Mathematics for the World: Publishing Mathematics and the International Book Trade, Macmillan and Co.

Sylvia Marie Nickerson

Abstract Several historians including Andrew Warwick, Joan Richards, and Tony Crilly have offered explanations for why a stale culture of mathematics existed in nineteenth-century England. Nineteenth-century British culture did not generally regard mathematics as capable of failure, growth, or change. This paper argues that a significant contributing influence to this climate was book publishers, and the publisher Macmillan and Company in particular. From 1850 to 1900 Macmillan published hundreds of thousands of mathematical textbooks through industrialized book production. Macmillan distributed these pedagogical materials throughout the UK, Canada, the USA, Australia, India, and elsewhere. Motivated by profits from sales, and abetted by the efforts of their collaborator on mathematical subjects, Isaac Todhunter, Macmillan perpetuated a stale, Cambridge-centric image of mathematics among subsequent generations of mathematical learners in educational contexts around the world. How some of these books may have shaped the pedagogical experience of Canadian mathematician J. C. Fields during his high school and undergraduate education in mathematics is considered.

1 Introduction

An underexplored facet within the history of mathematics is how the book trade, and in particular book publishers, shaped knowledge formation in mathematics. Recently historians have recognized the study of book history and printed culture as a fertile ground from which relevant questions may be raised about texts, their origin, and influence within culture (Simon 2012, p. 340). Previously historians have often presumed authors to be the sole producers of textual ideas, while ignoring the mediating role that publishers and the allied trades of printers, distributors, advertisers, booksellers, illustrators, and libraries, played in the molding and communication of information and ideas through printed texts (Topham 2000, p. 560). The present work aims to question assumptions of authorial primacy within the

S.M. Nickerson (✉)
York University, Toronto, ON, Canada
e-mail: nickerso@yorku.ca

M. Zack, E. Landry (eds.), *Research in History and Philosophy of Mathematics*,
DOI 10.1007/978-3-319-22258-5_9

history of mathematics and suggests that book publishers in addition to authors, played a role in shaping mathematical culture.

The focus of this study is the mathematical publications of the British book publisher Macmillan and Company in the second half of the nineteenth century. Macmillan's production and distribution of mathematical books influenced the development of mathematical culture in the contexts in which their mathematical books were read and used. The Canadian mathematician John Charles Fields used several Macmillan textbooks during his high school and university education in Hamilton and Toronto, Canada (Riehm and Hoffman 2011, pp. 15–17, 21). Through Fields' life one can evaluate the influence of book culture on the mathematician. Fields was both a reader of many mathematical textbooks, and later in life he authored one research monograph about complex functions (Fields 1906). Isaac Todhunter, by comparison, authored many mathematical class books and collaborated with the Macmillan family in the development of their mathematical publication program, formidable in its multiplicity of publications (see Appendices 1 and 2). This paper examines how this author–publisher partnership evolved within the Cambridge University community, how the Cambridge context influenced their publications, and suggests that these pedagogical materials formed first impressions about mathematics on several generations of mathematical students. Through these numerous publications, Macmillan and Todhunter wielded influence upon mathematical pedagogy within the Anglophone context during the late nineteenth-century period.

2 John Charles Fields' Mathematical Studentship

The Canadian mathematician John Charles Fields (1863–1932) was born and raised in Hamilton, Ontario. At the time of Field's youth in Hamilton, new models of public education had been enacted in Ontario since the mid-century (Parvin 1965, pp. 6–26). Fields arrived on the scene at just the right moment to attend the original model school for elementary public education, Hamilton Central School, and the second public high school in Ontario, Hamilton Collegiate Institute (Smith 1910, p. 83). Fields had excellent teachers at these schools. One of his science teachers at Hamilton Collegiate Institute, J. W. Spencer, had received his PhD in geology from Göttingen, Germany. George Dickson, a chemist, was principal. Beyond their teaching roles, both Dickson and Spencer were active in their scientific fields. W. H. Ballard taught mathematics, and under his tutelage, many students were successful in the matriculation examinations in mathematics at the University of Toronto. Two students from Fields' class at Hamilton Collegiate Institute went on to achieve PhDs in mathematics: J. C. Fields and Milton Haight (Riehm and Hoffman 2011, pp. 12–14).

Records from Hamilton Collegiate Institute indicate what books were used in Fields' course of mathematical study. During his time as a student there in the 1870s, he read the Canadian edition of *Elementary Algebra* (1877) by J. Hamblin Smith

(of Gonville & Caius College Cambridge), which contained an appendix by Alfred Baker, a mathematical tutor at the University of Toronto. *The Elements of Algebra; for the Use of Schools and Colleges*, Part I (Toronto: Adam, Stevenson and Co., 1873) by James Loudon was on the curriculum. James Loudon was also a tutor, and later professor of mathematics at the University of Toronto. Another book by Hamblin Smith, *Geometry, the Elements of Geometry containing Book I to VI and portions of books XI and XII of Euclid with a Selection of Examinations Papers by Thomas Kirkland, M.A.* (1877) was used at Hamilton Collegiate.

Smith's 1877 *Geometry* and Smith's 1877 *Elementary Algebra* were "Canadian" editions of what had been originally British-published books. Typically, a Canadian edition of a British textbook was mostly identical to the British original with the addition of a preface, exam questions, and the name of a prominent Canadian teacher on the book's frontispiece. Several excerpts from positive testimonials or reviews from Ontario newspapers can also frequently be found in Canadianized editions. The Canadian edition of Hamblin Smith's *Geometry*, for example, fit these features, as it included exam papers by Thomas Kirkland of Toronto's Normal School. Fields was also exposed to a Toronto edition of Isaac Todhunter's *The Elements of Euclid for the Use of Schools and Colleges, comprising the first six books and portions of the eleventh and twelfth books* (Toronto, new edition, 1876). In the frontispiece of the book Todhunter was identified as Fellow and Principal Mathematical Lecturer at St. John's College, Cambridge (Riehm and Hoffman 2011, pp. 15–17) (Fig. 1).

