

Cambridge University Press

978-0-521-00231-8 - The Life and Legacy of G.I. Taylor

George Batchelor

Excerpt

[More information](#)

CHAPTER I

An introduction to G.I. Taylor

Geoffrey Ingram Taylor was born on 7 March 1886 in St John's Wood, London, and died at the age of 89 in Cambridge after having lived there for most of his life. He was one of the most notable scientists of this century, and over a period of more than 60 years produced a steady stream of research papers of the highest originality. He occupied a leading place in applied mathematics, in classical physics and in engineering science, and was equally at home and equally respected in these three disciplines. Taylor's work is of the greatest importance to the mechanics of fluids and solids and to their application in meteorology, oceanography, aeronautics, hydraulics, metal physics, mechanical engineering and chemical engineering. His research in fluid mechanics in particular could be said to have given the subject much of its present character. He stands in the great British tradition represented by Kelvin, Rayleigh, Reynolds, Richardson and Stokes, although he got more from experiments than any one of these men – and he was in my judgement the most original. He had the rare honour of seeing his scientific papers, some previously unpublished, gathered and published in four thick volumes during his lifetime. Taylor was elected to Fellowship of the Royal Society in 1919, knighted in 1944, awarded the US Medal for Merit in 1946, and appointed to the Order of Merit in 1969.

He was also an adventurer. In 1913 he served as meteorologist in an expedition on the old sailing ship *Scotia* sent to get information about icebergs on the Newfoundland Banks following the disastrous sinking of the *Titanic*, and seized the opportunity to measure the vertical distribution of wind velocity, temperature, and humidity over the sea surface by lifting instruments up to heights of about 2500 metres by means of kites and balloons. In the following year he joined a group of civilians at the Royal Aircraft Factory at Farnborough

Cambridge University Press

978-0-521-00231-8 - The Life and Legacy of G.I. Taylor

George Batchelor

Excerpt

[More information](#)

1. An introduction to G.I. Taylor

helping the Royal Flying Corps to put the design and operation of aircraft on a scientific basis, and learnt to fly in order to have direct experience of an aeroplane as a mechanism and, later, to parachute. He was among the first British people to enjoy the sport of skiing in Switzerland; he was a keen rock-climber; and he tried at the age of 80 to master water-skiing. In 1929 he and his wife, Stephanie, explored on foot remote parts of Borneo where the natives had not previously seen a white person.

But sailing was his greatest love. As a schoolboy he designed and built a boat in his bedroom, and sailed on the Thames, sleeping on board overnight. In later years he owned larger sailing boats, in particular *Frolic*, a cutter 48 feet long in which he and Stephanie made some enterprising voyages, including a cruise up the coast of Norway to the Lofoton Islands for which he was awarded the Royal Cruising Club Cup for 1927. In all these activities the spice of adventure was mixed with intellectual curiosity about how things worked and how improvements might be made. Among the improvements was a revolutionary design of anchor for small boats.

Geoffrey Taylor was a member of a distinguished family. Scientific creativity of high order had appeared in several of his ancestors, most notably in his grandfather, George Boole, who founded the study of mathematical logic.

Behind Taylor's immense scientific achievements and adventurous pursuits was a modest, gentle, lovable man with a razor-sharp mind which was never used to hurt anyone. He had the engaging curiosity of a bright child, and retained that fresh enquiring attitude throughout his life, even into his eighties. He was rational in his approach to everything, and confident of his abilities. His childhood in a stable secure family unit was a happy one, and his marriage, although childless, was successful. This serene background to his personal life as a child and as an adult no doubt helped him to develop and retain a well-balanced contented uncomplicated personality. He was also extremely independent, both in his personal life and in his scientific work. Present-day scientists will be impressed to learn that, to the best of my knowledge, he never had a secretary, never took leave

Cambridge University Press

978-0-521-00231-8 - The Life and Legacy of G.I. Taylor

George Batchelor

Excerpt

[More information](#)

1. An introduction to G.I. Taylor

away from Cambridge (except to advise on problems of national importance), and never applied for a research grant.

