

Philippa Fawcett Collection: Brief notes on some of the books in the collection

Mary Steadman ALDIS (née Robinson) 1838-1897:

Consider the Heavens: A Popular Introduction to Astronomy 1895 - an elementary introduction to astronomy.

The Author

Mary Robinson was born in Kettering, Northamptonshire, and worked as a children's governess. She married William Steadman Aldis in 1863 and they had three children.

She moved to Auckland, New Zealand, in 1884 when her husband was appointed Professor of Mathematics at Auckland University College. She wrote an elementary guide to mathematics entitled *The Giant Arithmos* in 1882, aimed at children.

Aldis campaigned for the right of women to receive higher education, specifically in the sciences and mathematics. She was active in the suffrage movement in New Zealand, and by correspondence with activists in Britain.

Aldis returned with her husband to England in 1894 and died three years later.

Herta AYRTON 1854-1923, née Marks: *The Electric Arc*, 1902.

This book was a comprehensive treatment of contemporary knowledge of the electric arc, as well as an account of new phenomena Ayrton had discovered.

The Author

Ayrton was educated at a family-owned school, but went to work at 16.

She won a scholarship to read mathematics at Girton College, Cambridge.

Through taking a course in electrical engineering, she met her husband Professor William Ayrton.

They had two children.

She was elected MIEE (Member of the Institution of Electrical Engineers) in 1899 (the only woman until 1958).

She developed a fan to disperse poison gas in trenches in the First World War.

Ayrton was an active supporter of the suffrage movement.

Mary BOOLE (née Everest) 1832-1916:

The Collected Works vols i-iv (first edition) 1931

The Author

Boole was born in Gloucestershire, but lived with her family in France from 1837 to 1843. On returning to England she attended boarding school and was also taught by her father, the Reverend Thomas Everest (brother of the famous mountaineer).

She met her husband George Boole whilst visiting her uncle, Vice-Chancellor of Queen's College, Cork, where he was Professor of Mathematics. He encouraged her to develop her interest in mathematics. She went on to have five children including a daughter, Alicia Boole, who became a fine intuitive geometer. After her husband died in 1864, she worked until 1873 as Librarian at Queen's College, London (the first institution to offer some education for women at a tertiary level) where she tutored in geometry and mathematics. She was recognised by the London Education Board for outstanding teaching.

Boole invented the Boole Curve Sewing Cards, which created curves as envelopes rather than in the usual way as loci. These produced attractive geometric designs having both theoretical and practical applications, and had some commercial success.

She believed in women's equality and campaigned to increase educational access for women to science, mathematics and economics.

Margaret BRYAN fl. 1795-1815:

A Compendious System of Astronomy 1797, 1799 (reprinted).

System of Astronomy was said to be compiled from lecture notes prepared for her students. It contained an endorsement by Charles Hutton.

The Author

Only Bryan's married name is known; she had two daughters.

She ran boarding schools for girls, successively at Blackheath, London, and on the south coast, at which mathematics and science were an accepted part of the curriculum.

Arabella BUCKLEY 1840-1929, née Fisher:

The Fairy-land of Science, 1879, 1892 (reprinted).

The Fairy-land of Science and its sequel, *Through Magic Glasses* (1890) were among the books Buckley wrote for young people. These two were the only ones dealing with the physical sciences.

The Author

Buckley is an example of a woman from a prosperous family, who, according to custom, was educated at home. Through her family connections she became personally acquainted with the leading scientists of the day, and was recognized as knowledgeable on evolution.

She gained a considerable reputation as a scientific populariser.

Ida Winifred BUSBRIDGE 1908-1988:

The Mathematics of Radiative Transfer, 1960.

This book is a mathematical treatment of a theoretical problem in astrophysics. Busbridge published a number of articles, but this is her only book.

The Author

Busbridge received her first degree at Royal Holloway College, London.

Self-funded by teaching, she obtained higher degrees and was appointed a lecturer at St Hugh's College, Oxford in 1938; during the Second World War she was responsible for all the mathematics taught in the five women's colleges at Oxford.

