-popular books *Science: sense and nonsense* (23), *Kandelman's Krim* (34) and *Talking about relativity* (51). He published well over 200 papers, the last research paper (with J. G. Kingston) being at the age of 91 years (57); it was, appropriately enough, on geometry, his lifelong love. He also wrote a number of concise and hugely entertaining book reviews in scientific journals (for example (27, 52, 54)) and in *The Irish Times* in the 1970s. Every book and every single paper is a remarkable work of art, characterized by his striking 'clarity of expression' and the sheer beauty of his prose and, of course, by Synge's geometric spirit.

The almost universal geometrical approach to the theory of relativity that began in the 1960s is due primarily to Synge's influence, especially to his two epoch-making books *Relativity: the special theory* (31), published in 1956, and *Relativity: the general theory* (39), published in 1960. In these two books Synge demolishes the 'procrustean bed' of Newtonian theory and develops Einstein's theory of relativity as an independent theory that stands sturdily on its own feet. Space-time diagrams are freely and effectively used throughout the books, in stark contrast to all the previous standard books in which hardly a single space-time diagram appeared. By themselves space-time diagrams do not prove anything, but, for example, 'When the head begins to swim with contracted rods and slowed clocks, the best antidote to confusion is a simple space-time diagram' (27).

The profound influence that the above two books had on the subsequent development of relativity can best be illustrated by the following story. In 1992 the first J. L. Synge Public Lecture was given in Trinity College by the late Sir Hermann Bondi (1919–2005) FRS, with the present author as chairman. To one of my introductory remarks, mentioned above, that by the mid 1960s 12% of the world's relativists passed through the Institute, Bondi had this to say:

> When you say that 12% of the world's relativists went through instruction and guidance by him I think that is a gross underestimate, because every one of the other 88% has been deeply influenced by his geometric vision and the clarity of his expression. Some of us, I may say, have at times been daunted by this clarity because it sets a standard that the rest of us can strive for but it's very hard to attain.

It is on record that, for example, the outstanding relativist Sir Roger Penrose FRS (initially an algebraic geometer) decided to go seriously into the field of relativity after reading Synge's books on the subject.

Characteristically, Synge himself had this to say in 1972: 'If you were to ask me what I have contributed to the theory of relativity, I believe that I could claim to have emphasized its geometric aspect' (53).

The extraordinary qualities, already mentioned more than once, that characterize all his writings also characterize all his lectures and seminars. He was indeed a superb lecturer, perhaps the best of his generation. Writing in *The Times Educational Supplement* in 1974 on success in teaching mathematics, Sir William Hunter McCrea (1904–99) FRS, another outstanding Irish theoretical physicist, pays the following moving tribute to Synge:

> The greatest living lecturer in mathematics lives in Dublin. Readers who know his identity will surely agree with this categorical claim, even if they are in the top flight themselves. And if this Professor *X* recognizes himself, let him take these remarks as a humble tribute. Every lecture he gives is the superb performance of a master—or ought I say maestro?

There is no doubt that McCrea, my PhD supervisor of long ago, was referring to none other than Synge. It may be added that the word *maestro* is in no way misplaced. Synge (figure 3), with his goatee beard, has a striking resemblance to the famous English orchestral conductor Sir Thomas Beecham. So much so that when, on a short visit to London in 1957, Synge was walking in the neighbourhood of the Royal Festival Hall, a passer-by raised his hand politely and said, 'Good evening, Sir Thomas.' This story was told amidst great laughter by Professor Werner Israel FRS, another outstanding student of Synge's, in 1994 when he delivered the second J. L Synge Public Lecture.

The final years, 1972–95

A year after his retirement, Mrs Synge's health began to deteriorate, leading to her death in 1985. We let Synge take up the story because it is told most movingly and it brings out the human side of his character:

> She had a stroke in 1973 and was in hospital for six weeks. She lost her speech entirely, but it was restored by a speech-therapist. … But then she had an epileptic attack, and these attacks occurred from time to time until her death on 21 September 1985. … The cause of her death was a heart condition she had had for some time. … Her death (at the age of 89) was a release from a situation which she bore with great courage. Now, living alone, I feel her loss very much, although I have now a freedom I did not have for thirteen years during which I never knew when one of her attacks might come on. During those years, and indeed until less than a year before her death, she would come with me in the car when I went shopping twice a week, and we would take long drives in the country. These she enjoyed very much, and the strange fact is that she never had an epileptic attack during any of these drives.

During his wife's illness he worked in his study at home on a number of problems, mainly on geometry and scalar waves. After his wife's death, he continued to live in 'Torfan', looking after himself, until 1992, when he reluctantly agreed to move into the Newtown Park House nursing home, not far from his own house.

Synge was the recipient of many honours throughout his long life: Member (1926) and President (1961–64) of the RIA, Fellow of the Royal Society of London (1943) and of the Royal Society of Canada (1932) and Honorary Fellow of TCD (1954). He was awarded honorary doctorates from the University of St Andrews (1966), the Queen's University of Belfast (1969) and the National University of Ireland (1970), the (first) Tory Medal of the Royal Society of Canada (1943) and the Boyle Medal of the Royal Dublin Society (1972). In 1986 the Royal Society of Canada established the John L. Synge Award in his honour, and in 1992 TCD, his Alma Mater, founded the J. L. Synge Public Lecture and the J. L. Synge Prize in Mathematics (given in alternate years).

Synge died on 30 March 1995, exactly one week after his 98th birthday. He is survived by his two daughters Cathleen, whom we have encountered several times in this memoir, and Isabel Seddon, a talented musician now living in Australia; his eldest daughter Margaret (Pegeen) died in 1963.

Synge's mind was lively and vivid to the very end of his life, reading avidly and thinking about mathematical problems. On one of my visits to him towards the end of 1993, he told me that the problem that occupied his mind at the time was Fermat's last theorem. When I ventured to say, 'The problem was solved last July', he said, 'Oh, I know that, but I am thinking of the problem from a different angle, in terms of the *zeroes* of the Fermat function $x^t + y^t - z^t$. You can think of t as a parameter and (x, y, z) as a point in a three-dimensional space, or you can think of (x, y, z, t) as a point in a four-dimensional space.' I do not know how far this approach would have led him, but it clearly indicated that his 'geometrical vision' remained undiminished to the very end.

Professor Synge was a kind and generous man. He encouraged, helped and inspired several generations of students who will always remember him with gratitude, fondness, admiration and the deepest respect. In old age Synge suggested that a significant part of his epitaph might read:

He encouraged younger men.

Alas, there is no tomb on which to engrave an epitaph; Synge bequeathed his body to the Medical School of TCD. It is, however, deeply and permanently engraved in the heart and mind of each one of his students, and those who were fortunate enough to come in touch with him.

Acknowledgements

This memoir is based to a very large extent on Synge's unedited and unpublished autobiography (referred to in the text as SAB), on my recent article on J. L. Synge (Florides 2003), on personal knowledge over many years, and on information I have received from a number of people. These include Mrs Margaret Synge (wife of J. L. Synge's first cousin John Samuel Synge) and Dr Diarmuid Ó Mathúna, Dr Vincent Hart, Dr David Simms and Dr David Spearman; I am most thankful to them. My former student professor Paul McNicholas has given me invaluable assistance in the typing of the memoir, for which I am deeply grateful. To Professor Brendan Scaife I extend my special thanks for reading the manuscript, and for his critical comments and useful suggestions.

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