OBSERVATION, EXPERIMENT OR AUTONOMY IN THE DOMESTIC
SPHERE? WOMEN'S FAMILIAR SCIENCE WRITING IN BRITAIN, 1790–1830

by

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This paper examines three female writers who chose to affiliate their educational scientific works with the ‘domestic sphere’: Priscilla Wakefield, Jane Marcet and Maria Edgeworth. It shows that within what is now broadly categorized as ‘familiar science’, differing motivations for writing, publishing and reading existed. Between 1790 and 1830 many educationalists claimed that the best way for children to learn was for them to exercise their memory on things encountered in everyday life. Religious allegiances, attitudes towards female science education and the utility of science in the home help to explain why these writers chose to introduce their readers to the illimitable world of science by setting their books in the seemingly restrictive domestic sphere. Furthermore, this paper argues that three different authors envisioned subtly different domestic spheres as settings for their work. Rather than there being a single homogeneous domestic sphere in which women and children received their education, and about which such authors wrote, there existed a multiplicity of domestic spheres depicted across the genre of educational science texts.

Keywords: domestic sphere; familiar science; science education;
Priscilla Wakefield; Jane Marcet; Maria Edgeworth

INTRODUCTION

This paper examines three female writers who chose to affiliate their educational scientific works with the ‘domestic sphere’: Priscilla Wakefield, Jane Marcet and Maria Edgeworth. It shows that within what is now broadly categorized as ‘familiar science’, differing motivations for writing, publishing and reading existed. Between 1790 and 1830 many educationalists claimed that the best way for children to learn was for them to exercise their memory on things encountered in everyday life. Religious allegiances, attitudes towards female science education and the utility of science in the home help to explain why these writers chose to introduce their readers to the illimitable world of science by setting their books in the seemingly restrictive domestic sphere. Furthermore, this paper

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argues that three different authors envisioned subtly different domestic spheres as settings for their work. Rather than there being a single homogeneous domestic sphere in which women and children received their education, and about which such authors wrote, there existed a multiplicity of domestic spheres depicted across the genre of educational science texts.

In the late eighteenth and early nineteenth centuries middle-class British women may well have been encouraged to retire to the private sphere and to domestic life,¹ but that withdrawal from the public sphere did not leave women bereft of scientific knowledge or purpose. A mother's education, including scientific education, of her children was integral to good domestic management in those many middle-class homes which accepted the advantages of teaching at home rather than in an institution.² Writers also recommended education on scientific topics as a way of enhancing women's abilities in the domestic sphere. Mary Wollstonecraft argued that middle- and upper-class young women should replace the novels, music, poetry and gallantry that made them slaves to their senses and, instead, exercise more properly their understanding, pursue fine literature, gardening—and experimental philosophy.³ Female writers, assuming the mantle of mother or governess, portrayed scientific activities as an extension of 'womanly duties'.⁴ Thus, the domestic sphere was a site for the diffusion of scientific knowledge;⁵ it was a space where everyday household objects and chores could be transformed into scientific lessons for children and adults alike.⁶

One way in which these opportunities and practices within the domestic sphere were reflected in science writing was through what Melanie Keene has called 'familiar science'. In the early nineteenth century, publishers were beginning to recognize that new commercial opportunities lay in the production of science texts aimed at the 'information-hungry' middle classes. Scientific works for general readers were produced and sold in Britain, across Europe and in the British colonies.⁷ To call published science writing intended for a wide readership 'popular science' is not without its problems,⁸ and the term 'popularization' has proved hard to disconnect from the idea of transmission of learned elite knowledge, perhaps in diluted form, to non-elite consumers.⁹ Keene's term helps to avoid these problems by making 'familiar science' texts those that deploy a conversational format and lessons that were centred on using everyday objects or were set in the domestic sphere.¹⁰ The authors I discuss tended, then, to avoid complex scientific jargon and instead adopt 'familiar' formats, in domestic environments, to establish a close relationship with their readers.

