

Cambridge University Press

978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge

Walter William Rouse Ball

Frontmatter

[More information](#)

CAMBRIDGE LIBRARY COLLECTION

Books of enduring scholarly value

Cambridge

The city of Cambridge received its royal charter in 1201, having already been home to Britons, Romans and Anglo-Saxons for many centuries. Cambridge University was founded soon afterwards and celebrates its octocentenary in 2009. This series explores the history and influence of Cambridge as a centre of science, learning, and discovery, its contributions to national and global politics and culture, and its inevitable controversies and scandals.

A History of the Study of Mathematics at Cambridge

For centuries, Cambridge University has attracted some of the world's greatest mathematicians. This 1889 book gives a compelling account of how mathematics developed at Cambridge from the middle ages to the late nineteenth century, from the viewpoint of a leading scholar based at Trinity College who was closely involved in teaching the subject. The achievements of notable individuals including Newton and his school are set in the context of the history of the university, its sometimes uneasy relationship with the town community, the college system, and the origin and growth of the mathematical tripos.

Cambridge University Press

978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge

Walter William Rouse Ball

Frontmatter

[More information](#)

Cambridge University Press has long been a pioneer in the reissuing of out-of-print titles from its own backlist, producing digital reprints of books that are still sought after by scholars and students but could not be reprinted economically using traditional technology. The Cambridge Library Collection extends this activity to a wider range of books which are still of importance to researchers and professionals, either for the source material they contain, or as landmarks in the history of their academic discipline.

Drawing from the world-renowned collections in the Cambridge University Library, and guided by the advice of experts in each subject area, Cambridge University Press is using state-of-the-art scanning machines in its own Printing House to capture the content of each book selected for inclusion. The files are processed to give a consistently clear, crisp image, and the books finished to the high quality standard for which the Press is recognised around the world. The latest print-on-demand technology ensures that the books will remain available indefinitely, and that orders for single or multiple copies can quickly be supplied.

The Cambridge Library Collection will bring back to life books of enduring scholarly value across a wide range of disciplines in the humanities and social sciences and in science and technology.

Cambridge University Press

978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge

Walter William Rouse Ball

Frontmatter

[More information](#)

A History of the Study of Mathematics at Cambridge

WALTER WILLIAM ROUSE BALL



CAMBRIDGE
UNIVERSITY PRESS

Cambridge University Press
978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge
Walter William Rouse Ball
Frontmatter
[More information](#)

CAMBRIDGE UNIVERSITY PRESS

Cambridge New York Melbourne Madrid Cape Town Singapore São Paulo Delhi

Published in the United States of America by Cambridge University Press, New York

www.cambridge.org

Information on this title: www.cambridge.org/9781108002073

© in this compilation Cambridge University Press 2009

This edition first published 1889

This digitally printed version 2009

ISBN 978-1-108-00207-3

This book reproduces the text of the original edition. The content and language reflect the beliefs, practices and terminology of their time, and have not been updated.

Cambridge University Press

978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge

Walter William Rouse Ball

Frontmatter

[More information](#)

A HISTORY

OF THE STUDY OF

MATHEMATICS AT CAMBRIDGE.

Cambridge University Press

978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge

Walter William Rouse Ball

Frontmatter

[More information](#)

London: C. J. CLAY AND SONS,
CAMBRIDGE UNIVERSITY PRESS WAREHOUSE,
AVE MARIA LANE.



Cambridge: DEIGHTON, BELL, AND CO.
Leipzig: F. A. BROCKHAUS.

Cambridge University Press

978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge

Walter William Rouse Ball

Frontmatter

[More information](#)

A HISTORY

OF THE STUDY OF

MATHEMATICS AT CAMBRIDGE

BY

W. W. ROUSE BALL,

FELLOW AND LECTURER OF TRINITY COLLEGE, CAMBRIDGE;
AUTHOR OF A HISTORY OF MATHEMATICS.

Cambridge :
AT THE UNIVERSITY PRESS.

1889

[All Rights reserved.]

Cambridge University Press

978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge

Walter William Rouse Ball

Frontmatter

[More information](#)

Cambridge :

PRINTED BY C. J. CLAY, M.A. AND SONS,

AT THE UNIVERSITY PRESS.