She was not elected a Fellow until 1945, the year in which she became the first female University Lecturer in mathematics. She was awarded a D Sc in 1962.

Dame Mary Lucy CARTWRIGHT 1900-1988:

Integral Functions 1956

The Author

Cartwright was born on 17 December 1900 in Aynho, Northamptonshire, where she lived with her father William who was a curate and her mother Lucy (née Bury), and five siblings.

She attended Leamington High School and Godolphin College before entering St Hilda's College, Oxford, to study mathematics, earning a First in 1923.

Self-funded by four year's teaching, she returned to Oxford in 1928 and was awarded a D.Phil. in 1930.

Cartwright joined Girton College, Cambridge in 1930 as a Yarrow Research Fellow. In 1934 she was appointed Fellow and Director of Studies in Mathematics, a position she held until 1949 when she became a Consultant to the US Navy, carrying out mathematical research projects at Yale and Princeton: her work laid some essential foundations in chaos theory. At that time she was appointed Mistress of Girton, a position she held until retirement in 1968. Cartwright lectured at Girton continuously from 1935 until she retired, and from 1959 held the position of Reader in Theoretical Functions.

In 1947 Cartwright was the one of the group of women (the only mathematician among them) first elected to the Royal Society (FRS), and was later elected first female member of the Council. She was President of the Mathematical Association from 1951-1952 and President of the London Mathematical Society from 1961-63.

Upon retirement Cartwright was appointed Dame for her services to mathematics and was a Life Fellow and Emeritus Reader of Girton College, a position she held until her death on 3rd April 1998.

Émilie Le Tonnelier de Breteuil, Marquise du CHATELET 1706-1749:

Institutions de Physique (“Lessons in Physics”), 1740.

Institutions de Physique was presented as a review of new ideas in science and philosophy to be studied by Du Châtelet's thirteen-year-old son, but it incorporated and sought to reconcile complex ideas from the leading thinkers of the time.

The Author

Du Châtelet was remarkably well educated by her parents. She married at 20, and her first lover encouraged her to learn about the conflicting physical theories then current. Her mentors were mathematicians, astronomers and physicists, notably Maupertuis, and later Clairaut.

Du Châtelet became the long-time companion of Voltaire (tolerated by her husband) when he returned from exile in London as a convinced Newtonian. They lived in her country house, discussing physics and mathematics and she published scientific articles.

In the year of her death, she completed the work regarded as her outstanding achievement: her translation into French, with her own commentary, of Newton's *Principia Mathematica*.

Voltaire, in a letter to his friend King Frederick II of Prussia, declared that du Châtelet was “a great man whose only fault was being a woman”.

Agnes Mary CLERKE 1842-1907:

A Popular History of Astronomy in the Nineteenth Century 1897 second edition

Problems in Astrophysics 1903 first edition

Modern Cosmogonies 1905 first edition

The System of the Stars 1905 second edition

The Author

Clerke's father was a keen amateur astronomer who educated all three of his children at home. In 1867 the family moved to Florence, Italy. Women were permitted to use public libraries there and Clerke studied the history of astronomy through original works such as that of Copernicus – the subject of her first published paper (1877) in the *Edinburgh Review*.

Clerke settled permanently in London in 1877, living with her elder sister Ellen Mary Clerke, who was also interested in astronomy, though less productively; neither would marry. In 1888 Clerke spent two months at the observatory at the Cape of Good Hope in South Africa. In London, she continued her self-motivated scientific education, to become a well-regarded historian of astronomy as well as a leading commentator in the new field of astronomical spectroscopy. Throughout her lifetime she published over 50 papers in astronomy and astrophysics, and was the author of numerous entries in the *Dictionary of National Biography*. She also wrote the entry 'Astronomy' (published posthumously in the 1910 edition) for the *Encyclopaedia Britannica*, having previously contributed a number of biographical articles, notably on Galileo and Laplace.

Clerke won the 1893 Actonian Prize for science writing awarded by the Royal Institution of Great Britain.

In 1903 she was elected an honorary member of the Royal Astronomical Society (since its Charter did not permit women to become Fellows).

Clerke died in 1907, within a year of her sister.