This paper builds upon earlier discussions of female naturalists, natural philosophers and, especially, science writers¹¹ to show that the domestic sphere, rather than being a homogeneous entity, was a creative resource for female writers, who represented it in a multiplicity of ways. I examine a group of female authors who collectively but distinctively re-imagined a variety of domestic spheres each of which was an arena for 'familiar science'. Although I draw in this paper upon the work of many authors, I have chosen to focus on three of the best known female scientific writers of this period, each of whom offered different ideas regarding education, especially scientific education, in the domestic sphere: Priscilla Wakefield (1751–1832), an English educational writer and member of the Religious Society of Friends; Jane Marcet (1769–1858), an English writer best known for her *Conversations* series; and Maria Edgeworth (1768–1849), a prolific Anglo-Irish author and educationalist.

How were these imagined domestic spheres, the venues of familiar science, equipped, moralized and organized? Were hygrometers, chemical cabinets and elaborate gardens in

easy reach of privileged characters—or did poorer figures make do with the simplest household items? Were such homes places of religious practice, with God's creation displayed, or sites of utility, with science beneficially applied to cookery? Were fictional beginners in science destined to remain passive recipients for ever or might they exercise the liberty to pursue their own interests, to challenge the authority of their siblings, friends and teachers? In this paper I argue that the works of Wakefield, Marcet and Edgeworth depicted varying domestic spheres within which the child's education, the role of women in science and pedagogy, and the values of science were all explored.

PRISCILLA WAKEFIELD: OBSERVATION, REFLECTION AND CONVERSATION IN THE DOMESTIC SPHERE

Priscilla Wakefield's books present a familiar, intimate and private relationship between parents and children in the domestic sphere. Wakefield used her own experiences of educating her children and grandchildren when she constructed familiar science texts for the middle classes and wealthier families.¹² Although Wakefield's works for children focus on the practical and on common sense, the author also made her books lively and entertaining.¹³ Wakefield's *Domestic Recreations: Or, Dialogues Illustrative of Natural and Scientific Subjects* (1805), epitomized her middle-class ideal of embracing scientific pursuits as a family and within the domestic sphere. From the comfort of their own home, Mrs Dimsdale's children, Emily and Lucy, view a collection of dried insects, use a microscope to inspect greenfly and hair-like insects, examine sea anemone specimens and observe a rainbow from a bedroom window, from which Mrs Dimsdale explains the refraction of light.¹⁴ Knowledge of Wakefield's Quaker beliefs helps us to understand why she situated her writings within the domestic sphere. Wakefield's emphasis upon the intimacy and closeness of the family, and her concern for women, as pupils and as teachers, is simultaneously present throughout her writing. This in turn dictated how the readers of her works were expected to mimic Wakefield's prescribed domestic sphere.

Wakefield stressed throughout *Domestic Recreations* that her goal was to instil the habit of reflection and encourage attentive observation in her readers, for without these skills 'books and instruction are of little avail to enrich the mind, though with it they are admirable assistants'.¹⁵ This emphasis on 'observation' and 'reflection' stemmed from Wakefield's Quaker affiliations.¹⁶ At the time Wakefield was writing, Quakers rarely cited the Bible in their discussions of the physical world, seeking instead to comprehend through the senses the observable world created by God.¹⁷ The design arguments typical of the period were used by Quakers; but Quakers placed a special premium on the direct experience of observing God's creation. In the opening of Wakefield's *An Introduction to Botany in a Series of Familiar Letters* (1796), Wakefield explained that her motives for writing the book were to:

cultivate a taste in young persons for the study of nature, which is the most familiar means of introducing suitable ideas of the attributes of the Divine being, by exemplifying them in the order and harmony of the visible creation.

Quakers emphasized that the end result of careful observation of the physical properties of a specimen was an appreciation of the beauty and artistry of the Maker. In *An Introduction to*

Botany, a clear and simple exposition of Linnaean classes, orders and genera is provided, but the true goal of imparting and receiving this scientific education is reinforced by Wakefield:

The finger of the Divine Artist is visible in the most minute of his works; let us be excited to observe them with the greatest attention; they will not only supply us with present amusement and wonder, but will serve as a hidden treasure to alleviate the solitude and wearisomeness of old age.