Taylor had the gift of naturalness, which enabled him to face any task or problem, scientific or non-scientific, without stress or self-concern. He knew what he wanted to do with his life, namely, to study mechanical phenomena. Some perceptive institutions awarded him the means to do exactly that; and he proceeded to do it supremely well. He had every reason to be happy, and he was. The degree of naturalness that Taylor possessed is uncommon among members of the human race, and I believe it is the primary source of his outstanding success as a scientist. Most great men have wide interests and varied experiences, and they develop a complex network of interactions with other people. By contrast, Taylor was a simple man whose mind was uncluttered and free at all times for the scientific enquiry that he loved above all else. His character and his activities were perfectly matched, and the self-regard and irrationalities and self-made obstacles to success which beset most of us did not exist for him.

There is a paradox here, in that the life of such a simple straightforward man may seem not to justify publication of a biography. There might seem to be little needing to be said beyond a description of his scientific achievements. But Taylor's research contributions were only half the story. His simplicity of character and outlook was a source of great scientific strength, and we should enquire how he was able to make simplicity such a positive quality. He left us a legacy, which was characterized at an international symposium at Cambridge in March 1986 to commemorate the 100th anniversary of his birth as 'fluid mechanics in the spirit of G.I. Taylor'. This legacy contains a lesson for scientists, in particular for those involved in the training of young people for research.

He summed up his attitude to life with characteristic modesty and light-heartedness at the end of a lecture of reminiscences (1952e); 'One never regrets the things one has done. It is the things one has not done when the opportunity came that cause the bitterest pangs.' It seems unlikely that Taylor had cause for many pangs of regret, for

Cambridge University Press

978-0-521-00231-8 - The Life and Legacy of G.I. Taylor

George Batchelor

Excerpt

[More information](#)

1. An introduction to G.I. Taylor

in another lecture given in the same year he said: ‘I think that if I were to start again I should still try to be an applied mathematician, because the number of amusing activities to which mathematics can lead one is so great.’

CHAPTER 2

Taylor's family

George Boole

Taylor's mother came from an interesting and talented family, and he was proud to be a part of it. The family tree shown in figure 2.1 begins with John Boole, Taylor's great-grandfather on his mother's side, who was a cobbler in Lincoln. John Boole had a lively mind and wide interests which included the making of scientific instruments and observing the stars with his own telescope. He was a poor man, and his eldest son, George, who was born in 1815, felt obliged to go to work at an early age despite an intense wish to be educated. George's formal education went little further than elementary school, but after some help with mathematics and classical and modern languages from his father and family friends he made very rapid progress by his own efforts. Difficult to credit though it may be, the cobbler John Boole and his home-educated son corresponded with each other in Greek. George was drawn increasingly to mathematics and, while still in his teens and working as a school teacher, read Newton's *Principia* and Lagrange's *Mécanique Analytique*. He began independent mathematical work, and became especially interested in the laws of combination of symbols representing mathematical operations. His profound originality was soon evident. George Boole was awarded a Royal Medal by the Royal Society in 1844, at the age of 29, for his contributions to symbolic logic, and was elected a Fellow in 1857. His opportunities to pursue his mathematical research increased greatly when in 1849 he was appointed the first Professor of Mathematics at the newly founded Queen's College, Cork. It was here that he met and married Mary Everest, with whom he had five children, all girls, before his death in 1864.

Cambridge University Press

978-0-521-00231-8 - The Life and Legacy of G.I. Taylor

George Batchelor

Excerpt

[More information](#)

2. Taylor's family

Much more information about George Boole and his work than I have space for here may be found in the recent biographical study by MacHale.¹

Taylor wrote several engaging articles about the life of George Boole, two essentially the same on the occasion of the centenary of the publication of Boole's *The Laws of Thought* (1954f, 1956e) and a third for a meeting in Lincoln to mark the centenary of Boole's death (1964c), which Taylor attended as the only survivor of Boole's eight grandchildren. Taylor brings out well the almost saintly character of his grandfather. These articles are clearly and attractively written, like others by Taylor in his later years, and they tell us things about him as well as about Boole. I am therefore reproducing here the greater part of Taylor's address on the life of George Boole to the Royal Irish Academy (1954f), with the incorporation of some short extracts from the later version (1956e):

I have been asked to give a short account of the life but not the scientific works of my grandfather. For this task I fear I am little better fitted than any other student, for Boole died when my mother, his second daughter, was only six and I have met only two people who remembered him. One was my grandmother, who survived her husband for 52 years.² Fortunately in 1878 she wrote sketches of her life with Boole in the now defunct *University Magazine* and these give a clear picture of his short married life from 1855 until his death in 1864.³ They reveal an attractive and sensitive person whose thoughts and actions were much affected by a religion which he felt deeply but seldom mentioned.

