



Chemical Ladies

Dr Andrew Szydlo discusses the significance of two influential female scientists in the history of Chemistry

This portrait shows one of the greatest chemistry teachers of all time.

Her name was Jane Haldimand Marcet (1769 – 1858) and she lived in Clapham in London. She wrote a book that became a best seller in the 19th century. It was first published in 1805, was called *Conversations in Chemistry*, and was designed to have particular appeal to girls. It enabled the reader to gain a thorough understanding of chemistry through continuous reference to fascinating experiments. The book was written, as the title suggests, in the form of a conversation between two teenagers: Emily and Caroline, and their chemistry tutor – Mrs B. It went through 16 editions in England, was translated into French and German, and was illegally published in several editions in America.

Who then was Mrs Marcet, and why did she write such a book? She was born in London (one of 12 children) to wealthy parents, did not have a formal education in chemistry, but had the opportunity to meet leading scientists of the time through her family contacts. In 1799 she married the exiled Swiss physician Alexander Marcet who encouraged her to develop her interests further. She was lucky enough to witness spectacular chemical lectures at the Royal Institution which were given by the brilliant and flamboyant Humphry Davy. Furthermore, chemistry at the beginning of the 19th century was a rapidly expanding discipline of science with extraordinary discoveries being made on a regular basis – these included the use of electrolysis to isolate alkali metals, experiments on the physiological



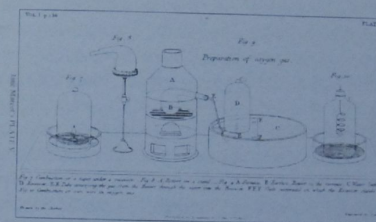
The illustration shows a fragment from a famous cartoon by Gillray in which the impish Humphry Davy observes the effects of laughing gas on a fellow scientist at a public lecture at the Royal Institution.

“Chemistry at the beginning of the 19th century was a rapidly expanding discipline of science with extraordinary discoveries being made on a regular basis”

effects of laughing gas, and the development of the Atomic Theory.

The combination of fascinating company, a rapidly expanding science and brilliant demonstrations caused Jane Marcet to develop a passionate interest in chemistry. Furthermore she became convinced that she should try to popularise the subject among girls, who were not considered worthy of its study.

Here is a typical diagram from her book:



“Mrs B. attaches a piece of lighted tinder to the end of a spiral of iron wire, which she then introduces into a receiver filled with oxygen. The iron quickly becomes incandescent, and burns vividly.

CAROLINE. Oh what a brilliant and beautiful flame!

EMILY. It is as white and dazzling as the sun! – Now a piece of melted iron drops to the bottom: I fear it is extinguished; but no, it burns again as bright as ever.”

Mrs Marcet’s work has naturally been commented on by several scholars during the past two centuries. In 1947, Professor John Read wrote: “Caroline shows a somewhat perfunctory interest in chemistry, except at

exciting moments. She is always ready to take a risk in the interests of science – and has to be restrained by Mrs B. from inhaling laughing-gas and liberating the ‘extremely fetid’ phosphoretted hydrogen gas in the house. Sad to say, she is also inclined to be careless. She burns a hole in her gown and damages her finger with sulphuric acid [...] is the kind of girl that would cheerfully faint in the H₂S-room [she wouldn’t have had much choice, since hydrogen sulphide is one of the most poisonous gases known. We make it at Highgate as part of our Year 9 chemistry programme – AZS], or use her gown as a chemical artist’s palette, or jerk her neighbour’s most prized preparation on the floor and step on it to make sure [...] Fortunately, in the interests of humanism, there are still many Carolines in chemistry classes.”

More fortunately still, there are several of them at Highgate School today! These splendid and enthusiastic, and just a little naughty, pupils abound in every class. Not to mention our equally enthusiastic and dedicated teachers Miss Tod and Miss Ward!

Whilst visiting the chemistry department recently during an inspection, our photographer captured a

“Caroline and Emily” who had been specifically instructed to use ONE burning splint to ignite their Bunsen burner. Oh dear!