In *An Introduction to Botany*, a combination of books and natural specimens is used in the education of the young Felicia, but, as reiterated by Felicia herself, a greater emphasis is put on the experience of handling specimens than reading about them: 'I am fearful, my dear sister, that you are fatigued with these tedious definitions and descriptions of parts; to me they have been rendered more agreeable as I have become acquainted with them from visible objects.'¹⁸ Through the text's detailed descriptions, readers are informed of what they will be expected to discover in their own observations: an understanding of the physical properties of a flower, and an appreciation of the beauty of a flower as a creation of God. For Quakers, hands-on, experimental science was prized because it offered a chance to reveal more about the eternal purposes of God while avoiding the idleness of contemplation.¹⁹ Indeed, Mrs Harcourt, in Wakefield's *Mental Improvement* (1794), warns her children never to be unemployed: '[R]ead, draw, work, walk—accustom yourself to observe everything you see with attention.'²⁰ Wakefield's domestic sphere was a setting where there were no idle children; all members of the household could have, and were encouraged to have, direct experiences with nature every day.

Wakefield's religious affiliation with Quakerism motivated her to write scientific books aimed at women readers. Camilla Leach has argued that there was a prominent role to be played by women in both the public and private spheres of the Religious Society of Friends, as Quakers believed that the soul had no gender.²¹ However, although women had power and autonomy within the Quaker movement, their position was not one of equality. Science writing, especially of an elementary or introductory nature, gave women one of their few entrées to science and authorship.²² Nevertheless, the provision of science education within Quakerism does not appear to have been differentiated by gender. A firm belief in equality of elementary education for boys and girls is apparent in Wakefield's *Reflections on the Present Condition of the Female Sex* (1798). Echoing the words of Mary Wollstonecraft, Wakefield argued that women possessed the same mental powers as men, but did not know how to use them because their intellectual faculties had been confined by narrow and ill-directed modes of education. Wakefield remained concerned that women retain their modesty and decorum, but she did not see women's pursuit of various branches of science as impinging upon the 'peculiar characteristics of their sex'. Rather, in *Reflections* she claimed:

A knowledge of the customs and manners of different nations, geography, chemistry, electricity, botany ... may each in succession fill up a leisure opportunity with innocence and usefulness, and become a pleasing antidote to the indolent habit of loitering away time in an unprofitable manner ...

Wakefield considered 'showy, superficial accomplishments' to be redundant in marriage. Instead, she felt that women contemplating marriage ought to be educated in science to help them manage their domestic affairs, look after their husband's finances and educate their children. Wakefield considered maternal instruction to be preferable to education in

schools. Indeed, she considered it improper for children and women to be educated outside the family home: '[D]omestic privacy is the only sure asylum for the juvenile part of the sex; nor can the grave matron step far beyond that boundary with propriety.'²³ Wakefield's sentiments are reflected in *An Introduction to Botany* as Felicia does not venture beyond the garden and the adjacent fields or beyond a domestic arena in her scientific education.

However, Wakefield also warned women that excessive attention to their education would be detrimental to their domestic duties. For working women, Wakefield's *Reflections* recommended only basic literacy, numeracy and bible studies; there was little point learning mathematics beyond the level required for domestic book-keeping.²⁴ Wakefield did not see the need for a woman living in a poor household to attain a scientific education. Instead, Wakefield proposed that such a woman should be taught how to clean her house and how to wash and mend clothes 'to prepare them to become useful servants, or as the wives of labourers'.²⁵ Very different was Wakefield's portrayal of the domestic spheres of the middle to upper classes, where an intelligent and knowledgeable woman such as Mrs Dimsdale would conduct interesting experiments and instructional conversation with her children.

