

WOMAN IN CHEMISTRY. JANE MARCET, A RELEVANT FIGURE IN CHEMISTRY EDUCATION**Johanna Camacho Gonzalez^{a,*} and Alvaro Muñoz-Castro^b**^aDepartamento de Estudios Pedagógicos, Facultad de Filosofía y Humanidades, Universidad de Chile, Av. Capitán Ignacio Carrera Pinto 1025, Ñuñoa, Santiago de Chile^bLaboratorio de Química Inorgánica y Materiales Moleculares, Universidad Autónoma de Chile, Llano Subercaceaux 2801, San Miguel, Santiago, Chile

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A historiographical study of Jane Marcet's role in spreading chemistry knowledge to a wider audience in the 19th century is presented here. Her efforts to spread scientific knowledge were crucial to sharing the most important theories of chemistry among different audiences, particularly women and young people. Through her book, "Conversations on Chemistry," which was published in several editions from 1806 to 1853, she contributed significantly to chemistry education. Despite controversy over the large number of editions, this text is a strong witness to the active participation of women in science. Her scientific rigor and contribution to narrative strategies in chemistry pedagogy have given Jane Marcet consideration not only as an important woman in the scientific community of England during the first half of the 19th century but also as a central figure in the early development of chemistry diffusion and education.

Keywords: chemical education; women in chemistry; history of science; textbooks.

INTRODUCTION**Dissemination of chemistry through textbooks in the late Eighteenth and early Nineteenth Centuries**

By the end of the 18th century, chemistry had branched off from natural philosophy and was recognized as a relevant component of gentlemen's education and as a subject of interest for the general audience. By these days, street conversations concerning chemistry issues discussed the use of chemicals that replaced pharmaceutical medicines.¹ Chemistry knowledge was showcased in different instances targeting the general public via experimental demonstrations and lectures, particularly those developed at The Royal Institution of London founded in 1799. Since 1801, Sir Humphry Davy (1778-1829) offered demonstration lectures oriented to a diverse audience ranging from middle class people to specialists, generating a fluid and active communication space with the aim of spreading the latest development in the field. The increasing interest in this field is due to the early general recognition of chemistry knowledge as a comfortable material benefit as well a basis for industrial development. Therefore, those communicational bridges were established with the aim of incorporating all the citizens into the scientific dialogue. However, the lectures were oriented toward men, even in cases when there was active female participation.

In this social context, an interesting and innovative compendium of chemistry appears in London, namely "Conversations on chemistry in which the elements of that science are familiarly explained and illustrated by experiments" (hereafter, *Conversations on Chemistry*), which was continuously published from 1806 to 1853, in two volumes of approximately 300 pages each. Such book deals with principles of chemistry involving several conversations and discussions, concerning specific issues.² Despite the popularity of several editions, the book's author was anonymous during first editions.

The conversations occur between one female tutor and two female students offering a dynamic scenario to share knowledge from

a specialized source. Mrs. Bryan (or Mrs. B) is the tutor who wishes her students would appreciate the need for chemistry in their daily lives and two intelligent young girls, Caroline and Emily.³ Caroline, a 15 year old girl, is impetuous, skeptical, curious and not very interested in chemistry. In contrast, Emily is a 13 year old excited by chemistry and visibly more curious, as it is shown in *Conversations I, On the general principles of Chemistry* of the 5th edition of 1817.

In the same period Samuel Parkes (1761-1825), published *Chemical Catechism in England*, a book aimed to disseminate chemical knowledge.⁴ It is important to note that neither of these books were exactly textbooks according to the characterization made by J. F. Daniell and Edward Turner in 1830, because the authors do not intend to offer a formal course, but rather a classification or systematization of knowledge. Such works were rare in an era where elementary scientific instruction was largely developed through popular lectures. Both books were loaded with theory and discussions, and hence were suggested as excellent guidelines to the understanding of the state-of-the-art developments of chemical theory in the early 19th century.⁴ Parkes book was centered on applied chemistry, showing a large number of details for important industrial processes in London.⁴ Nevertheless, such book was particularly difficult to read due to the turgid writing style employed by the author.^{5,6}

In *Conversations on Chemistry*, the aim of the author, who identified herself as a woman but did not provide her name, was "to offer to the public, and more particularly to the female sex, an Introduction to Chemistry",⁷ she recommended the book as a useful source of information since their "education is seldom calculated to prepare their minds for abstract ideas, or scientific language".⁷ Moreover, in these days women had little access to this means of instruction and "the author was not acquainted with any book that could prove a substitute for it".⁷ The book was motivated by the need for a useful beginner's text, as well as to satisfy women's intellectual needs, it attempted to augment the knowledge, offered in public institutions open to both sexes "which clearly proves that the general opinion no longer excludes women from an acquaintance with the elements of science"⁷ Additionally, the author was fascinated by the impressions she had "for the wonders of Nature, studied in this new point of view,

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which were still fresh and strong, that she might perhaps succeed the better in communicating to others the sentiments she herself experienced".⁷ The anonymous author admitted her interest in chemistry and science, although she did not have a Chemistry degree, which was normally held by men.