Marie-Sophie GERMAIN 1776-1831 in

Sophie Germain: an Essay in the History of the Theory of Elasticity, Bucciarelli, Louis L. and Dworsky, Nancy, 1980.

This book is a biography centred round Germain's work on elasticity. It emphasizes the deficiencies in her work and the hardships imposed by her relative isolation from the scientific community as well as the controversy surrounding the early development of elasticity theory.

Germain's mathematical work

In number theory, Germain proved Fermat's Last Theorem for the special case when the index is a prime number less than 100. She corresponded with Gauss (under the male pseudonym she had used as a student); he regarded her work favourably.

Her main work was in elasticity, and she submitted successive entries to the contests organized by the Académie des Sciences requiring a mathematical theory for the vibration of elastic surfaces. In 1811 and 1813 the judges pointed out flaws in her solutions, criticizing lack of rigour. At the third attempt in 1815 she was finally awarded the prize – though, even then, with a reservation, due to errors she could not correct because she was not told what they were.

Germain's early struggles

Germain was born into a prosperous Paris family but her parents were more than usually opposed to female intellectual activity and forbade her to use her father's extensive library during the day; they also tried to prevent her from studying at night by removing all sources of heat and light from her bedroom. She overcame these adverse conditions, and taught herself Latin in order to read the standard texts of Newton and Euler. She joined the newly-established École polytechnique 'by proxy' – taking the name 'Antoine-August LeBlanc' of a student acquaintance to obtain copies of the lectures that she was unable to attend in person.

Caroline Lucretia HERSCHEL 1750-1848:

Memoir and Correspondence of Caroline Herschel, (ed.) Herschel, Mrs John, 1875 (1879)

This account of Herschel's life is based on extended extracts from her Journals and has been compiled and edited by her great-niece-in-law, Mary Cornwallis Power Herschel.

The Subject

Caroline was rescued from domestic servitude in Hanover by her brother William, and she became an opera singer with his orchestra in Bath.

William then became interested in astronomy, and in 1781 discovered the planet Uranus, so the King employed him as an astronomer: naturally Caroline had to accompany him to live near London. Her dismay is described in this book.

William constructed a telescope for Caroline to sweep for comets, and she discovered eight. These had to be announced to the Royal Society by William or a male acquaintance.

In 1787 Caroline too was offered a salary and so became the first-ever paid female astronomer.

Hilda HUDSON 1881-1965:

Cremona Transformations in Plane and Space, 1927.

Hudson retired aged 40 to work full time on writing *Cremona Transformations*, her *magnum opus*.

The Author

Hudson was born in Cambridge into a distinguished mathematical family. Her father was Professor of Mathematics at King's College London; her mother was one of Newnham College's earliest students; her brother was senior wrangler in 1898; and her sister and she were bracketed with the 8th and 7th wranglers respectively in 1900 and 1903.

After graduating she spent a year at the University of Berlin, then nine years at Newnham, before becoming a lecturer at West Ham Technical Institute. During 1917-1918 she did war work for the Air Ministry, being awarded an OBE for 'Aero-dynamical research'. She spent two further years in industry before retiring.

HYPATIA of Alexandria, d. C.E. 415: in

Hypatia of Alexandria, by Maria Dzielska (trans. F Lyra) 1995.

This book is one of the more recent biographies of Hypatia.

The subject

Hypatia was the daughter of Theon (of Alexandria), who was a mathematician and philosopher in the ('pagan') Hellenist tradition. Hypatia was probably aged between 45 and 60 when she was murdered by a Christian mob.

Hypatia followed her father in lecturing and in editing mathematical and astronomical scrolls, at the Museum and Library at Alexandria.

By clarifying the texts and removing corruptions they may have ensured the survival of some of the original works of Euclid, Archimedes, Apollonius, Diophantus, Ptolemy.

Only recently has it been feasible to pinpoint Hypatia's distinctive contribution, since Knorr* has (1989) argued authoritatively for Hypatia as the editor of Archimedes' *Dimension of the Circle*, and has also identified other likely instances of her editorial activity.

* W R Knorr, *Textual Studies in Ancient and Medieval Geometry*, Birkhäuser, 1989, Chapter 11.