Finding out why readers chose Wakefield's books and how they used them is challenging. Aileen Fyfe has suggested that readers of Wakefield, or other educationalists, may have chosen to purchase the author's works because they harboured similar sentiments towards education, women and religion.²⁶ Potential purchasers associated different kinds of content and format with different publishers, and bought accordingly to suit their beliefs and values. The publisher of Wakefield's *Reflections*, Joseph Johnson, was renowned for publishing authors who were connected with the dissenting academies.²⁷ That said, Helen Braithwaite has argued that all too often Johnson has been presented as a 'radical', despite the fact that his list of authors was diverse.²⁸ Johnson's interest in serious didactic publishing for children continues to be solely attributed to having been fostered by dissenting educational writers such as Joseph Priestley and Anna Laetitia Aikin (Barbauld).²⁹ Due to internal divisions within religious communities, we cannot assume that all Quaker readers agreed with all of the content of the texts which Quakers distributed, nor did all Quaker writers agree with each other.³⁰ Wakefield's *An Introduction to Botany*, published by a Quaker, William Darton, went through 17 editions in the century after its publication; this book undoubtedly found its way into non-Quaker homes. This may be attributed to *An Introduction to Botany* being far cheaper than existing introductory texts; Wakefield hoped that it filled a niche in the market which other botanical writers had not adequately exploited.³¹ Moreover, changes in Quakerism throughout the eighteenth century paralleled the decline in their radical ethos and the emergence of Quakerism as a middle-class, family-oriented denomination.³² While Quakerism undoubtedly shaped Wakefield's writing, its impact on those who purchased or read her works is less decisive.

If we consider the format of Wakefield's books, we can see that they allowed readers to replicate Wakefield's idealized domestic situation for educating children. Science is endorsed by Wakefield as an everyday activity, which could take place without any specialist equipment within the family home. In the opening of *Mental Improvement*, Wakefield claimed that a 'judicious instructor will find matter for a lesson among those objects, that are termed common or insignificant'.³³ Having selected an object on which to focus, Wakefield promoted familial conversation about the object as a free and integral part of learning.³⁴ Despite Wakefield's emphasis on the use of 'common objects' found in

the family home, her educational scenarios were predominantly set in privileged households that could afford governesses, family outings and at least some scientific equipment.

In contrast, Harriet Martineau's *Household Education* (1848) depicted a domestic sphere without books, pens and paper to hand. Martineau suggested that mothers could use pins or peppercorns to teach their children to count, understanding that she could not expect a family to own any particular tools or materials. In rural properties, where the children routinely participated in daily chores and therefore had little time for book-learning, Martineau proposed that children could be taught the names of the trees, flowers and birds in their surroundings while they were working.³⁵ Martineau suggested throughout *Household Education* that, even in the poorest households, lessons were possible.

Wakefield's characters all enjoy science as a communal pursuit. In both *Mental Improvement* and *Domestic Recreations*, the entire family is engaged in scientific conversation. Every family member has a conversational role, a fact which may have made her books appealing to an intergenerational audience. In the preface of *Domestic Recreations*, Wakefield claims that when she selected subjects for the book she chose topics about which she felt a family would be likely to have extensive conversations.³⁶ Wakefield recommended these conversations be kept entertaining, instructive and short.³⁷ In *Mental Improvement*, Mr and Mrs Harcourt's children are always hungry for more knowledge, but their parents know when to end their evening conversations, despite Henry's begging: 'I am not very sleepy, and could sit a great while longer to hear papa tell us more about these large whales, and mountains of ice.'³⁸

Wakefield's didactic narratives have been compared to Christian catechisms in which children learnt answers to questions by rote, yet Wakefield gave her child characters a degree of autonomy. In *An Introduction to Botany*, Felicia recommends that her sister 'proceed step by step, and make [her]self perfectly acquainted with the classes' since 'science depends so much on memory and minute definitions'.³⁹ The question and answer format chosen by Wakefield might have separated teacher and learner, reinforcing distinctions between knowledge producers and consumers.⁴⁰ Yet in Wakefield's *An Introduction to Botany*, the learner, Felicia, becomes the teacher as she disseminates her newly acquired knowledge to her sister. Family conversation in *Mental Improvement* might appear to be driven by parents who chose the topics to be discussed.⁴¹ Perhaps this is why Wakefield's works have been compared to Sarah Trimmer's Christian catechisms of the 1780s.⁴² But the children in Wakefield's *Mental Improvement* do not lack freedom in their choice of studies. The daughter of the Harcourt family featured in *Mental Improvement* keeps and augments a cabinet of natural rarities of her own accord.⁴³ The same autonomy can be seen in *An Introduction to Botany* when Felicia discusses the dissection of flowers, for it is she who recommends which simple household tools should be used for dissection.⁴⁴ Wakefield's pupil characters were not passive recipients of their parents' or instructors' lessons. They were active participants in scientific activities to be copied by child readers.