Cambridge University Press

978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge

Walter William Rouse Ball

Frontmatter

[More information](#)

PREFACE.

THE following pages contain an account of the development of the study of mathematics in the university of Cambridge, and the means by which proficiency in that study was at various times tested. The general arrangement is as follows.

The first seven chapters are devoted to an enumeration of the more eminent Cambridge mathematicians, arranged chronologically. I have in general contented myself with mentioning the subject-matter of their more important works, and indicating the methods of exposition which they adopted, but I have not attempted to give a detailed analysis of their writings. These chapters necessarily partake somewhat of the nature of an index. A few remarks on the general characteristics of each period are given in the introductory paragraphs of the chapter devoted to it; and possibly for many readers this will supply all the information that is wanted.

The following chapters deal with the manner in which at different times mathematics was taught, and the means by which proficiency in the study was tested. The table of contents will shew how they are arranged. Some knowledge of the constitution, organization and

Cambridge University Press

978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge

Walter William Rouse Ball

Frontmatter

[More information](#)

general history of the university is, in my opinion, essential to any who would understand the way in which mathematics was introduced into the university curriculum, and its relation to other departments of study. I have therefore added in chapter XI. (as a sort of appendix) a very brief sketch of the general history of the university for any of my readers who may not be acquainted with the larger works which deal with that subject. I hope that the addition of that chapter and of the similar chapter dealing with the organization of studies in the mediæval university will sufficiently justify me in the use in the earlier chapters of various technical words, such as regents, caput, tripos, prævaricator, &c.

I have tried to give references in the footnotes to the authorities on which I have mainly relied. In the few cases where no reference is inserted, I have had to compile my account from various sources. Of the numerous dictionaries of biography which I have consulted the only ones which have proved of much use are the *Biographica Britannica*, six volumes, London, 1747—66 (second edition, enlarged, letters *A* to *Fas* only, five volumes, 1778—93); the *Penny Cyclopaedia*, twenty-seven volumes, London, 1833—43; J. C. Poggendorff's *Biographisch-Literarisches Handwörterbuch zur Geschichte der exacten Wissenschaften*, two volumes, Leipzig, 1863; and the new *Dictionary of national biography*, which at present only contains references to those whose names commence with one of the early letters of the alphabet. To these four works I have been constantly indebted: I have found them almost always reliable, and very useful,

Cambridge University Press

978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge

Walter William Rouse Ball

Frontmatter

[More information](#)

PREFACE.

vii

not only where no other accounts were available, but also for the verification of such biographical notes as I had given, and often for the addition of other details to them.

No one who has not been engaged in such a work can imagine how difficult it is to settle many a small point, or how persistently mistakes if once printed are reproduced in every subsequent account. In spite of the care I have taken I have no doubt that there are some omissions and errors in the following pages; and I shall thankfully accept notices of additions or corrections which may occur to any of my readers.

W. W. ROUSE BALL.

TRINITY COLLEGE, CAMBRIDGE.

May, 1889.

Cambridge University Press

978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge

Walter William Rouse Ball

Frontmatter

[More information](#)

TABLE OF CONTENTS.

Chapter I. Mediæval mathematics.

	PAGE
The curriculum in arts of a mediæval university.	2
The extent of mathematics read during the twelfth century.	2
The extent of mathematics read during the thirteenth century.	3
The introduction of Arab science into Europe.	4
The extent of mathematics read during the fourteenth century.	6
Cambridge mathematicians of the fifteenth century.	9
Cambridge mathematicians of the sixteenth century.	10
Cuthbert Tonstall, 1474—1559.	10

Chapter II. The mathematics of the renaissance.

The renaissance in mathematics.	12
The study of mathematics under the Edwardian statutes of 1549.	13
The study of mathematics under the Elizabethan statutes of 1570.	13
Robert Recorde, 1510—1558.	15
The <i>Grounde of artes</i> , (on arithmetic) published in 1540.	15
The <i>Whetstone of witte</i> , (on algebra) published in 1556.	17
His astronomy and other works.	18
John Dee, 1527—1608.	19
Thomas Digges, 1546—1595.	21
The earliest English spherical trigonometry.	21
Thomas Blundeville, died in 1595.	21
The earliest English plane trigonometry (1594).	22
William Buckley, died in 1569.	22
Sir Henry Billingsley, died in 1606.	22
The first English translation of Euclid (1570).	22
Thomas Hill. Thomas Bedwell. Thomas Hood.	23

Cambridge University Press

978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge

Walter William Rouse Ball

Frontmatter

[More information](#)

x

TABLE OF CONTENTS.

