Faraday and the Christmas Lectures: The Chemical History of a Candle

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Pictured: A candle flame, and Michael Faraday. Both images are in the public domain.
'There is no better, there is no more open door by which you can enter into the study of natural philosophy, than by considering the physical phenomena of a candle.' The Chemical History of a Candle (1861).¹

The Chemical History of a Candle was arguably the greatest series of Michael Faraday’s Christmas Lectures at the Royal Institution. It was this course of six lectures, first given in 1848 and based on an Afternoon Lecture of his first given in 1831,² that were to be his last. Delivered over the winter of 1860 and 1861, they were published, first in William Crookes’s periodical Chemical News, and then in book form, in 1861. A rare copy of this first edition of the book version is at Homerton College Library. This blog post will shed some (candle)light on the background to this book, telling the story of Faraday and his famous Lectures, of the publication of the book, and of the item itself.

During his time at Princeton University (1933-1955)³ Albert Einstein kept three portraits in his study: of Sir Isaac Newton, James Clerk Maxwell, and Michael Faraday.⁴

Faraday (1791-1867), known as the ‘Father of Electricity’, is regarded as one of the greatest scientists of all time. His many discoveries and contributions included the concept of electromagnetic induction and rotation⁵ (heralding, essentially, electricity in usable form), Faraday’s law of electrolysis, and nanoparticles (as they are now known).⁶

Born in Newington Butts, Surrey (now part of Southwark, London) in 1791, his father was a blacksmith, the family were not well-off, and he received very little formal education. At the age of 14 he became a bookbinder’s apprentice. It was there, surrounded by volumes on many different subjects, that he quenched his great thirst for knowledge and discovery. He was particularly drawn to the natural sciences, and one of his favourite books was Conversations on Chemistry (1805) by Jane Marcet (1769-1858).⁷

In March 1813, at the age of 21, Faraday was appointed Chemical Assistant at the Royal Institution.⁸

The Royal Institution (Ri) was founded in London in 1799 by a group of leading British intellectuals including William Wilberforce and the Petrean, Henry Cavendish. The aim was the advancement and dissemination of scientific knowledge. One of its core purposes was and continues to be ‘communicating science to a general audience’, with public lectures and scientific demonstrations at their premises so well-attended that they led to the creation of London’s first one way street. It was the great scientist Humphry Davy (1778-1829) that really took the lead on this kind of public engagement in the early years of the Ri, and his Afternoon Lectures there made him something of a London sensation in the first decade of the
Known for the mine safety lamp that bore his name, and many other contributions, it has been said that Humphrey Davy’s greatest discovery was Michael Faraday, for it was as Davy’s assistant that the door to the Ri was opened, after Faraday sent him hundreds of pages of notes on one of Davy’s lectures that he had attended.

Faraday delivered his first lecture at the Ri in 1824, and by the 1840s had become, like Davy, something of a celebrity. The famous Christmas Lectures at the Royal Institution – still going strong today – were first delivered in 1825, to a ‘juvenile auditory’. Faraday delivered his first series in 1827-8, and these showcases of experimental chemistry, complete with explosions and hands-on demonstrations, made Faraday’s Christmas Lectures a popular feature of mid-Victorian life. ‘There can be no greater treat to any one fond of scientific pursuits,’ said one commentator in 1861, ‘than to attend a course of these lectures.’

Then, as they have been ever since, the Christmas Lectures were known to be entertaining, but they were also informative. Broadly speaking, lectures like these were part of the great contemporary culture of science popularisation: educational science for young people and the adult masses.

From the late eighteenth century, and peaking during the early Victorian era, science education aimed at juveniles found a subgenre within ‘popular science’, which was what Keene calls ‘familiar science’. Writers like Daniel Cooper (The Little Book of Botany, 1839) and Christopher Irving (A Catechism of Practical Chemistry, 1821) sought to introduce children and young people to science by making familiar settings, such as the home, the classroom. Everyday objects familiar to all Victorians – such as candles, chalk, coal and copper kettles - were the objects of study. These commonplace objects were often used as starting-points for the discussion of more complex ideas. Familiar science is, as Keene argues, a necessary distinction for academic engagement with what we now understand to be a culture of nineteenth-century science education which was not simply just a question of the two camps of ‘popular’ and ‘academic’. Engaging with audiences through lectures and practical demonstrations as well as through the instructional works of the catechisms and dialogues was, therefore, an important part of science education which fed into the development of science teaching and learning.