In Wakefield's domestic sphere, science was taught under the guidance of parents, or a governess, and was to be enjoyed by children of both sexes as a rational pursuit in affluent households. Her dual concern with science and pedagogy was undoubtedly shaped by her affiliation with Quakerism. Throughout her educational books Wakefield's domestic sphere provided her pupils with ample opportunity to have direct experiences with nature. The outcome of such an education would be that children would gain an ever greater independent understanding of the world which God had created for them. Another

key ingredient for Wakefield's domestic sphere was the allowance of time for private, familiar conversation which would engage the family. Although her child characters appeared to have their own unique scientific interests, adults were ever-present to offer their guidance and support. However, Wakefield's opinions on what constituted the ideal domestic setting for scientific lessons were not shared by all of her contemporaries. In the following sections I explore alternative domestic spheres.

JANE MARCET: THE WELL-EQUIPPED DOMESTIC LABORATORY

Jane Marcet's 'familiar science' writing featured a country house, an authoritative mother figure and eager pupils with access to a ready supply of scientific materials. The roots of her husband, the Geneva-born chemist and physician Alexandre Marcet, partially explain why Marcet chose to situate her science writing within a domestic sphere. Geneva's social and political system reinforced the development of science among the ruling classes, and Genevan patricians were personally responsible for the education of their children. Girls were often educated alongside their brothers, and mothers took a leading role in their children's education and in their husband's work.⁴⁵ As I have suggested, a middle-class or elite education in a British home would often have involved 'familiar conversation' for the whole family to teach children subjects ranging from history to manners.⁴⁶ Jane Marcet's 'conversations' covered a vast array of topics, but her scientific conversations are her most well-known. Marcet's domestic sphere brought elements of the laboratory into the home in order to render scientific subjects approachable to her readers. Specifically, Marcet was aiming to introduce science into women's lives. Marcet also appears to have had a utilitarian motivation for providing women with a scientific platform within the home.

Jane Marcet's dialogue *Conversations on Chemistry* (1806) features an authoritative female mentor, Mrs B, and her novice pupils, Emily and Caroline. These characters and their discourse enabled readers to grasp the essentials of chemistry in the home. Marcet ensures that her readers first establish a basic knowledge of the subjects covered before attempting more complex topics. For example, when Emily questions Mrs B on why light causes endive to grow white instead of green, Mrs B encourages Emily's curiosity but responds with: 'This I cannot explain to you until you have obtained a further knowledge of chemistry.' Mrs B then promptly turns the conversation to a more basic explanation of heat and light.⁴⁷ Later Emily asks if Mrs B could show her an experiment 'in which liquids, by being mixed, become solid, and disengage latent heat'. Again, Mrs B informs Emily that she is 'not sufficiently advanced to understand them well'; but Mrs B makes it apparent that she is aware of many experiments of this nature and that she could perform them in the home.⁴⁸ The domestic sphere designed by Marcet did not prevent Mrs B from performing more complex experiments; a concern with her pupils' understanding did. Through Mrs B, Marcet made it clear that there was little point in carrying out an experiment when the purpose and result were not understood by its observers.

