Science at Play: Yesterday, Today, and Tomorrow!

by Bonnie Lawlor

The Chemical Heritage Foundation (CHF), located in Philadelphia, PA (USA), opened an exhibition in the fall of last year entitled *Science at Play*. According to CHF, this is the first major exhibition to focus on chemistry sets. On display are a broad spectrum of fascinating and colorful miniature scientific laboratories for children, part of CHF's collection of more than two hundred and fifty science kits and toys.

But the exhibit is not just about the toys. It provides a fascinating look at how science began to emerge beyond the closed circles of university researchers in the early 1800's, to be embraced by the general public—adults and children alike. It follows the history of science toys through to this day, including how gender, race, and legislation shaped their evolution. While the exhibit is not large (it is a special side exhibit off from the main permanent displays), it is interesting, educational, and fun—hopefully this review will encourage those who plan to be in Philadelphia this year to attend the American Chemical Society meeting (21-25 August) to stop by and take a look.

The Early Days

The first chemistry set was mentioned in the book, *Description of a Portable Chest of Chemistry; or Complete Collection of Chemical Tests,* written by a German chemist, Johann Friedrich Göttling, in 1791. The chest contained the equipment and instructions necessary to perform basic experiments and was geared towards chemists, physicians, mineralogists, etc. Shortly thereafter, in 1797, James Woodhouse, an American chemist in Philadelphia, PA, published his own book of chemical experiments, *The Young Chemist's Pocket Companion*, and it, too, came with a portable lab. It was very similar to Göttling's, but had a different audience —ladies and gentlemen, not scientists. Science was becoming mainstream. Anyone interested in science could attend lectures and, if they had the funds, could purchase scientific equipment and set up laboratories in their homes. This interest was fueled by a book entitled *Conversations on Chemistry*, written in 1806 by Jane Marcet [1] in order to supplement the popular public lectures. It attempted to convey the most current perspectives on chemistry through a dialogue between a fictional Mrs. B. and her young students, Caroline and Emily. The exhibit points out that the book was quickly adopted by American chemistry instructors and that "twenty-three American printings of the book appeared between 1806 and 1850, making it the most successful introductory chemistry textbook of this period in American history." It was also printed in French and German. [2] Michael Faraday is quoted as having said that the book gave him his foundation in chemistry. [3]

Indeed, by the early 1800's chemistry had become "recreational":

> "Chemistry is the science which makes known to us the properties of the component particles of all natural bodies. So infinitely varied are the objects of Chemistry that it is an everlasting source of occupation and amusement."

The above quote is from the tenth edition of a book first published in 1823, entitled *Chemical Recreations: A Popular Manual of Experimental Chemistry* by John Joseph Griffin. [4] Learning about chemistry was often a family endeavor in which parents and children worked together on "chemical recreation" experiments. The exhibit also points out that early science books written for children at that time also used the opportunity to teach manners and morals, and visitors are directed to the permanent exhibit in the main portion of the museum where a wonderful book is on display—*Real Fairy Folks: Exploration in the World of Atoms* by Lucy Rider Meyer (1887), in which the elements are portrayed as personable little fairies, with linked arms, legs, and wings representing chemical bonds. [5]

The demand for chemistry sets grew and by the 1860's a new manufacturer, J. J. Griffin & Sons (the author of "Chemical Recreations" split his publishing business to focus on the manufacturing of chemistry sets) emerged in the U.K., offering eleven different sets. This

company became the most popular and for decades served both beginners as well as experienced college and university students. But the advent of World War I in 1914 caused problems for manufacturing in Europe. Chemicals became difficult to obtain and people had neither the discretionary funds with which to purchase the sets nor the time with which to play with them. The manufacturing of chemistry sets went into a serious decline.

Growth in Popularity

However, this decline in Europe provided an opportunity for production in the United States. The Porter Chemical Company, located in Hagerstown, MD, recognized the void and began making chemistry sets for children in 1915. The exhibit points out that their Chemcraft sets sold from seventy-five cents to one U.S. Dollar in 1916 at a time when the average weekly wage was seven to ten dollars. But these were intellectually-stimulating toys and as their popularity grew so did the variety of science sets that Porter offered, such as the Porter Mathcraft set, at right (top).

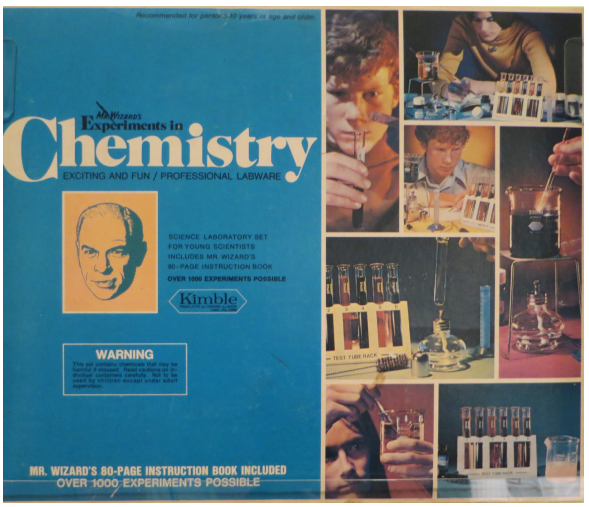
Chemcraft became a mass-marketed brand and the exhibit notes that in 1955, during the company's peak years, it produced 425,000 chemistry and microscope sets—their two most popular science toys. Children all over the world wrote letters to Chemcraft, USA and the U.S. Post Office made sure that the letters were properly delivered.

