Online resource for the history of astronomy

MacTutor, a database of mathematicians' biographies, also encompasses a wealth of astronomical content, as the **MacTutor team** explains.

Astronomy and mathematics have been intimately linked throughout history, so it is hardly surprising to find that nearly 600 astronomers – from antiquity to the 20th century – feature in our award-winning MacTutor biographical database of mathematicians. This astronomical material has recently been made more easily discoverable, aiming to increase the public visibility of the history of astronomy as the bicentenary of the Royal Astronomical Society approaches in 2020.

If you are looking for historical information to enhance astronomy teaching, engage the public, or as a source of anecdotes, MacTutor is a good place to start: http://www-history.mcs.st-and.ac.uk. The database has been developed over the past 30 years by John O'Connor and Edmund Robertson of the University of St Andrews. Initially designed to enrich their teaching of undergraduate mathematicians, it now contains more than 2800 detailed biographies of mathematicians, astronomers and related scientists, with bibliographies accompanying each article, plus around 150 historical articles on mathematical topics, more than 2000 other pages of essays on specific topics, and further resources.

Prize-winning site

MacTutor aims to provide accurate and interesting information that is accessible to all. Its success can be judged by its hit count: around 2 million per week, with as many distinct users. Many of the biographies of mathematicians in Wikipedia have been drawn from MacTutor. In 2015, Robertson and O'Connor received the Hirst Prize from the London Mathematical Society for their work. The citation says MacTutor is "the first port of call for those interested in the historical side of the mathematical sciences, giving mathematicians direct links to their profession's past. It bridges the gap between old books and modern journals,

and its biographies give lives to names otherwise known only for the theorems to which they are attached."

Among this wealth of data, it is easy to miss the nearly 600 astronomers included, from across the world, and from the ancient such as Aristarchus, to 20th-century scientists such as Fred Hoyle. There are also about 20 essays on astronomical topics and eight on national astronomical societies or societies that include astronomy in their remit.

The site has grown organically as articles are added every year by its creators, but navigating to an astronomy section of the website had become confusing. As part of our project to create a more user-friendly interface, we sifted through hundreds of biographies to find the ones about astronomers and collated a linked index. We compiled a similar index for astronomical topics among the historical articles and essays, one for the essays on astronomy in various historical cultures, and one for the astronomical societies.

To help those unfamiliar with astronomy and astronomers, we wrote short essays on themes in the history of astronomy (such as the structure of the solar system, and discovering the extent of the Milky Way) with links to important biographies. All this material is linked from a new astronomy homepage at http://www-history.mcs.st-andrews.ac.uk/Astronomy/index.html.

Our project to make the history of astronomy on MacTutor more accessible has been founded on the philosophy expressed by Einstein: "A knowledge of the historic and philosophical background gives that kind of independence from prejudices of his generation from which most scientists are suffering" (Einstein to Robert Thornton, 7 December 1944, Einstein Archive 61-574). We feel that a significant

aspect of science is engaging students and the public to help them foster an interest and appreciation for the importance of scientific work. The history of astronomy, in particular, can give students a framework for grasping challenging concepts, make science more accessible to those interested in people but wary of mathematics, and provide researchers with new ideas, challenging tacit assumptions.

1 John Herschel, painted in 1829 by Alfred Edward Chalon, one of several images of him in the MacTutor database. This article uses Herschel's biography as an example of the scope of the entries. (Wikimedia Commons)
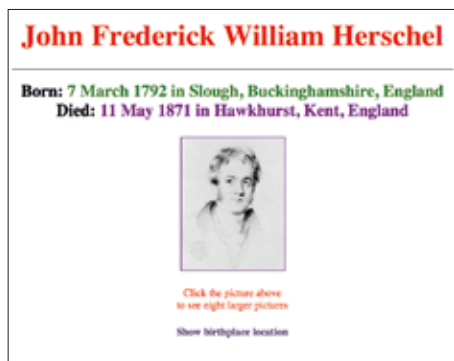
Example entry

Sir John Herschel (1792–1871; figure 1), a prominent founder of the RAS, provides an example of the type of information available on MacTutor. A visitor looking for John Herschel can locate his entry via a search, or via the index of biographies, but visitors with such a clear target are unusual. Rather, someone is more likely to come across Herschel while browsing the essay "The reaches of the Milky Way", where his work on stellar parallax is mentioned, or the biography of his better-known friend, Charles Babbage, which recounts their work in promoting continental mathematics at Cambridge, or in the essay on the founding of the RAS that discusses his Address setting out the objectives of the new society. All these, and many more biographies, link through to the entry for John Herschel, for he was an influential figure in the 19th century.

As with all the biographies, Herschel's (figure 2) starts with his dates, place of birth, a thumbnail image with link to other images, and a link to a map showing the location of his birth and those of other mathematicians born in the same country.

The 2800-word biography of Herschel that follows mentions and links to the biographies of 20 other mathematicians and scientists. We read about his father, William Herschel, discoverer of Uranus, and his aunt Caroline, William's sister. She played a

John Frederick William Herschel

Born: 7 March 1792 in Slough, Buckinghamshire, England
Died: 11 May 1871 in Hawkhurst, Kent, England

Click the picture above
to see eight larger pictures

Show birthplace location

2 (Above) The opening screen of the biography of John Herschel on MacTutor.

3 (Right) MacTutor's supplementary material on John Herschel.