To develop the understanding of her readers, Marcet employed figurative illustrations and descriptions of sensory experiences from everyday life as familiar explanatory tools.⁴⁹ Hands are converted into scientific instruments: 'If you lay your hand successively on every object in the room, you will discover which are good, and which are bad conductors of heat, by the different degrees of cold you feel.'⁵⁰ The simplest objects are employed by Mrs B as aids in

defining scientific terms: a loaf of bread, for example, explains the difference between 'division' and 'decomposition'.⁵¹ In this period, common objects such as coal, pebbles, feathers, candles or, indeed, loaves of bread were all used to provide a familiar entry-point into the sciences. Existing knowledge could be exploited and reworked to 'open the eyes' of the audience to the wondrous world they inhabited.⁵² Hands-on experimentation with common objects is also recommended in *Conversations on Vegetable Physiology* (1829). Readers are told that they could ascertain the age of a tree by counting the layers at either end of a cut log. The character Emily admits to readers: 'I little thought I could ever have taken so much interest in a log of firewood.' Mrs B responds that 'when studied in a philosophical point of view, they are no less objects of interest and admiration'.⁵³

Despite the simplicity of these experiments with everyday things, the readers of Marcet's *Conversations* series were confronted with wealthy, educated characters that had access to expensive scientific equipment or luxuries. This is the same paradox which is presented throughout Wakefield's books. In *Conversations on Chemistry*, pieces of apparatus, such as a pyrometer and an air pump, and a wide variety of chemicals are used. When Mrs B explains the crystallization of carbon by displaying her diamond ring to her pupils she also reveals the wealth of some of Marcet's characters. Marcet also expected her readers to have access to certain scientific equipment. In a footnote to one experiment she recommended introducing a thermometer through a cork into a bottle to show how much water cools while boiling.⁵⁴ Many introductory chemical works in this period similarly required a combination of household equipment and apparatus purchased especially for the job.

Marcet assumed that her female readers would have received a limited education and therefore explained in the preface of her *Conversations on Chemistry* that she would be adopting the tried and tested format of familiar conversation:

Familiar conversation was, in studying of this kind, a most useful auxiliary source of information; and more especially to the female sex, whose education is seldom calculated to prepare their minds for abstract ideas, or scientific language.⁵⁵

Saba Bahar has argued that Marcet's address of an exclusively feminine audience, actually promoted the exclusion of women from any participation in intellectual and professional activity beyond an introductory level.⁵⁶ Bahar's critique of *Conversations* concluded that Marcet taught women to enjoy the pleasures of the rational mind and to participate in the conversational world of learning, but then did women a disservice by failing to encourage them to abandon domestic seclusion.⁵⁷ Marcet felt the need to publish her work anonymously for a number of years, and she was self-deprecating in her preface to *Conversations on Chemistry*: '[My] knowledge on the subject is but recent, and as [I] can have no real claims to the title of chemist.'⁵⁸ In the opening pages of *Conversations on Chemistry*, Mrs B warns her female pupils that pharmacy 'properly belongs to professional men, and is therefore the last that I should advise you to study'.⁵⁹ Since Marcet did not propose to inspire women to forge scientific careers outside the domestic sphere, I suggest it is inappropriate to criticize her work for failing to discuss the career prospects of a scientifically educated female. Rather than focus on authorial limitations, we might consider the benefits to women from reading Marcet's works and, in turn, gain a greater understanding of Marcet's audience. In a period when familiar conversation was highly valued,⁶⁰ Marcet taught women to 'participate in the conversational world of learning', providing a vital accomplishment for those in middle- and upper-class society,

whether or not they went on to apply their knowledge outside the domestic sphere. The domestic sphere which Marcet portrayed was, like that of Wakefield's literary creations, one of privilege. Marcet's imaginary households were ones in which educated and affluent adults participated in polite conversation with their children as an integral part of their offspring's upbringing.