Moreover, the dialogue format employed seeks to stress the human dimension of science, allowing students to participate actively in its evolution,⁶ spreading the chemistry knowledge from a selected group of scientists to a large diverse audience involving both children and woman.

According to the preface in the different editions of *Conversations on Chemistry*, the author attended lectures offered at the Royal Institution by Professor Sir Humphry Davy, where she realized that it was almost impossible to obtain a clear or satisfactory picture through such demonstrations. She repeated a variety of experiments and shared her observations in informal conversations with her friends where discussions about current issues in chemistry were developed. This experience gave the author the conviction that dialogue was an important and useful source of information and discussion.

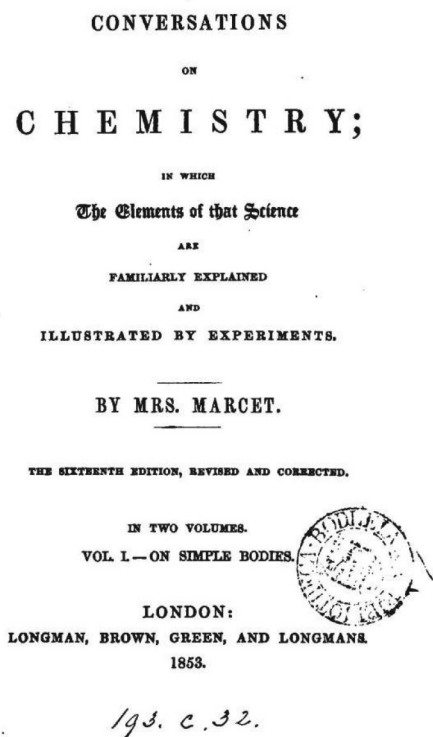


Figure 1. Title page from *Conversations on Chemistry*, 1853 (Courtesy of Biblioteca de Ciència i Tecnologia at Universitat Autònoma de Barcelona)

Conversations on Chemistry was attributed to several women who wrote about science in that era, including Sarah Mary Fitton, author of “*Conversations on Botany*” (1817), and Margaret Bryan, author of “*A Compendious System of Astronomy*” (1797). The latter name strongly was supported by speculations derived from the name of one of the characters in *Conversations*, Mrs. Bryan or simply Mrs. B. Indeed, Mrs. Bryan alluded to Margaret Bryan in recognition of her career at that time, which was dedicated to the diffusion of science across different audiences.⁵ In 1837, the speculations about the name of the author finally ceased in the 13th English edition, Mrs. Marcet finally recognized her valuable work,⁷ maintaining her name on the cover until the last edition in 1853 (Figure 1).

Jane Haldimand Marcet

Jane Haldimand (Figure 2) was born in London, England in 1769, the eldest daughter in the well-to-do family of a Swiss banker and an Englishwoman. She received a homeschooled education where private tutors introduced topics on natural and physical philosophy, a traditional system of education among wealthy Swiss families.

At the age of 15, she took over the responsibilities at home due to her mother’s death. Her duties included, supervising her five younger siblings and attending to her father’s clients, with whom she had the opportunity to learn about and discuss current issues. When she was 17, she travelled to Italy where she became interested in painting and developed her talent for drawing through lessons with Joshua Reynolds and Thomas Lawrence. This ultimately led her to make elegant drawings in the illustrations of her books.^{1,8}



Figure 2. Portrait of Jane Marcet (Courtesy Edgar Fahs Smith Collection, University of Pennsylvania Library)

In 1799, Mrs. Haldimand married one of her father’s clients, Alexander John Gaspard Marcet, who during the genevan conflicts of the late 18th century moved to Edinburgh to study medicine and later became a physicist at the Royal College in London.² Alexander Marcet gave lectures and experimental demonstrations on chemistry at the medical school of Guy’s Hospital. His work and analysis was relevant for the diagnosis and control of renal calculi.^{2,9} Alexander and Jane Marcet complemented each other, participating actively in the foundation of the Royal Society of Medicine, where Dr. Marcet was the first Foreign Secretary.^{9,10}