It wasn't long before Porter was faced with a rival. Alfred Carlton Gilbert had been successful with his popular erector construction sets and in 1920 he released a series of Chemical "magic" sets. These sets focused on demonstrating what appeared to be the magic of chemistry—teaching "tricks" such as melting, changing colors, etc. According to Gilbert, the sets were perfectly safe and with them boys (he did not mention girls) could perform hundreds of experiments. They were fun and educational. Parents loved the toys and saw them as potential career builders.

Porter and Gilbert competed for the next thirty years and after World War II were joined by other manufacturers. The general public was fascinated by the scientific developments that came out of the war (in fact, U.S. President Dwight D. Eisenhower believed that it was because of science that the U.S and its allies were able to win the war). There was a post-war surge in scientific development and a fascination with atomic energy. One of the newer chemistry sets even included depleted uranium dust and the tools with which to observe the waves of radiation emitted by the dust!

One of the most popular post-war technologies was the television and the public's fascination with science was fueled by a science-based TV show entitled *Watch Mr. Wizard.* [6] The show's host was a science hobbyist. Every weekend a young boy or girl would drop by his house to visit. There was always an experiment in progress, many of which initially seemed impossible, but were usually simple enough to be re-created by viewers. (I was one of the many fascinated viewers, but did not try to duplicate anything!). The show ran from 1951 to 1965 (the videos are available even today [7]) and resulted in the creation of more than fifty thousand Mr. Wizard Science Clubs in North America. The show also had its own chemistry set, as seen below (bottom).

By the late 1950's, chemistry sets were common playthings for boys and girls. But environmental concerns and legislation would soon bring the demand for chemistry sets to an all-time low.



The Decline of Chemistry Sets

In 1962, Rachael Carson's book, *Silent Spring*, was released and gave birth to the environmental protection movement. The book focused on the powerful pesticide, DDT, and its negative impact on wildlife and the environment. [8] The U.S. President at the time, John F. Kennedy, ordered the President's Science Advisory Committee to examine the issues that were raised by Carson. Its report thoroughly vindicated both *Silent Spring* and its author. The book ultimately resulted in the creation of the U.S. Environmental Protection Agency in 1970 and was a major factor in shaping the public's negative opinion of chemicals and the chemistry industry overall.

Legislation also played a part in the decline of the chemistry set. The U.S. Federal Hazardous Substances Act (FSHA) of 1960 mandated that the chemicals in the sets be labeled appropriately as toxic, explosive, flammable, etc. As a result, manufacturers chose to remove the chemicals, making the sets boring in comparison to their predecessors. Three additional U.S. laws put nails in the chemistry set's coffin: The Child Protection and Toy Safety Act (1969); the Consumer Product Safety Act (1972); and the Toxic Substances Control Act (1976). Chemistry sets were not as much fun as they used to be—the "magic" was gone. By 1967 Gilbert closed its doors. Porter continued, but although one of its final chemistry sets attempted to recreate the spirit of earlier sets, it did not provide near as much fun due to the limited number (and the innocuous nature) of the chemicals that were included. Porter went the way of Gilbert and closed its doors in 1984.

A renewed interest in science grew out of a 1983 report on the status of education in the United States entitled *A Nation at Risk: The Imperative for Education Reform* from the U.S. National Commission on Excellence in Education. The report indicated that the U.S.A had fallen behind in mathematics and science education. But it was not until the late 1990's that this interest caught on with children. As in the early 1800's, the interest was due to a book. This time the book was *Harry Potter and the Philosopher's Stone*, by J. K. Rowling. This book, the six to follow, and the movies created from them, created a curiosity about alchemy and magic (not so much the reality that is science). The series spawned its own "chemistry" set—one that includes very few chemicals and a cauldron rather than lab glassware—a far cry from the Gilbert/Porter Chemistry Experiment labs of bygone era.

The exhibit points out that today's chemistry sets are truly "lite." They include petri dishes, goggles, and instructions, but NO chemicals. Instead, they tell budding scientists to use things from around their home: vinegar, baking soda, soap, etc.

Michelle M. Francl, a chemistry professor at Bryn Mawr College in Bryn Mawr, PA (USA), wrote an interesting article on what attracts young people to the science of chemistry. [9] She proposes that, at some level, it is risk, and raises the following question: "Are we being so vigilant with regard to safety that we have inadvertently deprived a generation of potential chemists of pivotal, if not necessarily essential, experiences?" Dr. Francl is also the author of the blog, the *Culture of Chemistry* (see: http://cultureofchemistry.fieldofscience.com/)—definitely worth a read!

Porter and Gilbert Reborn?