Sonya Vasilevna KOVALEVSKAYA, 1850-1891, née Krukovskaya: see

The Mathematics of Sonya Kovalevskaya by Roger Cooke, 1984.

This book is a detailed biography of Kovalevskaya's mathematics.

The Subject

Kovalevskaya was educated at home in Russia. She could only obtain a university degree by going to Europe accompanied by a male relative, so she made a marriage of convenience.

In 1871, after two years at Heidelberg, she moved to Berlin, where she had to take private lessons from Karl Weierstrass since the university did not admit women. She was awarded her degree *summa cum laude* from the University of Göttingen.

After her husband's suicide in 1883, she went to Sweden. In 1888 she won the prestigious Paris *Prix Bordin* for work on the spinning top, and the following year was appointed professor in Stockholm. Kovalevskaya was the first woman in modern Europe to earn a doctorate in mathematics, to hold a university professorship in mathematics, and to be on the editorial board of a major scientific journal, *Acta Mathematica*.

(Augusta) Ada LOVELACE (Countess) née Byron 1815-1852: in

Faster than Thought: A Symposium on Digital Computing Machines, ed. Bowden 1953.

This volume of conference proceedings contains, as Appendix I, a reprint of Lovelace's 1843 publication 'Sketch of the analytical engine invented by Charles Babbage ...'. This consisted of her translation of a paper by General L F Menebrea of Turin (pp.341-62), to which she added very extensive notes (pp.362-408). She included a computer program invented to demonstrate how Babbage's projected machine could be applied to calculate Bernoulli numbers.

The Author of the Appendix

Unusually, her mother arranged for Lovelace to receive a scientific and mathematical education, as a precaution against her becoming a poet like her father; one of her tutors was De Morgan.

At 17 she met Charles Babbage, probably through Mary Somerville, and became fascinated by his ideas and designs for developing a programmable computing machine.

At 20 Lovelace married William, Baron King, and they had two sons. She died early of cancer. There are several books containing biographical material in this Collection.

*In Taylor's *Scientific Memoirs*, vol.3, pp.666-731.

Emmy NOETHER 1882-1935: see

Emmy Noether in Bryn Mawr: Festschrift, 1983 (edited by Bhama Srinivasan and Judith Sally)

This book contains many tributes to Noether's work, celebrating Noether's theorem (1915, concerning the relationship between symmetry and physical conservation laws), and her pioneering work in algebra.

The Subject

Daughter of the mathematician Max Noether, Emmy Noether studied mathematics at the University of Erlangen where her father lectured. After completing her dissertation, she worked at the Mathematical Institute without pay for seven years.

In 1915 she was invited by Hilbert and Klein to join the mathematics department at Göttingen. The Philosophy Faculty objected, however, and she spent the first four years lecturing under Hilbert's name. What many mathematicians consider her most important paper *The Theory of Ideals in Rings*

was published in 1921. In 1933, Germany's Nazi government fired her from Göttingen, and she moved to the USA, where she became a lecturer at Bryn Mawr. In 1935 she died unexpectedly after surgery. Einstein wrote an obituary.

Mary PROCTOR 1862-1957:

Everyman's Astronomy 1939.

Proctor wrote on astronomy for general readers, and *Everyman's Astronomy* is the last of her 16 books. More than half her books were aimed at children.

The Author

Born in Dublin, Proctor graduated from Columbia University. She learnt the craft of scientific writing from her father. After his death in 1888 she became well regarded as a popularizer of astronomy, and was also an accomplished lecturer to mixed audiences.

She was one of the first women to be elected a Fellow of the Royal Astronomical Society when this became possible in 1916.

Charlotte Angas SCOTT 1858-1931:

An Introductory Account of Certain Modern Ideas and Methods in Plane Analytical Geometry, 1894

Plane Analytical Geometry was one of Scott's two books, which included the latest developments and was widely used. She wrote many papers.