In 1880 after high school, Fields entered the University of Toronto to study mathematics. University records contain the courses in mathematics that were taught at the university at this time. Elaine McKinnon Riehm and Frances Hoffman uncovered the subjects and books presented to Fields as a student at the University of Toronto in the 1880s (see Fig. 2). Several of these books were published in London by the publisher Macmillan, including Todhunter's *Spherical Trigonometry*, Tait and Steele's *Dynamics of a Particle*, and Boole's *Differential Equations* (Fig. 3).

After Fields graduated from the University of Toronto's math department, he went on to study mathematics at Johns Hopkins University. After completing a PhD degree at Johns Hopkins in 1887, he taught for a few years. Then Fields undertook an extended period of further study in Europe, from 1892 to 1900. He attended classes at the Collège de France and the Sorbonne in Paris, after which he moved to Germany where he attended more lectures at the University of Berlin. In France he came to know the work of Henri Poincaré, Émile Picard, Paul Painlevé, and Paul-Émile Appell, and in Germany that of Karl Weierstrass and Georg Riemann (Riehm and Hoffman 2011, pp. 32, 37–38).

In 1900 Fields returned to Toronto, and spent the rest of his life as a mathematics teacher at the University of Toronto. In a 1908 sketch he wrote about his mathematical life, Fields made this reflection about his education in Canada: "Fifteen years after I had received my grounding in the calculus I discovered, I am ashamed to say, in a German University, the University of Berlin, that it had been taught to me falsely, irremediably and fundamentally falsely" (Riehm and Hoffman 2011, pp. 21–22).

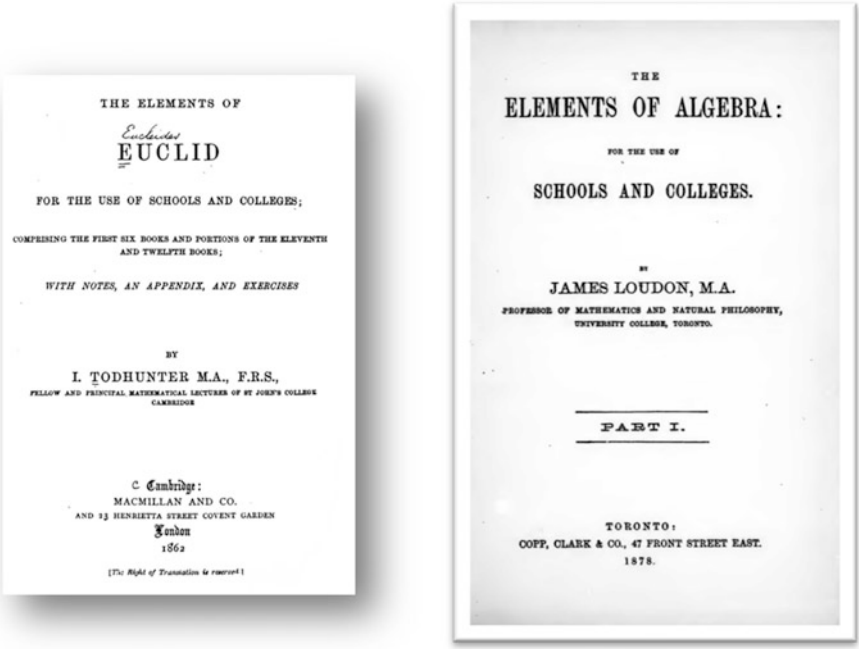


Fig. 1 Mathematical books used in J. C. Fields' education in Hamilton, Ontario (ca. 1876). *Right*: Isaac Todhunter, *The Elements of Euclid*, London: Macmillan and Co., 1862. (British edition). *Left*: James Loudon, *The Elements of Algebra* ... Toronto: Copp Clark & Co. 1878 (first published 1873)

First Year: Algebra; Euclid; Plane Geometry; Salmon's *Analytical Conic Sections*

Second Year: Elements of statics and Dynamics; Newton's Principia, Sec. I (Main's ed.); *Differential Calculus* (Williamson's); Solid Geometry; *Spherical Trigonometry* (Todhunter's); *Theory of Equations* (Todhunter's)

Third Year: Elements of Hydrostatics and Optics; *Analytical Statics* (Minchin's); *Dynamics of a Particle* (Tait and Steele's); Newton's Principia, Secs. II and III; Geometrical Optics (Jamin); *Hydrostatics* (Besant's); Rigid Dynamics; Eulerian Integrals

Fourth Year: Elements of Astronomy, Acoustics, Heat. Mathematics: 1. Modern Geometry; Salmon's *Conic Sections*, Chaps. 4, 9, 14, 15; Salmon's *Higher Plane Curves* Chaps. 1-4. 2. Modern Algebra; Salmon's *Higher Algebra*, Chaps. 1-9. 3. *Differential Equations*; Boole, Chaps 1-12. 4. Theory of Probability. 5. *Plane Astronomy*; Godfray. 6. Quaternions.