Arguably the best example of this hands-on approach within familiar science is Faraday’s The Chemical History of a Candle (often shortened to The Candle or simply Candle), ‘one of the best-known examples of familiar chemistry from early Victorian Britain’. These lectures of Faraday’s, like many of his others, built on the popular ideas of the time that
experimentation and sensory experience was crucial to the learning and teaching of science.\textsuperscript{17} As John Joseph Griffin said in his \textit{Chemical Recreations} of 1824 (3\textsuperscript{rd} ed.): ‘The hearing of lectures, and the reading of books, will never benefit him who attends to nothing else; for Chemistry can only be studied to advantage \textit{practically}.’\textsuperscript{18}

Before publication in full, Faraday’s \textsl{Candle} lectures made an appearance in a different form, in a story in the periodical \textit{Household Words}, established in 1850 by Charles Dickens, the editor, or in his words, the ‘conductor’.\textsuperscript{19}

Dickens wrote to Faraday in May 1850 suggesting that it ‘would be extremely beneficial to a large class of the public, to have some account of your late lectures on the breakfast table, and of those you addressed, last year, to children’.\textsuperscript{20}

Faraday kindly sent Dickens his lecture notes from \textit{Candle} and it formed the basis of this August 1850 story, co-written by Percival Leigh, and based loosely on Faraday’s 1848 \textit{Candle} lecture.\textsuperscript{21} The story was entitled \textit{Chemistry of a Candle}. The familiar science here took the lesson to the heart of Victorian family life, the evening dinner table, and helped popularise not just science learning in general but Faraday as a lecturer and great science populariser. The stories in Dickens’s periodical took the form of a group conservations, with family members and other characters acting as the explainers.\textsuperscript{22} The main character in candle story, Harry Wilkinson, explains the science of a candle flame in an entertaining but not overly simplistic way. I don’t think it is too much of a long shot to infer from this that it was not just a story in a journal, but a reflector of the culture of the time, that middle class households were familiar with science as popularised, and that the science popularisers were household names. The \textit{Candle} lectures captured, at the risk of sounding clichéd, the public imagination. This was science that was accessible and lively.

The book that’s featured in this post, \textit{The Chemical History of a Candle}, is based on, as mentioned above, the final Ri lectures of Faraday, the six Christmas Lectures given by him in the winter of 1860/61 (two in December and four in January). In his seventieth year, the old master delivered his most famous lecture to a pack crowd of young people, with the largest attendance being 740 at the fifth lecture.\textsuperscript{23}
This wonderful little publication, beautifully presented, begins with a poetic preface from the editor, William Crookes. The preface opens with: ‘From the primitive pine torch to the paraffin candle, how wide an interval!’

The contents page clearly sets out the book’s elegant plan. Six Lectures, plus the Lecture on Platinum, and the informative Notes section of technical points. The chapters (‘the Lectures’) are all headed with keywords to outline what will be discussed. Lecture I, for example: ‘A candle: The flame – Its sources – Structure – Mobility – Brightness.’

What is immediately obvious is its highly readable style. It is Faraday’s words as delivered in person, and his intellect and noted ability to captivate audiences emanates from every line.

‘And now, my boys and girls, I must first tell you of what candles are made.’

Detailed yet not clunky, perfectly pitched to the ‘juvenile auditory’ yet fascinating to all (Charles Dodgson, aka Lewis Carroll, wrote to Faraday to inquire about the concept of ‘capillary action’). The Lectures continue with experiments and practical demonstrations of particular concepts, some of which are illustrated with neat black and white drawings.

From reading the accompanying text on the pages below and looking at the illustration, you can, when he says, ‘We will put our candle there, and place it over a chimney, thus,’ imagine him doing this in the dusty, dimly lit lecture theatre on Albemarle Street, the fug of the burning candles and smell of chemicals punctuated throughout with bright lights and explosions.
Faraday first tells his audience about the physical make-up of candles, from naturally occurring ‘candles’, like the candle-wood of the peat bogs in Ireland, which burns like a candle when lit, to the manufacturing process of candles - those
made of tallow and cotton, and those made of beeswax. He even produced, at the beginning of the lecture, a candle salvaged from an old shipwreck. Even after years in saltwater, it still burned. A well-made candle, he demonstrated to his audience, was a remarkable thing which could still function even after a long period spent under adverse conditions.

Essentially these lectures are talking about the nature of combustion – what it needs to burn, how it burns, and the products of that burning, among other things.

‘Michael Faraday’s The Chemical History of a Candle must rank as one of the most popular science books ever published.’ That is how science historian Frank James describes the book in his introduction to its 150th anniversary edition.

It first appeared in William Crookes’s periodical Chemical News in early 1861, and was first published in book form in March 1861 by Griffin, Bohn and Company, in London.