Boole came from a family of farmers and small tradesmen who lived in and round Lincoln. The earliest member of the family who has been traced is Joshua Boole, who was born in 1670. None of the family seems to have been in any way remarkable except John Boole, George Boole's father. John Boole was a cobbler, but his real interest lay in mathematics and

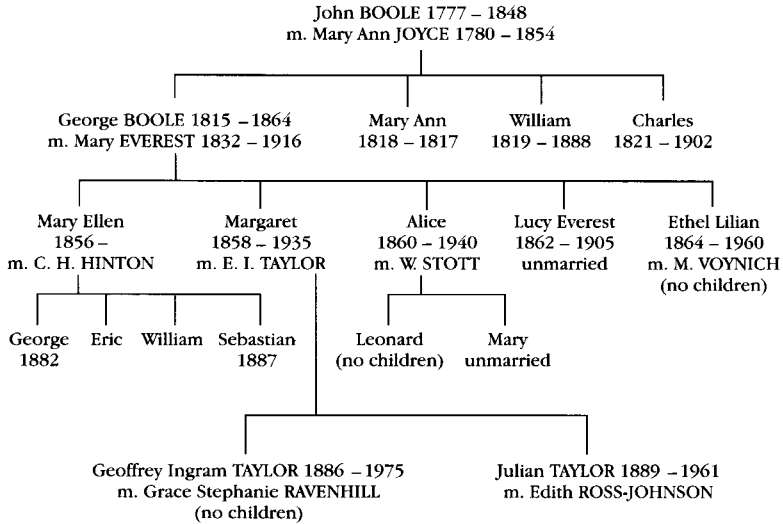
1. *George Boole: his Life and Work*, by Desmond MacHale. Boole Press, Dublin, 1985.
2. And the other? Lord Kelvin, it seems - see chapter 3.
3. 'Home-side of a scientific mind', by Mary Everest Boole. *The University Magazine*, 1878, in four parts, pp. 105, 173, 326, 454.

Cambridge University Press

978-0-521-00231-8 - The Life and Legacy of G.I. Taylor

George Batchelor

Excerpt

[More information](#)*George Boole*Figure 2.1 *The Boole family tree.*

in making optical instruments. His parents must, I think, have been fairly prosperous, for I have inherited some silver tablespoons dated 1789 bearing John Boole's monogram. Perhaps they were confirmation gifts, for he was only 12 in 1789. Another thing I have inherited is a box made by John Boole for a microscope that he had made. In the lid is pasted a note in my grandmother's handwriting giving this information and adding, 'He seems to have been able to do anything well except his own business of managing the shop.' The decline in John Boole's business, owing perhaps to his many outside activities, had an important effect on his son's life, for when it became clear that George had outstanding mathematical ability he was urged to go to Cambridge, but he would not do so because he wished to stay and help his father in his financial difficulties. It seems likely that the fact that Boole had no university training but absorbed his knowledge by reading great masters like Lagrange and Newton may have helped to develop the profound originality which appeared later.

John Boole was evidently a well-known character in Lincoln. He was largely instrumental in founding the Mechanics' Institute there, to give people an interest in their leisure hours, and it was partly due to his agitation that early closing of shops was

Cambridge University Press

978-0-521-00231-8 - The Life and Legacy of G.I. Taylor

George Batchelor

Excerpt

[More information](#)

2. Taylor's family



Figure 2.2 *George Boole, FRS, 1815–1864.*

enforced so that leisure was available. George helped him in this work and when early closing was introduced, he gave a lecture on the right use of leisure, which, though full of admirable advice beautifully expressed, must have seemed a counsel of perfection to his audience.