Fig. 2 Mathematical books used in J. C. Fields' education at the University of Toronto, ca. 1880–1884. List derived from the University of Toronto Calendar, 1883/84, reproduced in Riehm and Hoffman (2011, p. 21)

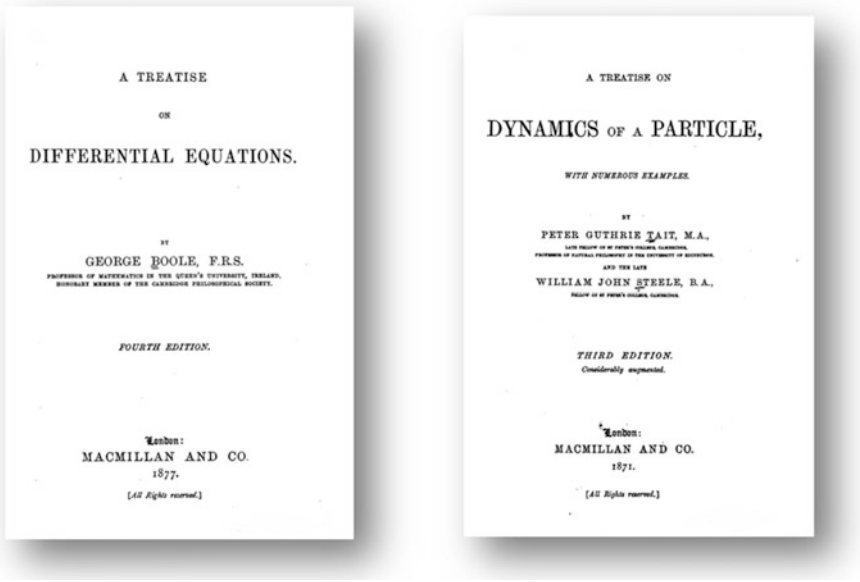


Fig. 3 Frontispieces from mathematical books used in J. C. Fields' education in Toronto (ca. 1880–1884). *Right*: George Boole, *A Treatise on Differential Equations*, London: Macmillan and Co. (4th edn.) 1877. *Left*: P. G. Tait and W. J. Steele, *A Treatise on Dynamics of a Particle, with numerous examples*, London: Macmillan and Co. (3rd edn.) 1871

3 Isaac Todhunter's Mathematical Textbooks

Isaac Todhunter is known to history as having been the British author of many nineteenth-century mathematical textbooks (Barrow-Green 2001, p. 189). Indeed, Todhunter was the author of some of the mathematical textbooks assigned to Fields during his Canadian studentship in mathematics. Todhunter published over forty mathematical books with the publishing company Macmillan between the years 1843 and his death in 1884 (see Appendix 1). Many of Todhunter's books reached unprecedented levels of circulation in educational contexts inside and outside Britain in the latter half of the nineteenth century (Eliot 2002, p. 23; Eliot 1994, p. 13) (Fig. 4).[1]

Todhunter's books were used as course texts by the Universities of Manchester, Leeds, Liverpool, Edinburgh, and Bristol, as well as becoming set texts for schools

[1] Simon Eliot has defined any book whose total print-run exceeded 10,000 copies as unambiguous publishing successes for Macmillan (Eliot 2002, p. 20). Many of Todhunter's textbooks were printed in numbers greater than 10,000, see Appendix 1.

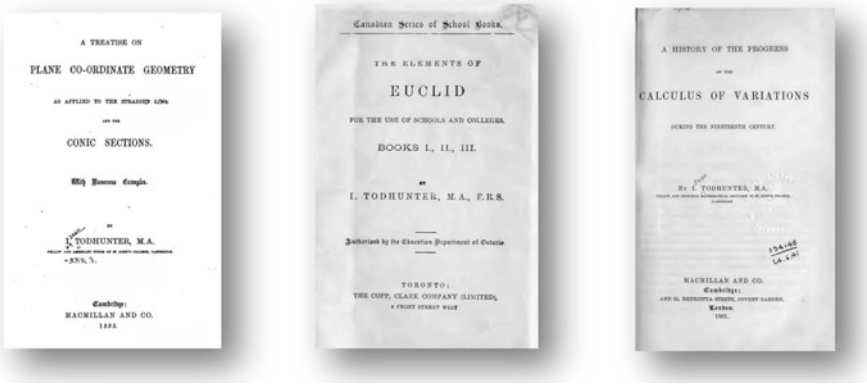


Fig. 4 From *right*: The frontispieces from some of Todhunter's textbooks: I. Todhunter, *A Treatise on Plane Co-ordinate Geometry* . . . Cambridge: Macmillan and Co., 1855. I. Todhunter, *The Elements of Euclid for the use of Schools and Colleges*, Books I, II, III. Toronto: Copp, Clark Company, 1876. I. Todhunter, *A History of the Progress of the Calculus of Variations During the Nineteenth Century*. Cambridge and London: Macmillan and Co., 1861

in the USA, Canada, and Australia (Barrow-Green 2001, pp. 187–189). In 1878 Todhunter wrote to his wife, "there is a library of mathematical books provided by the Civil Service Commission [of India] for the use of the Examiners. It consists of fourteen volumes, ten of which are by myself" (quoted in Barrow-Green 2001, p. 184). A decade after he died, twelve of Todhunter's textbooks were still recommended as useful reading material for the Cambridge undergraduate (Besant 1893, pp. 33–38).

One well-known student of mathematics who attended Cambridge in the 1890s, and thus who likely made use of Todhunter's textbooks, was the philosopher and logician Bertrand Russell (Crilly 1999, p. 131). Russell studied mathematics at Cambridge from 1890 to 1893. Like Fields, Russell also found his mathematical education lacking, and he later reflected that his mathematical studentship involved practices and materials that were outmoded and out of date. He reflected in his memoir, *My Philosophical Development*, that as a Cambridge undergraduate he had never studied nor heard of most contemporary German or French mathematicians, including Karl Weierstrass, Richard Dedekind, Georg Cantor, Gottlob Frege, or Giuseppe Peano (Russell 1959, p. 39). He wrote that "the 'proofs' that were offered of mathematical theorems [at Cambridge] were an insult to the logical intelligence" and "my teachers offered me proofs which I felt to be fallacious and which, as I learned later, had been recognized as fallacious" (Russell 1956, p. 20; Russell 1959, pp. 37–38).