The couple’s circle of friends and acquaintances included several important figures,^{9,10} such as, Berzelius (1779-1848), Wollaston (1776-1828), Humphry Davy (1778-1829), Pierre Prevost and Marc Auguste Pictet, the botanist Augustin de Candolle (1778-1841), the mathematician Horace Benedict de Saussure (1740-1799), the writers Maria Edgaworth and Harriet Martineau, the physicist Auguste de la Rive (1801-1873), the politician and economist Thomas Malthus (1766-1834), and Jeffrey and Sydney Smith, founders of the *Edinburgh Review*; among others.^{2,9}

Mrs. Marcet rapidly adopted the theories and discoveries from lectures at the Royal Society and conversations at her own household, where she paid particular attention to chemical issues, deciding to create a book for women who did not have access to the same privileged instruction. The Marcet’s couple played a fundamental role in Jane’s book; this collaboration included the revision and corrections of every topic.⁹ This support allowed her to avoid the struggle between her scientific interest and family life, a problematic issue for the scientific endeavors of 19th century women. For Mrs. Marcet, marriage opened the doors to the world of science and allowed her to

pursue the interests on her own terms.¹¹ Her contribution was not of a mere collaborator for a creator husband, or as a coauthor (dependent or independent) of marital work, but as a promoter of science who chose to adopt anonymity in her work to avoid a conflict of interest with her husband's research in chemistry.^{2,11}

Jane Marcet started writing her book in 1803. Once she finished it in the early autumn of 1806, it was handed to her friend John Yelloy (1774-1882), an English physicist who coordinated the editing, printing and publication of *Conversations on Chemistry* in two pocket size volumes. She also published *Conversations on Political Economy* (1816), *Conversations on Natural Philosophy* (1820) dedicated to her siblings, *Conversations on Evidences of Christianity* (1826), *Conversations on Vegetable Physiology* (1829) and *Conversations on the History of England* (1842).^{8,10} Before his death in 1822, Alexander had the satisfaction of witnessing how successful his wife's popular science books were.^{9,11}

ABOUT CONVERSATIONS ON CHEMISTRY

Structure of the book

The target audience of *Conversations on Chemistry* was from the beginning explicitly women, in part because the author identified herself as one. The text also addressed itself particularly to young students and beginners, "who should occasionally refer to it, with a view to procure information on particular subjects".⁷ However, in the American editions (vide infra); the target audience stated by the authors was redefined as students who were beginning to learn about chemistry, aimed at both men and women.

The discourse generated among Mrs. Bryan, Caroline and Emily, is one of the most interesting aspects that made the book successful, being popular among different Chemistry textbooks in the 19th Century.⁶ Such approach fit well with the author's desire to introduce the science of chemistry as she herself learned it: through observations, discussion and experiments.

The narrative of Marcet's text is of rhetorical doubt, where several questions are formulated in order to generate further discussion, and then in turn are answered as the text progresses. This question & answer based discussion provides the structure for explanations of the different topics in *Conversations on Chemistry*.^{3,12} The teaching and learning situation take place in a context of theoretical discussion, encouraging the students' active participation in defining concepts, discussing topics and even doubting the veracity of the theories, some of which were not yet accepted. Emily's characteristics are very central to fostering discussion and contextualization of the topics, while through Caroline the reader remembers previous conversations and thereby establishes relationships among the concepts being discussed.¹² A deeper description into the details of the structure of the conversations presented on *Conversations on Chemistry*, and how this style of exposing the different ideas will contribute to chemistry teaching in the 20th Century has been discussed by Derrick (1985).³

Interestingly such discursive style has been used since the Greeks, and was adopted by Galileo, Boyle among others. The author found it convenient, as it had been the way in which she acquired her chemistry knowledge, as she mentioned in the preface of her book.⁷ This innovative style presented fictitious conversations about the most current topics of chemistry and its implications in the rapid socioeconomic changes associated with the British chemical industry,¹³ communicating with the greatest possible clarity, facilitating maximum understanding of the book content in such era.