Among the optical instruments that John Boole made was a

Cambridge University Press

978-0-521-00231-8 - The Life and Legacy of G.I. Taylor

George Batchelor

Excerpt

[More information](#)*George Boole*

telescope. When this was finished he put a notice in his shop, 'Anyone who wishes to observe the works of God in a spirit of reverence is invited to come in and look through my telescope'. My grandmother told me that when someone asked George's mother whether she was not proud of her famous son she said, 'Ah, but did you know his father? He *was* a philosopher.'

George had only a very simple education. After leaving his local elementary school he went for a short time to a commercial school, but his real ambition was to become an educated man. To this end he took lessons in Latin from a Lincoln bookseller, Mr. William Brooke, who became one of his closest friends. Boole then taught himself Greek and later French and German out of borrowed books. When he was 14 his father sent a verse translation of the Greek poet Meleager's 'Ode to Spring' to the local paper with a note that it was written by a boy of 14. This was printed, and was, in fact, Boole's first published work. Through the medium of the Royal Irish Academy the Lincolnshire Archives Committee has unearthed the translation from the Lincoln records and sent it to me. I showed it to Professor Donald Robertson, late professor of Greek at Cambridge, and he writes that it is a good translation in the style of Sir William Jones' translations of Persian poets in the later eighteenth century. This translation had some effect on Boole's career, for someone wrote to the editor saying that no boy of 14 could have written it. This, I think, called the attention of the people of Lincoln to the fact that they had a genius among them.

When he started to study the classics Boole wanted to be a clergyman. According to E.T. Bell who wrote an imaginative but very readable account of Boole in his *Men of Mathematics*⁴, this desire was inspired by a snobbish wish to raise himself into a higher class of society than that into which he had been born. It seems to me that there is not the slightest evidence in Boole's papers or letters or in anything that his contemporaries wrote about him that that is true.⁵ On the contrary, all his published non-mathematical work, as well as the accounts of those who knew him, show him to be a person whose thoughts were continually directed to, and his acts directed by, his religious

4. Penguin, 1937, chapter 23.

5. MacHale (*loc. cit.*) is also critical of Bell's tendency to ascribe to Boole motives for which there appears to be no evidence whatsoever.

Cambridge University Press

978-0-521-00231-8 - The Life and Legacy of G.I. Taylor

George Batchelor

Excerpt

[More information](#)

2. *Taylor's family*

convictions, so that it was very natural that he should want to enter the Church. It would be quite natural for a poor but clever boy to wish to use his talents to raise himself in the social scale, but I can find no evidence that this was in fact the driving motive in Boole's terrific efforts to educate himself. Contemporaries who have recorded their impressions of Boole's sense of social distinctions agree that he had none at all. My aunt (Mrs. Voynich, Boole's youngest daughter, who lives in New York) wrote me that an old lady who had known Boole in Cork in her youth told her of the following incident. 'One day in June, 1856, she went into the slum alley behind the College to engage a chimney sweep for her flues. As she was walking down the alley, she saw father ahead of her, knocking at one door after another. She came past him in time to see him passionately shaking hands with a ragged and barefoot man, and saying "I had to come and tell you, dear friends: I've got a baby and she *is* such a beauty."'

While on this subject I must comment on Bell's method of writing history. After explaining his idea that the class into which Boole was born was held in contempt by people higher in the social scale, he records his opinion of the effect on Boole of this state of affairs in the following words: 'To say that Boole's early struggles to educate himself into a station above that "it had pleased God to call him" were a fair imitation of purgatory is putting it mildly. By an act of divine providence Boole's great spirit had been assigned to the meanest class; let it stay there and stew in its own ambitious juice. Americans may like to recall that Abraham Lincoln, only six years older than Boole, had his struggle about the same time. Lincoln was not sneered at but encouraged.'

It is of course, true that Boole had a great struggle to educate himself. After a very little teaching of elementary Latin by Mr Brooke, Boole continued his lonely education by reading borrowed books, while he was teaching all day in his school. This must have been a really hard struggle. On the other hand, I know of no evidence that Boole suffered through, or indeed ever experienced, the contempt which Bell describes. There is plenty of evidence that, from an early age, Boole was encouraged and helped, to the best of their ability, by his neighbours and friends and the clergy of Lincoln. When Boole was only 19 and had been studying mathematics for two years he was asked by his fellow-townsmen to give an address about Newton on an occasion when a bust of Newton was presented