	PAGE
Richard Harvey. John Harvey. Simon Forman.	24
Edward Wright, died in 1616.	25
The earliest treatment of navigation as a science.	26
Henry Briggs, 1556—1630.	27
His tables of logarithms.	28
Introduction of the decimal notation.	28
His election to the 'Savilian chair of geometry at Oxford.	30
William Oughtred, 1574—1660.	30
The <i>Clavis</i> , and his other works.	30

Chapter III. The commencement of modern mathematics.

Characteristics of modern mathematics.	33
Change in the character of the scholastic exercises.	35
Jeremiah Horrox, 1619—1641.	35
Catalogue of his library.	36
Seth Ward, 1617—1689.	36
Samuel Foster. Lawrence Rooke.	38
Nicholas Culpepper. Gilbert Clerke.	39
John Pell, 1610—1685.	40
John Wallis, 1616—1703.	41
His account of the study of mathematics at Cambridge, 1636.	41
The <i>Arithmetica infinitorum</i>	42
His <i>Conic sections</i> , <i>Algebra</i> , and minor works.	44
Isaac Barrow, 1630—1677.	46
His account of the study of mathematics at Cambridge, 1654.	46
Election to the Lucasian chair (founded in 1662).	47
His <i>Lectiones opticae et geometricae</i>	47
Arthur Dacres. Andrew Tooke. Sir Samuel Morland.	49

Chapter IV. The life and works of Newton.

Newton's education at school and college.	52
Discovery in 1665 of fluxions and the theory of gravitation.	52
Investigations on expansion in series, algebra, and optics, 1668—70.	53
His optical discoveries and lectures, 1669—72.	53
His theory of physical optics, 1675.	54
The letter to Leibnitz on expansion in series, 1676.	56
The <i>Universal arithmetic</i> ; the substance of his lectures for 1676—84.	58
New results in the theory of equations.	58

Cambridge University Press

978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge

Walter William Rouse Ball

Frontmatter

[More information](#)

TABLE OF CONTENTS.

xi

	PAGE
The theory of gravitation, 1684. The <i>De motu</i>	59
The <i>Principia</i> published in 1687.	60
Subject-matter of the first book.	60
Subject-matter of the second book.	61
Subject-matter of the third book.	61
His election to parliament, 1689.	62
The letters to Wallis on the method of fluxions, 1692.	62
His illness in 1692–94.	62
His table of corrections for refraction, 1694.	63
His appointment at the Mint, 1695, and removal to London.	63
His <i>Optics</i> published in 1704.	63
The appendix on cubic curves.	64
The appendix on the quadrature of curves, fluxions, &c.	65
The publication of his <i>Universal arithmetic</i> , and other works.	66
His death, 1727.	67
His appearance and character.	67
The explanation of his adoption of geometrical methods of proof.	69
His theory of fluxions.	70
The controversy with Leibnitz.	72

Chapter V. The rise of the Newtonian school.

The rise of the Newtonian school.	74
Richard Laughton, died in 1726.	75
Samuel Clarke, 1675–1729.	76
John Craig, died in 1731.	77
John Flamsteed, 1646–1719.	78
Richard Bentley, 1662–1742.	80
Introduction of examination by written papers.	81
William Whiston, 1667–1752.	83
Nicholas Saunderson, 1682–1739.	86
Thomas Byrdall. James Jurin.	87
The Newtonian school dominant in Oxford and London.	87
Brook Taylor, 1685–1731.	88
Roger Cotes, 1682–1716.	88
His election to the Plumian chair (founded in 1704).	89
The second edition of the <i>Principia</i>	89
The <i>Harmonia mensurarum</i> and <i>Opera miscellanea</i>	90
Foundation of the Sadlerian lectureships.	91
Robert Smith, 1689–1768.	91
List of text-books in common use about the year 1730.	92

Cambridge University Press

978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge

Walter William Rouse Ball

Frontmatter

[More information](#)

xii

TABLE OF CONTENTS.

	PAGE
The course of reading recommended by Waterland in 1706.	94
The course of reading recommended by Green in 1707.	95

Chapter VI. The later Newtonian school.