In *Conversations on Chemistry*, the preface was maintained from its first publication in 1806 until the last edition in 1853 with a

slight modification at the end. Despite this, the book was constantly reviewed and modified, and new elements were added by Mrs. Marcet according to the further discoveries in Chemistry, as well as, their important applications, such as the steam engine.^{10,12} In the 1832 edition, modifications of electrochemistry were introduced,⁹ and in the last edition of 1853, a new conversation on agriculture was added, just to name a few cases.¹²

The theories on which Jane Marcet based her studies were mainly developed by Antoine Lavoisier, who had published the scheme of classification in the *Traité Élémentaire de Chimie* when she was 20 years old. Also, her work involves Newton's corpuscular theory of matter which she employed to explain chemical reactions in terms of affinity, aggregation, and repulsion.^{2,5} The dialogues throughout *Conversations on Chemistry*, describe inspiring discoveries performed by Galvanic, Volta, Franklin, Count Rumford, Priestley, Cavendish, and Davy, among other scientists. Despite the great number of underdeveloped theories, she did not mention the work performed by Dalton (1766-1844) related to the laws on chemical combination, which received the Medal of the Royal Society in 1826, due to her doubts about their validity.⁵ All the contents were nicely complemented with illustrations taken from Marcet's elegant drawings (for example, see Figure 3), who develop her drawing skills learning from Joshua Reynolds (1723-1792), a prominent member of the Royal Academy, the Royal Society and the Royal Society of Arts, and, from Thomas Lawrence (1769-1830), a student from the Royal Academy of London, both of them well-known English portrait painters.⁸

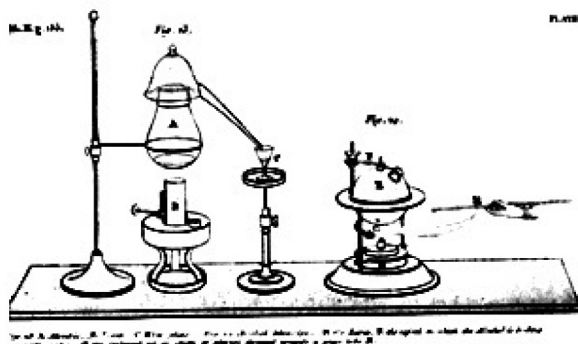


Figure 3. Apparatus for distillation of wine and combustion of alcohol, 1807 (Courtesy Edgar Fahs Smith Collection, University of Pennsylvania Library)

An important aspect denoting the impact of Jane Marcet regarding the diffusion of chemistry knowledge^{13,14} is shown in the scientific education of Faraday between 1809 and 1821, since it seems that Mrs. Marcet's *Conversations* together with *Encyclopedia Britannica* could have influenced his later work on electrochemistry.^{13,14} He knew about Marcet's book in its early editions in 1810, when Sir Humphry Davy's experiments on electrochemistry were discussed. Therefore, one could argue that she had an influence not only on Faraday's education^{14,15} but also encouraged the understanding of chemistry as a popular science.¹⁵

Marcet's desire to include the most up-to-date information is exemplified in her correspondence to Faraday dated on November 24th, 1845, requesting permission to incorporate his latest findings into her book.¹⁴ Faraday acknowledged Jane Marcet as a master and paid tribute to her memory when she passed away in 1858 in London, recognizing her long term efforts in science.^{14,16} Another remarkable reader of Marcet's works from the United States was Thomas Jefferson who mentioned that he had read her book.^{13,16}

In a practical sense, *Conversations on Chemistry* explains several principles of chemistry in a fundamental manner, which is a constant through the different editions of the book.

Conversations on Chemistry in the United States

Jane Marcet's book arrived to America a few months after the first English edition.^{10,13} From 1806 to 1850, twenty-three printings were made of several editions in different cities, such as Boston, Hartford, New Haven, Philadelphia and New York.⁵ Some changes from the original work were made; for example, the exclusion of humor and personal comments by Mrs. Bryan. The editors from the United States also added a system of questions at the end of each page, a glossary, guidelines for experiments, in addition to critical reviews that questioned the theories, drawings within the text, and experimental warnings. All these modifications carried out in American versions of *Conversations on Chemistry*, were made in order to present it as an early education textbook.^{12,14}

An important editor in the United States was J. L. Comstock (1789-1858, Figure 4), a former army surgeon during the 1812 war. Comstock commented on the fourth edition in 1818 anonymously, under the pen name of American Gentleman. This name only appeared until 1822. He had dedicated himself to editing textbooks on Chemistry, Natural History, Botany, Physiology and Mineralogy, and among them, *Conversations on Natural Philosophy*. Notably, the new editions also included the works from the American scientists Robert Hare and Benjamin Franklin, which had been absent in different editions of the Marcet's work. According to the editors, she had misinterpreted these authors' developments.⁵

The continuous competition among several editors originated sixteen editions between 1831 and 1850 and a highly imitative version,⁵ *New Conversations on Chemistry* by Thomas P. Jones, a chemistry professor from the Department of Medicine of Columbia College in Washington, leading to eighteen printings between 1818 and 1844.⁴ This version, despite of having some modifications from the original dialogue, was the only one that mentioned Marcet's name on the cover. This acknowledgement was omitted in other editions, even in the cases that claimed to be faithful copies of the authors which were examined and stamped by Charles A. Ingersoll, a District employee. For this reason, most copies of *Conversations on Chemistry* as a textbook in the United States, were attributed to the men who edited it.^{5,14}

