

George Boole and Geometry

DES MACHALE

George Boole FRS (1815–1864) was the first professor of mathematics at Queen’s College Cork, now University College Cork, from 1849 to 1864. Though a seemingly quiet, gentle and peace-loving man, he was involved in several controversies and disputes during that period. His problem, if problem it was, was that he could not stand idly by if he saw what he felt were abuses in the university system without speaking out against them in public. For many years he was at loggerheads with the then president of QCC, Sir Robert Kane FRS, which culminated in a Royal Commission being set up to investigate the state of the Irish university system ([5, pp. 171-174, 201-203] details Boole’s whistleblowing, Kane’s Behaviour, and the admonition of Boole; the author’s biography [2] may be used as a general reference for Boole-related assertions and facts mentioned in this article).

Kane was an eminent scientist, chemist and environmentalist who had written several groundbreaking works including a monumental *Elements of Chemistry* and *The Industrial Resources of Ireland*, a book way before its time and still relevant today. Kane had also worked on the Bordeaux Mixture, a chemical fungicide which could have averted the calamitous Irish potato famine, but sadly not in time.

In Boole’s opinion, and many others agreed with him, Kane was not content to be just a university president and administrator but interfered too much in the internal affairs of academic departments even down to the content of courses - he felt he knew better than the professors who had been appointed. Kane’s own appointment as president was probably due to the fact that he was a Catholic, one of two senior staff chosen to counteract the nineteen other Protestant professorial appointments. These choices caused great controversy locally as QCC was intended largely for the higher-level education of the Catholic middle classes (all male of course). At the Synod of Thurles in 1851, QCC was condemned as a ‘Godless College’ by the Irish bishops, led by Archbishop John MacHale of Tuam. Incidentally, Kane also refused to live in Cork, because it is said that Lady Kane much preferred the social life and other delights of Dublin.

The report of the resultant Royal Commission of 1857 largely vindicated Boole’s whistle-blowing activities but he was reprimanded for sending anonymous letters to the newspapers exposing the problems of university life in Cork. But there was a distinct tension between the two men for the rest of their lives. To add to the complication, Boole was allied to the Vice-President Professor John Ryall, the uncle of his future wife, Mary Everest, in a large anti-Kane faction at QCC. However, conflict between Boole and Kane had started much earlier. Kane had received from Colonel Portlock, Superintendent at Woolwich in England, a letter claiming that students who went to Woolwich from Queen’s College Cork were not properly instructed in the elements of geometry.¹ Kane placed the letter in Boole’s hands but took no further action. The

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¹This letter seems no longer to exist, nor has the author ever seen it.

message however was clear - Kane, the practical scientist, considered the applications of elementary geometry to be of much more importance than the niceties of algebra for which Boole was now widely famous.

Boole was rightly furious and countered that he had never neglected to impart instruction in elementary and more advanced geometry. However, he stated that he was of the opinion that geometry received too much attention in university courses. Boole also added that he could recall only one student of his who had gone from Cork to Woolwich and that student had received the lowest possible mark at the sessional examinations.

The purpose of this article is to back Boole's assertion that geometry was not neglected at Queen's College Cork, and in fact formed a major part of the curriculum there. The mathematical courses of the 1850's in the QCC calendar clearly mention 'The Elements of Euclid with deductions from the propositions'. We cannot of course tell what was taught in class by Boole, and he was the only teacher in the mathematics department, but surely examination papers set by Boole during this time must reflect the content of these courses at all levels. Luckily, these examination papers still survive in the archives of the Boole Library at University College Cork [1], and we now present a selection of those questions on geometry, which may be of independent interest.

- (1) Explain the nature and object of the science of geometry and define the following terms viz. Axiom, Postulate, Problem, Theorem; also the terms Line, Angle, and Surface.
- (2) Define a rhombus. Show that the diagonals of a rhombus bisect each other at right angles.
- (3) Find the locus of the centre of a circle which passes through a given point and touches a given straight line.
- (4) Give Euclid's definition of proportion and show that it virtually involves the arithmetical definition.
- (5) Show how to describe (construct) an equilateral triangle equal in area to a given triangle.
- (6) Deduce expressions for the radii of the escribed circles of a triangle whose sides are a , b and c .