Characteristic features of the later Newtonian school.	97
Its isolation.	98
Its use of fluxions and geometry.	98
<i>The Lucasian professors.</i>	
John Colson, 1680—1760.	100
Edward Waring, 1736—1798.	101
Isaac Milner, 1751—1820.	102
<i>The Plumian professors.</i>	
Anthony Shepherd, 1722—1795.	103
Samuel Vince, 1754—1821.	103
Syllabus of his lectures.	104
<i>The Lowndean professors. (Foundation of Lowndean chair in 1749.)</i>	
Roger Long, 1680—1770.	105
John Smith. William Lax.	105
The lectures of F. J. H. Wollaston and W. Farish.	106
<i>Other mathematicians of this time.</i>	
John Rowning, Francis Wollaston. George Atwood.	107
Francis Maseres. Nevil Maskelyne.	108
Bewick Bridge. William Friend. John Brinckley.	109
Daniel Cresswell. Miles Bland. James Wood.	110
<i>List of text-books in common use about the year 1800.</i>	111
Sir Frederick Pollock on the course of study in 1806.	111
<i>Experimental physicists of this time.</i>	
Henry Cavendish, 1731—1810.	114
Thomas Young, 1773—1829.	115
William Hyde Wollaston, 1776—1828.	116

Chapter VII. The analytical school.

Robert Woodhouse, 1773—1827.	118
Character and influence of his works.	119
The Analytical Society: its objects.	120
Translation of Lacroix's <i>Differential calculus</i>	120
Introduction of analysis into the senate-house examination in 1817.	120
Rapid success of the analytical movement.	123
George Peacock, 1791—1858.	124

Cambridge University Press

978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge

Walter William Rouse Ball

Frontmatter

[More information](#)

TABLE OF CONTENTS.

xiii

	PAGE
Charles Babbage, 1792—1871.	125
Sir John Herschel, 1792—1871.	126
William Whewell, 1794—1866.	127
Foundation of the Cambridge Philosophical Society.	128
Text-books illustrative of analytical methods.	128
on analytical geometry.	129
on the calculus.	130
on mechanics.	130
on optics.	131
List of professors belonging to the analytical school.	132
Note on Augustus De Morgan.	132
Note on George Green.	134
Note on James Clerk Maxwell.	135

Chapter VIII. The organization and subjects of education.

Subject-matter of the chapter.	138
<i>The mediæval system of education.</i>	
Education at a hostel in the thirteenth and fourteenth centuries.	140
Students in grammar.	140
Students in arts.	142
Systems of lectures.	143
The exercises of a sophister and questionist.	145
The ceremony of inception to the title of bachelor.	146
The determinations in quadragesima.	147
The exercises of a bachelor.	148
The ceremony of creation of a master.	149
The doctorate.	151
Philosophy the dominant study: evil effects of this.	152
<i>The period of transition, 1535—1570.</i>	
The Edwardian statutes of 1549.	153
Establishment of professorships.	154
The colleges opened to pensioners.	154
Rapid development of the college system.	155
<i>The system of education under the Elizabethan statutes.</i>	
The Elizabethan statutes of 1570.	155
Statutable course for the degree of B.A.	156
Statutable course for the degree of M.A.	157
The professorial system of instruction.	158
Its failure to meet requirements of majority of students.	158
Education of undergraduates abandoned by university to colleges.	158
College system of education in the sixteenth century.	158

Cambridge University Press

978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge

Walter William Rouse Ball

Frontmatter

[More information](#)

xiv

TABLE OF CONTENTS.

	PAGE
College system of education at beginning of eighteenth century.	159
College tutorial system.	160
Private tutors or coaches.	160
System originated in the eighteenth century.	161
Practice of employing private tutors became general.	162

Chapter IX. The exercises in the schools.

Subject-matter of acts under the Elizabethan statutes.	164
General account of the procedure.	165
Details of the procedure in the eighteenth century.	166
Arrangement of candidates in order of merit.	170
The honorary optime degrees.	170
The moderators's book for 1778.	171
Verbatim account of a disputation in the sophs's schools in 1784.	174
Description of acts kept in 1790 (Gooch's account).	179
List of subjects discussed from 1772 to 1792.	180
Value of the system. Remarks of Whewell and De Morgan.	181
The pretence exercises in the sophs's schools. Huddling.	184
The ceremony of entering the questions was merely formal.	184
The quadragesimal exercises were huddled.	184
The exercises for the higher degrees were huddled.	184

Chapter X. The mathematical tripos.