The Author

Scott's father was president of the Lancashire College, whose mathematics tutors were available for the family. Scott won a scholarship to Girton College and in 1880 was ranked equal to the 8th wrangler in the Cambridge Mathematical Tripos. Her spectacular achievement—she was the first woman ranked equal to a wrangler—resulted eventually in women having their examination successes announced publicly. She taught at Girton till 1885, when she was awarded a DSc from London University, and then became a lecturer at Bryn Mawr.

Scott was active in the founding of the (American) Mathematical Society and co-edited the American Journal of Mathematics. She was the first holder of a Chair at Bryn Mawr. She returned to Cambridge in retirement.

Mary SOMERVILLE 1780-1872, formerly Greig, née Fairfax:

On the Connexion of the Physical Sciences, 1834.

On the Physical Sciences was regarded as a seminal work of scientific exposition, contributing to a redefinition of 'physical sciences'.

Somerville's achievements

Somerville's family, and also her (first) husband, strongly discouraged her from learning mathematics. When he died (she was already 27 and had two children) she was then able to study mathematics seriously. She had four more children with her second husband, who was extremely supportive.

Her earliest book was *The Mechanism of the Heavens* (1831) a rendition (translation plus elucidation) of the first four books of Laplace's *Mécanique céleste*, which was received with acclaim.

Unfortunately, this is the only one of her works that we do not have in the Collection.

Somerville was much honoured in her lifetime, being elected, with Caroline Herschel, the first female honorary members of the Royal Astronomical Society.

One of the original women's colleges at Oxford is named after her.

Somerville's early difficulties

Somerville received little formal education, but her interest in 'algebra' was aroused by some puzzles in a ladies' fashion magazine which were popular features at that time*. However, Somerville's father forbade her to study mathematics, fearing that it might affect her health, so she had to work surreptitiously, and to persuade her brother's tutor to buy the books she needed, since no young lady could purchase a book of that kind without it being referred to her parents.

Somerville's first husband had a poor opinion of the intellectual capacity of women. At his death she gained financial independence, as well as the respectability of widowhood,

* For instance: Thomas Leybourn, *The Mathematical Questions Proposed in the Ladies' Diary 1704-1816*, Vols. I - IV, Mawman, Deighton, Parker 1817. There is a copy of this in the Collection.

E G R TAYLOR 1879-1966:

The Mathematical Practitioners of Tudor & Stuart England, 1954, 1967 (reprinted).

This book and its companion, *The Mathematical Practitioners of Hanoverian England 1714-1840*, 1966, quickly became standard authorities. (She never used any first name on her publications.)

The Author

Taylor obtained her first degree in chemistry at Royal Holloway College, London.

After a diploma in geography at Oxford, she first combined teaching, writing textbooks, and bringing up a family, then progressed to lecturing at teacher training colleges and London University. She was awarded D.Sc. in geography in 1929, and appointed to the Chair of Geography at Birkbeck College, London, 1930-44.

Her major works were published in retirement.

Dorothy Maud WRINCH (married names Nicholson, Glaser) 1894-1976:

Fourier Transforms and Structure Factors 1946.

This monograph, *Fourier Transforms*, is a mathematical contribution to the theory of crystallography. It remained a standard text for many years. Wrinch wrote only two books, but she published numerous papers.

The Author

Wrinch gained a scholarship to Girton College, Cambridge, where she became friendly with Bertrand Russell. Her research extended from analysis to mathematical physics.

She was awarded a London D Sc in 1921, and worked in London, Cambridge, and then Oxford, where she had a child, and also received (1929) the first D Sc awarded there to a woman.

Later she concentrated on mathematical biology (involving some collaboration with the future Nobel prize-winner, Dorothy Crowfoot Hodgkin). She continued this research in the United States after the outbreak of the Second World War.

Florence Annie YELDHAM 1877-1945:

The Teaching of Arithmetic through Four Hundred Years (1535-1935), 1936.

The Teaching of Arithmetic is still well-regarded, since it contains material that is not readily available elsewhere.

The Author

After a sound education Yeldham took a science degree at Bedford College, London, and became a mathematics teacher. Having deplored the lack of suitable books on the history of mathematics, she took the unusual action of qualifying herself to write them, by taking a PhD course at University College London, at the age of 45.