Reviving the chemistry set

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Chemistry magic shows are a common way of introducing the public and students to chemistry (e.g., Beer, 2009), although whether the emphasis on smells, explosions and colour changes is a good representation of the subject is open to debate. When I see these demonstrations, I am reminded of Para Pools’ assertion that their product is “better than a beach in your own backyard”, and until earlier this year I was one of those who lamented the passing of the chemistry set: the personal magic show, if you will.

The earliest chemistry set is described by DiVernieri (2008) as accompanying a text Description of a Portable Chest of Chemistry… (Goettling, 1791) that was intended for use by “chemists, physicians, mineralogists, metallurgists, scientific artists, manufacturers, farmers and the cultivators of natural philosophy”. Very similar experiments and equipment were then marketed to a rather different audience – the ‘young chemist’ (Woodhouse, 1792). The nineteenth century saw a greater complexity of experiments and their accompanying texts (e.g., Accum, 1818), and the sets themselves were complemented by public lectures and demonstrations. Even colonial New Zealand was not spared these public demonstrations of chemistry. The immensely popular chemistry and physics public lectures by Christchurch’s Professor Bickerton (Burdon, 1956), for example, included lectures entitled ‘Romance of a Molecule’, ‘The Songs of Atoms’ and ‘The Battle of the Elements’, while posters advertising lectures to be delivered by a visiting Clement L. Wragge in 1909 promised “grand scientific entertainments” in the Wellington Town Hall that included “lectures on ‘marvellous radium’, demonstrated with actual specimens”.

Schmidt (2001) attributes the heightened interest in chemistry in the twentieth century to the growth of

Fig. 1: A chemistry magic show at the King Edward Barracks in Christchurch. Demonstrations like this and interactive exhibits that invited experimentation on a variety of physical phenomena were the forerunner of the National Science Technology Roadshow Trust’s mobile science centres which have toured New Zealand for the last 25 years. [Photo courtesy of National Science Technology Roadshow Trust]
chemical industries at the time of the First World War, and this appears to have been responsible for the ‘rebirth’ of the chemistry set. Dominant in the development and marketing of chemistry sets were the Porter Chemical Company and AC Gilbert. Initially featuring “chemical magic”, Porter marketed a range of Chemcraft sets of varying sizes and prices. Porter’s principal competition was AC Gilbert, whose initial commercial success was with the “Erector Set” in 1913, allegedly inspired by his witnessing railway construction works, and whose chemistry sets first appeared in 1920. For the next thirty years the Porter and Gilbert companies were rivals for the burgeoning market, advertising in comic books and publications aimed at children, as well as in the magazine *Popular Science*.

The sets themselves often opened in the manner of a book held upright, and in this sense are reminiscent of the ‘cabinets of curiosities’ in which scientists and explorers have traditionally displayed their collections (Bann, 2003). The ‘Chemcraft Master De-Luxe Lab’ (Cherry, 2008) promised 915 ‘fascinating chemical experiments’ through which the user could investigate the wonders of general and inorganic chemistry, outer space, atomic energy, plastics, glass blowing, magic and many others. Charts show structure of matter with illustrations. Includes huge supply of chemicals and professional equipment plus a comprehensive fully illustrated instruction manual. Strong 4-panel wood cabinet opens to 36 x 16 inches ($27.95).

A smaller version, priced at $19.95, offered a mere 725 experiments, but included a balance, an alcohol lamp, test tubes, etc. in a six-panel metal cabinet.

In the aftermath of the Second World War sales of chemistry sets continued to boom in America. Di-Vernieri (2008) captures the mood and its change in the late 1950s well:

The figures on the covers [of sets and manuals] and in the advertisements were well groomed, intelligent and obviously successful, representing the boom in the American chemical companies, such as Dow and DuPont, and the expansion of other scientific fields like physics. The Chemcraft corporate slogan at this time, ‘Experimenter Today ... Scientist tomorrow’, was the essence of the time.

By the 1950s, however, the attitude towards chemistry and science in general had started to change. Being a scientist was no longer enough. With the dawn of the nuclear age and the race for space, there were big issues that needed big solutions and people began to expect more of chemistry and science. In order to stay on top, children needed a grounding in complicated topics like fusion/fission and even quantum mechanics. The more abstract box images and Chemcraft’s slogan at this period - ‘Porter Science Prepares Young America for World Leadership’ - capture this shift nicely.

These sociological changes to the expectations of chemistry and science coupled with concerns about the safety of toys generally saw the decline of the chemistry set from the 1960s. The development of science centres, epitomised by San Francisco’s Exploratorium developed in the 1960s, provided an opportunity for hands-on scientific investigation, but these were principally in areas of physics (Butler 1993). In the few science centres where chemistry featured at all, ‘magic shows’ (Fig. 1) were the usual means of presentation, although the early Exploratory in Bristol England had an impressively large exhibit in which water was electrolysed and the resulting hydrogen and oxygen ignited at the touch of a button (Fig. 2).
For the more motivated New Zealand student, science fairs and the CREST scheme (Coles & Coles 1997) offer the possibility of chemistry experimentation, but for most young students the only places where they can currently experience experimental chemistry is the school laboratory, in which activities are heavily regulated and constrained by the limitations actually or perceived to be imposed by the curriculum.

However, the development of online science education has started to change that. Clearly while online simulations of reactions can demonstrate the chemistry of reactions, and can extend to showing their energy relationships and mechanisms, these activities do not address the concern that student nurses and other budding science professionals need hands-on laboratory experiences as well. To meet this need:

Enter the myriad homespun cardboard-boxed science kits available to educators and their online students. Now previously detached students are snipping open frog’s intestines with dissection scissors and determining the calorific content of their lunch with a Bunsen burner and a test tube, all on their newspaper-draped kitchen tables. (Home Dissection Kits and More, 2009)

Escienceclabs.com, for example, markets kits in a range of science areas, including chemistry. Of their Introductory Chemistry set, the website intones that it:

...includes carefully crafted experiments that bring safety to a new level by reducing or eliminating the use of hazardous chemicals. The accompanying manual guides students through innovative problem-solving pedagogy ... a student explores the critical components of chemistry using environmentally- and human-friendly chemicals.

One might hope that the sample experiment on the website which passes electrical current from a 9-volt battery via steel (-ve) and iron (+ve) electrodes into solutions of salt and sugar, and which suggests that this and attempts to measure the melting points of the substances constitute an adequate demonstration of the nature of ionic and covalent bonds, is not typical of the experience offered.

The President and Chief Executive Officer says of her company (Hands-On Labs) which also has developed products to support distance and online courses in science, “This is not baking soda and vinegar... These [kits] are not toys and contain potentially dangerous things.” The website indicates that the experiments are “academically aligned and mirror those performed on campus...” and that the kits “contain traditional experiments developed in accordance with microscale chemistry principles and techniques to provide students with safe, yet effective laboratory experiences.”

Interestingly it is the companies marketing these kits not the educational provider that bear the costs of insurance to cover the risk of accidents occurring. This transfer of risk may well be a major influence in the welcome rebirth of the chemistry set.

References