There was a strong emphasis on trigonometry too, especially with applications to surveying for agricultural students:

- (7) Show how to find the distance between two inaccessible objects on a horizontal plane.
- (8) State the chief difference in principle and performance between the sextant and the theodolite.

Boole seems to have had a particular fondness for conic sections, and there were whole examination papers on this topic, presumably following such a course.

- (9) Show how to draw a tangent at a given point on a parabola.
- (10) Find the equation of a tangent to an ellipse and show that it makes equal angles with the focal distances.

Boole seems to have included a course on spherical trigonometry, not much in vogue nowadays. Typical examination questions were:

- (11) Prove that the sum of the sides [sic] of a spherical triangle is less than four right angles.
- (12) Show how to find the distance between two points on the Earth's surface, given their latitude and longitude.

Other topics included a three-dimensional helix, alternative axioms to Euclid, coordinate plane geometry, and complete quadrilaterals. It would be difficult to imagine a student without a thorough knowledge of both basic and advanced geometry answering

any of these questions. So, we find George Boole not guilty of the charge of having neglected the teaching of geometry at Queen's College Cork.

Other course and examination topics included calculus in abundance, differential equations, algebraic equations, commercial and mathematical arithmetic, and a strong emphasis on axioms and definitions in algebra. However, it is perhaps of more significance to list topics and subjects which do not seem to have been included in Boole's courses at Queen's College Cork.

- (1) There is no mention of Matrix Theory, initiated by Boole's friend Arthur Cayley around this time. Not even determinants appear anywhere.
- (2) Group Theory, also formalised by Cayley in 1853, is conspicuous by its absence.
- (3) Quaternions, discovered by Hamilton in 1843, and on which Boole had written a paper in 1848, do not feature anywhere.
- (4) Number Theory, particularly the results of Fermat, Lagrange and Gauss do not appear anywhere.
- (5) Perhaps most inexplicably, Boole's own creations, including invariant theory, operator methods for solving both difference equations and differential equations and particularly his algebra of logic of 1847, seem not to feature at all in his courses.

Admittedly, none of these topics had yet reached mainstream mathematics, but one wonders if he discussed them with his more able students. Or were they considered too difficult or too radical for undergraduates in the 1850's? Maybe he was scared of what President Kane might say, if he found out that Boole was filling students' heads with silly algebraic notions. But then if Kane had had his way, we might never have had the digital revolution!

One wonders what George Boole would have made of the current Department of Mathematics at University College Cork where he laboured singlehandedly for fifteen years and to which he probably sacrificed his life by walking from Ballintemple in a blinding November rainstorm and lecturing all day in soaking clothes. Doubtless he would have been proud of his many successors and mathematical graduates who have contributed so much to the subject worldwide. He would have been delighted too that his old chair is now termed the George Boole Chair of Mathematics.

And we have not forgotten him either - there is the magnificent Boole Library at UCC, the Boole Window in the Aula Maxima at UCC, the Boole window in Lincoln Cathedral, Boole statues in both Lincoln and Cork, plaques on his many houses and the Boole Crater on the moon. Finally, there is Boolean Algebra, known to every mathematician on the planet, and the basis of the most extraordinary inventions of mankind - the electronic computer and digital technology.

REFERENCES

- [1] *The George Boole Examinations Scrapbook, June 1850 – October 1874, (IE BL/SC/GB/1)*, 114 pp. & 9 enclosures, Special Collections and Archives, Boole Library, University College Cork. Available online as part of the *Digitised Boole Collection* at [Link](#).
- [2] Desmond MacHale: *The Life and Work of George Boole – A Prelude to the Digital Age*, Cork University Press, 2015, ISBN 978-1-78205-004-9.
- [3] Desmond MacHale and Yvonne Cohen: *New Light on George Boole*, Cork University Press, 2018, ISBN 978-1-78205-290-6.
- [4] Desmond MacHale and Yvonne Cohen: *The Essential George Boole*, Mercier Press Cork, 2024, ISBN 978-1-78117-840-9.
- [5] *Report of Her Majesty's Commissioners Appointed to Inquire into the Progress and Condition of the Queen's Colleges at Belfast, Cork, and Galway: with minutes of evidence, documents, and tables and returns*, iv, 37, 472 pp. Printed in Dublin by Alex. Thom and Sons, for Her Majesty's Stationery Office, (1858).

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