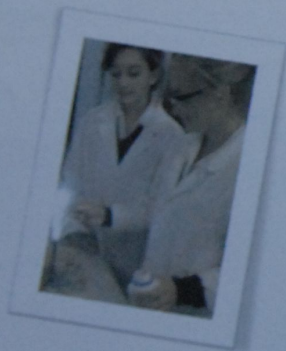


"For her work in science, Maria became a celebrity in her own lifetime. And all of this in spite of her tragic personal circumstances..."

Another "Caroline and Emily" got just a little carried away when investigating the oxidation of magnesium in the fume cupboard in room C2.



Two other young ladies who were supposed to investigate the melting point of zinc discovered that it burns rather well. (And where are your safety spectacles may I ask?)



So who did Mrs Marcet's book influence, and how was it received by other chemists and teachers? It was the main inspiring force for Michael Faraday who was arguably the greatest experimental chemist of all time. (Incidentally, did you know that he is buried at Highgate

Cemetery?) That alone qualifies it as one of the most important chemistry books of all time.

In more recent times, another chemical lady has made a huge impact on our understanding of the nature of matter. Maria Skłodowska was born in Warsaw in the Russian Empire (Poland had been partitioned in 1793 and had disappeared off the map of Europe until 1918) in 1867. Her parents were teachers and her grandfather had also been a teacher. Unlike Jane Marcet, Maria did have a formal education in sciences and in mathematics – these were subjects in which she excelled. In 1891 she travelled to Paris in order to study physics at the famous Sorbonne University. She graduated in 1893 (highest marks), and a second time in 1894 – in mathematics (2nd highest marks). In 1895 she married the brilliant French physicist Pierre Curie. At this time, huge developments were being made by a large number of physicists in Europe, who were investigating electric and magnetic phenomena and their relationship to the structure of atoms. Henri Becquerel, who was a keen photographer as well as a physicist, had observed in 1896 that invisible rays were being produced by certain uranium salts. These rays would penetrate black paper and affect photographic film. Pierre Curie had invented an apparatus for detecting these invisible rays – it was called an electroscope.

Marie decided to investigate these rays as the main theme for her PhD thesis at the Sorbonne. She had noted that uranium ore, which also contains thorium (echeinite) produced a far higher level of radiation than could be accounted for by uranium alone – she reasoned that this was probably due to the presence of another much more reactive element. After two years of experimental work, she isolated a highly radioactive new element which she named after her country of origin – Polonium. This was in



Maria Skłodowska in 1890

1898. She also realised that there was another vastly more radioactive element present in pitchblende (another ore of uranium), and after 5 more years of practical work – she had to process 6 tons of uranium ore in a wooden shed which served as her laboratory - she managed to extract a few milligrams of yet another super-radioactive element which she called radium. To describe the effect of the invisible rays produced by the 2 new elements, she invented the word "radioactivity", which we continue to use today.

Maria Skłodowska-Curie was awarded her PhD in 1903, and in the same year her first Nobel Prize. This was for physics, and was awarded jointly with Henri Becquerel and Pierre Curie. In 1911 she was the outright winner of the Nobel Prize for chemistry.

For her work in science, Maria became a celebrity in her own lifetime. And all of this in spite of her tragic personal circumstances – she was born into an occupied and repressed country, she lost her mother at the age of 11, her husband was tragically killed in a road accident in 1906, she was discriminated against in scientific circles and she suffered from cancer which was a work-related illness, which finally killed her in 1934. At the Solvay conferences which were founded in 1911, and

at which the world's foremost scientists met, Maria Skłodowska-Curie was the only female chemist.



The Solvay Conference of 1911. Maria Skłodowska-Curie is sitting at the table, leaning on her elbow, Albert Einstein is second from the right.

It was this group of scientists, of which she was a founding member, which helped to elucidate the structure of the atom. **This was the most profound scientific achievement of the 20th century.**

Mrs Marcet and Marie Skłodowska-Curie were two very different, but nevertheless outstanding chemical ladies. I bet that they were just like Caroline and Emily at heart. ✕