4 Publishing and the History of Mathematics

Fields and Russell went on to become scholars who made original contributions to mathematics. Yet both men were critical of their mathematical educations. In light of their comments about their mathematical education in Canada and England, we might ask, why did these contexts present mathematics as a tool, but not introduce it as a craft? Why had the creative aspect of mathematics been deadened in these educational contexts?

Several historians have offered perspective on this question. In her 1988 book *Mathematical Visions*, Joan Richards presents the explanation that mathematics was not developed creatively within nineteenth-century English culture because the English viewed mathematics as a tool in which to discipline the mind, rather than as a subject capable of development. Richards argues that the English viewed mathematics as an empirically flawless body of knowledge and did not, in general, regard mathematics, in particular geometry, as capable of growth, failure, or change. As such, mathematics held special cultural value in English culture and society, for its ability to provide an exemplar, or norm, for truth (Richards 1980, pp. 346, 363). Richards argues that this image of mathematics was expressed in England's educational structures, and shaped the teaching of mathematics at the University of Cambridge (Richards 1988, chapter five).

Andrew Warwick's book, *Masters of Theory*, goes some way towards explaining the state of late nineteenth-century English mathematical culture by way of training and pedagogy, contending that Cambridge University's culture of mathematics at that time was largely focused on examinations in which one performed mixed or applied mathematics using synthetic methods (Warwick 2003, p. 434). The emphasis on utility in mathematics and its applications, Warrick suggests, may have deadened sensitivity to questions internal to the subject, or interest in new methods and theories being developed simultaneously in continental Europe (Warwick 2003, pp. 505–506).

In their paper about the history of mathematics in Canada prior to 1945, Tom Archibald and Louis Charbonneau claim that in order to develop a mathematical culture, three key aspects of a society must play a role. Firstly, a population or governing regime must place value on the acquisition of mathematical skill. Secondly, an educational infrastructure, including teachers, teaching materials, the curriculum, and its objectives, is critical in shaping and developing a local practice of mathematics. Thirdly, they note, people who are interested in mathematics rely on the activities of the book trade: publishers and printers make available basic mathematical knowledge (Archibald and Charbonneau 1995, p. 1).

Richard's work, mentioned above, has commented on the first of these requirements for a mathematical culture. She has described how the cultural value imbued in mathematics affected its practice in Victorian England. The second aspect—that of educational structures and teaching—has been examined by Warwick, while Karen Hungar Parshall and Tony Crilly have explored Arthur Cayley and James Joseph Sylvester as mentors and teachers at Cambridge who did not develop close

mentoring relationships with students (Crilly 1999, pp. 146, 151–152; Parshall 2006). According to Archibald and Charbonneau's criteria, the as-yet unexamined factor influencing the culture and practice of mathematics in Victorian England is the book trade.

How might this last element, the book trade element of Archibald and Charbonneau's criteria for mathematical culture, relate to the practice of mathematics in the nineteenth-century Anglophone context? In the case of Fields in Canada and Russell at Cambridge, British book publishers helped perpetuate a stale and dated image of mathematics through the pedagogical materials they produced. In the 1860s and 1870s, British publishers increasingly applied steam power and new industrialized methods of binding and printing to book production (Twyman 1998, p. 70). The application of these new technologies combined with the lessening of paper tax and the cost of raw materials helped bring about a revolution in the numbers of produced and distributed books (Eliot 1994, p. 107). These conditions increased the circulation of mathematical books as well, now that this genre, traditionally difficult and costly to produce, could be reproduced more effectively, cheaply, and numerously than ever before (Rider 1993, pp. 111–113). In turn, publishers who employed these techniques were part of an expanding colonial economy, which spread these numerous and relatively cheap textbooks into educational contexts inside and outside Britain (Feather 2006, pp. 115–116). As a result, the stale approach to mathematics contained in these books, many of which originated within the Cambridge context, helped perpetuate this image of the subject in Britain at large and in British colonial places where foreign trade took place. Macmillan Company is one example of a British publisher whose textbooks played this role within the development of nineteenth-century mathematics.

5 Macmillan and Company as a Mathematical Publisher

From 1843 to 1850, through leverage and hard work, the Macmillan brothers Daniel and Alexander came to run the bookshop at number one Trinity Street, Cambridge. This was one of the most prominent bookselling locations in Cambridge, located across from the university's Senate House and beside the University Church of St. Mary's, and within sight of the gates of Kings College. In the climate of teaching and learning at Cambridge in the 1840s and 1850s, many professors had little reason to be in direct contact with their students (Crilly 1999, pp. 151–152; Barrow-Green and Gray 2006, p. 328). The Macmillan's bookshop, however, served as a common ground, a place where both professors and students frequented (Morgan 1943, p. 30). The brothers' lodging above the shop became a sort of little college in itself, where Cambridge men stopped in for "a pipe and a chat", to discuss books, God and social reform, before attending the Sunday sermon (Morgan 1943, p. 34).

During their Cambridge bookselling days, the brothers Daniel and Alexander Macmillan began investing heavily in the publication of mathematics, reflecting the central role this subject held within the Cambridge University curriculum

(see Foster 1891, pp. 2–14, listing Macmillan's publications for the years 1845–1850). Initially they bought copyrights to produce and sell established mathematical textbooks, including the twelfth edition to Thomas Lund's *A Companion to Wood's Algebra* (1848), the second edition of J. C. Snowball's *The Elements of Mechanics* (1846), the fifth edition of Snowball and Lund's *Cambridge Course of Elementary Natural Philosophy* (1845), and the third edition to J. Hymers *A Treatise on Plane and Spherical Trigonometry* (1847). Buying these copyrights was expensive for Macmillan. For example, Thomas Lund commanded approximately 80 % of the profit on his 1851 book, *A Short and Easy Course of Algebra*, and 84 % of the profit for his twelfth edition of Wood's *Algebra*.[2] Soon the Macmillans began developing new relationships that produced textbook material that was more cheaply acquired. With Snowball, and eventually with Isaac Todhunter, the Macmillans negotiated to split profits equally between author and publisher (commonly known as the "half-profits" agreement, during the period).[3]