Never fear. It is possible to find chemistry sets that almost mimic those of the 1950's and 1960's—for a price—and they are currently produced by a company by the name of Thames and Kosmos. According to the company's web site (www.thamesandkosmos.com), "Thames and Kosmos was founded in 2001 by a science museum director and her son, who saw the great need and demand for better science education materials—resources for parents and their children that are more engaging, more effective, more relevant, and more fun. The company operates as the exclusive arm of parent company, Franckh-Kosmos Verlags-GmbH & Co. KG (Kosmos for short) that is based in Stuttgart, Germany. Founded in 1822, Kosmos operated solely as a book publisher until the 1920s, when the company published its first science kits aimed at explaining the world of science to children and young adults by bringing it to life with hands-on experiments."

Sounds like J. J. Griffin & Sons from 1860 all over again, so I searched the web for their chemistry sets

and found that they are widely available, even from Amazon. However, you might want to browse their online shop at: http://thamesandkosmos.shptron.com. I looked at their Chemistry set (C3000) which offers 333 experiments and also covers such topics as chemical equations and the periodic table, but it is pricey at about $280.00 U.S. dollars! (In comparison, the set that is marketed as a child's first chemistry set sells for about $45.00 U.S. dollars).

The online tour of the exhibit closes with the following statement: "The days of chemistry sets lining children's closets ARE GONE unless the gap left open by Porter and Gilbert is filled by new chemistry-set makers interested in sparking the curiosity and creativity of children."

Is it important that the gap be filled? In her above-mentioned article, Michelle Francl noted that half of the parents of the entrants in the 1960 Westinghouse Science Talent Search explicitly cited chemistry sets as significantly contributing to their teens' scientific interest and expertise, [10] and that a more recent study showed a strong correlation between a continuing interest in science and children's early engagement with science outside of an instructional setting. [11] So perhaps the gap does need to be filled. One US dollar in 1916 (the cost of a chemistry set at that time) is worth about $22.96 U.S. dollars in 2016 and the cost of a Thames-Kosmos set is more than ten times that amount. It is time for the competition to begin again!

Learn More

The *Science at Play* exhibit is definitely worth a visit. I realized afterwards that I was so taken with looking at the science sets themselves that I probably did not go through the exhibit in the order intended. But I later took advantage of the video that is available on the Chemical Heritage Foundation's website—it follows the history of chemistry sets in chronological order. While the video lacks the visual impact of the exhibit itself, it provides a wealth of information of which I freely made use for this article. [12] There is also a section on the site that includes tidbits and personal anecdotes that make for an interesting read. [13]

Both the exhibit and the website allow you to add your own experiences with chemistry sets. It is interesting to hear how those sets impacted successful scientists and others when they were children. While the exhibit is really not for young children as there are only a few 'hands-on' activities, it is for every scientist and for anyone with an interest in science. The Chemical Heritage Foundation Museum is a gem.

So if you find yourself in Philadelphia for any reason, I encourage you to visit the Chemical Heritage Foundation. It is a very short walk from the convention center, a stone's throw from Independence Hall, and in the shadow of Dow Chemical's Advanced Materials Division.

And to add a personal note—it is just about three doors down from the building that once housed Eugene Garfield's Institute for Scientific Information (ISI®), home to the Science Citation Index® and where I started my career in science publishing.

Notes and References

1. According to the website, famousscientists (www.famousscientists.org/), Jane Marcet was the first female science writer and her 1806 book became the standard text in chemistry education. The text can be freely-accessed at www.gutenberg.org/files/26908/26908-h/26908-h.htm
2. See the CHF piece on Jane Marcet at: www.chemheritage.org/discover/online-resources/chemistry-in-history/themes/chemical-education-and-public-policy/chemical-education/marcet.aspx
3. Faraday's quote can be accessed at www.famousscientists.org/jane-marcet/.
4. This book and others like it are available from Forgotten Books at www.forgottenbooks.com.
5. See sample illustrations at: http://othmeralia.tumblr.com/post/113958178803/assorted-illustrations-from-real-fairy-folks/.
6. See Watch Mr. Wizard on Wikipedia at: https://en.wikipedia.org/wiki/Watch_Mr._Wizard
7. www.mrwizardstudios.com
8. *The Story of Silent Spring*, Natural Resources Defense Council, at: http://www.nrdc.org/health/pesticides/hcarson.asp
9. Francl, N. M., "Homemade Chemists," *Nature Chemistry,* Volume 4, September 2012, pp. 687-688. http://dx.doi.org/10.1038/nchem.1441
10. Moore, S., *Science News Lett.,* Vol 79, pp. 362-363, 1960, http://dx.doi.org/10.2307/3942528.
11. Simpkins, S. D., David-Kean, P. E., & Eccles, J. S., *Dev. Psych.*, 42, pp. 70-83, 2006.
12. Go to the CHF website for the exhibit at: www.chemheritage.org/visit/museum/exhibits/science-at-play/, scroll down to "Stinks, Stanks, and Boom" and click on the interactive timeline.
13. http://scienceatplay.tumblr.com

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