The origin of the tripos, circ. 1725.	187
The character of the examination from 1750 to 1763.	189
The character of the examination from 1763 to 1779.	190
The disputations merely used as a preliminary to the tripos.	190
The examination oral.	190
Description of the examination in 1772 (Jebb's account).	191
Changes introduced in 1779.	193
Two of the problem papers set in 1785 and 1786.	195
Description of the examination in 1790 (Gooch's account).	196
Institution of a standard required from all candidates, 1799.	198
Description of the examination in 1802.	198
The problem papers set in 1802.	200
Changes introduced in 1800, 1808, 1818.	209
Changes introduced in 1827.	211
Changes introduced in 1833.	213
Changes introduced in 1838.	213

Cambridge University Press

978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge

Walter William Rouse Ball

Frontmatter

[More information](#)

TABLE OF CONTENTS.

XV

	PAGE
Changes introduced in 1848.	214
Constitution of a Board of mathematical studies.	215
Object of the regulations in force from 1839 to 1873.	216
Origin of the term <i>tripos</i>	217
Chapter XI. Outlines of the history of the university.	
The history is divisible into three periods.	221
<i>The mediæval university.</i>	
Typical development of a university of twelfth or thirteenth century.	221
The establishment of a <i>universitas scholarium</i> at Cambridge.	222
Privileges conferred by the state and the pope.	224
Similar facts about Paris and Oxford.	225
Constitution of university in thirteenth and fourteenth centuries.	226
The degree was a license to teach.	226
The regent and non-regent houses.	227
The officers of the university.	227
Erection of the schools and other university buildings.	229
Provision for board and lodging of students.	230
A scholar not recognized unless he had a tutor.	230
The hostels.	230
The colleges.	231
Establishment of numerous monasteries at Cambridge.	231
Chronic disputes between the university and monasteries.	232
Development of municipal life and authority.	233
The number of students.	233
The social position of the students.	234
Life in a hostel.	235
Life in a college.	236
The amusements of the students.	237
Strength of local ties and prejudices.	238
The dress of the students was secular.	239
Inventory of Metcalfe's goods.	239
The academical costume.	240
Poverty of the mediæval university and colleges.	241
Steady development and progress of Cambridge.	241
<i>The university from 1525 to 1858.</i>	
The renaissance in England.	242
In literature began at Oxford.	242
In science and divinity began (probably) at Cambridge.	242
The Oxford movement destroyed by the philosophers there.	242
History of the renaissance after 1500 centres at Cambridge.	242

Cambridge University Press

978-1-108-00207-3 - A History of the Study of Mathematics at Cambridge

Walter William Rouse Ball

Frontmatter

[More information](#)

xvi

TABLE OF CONTENTS.

	PAGE
Influence of Fisher and Erasmus.	242
Migration of Oxonians to Cambridge.	243
The reformation was wholly the work of Cambridge divines.	243
The royal injunctions of 1535.	244
Endowment of professorships.	245
Rapid growth of the colleges.	245
The Edwardian statutes of 1549.	245
The Elizabethan statutes of 1570.	245
Subjection of the university to the crown.	245
The university organized on an ecclesiastical basis	247
Provisions for ensuring general education.	247
Recognition of importance of making colleges efficient	247
The number of students	249
The social life and amusements of the undergraduates	250
Prevalent theological views at Cambridge, 1600—1858.	252
Prevalent political views at Cambridge, 1600—1858.	252
Prevalent subjects of study at Cambridge, 1600—1858.	253
INDEX	255

ERRATA.

- Page 14, line 3. After *under* insert *the*.
- Page 34, line 8. For *powers* read *power*.
- Page 38, lines 3 and 5. For *Bulialdus* read *Bullialdus*.
- Page 91, line 12. For *seventeenth* read *eighteenth*.
- Page 92, line 4 from end, and page 95, line 5 from end. For *Lahire* read *La Hire*.
- Page 115, line 12. For *His* read *Cavendish's*.
- Page 183, line 20. For *T. Bowstead* read *Joseph Bowstead*.