Moreover, besides the sixteen American editions, *Conversations on Chemistry* had four publications in Paris, one in Geneva and one in Germany. In England, the use of the book was apparently as Marcet expected: a guide for popular readings of chemistry or natural philosophy. However, in the United States it became a successful textbook.^{17,18} In the first half of the 19th century, 160,000 copies were sold from all of its editions, which made her book one of the most important elements in school chemistry teaching, as commented by Rufus during the 25th anniversary of the American Society of Chemistry.¹⁷

At the time when the 16th English edition was released, Mrs. Marcet was 84 years old and her book had sold 20,000 copies in England, and an estimated total of 140,000 sales of the 15th and 16th editions in several countries.^{14,18} Certainly, the influence of Marcet's book as a guide textbook for basic chemistry was greater in the United States. The extensive use of *Conversations on Chemistry* suggested its wide acceptance by American educators to introduce discussions about the basic theoretical and experimental knowledge of science, encouraged by the attractive style used by the author, the wide-ranging nature of the contents that Mrs. B deals with, and the structure of reading (comments of the American editions, written by Comstock).¹²

Mrs. Marcet could not control the additions or modifications to her book in the numerous copies in the American market, nor did she receive any benefits for the sales of the American editions, due to the absence of a copyright law in the United States, which appeared in 1790 for national citizens, and a century later for foreign

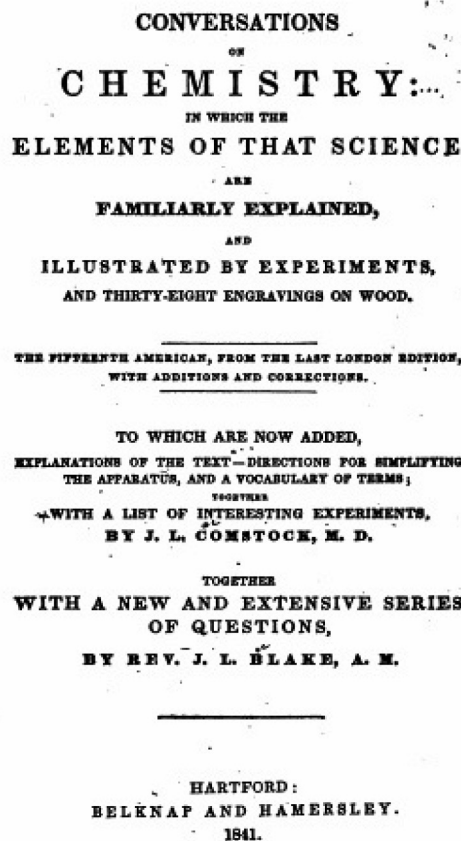


Figure 4. Title page from an American version of *Conversations on Chemistry*, 1843 (Courtesy of Biblioteca de Ciència i Tecnologia at Universitat Autònoma de Barcelona)

authors.^{2,15} After Jane Marcet's success, some textbooks related to her work appeared in the United States; *Fourteen Weeks in Chemistry* by J. Dorman Steele published 1867, which only dealt with the practical part of chemical knowledge needed in the schoolroom, the kitchen, the farm and the shop, and a male version of *Conversations on Chemistry*, called *Dialogues in Chemistry* by Jeremiah Joyce involved described dialogues between a male tutor and two young boys, Charles and James.⁵

CONCLUSIONS

The long-term effort of Jane Marcet crowned by *Conversations on Chemistry*, is a significant example of female participation in science in the early 19th century and their active role in scientific communication. Also, through the several editions of her book a rich testimony of the development of vast amount of chemistry theories developed by several scientists from the 19th century, in which she aimed to spread the chemistry knowledge from a selected group of scientists to a large diverse audience involving both children and woman.

Some comparisons of Marcet's book with Samuel Parker's book in England and with *Elements of Chemistry* by Edward Turner in the United States show that *Conversations on Chemistry* was not a book of home tips for housewives, but rather an important introduction to the chemical theories of that time and perhaps one of the most influential books for chemistry teaching.

The popular lectures and reading books about natural philosophy, astronomy, chemistry and botany legitimized little by little the inclusion of a female audience in the contemporary scientific theories. Jane Marcet's work popularized the knowledge and understanding of chemistry in United States, England and France, and contributed

notably to chemistry teaching through experimental demonstrations oriented to beginners of all kinds, being a historical witness of the chemical science development and how the current knowledge was generated.

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