List of References (15 books/articles)
A Poster of John Herschel
Mathematicians born in the same country
Additional Material in MacTutor
  1. Obituary: The Times
  2. Multiple entries in *The Mathematical Gazetteer of the British Isles*
Honours awarded to John Herschel
(Click below for those honoured in this way)
  1. Fellow of the Royal Society   1813
  2. Fellow of the Royal Society of Edinburgh 1820
  3. Royal Society Bakerian lecturer   1823
  4. Royal Society Royal Medal   1833, 1836 and 1840
  5. Royal Society Copley Medal   1821 and 1847
  6. Lunar features   **Crater J Herschel**
  7. Planetary features   **Crater Herschel** on Mars
Cross-references in MacTutor
  1. History Topics: Orbits and gravitation
  2. History Topics: Mathematical discovery of planets
  3. History Topics: A visit to James Clerk Maxwell's house
  4. History Topics: The history of measurement
  5. Chronology: 1810 to 1820
Other Web sites
  1. Encyclopaedia Britannica
  2. NNDB
  3. NAHSTE
  4. MathSciNet Author profile

large part in John's upbringing and has an entry in MacTutor as an astronomer in her own right: she was one of the first women to be paid for scientific work (£50 per year from George III, beginning in 1787), and received the RAS Gold Medal in 1828 for her catalogue of 2500 nebulae.

As an undergraduate at St John's College, Cambridge, Herschel met Charles Babbage and George Peacock and, in 1812, they formed the Analytical Society with the aim of introducing analytical mathematics, already developed in continental Europe, to the English universities. Among the many interesting anecdotes in the biography is that Babbage withdrew from the exam because he knew he could not compete with Herschel. Another is that on graduating, Herschel initially trained to become a lawyer, a career that he abandoned after 18 months or so.

Polymath

Herschel was elected a Fellow of the Royal Society of London in 1813 for his mathematical work, which he pursued until around 1820. He published on algebra, trigonometric series and applications of finite differences. By 1816, he had decided to continue his father's astronomical work, but he never devoted himself entirely to the subject. Even before his first astronomy paper was published, Herschel published details of his chemical and photography experiments in 1819 that, 20 years later, would prove of fundamental importance in the development of photography. And, in 1821, he received the Copley Medal of the Royal Society for his work on mathematical analysis.

It was not until 1822 that Herschel published his first paper on astronomy, a minor work on a new method to calculate the timings of eclipses of the Moon. His first major astronomical publication was a catalogue of double stars published in 1824 and he continued to work on double stars until 1833. In particular he developed methods to determine the orbits of double stars around a common centre of gravity. MacTutor explains that the work on double stars was part of a larger attempt to measure the parallax of stars and thus demonstrate the Earth's motion through space, for which there was no direct evidence until Bessell finally succeeded in measuring it in 1840. A linked glossary describes the concept of parallax.

> **"His peers considered John Herschel Britain's leading scientist and his death a major loss"**

Continuing to work on other topics alongside astronomy, in 1830 Herschel published an influential *Discourse on Natural Philosophy.* MacTutor emphasizes the importance of this work by quoting a letter from Faraday to Herschel: "When your work on the study of Natural Philosophy came out, I read it, as others did with delight. I took it as a school book for philosophers, and feel that it has made me a better reasoner and even experimenter, and has altogether heightened my character, and made me, if I may be permitted to say so, a better philosopher."

Herschel's biography outlines the progress of his career, including his extended visit to the Royal Observatory at the Cape of Good Hope, where he observed Halley's comet on its 1835 return. He calculated that, as well as gravitation, the comet was being subjected to a major repulsive force from the Sun. This was the first observation of the effects of what we now know to be the solar wind. Herschel also made the discovery that gas was evaporating from the comet. He spent nine years, after returning to the UK in 1838, reducing the data he had collected in the southern hemisphere (for which he received his second Copley Medal).

One of his many distractions from astronomy at this time was the development of photography. Herschel took the subject up again in January 1839 when he heard of the work of Daguerre and Fox Talbot. Within a few days he had invented the hydrosulphite method of fixing emulsions. In 1850, Herschel – Sir John since 1839 – accepted the position of Master of the Mint (once held by Newton). He did not enjoy the role. His health broke down and he resigned in 1855, returning to his family home in Collingwood, Kent.

Death

Sir John Herschel had no major breakthroughs attached to his name and our modern assumptions about the importance of "discovery" in advancing science are challenged by the realization that, despite this, his peers considered him Britain's leading scientist and his death a major loss. MacTutor drives this point home by concluding with quotations from his Royal Society obituary: "In John Frederick William Herschel, British science has sustained a loss greater than any which it has suffered since the death of Newton, and one not likely to be replaced." The author judged that of even higher value than his research "was the influence of his teaching and example in wakening the public to the power and beauty of science, and stimulating and guiding its pursuit".

MacTutor offers both different starting points for an investigation of historical astronomy and links to wider resources. Appended to each biography is a list of references and links to supplementary material such as primary sources (figure 3). For Herschel there are 15 references to secondary sources, links to his obituary in *The Times*, and to the many places his name occurs in MacTutor's *Mathematical Gazetteer of the British Isles* (http://www-history.mcs. st-andrews.ac.uk/Gaz), a list of honours, cross references to topical essays, and links to external sites. These form a comprehensive starting point for anyone wanting to discover more about John Herschel.

MacTutor contains a wealth of information on the history of astronomy. We hope that it will become an invaluable aid to astronomers interested in using history for outreach and public engagement, to enhance their teaching, or to advance their own understanding of their subject, as well as a direct entry point for the public into the history of astronomy. ●

AUTHORS
Gemma Talbot, Ian Shand, Isobel Falconer, Edmund Robertson and John O'Connor have developed the astronomical side of the MacTutor biographical database of mathematicians in the School of Mathematics & Statistics, University of St Andrews, UK. The recent astronomy indexing and homepage project within MacTutor was funded by the Royal Astronomical Society and the School of Mathematics & Statistics at St Andrews.