The most important influence shaping Macmillan's mathematical publications in the 1840s and 1850s was Isaac Todhunter, a student at Cambridge from 1844 to 1848, and a person the brothers met through the bookshop and its associated social gatherings (Morgan 1943, pp. 30, 37). Over 30 years Todhunter published over forty mathematical books with Macmillan, ranging from school and college texts to specialized monographs in mathematics and the history of mathematics (see Appendix 1). Correspondence and business records from the company suggest that Todhunter provided advice to the Macmillans about their publishing projects in education and mathematics, by reviewing manuscripts, looking over proofs, recommending new authors, and suggesting the format and presentation of educational works (Nickerson 2012, p. 37). Todhunter connected new authors, such as George Boole and Barnard Smith, with the Macmillan family. Books written by these authors displaced the stock-and-trade textbooks that the two brothers had first published when they began investing in mathematical books.

In 1858 Alexander Macmillan opened an office for their business in London. This brought the Macmillan Company into contact with new spheres of intellectuals. Alexander Macmillan, the surviving brother, began hosting soirees in which artists, writers, historians, theologians, and men of science gathered and discussed, quote, "Darwin and conundrums with general jollity pleasantly intermixed" (Morgan 1943, p. 52). These gatherings, at the Macmillan London office, were informally known as the Tobacco Parliaments. Just as their Cambridge bookshop and its associated social gatherings had facilitated the development of mathematical authors for the company, social evenings in London began to shift Macmillan's focus from mathematical textbooks to developing more broadly as publishers of books on science (Foster 1891, pp. 63–201, listing Macmillan's publications for 1860–1870). During the

[2]Printed catalogue from June 1, 1864, BL Ad. MS 54791, Publications Catalogues with Manuscript Additions, Macmillan Archive, British Library, London, UK.

[3]Printed Catalogue from June 21, 1851, BL Ad. MS 54790, Publications Catalogues with Manuscript Additions, Macmillan Archive, British Library, London, UK.

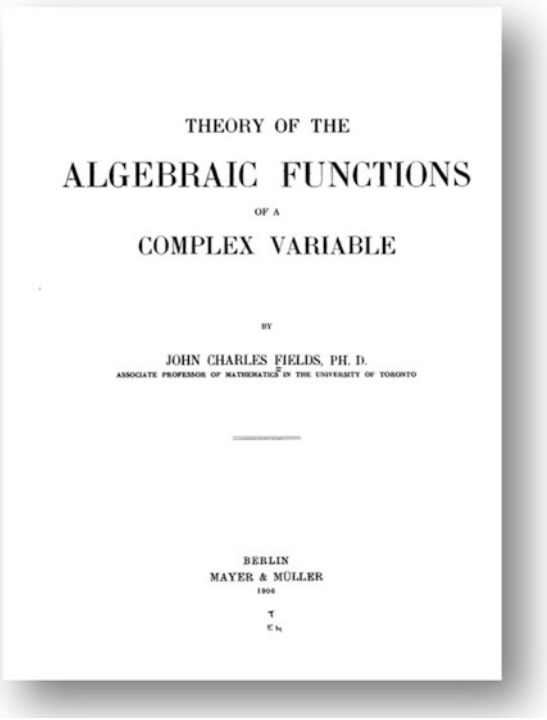
period from 1860 to 1875, as the business became ever more successful, Macmillan continued to reproduce editions of their mathematical textbooks in ever greater quantities, alongside their development of new books series in science and science education (see Appendix 2).

Mathematical textbooks, especially on the scale in which Macmillan produced them, had greater reach than most other printed sources in mathematics, and formed first impressions upon many students. The values expressed by these textbooks and the image of mathematics presented by them were closely tied to the cultural values about mathematics that were embodied at Cambridge University in the nineteenth century. Mathematical materials embodying the approach to mathematics embedded in the Cambridge University curriculum proceeded to publication in textbook form at Macmillan. This image of mathematics was then exported around the world, forming the first impression of mathematics on many students who used these books as course texts.

6 Book Trade Influence: Research Monographs Versus Textbooks

After J. C. Fields completed his Hamilton high school education and study in mathematics at the University of Toronto, he had the benefit, somewhat unusual at that time, of obtaining further education. He completed his PhD at Johns Hopkins followed by several more years of post-doctoral study in Europe. His exposure to mathematics continued in these contexts. At Johns Hopkins, he was introduced to books on differential equations by Charles Auguste Briot, Jean Claude Bouquet, Gaston Floquet, and Lazarus Fuchs, treatises on the theory of functions by Charles Hermite, Broit, Bouquet and Fuchs, and sources on elliptic and Abelian functions by Cayley, Alfred Clebsch and Paul Gordan (Barnes 2007, pp. 9–11). Fields kept detailed notebooks that recorded the lectures he attended during his postdoctoral study in France and Germany. These record lectures Fields' attended by Georg Frobenius, Fuchs, Kurt Hensel, Hermann A. Schwarz, Georg Hettner, Johannes Knoblauch, Ernst Steinitz, and Max Plank. These notes contain topics in number theory, analytic geometry, synthetic projective geometry, algebraic equations, hyperelliptic functions, differential equations, Abelian integrals, theory of functions of a complex variable, Fourier series, Cantor's theory of transfinite cardinals, and theoretical physics (see Barnes 2007, pp. 13–18).