Chemist John Joseph Griffin (1802-1877), author of Chemical Reactions (see above) and a co-founder of the Chemical Society in 1840, was for a time a partner in his family’s publishing firm, which in 1861 partnered with Bohn, with their address at Stationers’ Hall Court, London. It was printed by Reed and Pardon, of Paternoster Row, London, a business interest founded in 1842 under the name Tyler & Reed by Sir Charles Reed, one time MP for Hackney and father of author Talbot Baines Reed (1852-1893). Faraday was sceptical about whether a verbatim printing of a lecture would work, but the success of the first one published by editor William Crookes (1832-1919) and Griffin – The Various Forces of Matter - convinced him otherwise.

Most of the science still holds true. Some differences include changes in the names of certain chemical compositions, and certain elements of the experiments. Chemists today would disagree with, for example, Faraday’s description in Lecture III of zinc forming a kind of ‘protective coat’ when in water or acid. Reactivity here is more to with water temperature and relative oxidation.

There is something powerful in the simplicity of a candle as the subject of a great lecture. It symbolises the potential of learning – a light that never goes out, and which illuminates what was previously dark. The candle as a metaphor of enlightenment was certainly not lost on Faraday, and indeed the text is not subtle in this regard. He belonged to the Sandemanian sect of Christianity, and his lectures were ‘shot through with his theistic view of the world’. He spent his
career pursuing the advancement of science and an understanding of the forces of nature, and owing to his faith it was clear in his mind that these forces were God’s forces, and the laws of the universe God’s laws. He was a deeply moral man, not interested in great personal gain. He turned down a knighthood and, famously, the presidency of the Royal Institution.

The *Candle* as a published work represents not just a landmark in popular science and science education, but is a record the words of a pioneering scientist, almost, if you use your imagination, a recording itself, of a very significant time and place.

The copy of this book at Homerton is one of only two copies of the first edition in Cambridge – the other being at the University Library, and one of perhaps only 20 copies in libraries worldwide.*
Familiar Physics.—Lectures on the Various Forces of Matter, and Their Relation to Each Other. By Professor Faraday, D.C.L., F.R.S. With numerous Illustrations. Third edition. Foolscap 8vo. 3s. 6d., cloth.

Familiar Chemistry.—Lectures on the Chemical History of a Candle. By Professor Faraday, D.C.L., F.R.S. With numerous Illustrations. Foolscap 8vo. 5s. 6d., cloth.


Applied Science.—The Book of Trades: or, Circle of the Useful Arts. With numerous Engravings on steel and wood. Twelfth Edition. 16mo. 3s. 6d., cloth.
Pictured above: Homerton’s copy of Candle. The title page, and the publisher’s series statement on the recto of the title page, the present volume listed on 'Familiar Chemistry'

This item was originally part of the main lending collection at Homerton. It still bears the familiar library stamps and ownership labels, including ‘Homerton New College’, which was the name of the College for a short time upon its move to Cambridge from London in 1894. Though the 'received' date on the gridstamp on the title page verso is 2009, it is likely that this was the date it was re-catalogued as part of the lending library, rather than the item leaving Homerton and then returning! It was then later moved to the rare books Historic Teaching Collection.

It features a publisher’s catalogue at the end of the text, an index to the catalogue, and a short notes section. It is bound in a green textured cloth over hard boards and lettered in gilt on the spine.

This is a rare first edition of a classic text which would appeal to anyone interested in the fields of chemistry, physics, science education or juvenile literature.

If you would like to view this item, please contact either myself on jb719@cam.ac.uk, the library, library@homerton.cam.ac.uk, or come in and speak to any member of the team.

- One hundred and seventy years on from Faraday's first Christmas Candle and guest speakers at the Royal Institution are still delighting young audiences and adults alike. This year’s Christmas Lectures at the Ri will be given by Alice Roberts and Aoife McLysaght, on 11, 13 and 15 December; they may be sold out, so please see the Royal Institution website to check.
* This is based on a search of the COPAC online database, which provides searchable records for over '100 UK and Irish academic, national & specialist library catalogues'; and WorldCat, the world's largest bibliographic database, which pools the records of over 72,000 libraries worldwide.
Endnotes

1 Faraday, 1861, p.2.


3 Institute for Advanced Study, 2018.


6 Royal Institution, 2018.

7 Science History Institute, 2018.


13 Keene, 2014, p.53.

14 Keene, 2013, p.54.

15 Keene, 2014, p.54.

16 Keene, 2013, p.62.

17 Keene, 2013, p.55.
18 Griffin, quoted in Keene, 2013, p.58.


20 Dickens, quoted by Halpern, 2017.


22 Keene, 2014, p.61.


31 Simms, 1979, p.41.

Sources

Books


**Articles**


**Webpages**


**Also, you may also be interested in the following items, available (reference only) at Homerton College Library**