Fields returned to Canada in the spring of 1900 at the age of 37. After many years of his mathematical education and various perambulations around the world, Fields mathematical ambitions culminated in his single-author monograph, *Theory of the Algebraic Functions of a Complex Variable*, published in 1906 by Mayer and Müller and Acta Mathematica. Faced with a dearth of printers capable of handling his special monograph, Fields's acquaintance Gösta Mittag-Leffler in Sweden offered to assist in making arrangements for the publication (Riehm and Hoffman 2011, p. 62) (Fig. 5).


THEORY OF THE

ALGEBRAIC FUNCTIONS

OF A

COMPLEX VARIABLE

BY

JOHN CHARLES FIELDS, PH. D.

ASSOCIATE PROFESSOR OF MATHEMATICS IN THE UNIVERSITY OF TORONTO

BERLIN

MAYER & MÜLLER

1906

Fig. 5 Frontispiece to J. C. Fields, Theory of the Algebraic Functions of a Complex Variable, Berlin: Mayer & Müller, 1906

What relationship Fields' 1906 book may have had to mathematical research in its own day is still largely undetermined. Until recently, Fields' life and work had remained relatively unexplored. Historians who have offered an opinion seem to agree that Fields' *Algebraic Functions* is difficult to understand from a contemporary point of view.[4] It develops its own theory of algebraic curves, without reference to the dominant methods employed in Fields' own time (Barnes 2007, p. 3). The work presented is therefore alien to the modern reader, and, as such, difficult to enter into and evaluate. Apart from the undetermined status of its intellectual content, however, it can be seen to have significant symbolic content. It was one of the most sophisticated and ambitious contributions to research mathematics made by someone who grew up and made his career in a country that was, in 1906, still a remote place in which to be create pure mathematics.

Fields received notoriety for this symbolic achievement. In the popular press, the Toronto *Globe* noted the book's publication, giving its title and a brief description, however admitting that the book "convey[ed] little to the lay mind" (Riehm and Hoffman 2011, p. 63). A notice in the New York *Nation* commented

[4]This was Craig Fraser's interpretation in his talk, "J. C. Fields and the Utility of Mathematics" at Mills Library, McMaster University, Hamilton, Ontario, 24 November 2014, 1:30–2:30 p.m.

"From the eminence here attained one is permitted to behold readily a variety of classic propositions that have hitherto been found only by difficult and circuitous paths . . . " (Riehm and Hoffman 2011, p. 63). A professional review of the book by J. I. Hutchison appeared in the *Bulletin of the American Mathematical Society*, describing the work as "not intended as a treatise or a textbook on the theory of algebraic functions along any of the well-established lines of treatment. It is, on the contrary, a new and distinctive mode of approach to this class of functions" (quoted in Riehm and Hoffman 2011, p. 64).

While Fields' book had been a significant intellectual accomplishment, apart from notoriety for having published it, Fields' book seems to have left little intellectual impact on the development of mathematics in Canada or abroad. Marcus Barnes, in his 2007 MA thesis about Fields life and mathematics, described the reception of Fields monograph as lukewarm (Barnes 2007, p. 70). Riehm and Hoffman also point out in their biography of Fields that his influence as a mathematician was somewhat limited in that he, like Sylvester and Cayley, attracted few protégés.

By contrast, consider the influence that Macmillan as a book publisher, may have had on the English culture of mathematics. Macmillan's success as a publisher enabled the small and local context of Cambridge, out of which they developed their mathematical materials, to become amplified and exported, through the mass production of books, to foreign places around the world. Macmillan textbooks did a lot of work in the contexts in which they were used as pedagogical materials. Macmillan books brought to places like Canada the identities of the authors, the ideas, and the values about mathematics expressed by these publications. In Britain, the Macmillan publishing company had been a node around which a community of intellectuals and culture makers organized. During each decade in which the Macmillan brothers developed their publications list, the values of the social context of Cambridge, and its mathematical education system, in which the Macmillans and their closest advisors resided, became manifest in the physical object of the books they produced. Through the success and mass production of these books, the Macmillans amplified the influence of Cambridge University and its mathematical community outward into many far-flung places around the world.

Note on Macmillan and Company Sources

Records for Macmillan and Company are held in several collections. There are documents from Macmillan held at several locations in the UK: at the Palgrave–Macmillan head offices in Basingstoke, in the Special Collections department at Reading University, and in the Department of Manuscripts at the British Library. This paper makes use of the last of these collections. The Macmillan Archive (British Library Add MS 54786–56035) comprises nineteenth- and twentieth-century correspondence and business records from the publishing firm.

Included in Macmillan's many extensive records of their publishing activity are a series of production ledgers, the Editions Books, which list the number of books ordered, date of publication, name of printer, type and date of paper ordered, etc.,

for each published title. The first Editions Book covering Macmillan's publications to the year 1892 is held at the Palgrave–Macmillan head office in Basingstoke. Subsequent volumes are found in the British Library. For convenience sake, the British Library holds a CD-ROM copy of the first Editions Book as a complement to their Macmillan collections, and it was the British Library's CD-ROM copy consulted by this author. The tables in Appendices 1 and 2 were compiled from this source. However it should be noted that this source is not officially a part of the British Library's manuscript collections, and so the CD-ROM is not listed in their catalogue or in the records of manuscripts. By bringing attention to this I hope to alleviate any confusion for the reader wishing to locate the source.

Acknowledgements The author would like to thank Craig Fraser, June Barrow-Green, and Nicholas Griffin for their helpful comments on past iterations of the present work. Research conducted for this article was undertaken while funded by a Michael Smith Foreign Study Supplement and a Canada Graduate Scholarship (SSHRC). Errors are the author's own.

A.1 Appendix 1: Isaac Todhunter's Publications with Macmillan, 1843–1889

Year of first appearance	Title	Price[a]	Total copies printed[b]
1852	A Treatise on the Differential Calculus and the Elements of the Integral Calculus	10s. 6d.	24, 250
1853	A Treatise on Analytical Statics	10s. 6d.	9000
1855	A Treatise on Plane Co-ordinate Geometry	10s. 6d.	27, 700
1857	A Treatise on the Integral Calculus and its Applications	10s. 6d.	17, 500
1858	Algebra for the use of Colleges and Schools	7s. 6d.	138, 500
1858	Answer to Mr. Lund's Attack on Mr. Todhunter	Not known	2000
1858	Examples of Analytical Geometry of Three Dimensions	4s.	4000
1859	Plane Trigonometry	5s.	86, 500
1859	Spherical Trigonometry for the use of Colleges and Schools	4s. 6d.	32, 530
1861	A History of the Progress of the Calculus of Variations During the Nineteenth Century	12s.	500
1861	An Elementary Treatise on the Theory of Equations	7s. 6d.	13, 500
1862	The Elements of Euclid	3s. 6d.	525, 000
1863	Algebra for Beginners	2s. 6d.	693, 000
1865	A History of the Mathematical Theory of Probability from the Time of Pascal to That of Laplace	18s.	1000

Year of first appearance	Title	Price[a]	Total copies printed[b]
1866	Trigonometry for Beginners	2s. 6d.	108, 500
1867	Mechanics for Beginners	4s. 6d.	56, 000
1868	Key to Algebra for Beginners	6s. 6d.	21, 000
1869	Mensuration for Beginners	2s. 6d.	215, 000
1870	Key to Algebra for the use of Colleges and Schools	10s. 6d.	14, 000
1871	Researches in the Calculus of Variations	6s.	500
1873	The Conflict of Studies	10s. 6d.	1000
1873	A History of the Mathematical Theories of Attraction and the Figure of the Earth	24s.	500
1873	Key to Trigonometry for Beginners	8s. 6d.	6000
1874	Key to Plane Trigonometry	10s. 6d.	7000
1875	An Elementary Treatise on Laplace's Functions, Lamé's Functions, and Bessel's Functions	10s. 6d.	1000
1876	An Abridged Mensuration with Numerous Examples for Indian Students	1s.	5000
1876	Macmillan's Series of Text-Books for Indian Schools: Algebra for Indian Students	2s. 6d.	10, 000
1876	Macmillan's Series of Text-Books for Indian Schools: The Elements of Euclid for the use of Indian Students	2s.	27, 000
1876	Macmillan's Series of Text-Books for Indian Schools: Mensuration and Surveying for Beginners	2s.	42, 000
1877	Natural Philosophy for Beginners, Part I	3s. 6d.	11, 000
1877	Natural Philosophy for Beginners, Part II	3s. 6d.	6000
1878	Key to Mechanics for Beginners	6s. 6d.	4000
1880	Key to Exercises in Euclid	6s. 6d.	9500
1886	Key to Todhunter's Mensuration for Beginners (by L. McCarthy)	7s. 6d.	2750
1887	Solutions to Problems Contained in Plane Coordinate Geometry (ed. C. W. Bourne)	10s. 6d.	1000
1888	Key to Todhunter's Differential Calculus (by H. St. J. Hunter)	10s. 6d.	2750
1889	Key to Todhunter's Integral Calculus (by H. St. J. Hunter)	10s. 6d.	2250

Isaac Todhunter's publications with Macmillan 1843–1889 (Source: Macmillan's First Editions Book, British Library)

Calculations of lifetime print-run given in this chart were calculated from Macmillan's first editions book only

[a]Price, given in shillings (s.) and pence (d.) refers to either the most stable price or the price on first printing.

[b]Some titles may have been reprinted beyond the last year given here

A.2 Appendix 2: Macmillan's Mathematical Books with Print Runs Greater Than 100,000, 1843–1889

Total copies printed	Year of first printing	Last year printed[a]	Author	Title	Price[b]
693,000	1863	1917	I. Todhunter	Algebra for Beginners	2s. 6d.
608,000	1885	1937	H.S. Hall and S.R. Knight	Elementary Algebra	3s. 6d.
597,500	1854	1920	B. Smith	School Arithmetic	4s. 6d.
525,000	1862	1903	I. Todhunter	Euclid	3s. 6d.
430,000	1865	1906	B. Smith	Shilling Book of Arithmetic, Part I	1s.
362,000	1872	1925	B. Stewart	Science Primers: Physics	1s.
295,000	1889	1931	H.S. Hall and S.R. Knight	A Textbook of Euclid's Elements, Parts I & II, Books I–IV	3s.
270,000	1887	1930	H.S. Hall and S.R. Knight	A Textbook of Euclid's Elements, Part I, Book I & II	2s.
253,000	1888	1932	H.S. Hall and S.R. Knight	A Textbook of Euclid's Elements, Book I–IV & XI	4s. 6d.
215,000	1869	1931	I. Todhunter	Mensuration for Beginners with Numerous Examples	2s. 6d.
211,000	1879	1929	J. Thornton	First Lessons in Bookkeeping	2d. 6d.
210,500	1889	1922	H.S. Hall and F.H. Stevens	A Textbook of Euclid's Elements for the Use of Schools, Book I	1s.
206,500	1886	1929	J.B. Lock	Arithmetic for Schools	4s. 6d.
176,100	1887	1938	H.S. Hall and S.R. Knight	Higher Algebra	7s. 6d.
173,240	1881	1929	S.P. Thompson	Elementary Lessons in Electricity and Magnetism	4s. 6d.
167,000	1874	1920	J.N. Lockyer	Science Primers: Astronomy	1s.
153,500	1866	1928	B. Smith	Shilling Book of Arithmetic with Answers	1s. 6d.
138,500	1858	1911	I. Todhunter	Algebra for Colleges and Schools	7s. 6d.
138,380	1887	1936	J.T. Bottomley	Four Figure Mathematical Tables	2s. 6d.
133,500	1870	1934	W.S. Jevons	Elementary Lessons on Logic	3s. 6d.

Total copies printed	Year of first printing	Last year printed[a]	Author	Title	Price[b]
121,000	1886	1932	C. Smith	Elementary Algebra	4s. 6d.
108,500	1866	1921	I. Todhunter	Trigonometry for Beginners	2s. 6d.
104,500	1866	1901	B. Smith	Key to Shilling Book of Arithmetic	6d.
104,000	1882	1937	J.B. Lock	Treatise on Elementary Trigonometry	4s. 6d.
102,500	1870	1911	B. Stewart	Lessons in Elementary Physics	4s. 6d.
102,000	1872	1910	J. Brook-Smith	Arithmetic in Theory and Practice	3s. 6d.

Macmillan's mathematical books with print runs greater than 100,000, 1843–1889 (Source: Macmillan's First Editions Book, British Library)
Calculations of lifetime print-run given in this chart were calculated from Macmillan's first editions book only
[a]Some titles were reprinted beyond the last year given here
[b]Price, given in shillings (s.) and pence (d.) refers to either the most stable price or the price on first printing.

References

Archibald, T., & Charbonneau, L. (1995). Mathematics in Canada before 1945: A preliminary survey. In *Canadian Mathematical Society/Société Mathématique du Canada 1945–1995, Vol. 1, Mathematics in Canada/Les Mathématiques au Canada* (pp. 1–43). Ottawa, ON, Canada: Canadian Mathematical Society.

Barnes, M. (2007). *John Charles fields: A sketch of his life and mathematical work*. Masters of Science Thesis, Department of Mathematics, Simon Fraser University, Burnaby, British Columbia, Canada.

Barrow-Green, J. E. (2001). 'The advantage of proceeding from an author of some scientific reputation': Isaac Todhunter and his mathematical textbooks. In J. Smith & C. Stray (Eds.), *Teaching and learning in nineteenth-century Cambridge* (pp. 177–203).

Barrow-Green, J. E., & Gray, J. (2006). Geometry at Cambridge, 1863–1940. *Historia Mathematica, 33*, 315–356.

Besant, W. H. (1893). The mathematical tripos. In *The Student's guide to the University of Cambridge* (5th ed., pp. 1–38). Cambridge, UK: Deighton, Bell and Co./London: George Bell and Sons. Rochester, NY: Boydell Press.

Crilly, T. (1999). Arthur Cayley as Sadleirian Professor: A glimpse of mathematics teaching at 19th-century Cambridge. *Historia Mathematica, 26*, 125–160.

Eliot, S. (1994). Some patterns and trends in British Publishing, 1800–1900. Occasional Papers number 8. London: The Bibliographical Society.

Eliot, S. (2002). 'To You in Your Vast Business': Some features of the quantitative history of Macmillan 1843–91. In E. James (Ed.), *Macmillan: A publishing tradition* (pp. 11–51). Basingstoke, UK: Palgrave.

Feather, J. (2006). *A history of British publishing* (2nd ed.). New York: Routledge.

Fields, J. (1906). *Theory of the algebraic functions of a complex variable*. Berlin, Germany: Mayer & Müller.

Foster, J. (1891). *A bibliographical catalogue of Macmillan and Co'.s publications from 1843 to 1889*. London: Macmillan and Co.

Morgan, C. (1943). *The house of Macmillan (1843–1943)*. London: Macmillan & Co.

Nickerson, S. (2012). Referees, publisher's readers and the image of mathematics in nineteenth century England. *Publishing History, 71*, 27–67.

Parshall, K. (2006). *James Joseph Sylvester: Jewish mathematician in a Victorian world*. Baltimore: Johns Hopkins University Press.

Parvin, V. (1965). *Authorization of textbooks for the schools of Ontario: 1846–1950*. Toronto, ON, Canada: Canadian Textbooks Publishers' Institute/University of Toronto Press.

Richards, J. (1980). The art and the science of British algebra: A study in the perception of mathematical truth. *Historia Mathematica, 7*, 343–365.

Richards, J. (1988). *Mathematical visions: The pursuit of geometry in Victorian England*. San Diego, CA: Academic Press Inc.

Rider, R. (1993). Early modern mathematics in print. In R. Mazzolini (Ed.), *Non-verbal communications in science prior to 1900* (Vol. 11, Biblioteca di Nuncius studi e testi, pp. 91–113). Firenze, Italy: Instituto e museo di storia della scienza.

Riehm, E., & Hoffman, F. (2011). *Turbulent times in mathematics: The life of J. C. Fields and the history of the fields medal*. Providence, Rhode Island: American Mathematical Society/Toronto, ON, Canada: The Fields Institute.

Russell, B. (1956). *Portraits from memory and other essays*. London: Unwin Brothers Ltd.

Russell, B. (1959). *My philosophical development*. London: Unwin Brothers Ltd.

Simon, J. (2012). Secondary matters: Textbooks and the making of physics in nineteenth-century France and England. *History of Science, 50*(3), 339–374.

Smith, J. H. (1910). Historical sketch of the Central School, Hamilton, 1853–1903. In J. G. Hodgins (Ed.), *The establishment of schools and colleges in Ontario, 1792–1910* (Vol. 1, pp. 83–107). Toronto, ON, Canada: L. K. Cameron.

Topham, J. R. (2000). Scientific publishing and the reading of science in nineteenth-century Britain. *Studies in History and Philosophy of Science, 31*, 559–612.

Twyman, M. (1998). *The British library guide to printing: History and techniques.* London: The British Library/Toronto, ON, Canada: University of Toronto Press.

Warwick, A. (2003). *Masters of theory: Cambridge and the rise of mathematical physics*. Chicago: University of Chicago Press.