Marcet's *Conversations on Chemistry* is a prime example of text which blurred the lines between private and public, or institutional, education and which easily found readers beyond British shores. The readers of Marcet's *Conversations* extended far beyond her named female audience: copies of *Conversations on Chemistry* have been discovered in libraries, colleges and mechanics' institutes.⁶¹ The instruction in *Conversations on Chemistry* promoted feminine interest in science to a level which exceeded that required for mere domestic efficiency.⁶² Discussions of the steam engine and agricultural science had little bearing on domestic chores. Marcet followed Antoine-Laurent Lavoisier's scheme of classification of the elements and she also cited the theories of contemporary natural philosophers and chemists. Marcet's focus on chemical theory and hands-on laboratory instruction for female beginners in *Conversations on Chemistry* may explain why the book was adopted by American academies over other texts which argued for domestic and religious applications of scientific knowledge.⁶³ However, the association between *Conversations on Chemistry* and the domestic sphere should not be dismissed. Marcet's promotion of science as a domestic activity and for a female audience created a forum in which her female readership could undertake chemistry. Marcet effectively brought the science of Humphry Davy into the domestic sphere because that was where she thought her intended audience would understand chemistry best.⁶⁴ With such a socially and culturally diverse readership, Marcet knew that no specialist knowledge was to be presupposed.⁶⁵ Marcet only included experiments in her *Conversations on Chemistry* which could feasibly be carried out by her readers, albeit in a well-equipped home. Therefore, Marcet pointedly accepted her exclusion from the public forum, and instead she chose to create a domestic sphere that specifically catered to teaching women scientific subjects.

Marcet's religious motivations appear, unlike Wakefield's, to be subsidiary in her science writing whereas questions of utility loom large. When Caroline asks Mrs B why they cannot create diamonds or why any attempt to create imitations of diamonds proves fruitless, Mrs B explains that a diamond's formation 'is a secret that rests in the bosom of the Creator'.⁶⁶ *Conversations on Chemistry* did not justify studying chemistry by appealing to the goal of revealing the Creator's works. Although Marcet implied in her *Conversations on Vegetable Physiology* that 'lessons of piety' are to be learnt in studying any natural science, the phrase appears almost as an afterthought when Caroline refers to botany as merely 'the dry classification of flowers'.⁶⁷ On the other hand, Marcet seems to have approached her writing with a more utilitarian purpose than Wakefield. *Conversations on Vegetable Physiology* provided useful information about soil, the structure of seeds and diseases in plants. A similar theme appears in *Conversations on Botany* (1817), a book probably resulting from a collaboration between Marcet and Sarah and Elizabeth Fitton. The anonymous author or authors of *Conversations on Botany* discussed the usefulness of botany for physicians by emphasizing the medical properties of specimens examined.⁶⁸ Such utilitarian motivations are common in contemporary literature aimed at female emigrants living in the British colonies. Catharine Parr Traill's *The Backwoods of Canada* (1836), for example, although not intended as an exclusively

scientific text, makes numerous references to the study of botany and to subjects which required a beginner's knowledge in chemistry; Parr Traill's female emigrant should 'become skilled in the arts of boiling sugar, candle and soap-making, the making and baking of huge loaves ... She must know how to manufacture *hop-rising* or *salt-rising* for leavening her bread'.⁶⁹ Books promoting science, and especially useful science, from within the domestic sphere might be popular in the most challenging environments beyond Britain.

It has been suggested that Longmans published *Conversations on Botany* as a rival to Wakefield's *Introduction to Botany*.⁷⁰ The books were roughly the same length. Both taught botany as a part of domestic education and both included plates and a table of the Linnaean classes. However, the authors of *Conversations on Botany* appealed to a wider audience. Instead of Wakefield's governess, Marcet's authoritative figure is a mother. Marcet did not assume that all of her readers would relate to being educated by a governess. Instead, a mother could read *Conversations on Botany* to her child without having any previous knowledge of the subject, and still have an active role in her child's education. Marcet chose a male character to be the pupil in her book, which may have been a ploy to make the text more attractive to children of both sexes. Unlike the expensive equipment that Marcet's characters use in *Conversations on Chemistry*, Edward and his mother in *Conversations on Botany* explore the botanical world using only a magnifying glass, a needle and a sharp pointed pen-knife.⁷¹ The main text reiterates the fact that many botanical specimens of the different Linnaean classes grow in the family garden.⁷² Once again, Marcet accepted the domestic parameters she had set for herself: in her exploration of a scientific subject, she created a domestic sphere where all the tools and specimens that she required could be easily located.

The publishers of *Conversations on Chemistry*, Longmans, had been leading members of the book trade since 1724, and they had always had some involvement with the trade in school books and educational works. On the back of publications like *Conversations on Chemistry*, Longmans became phenomenally large and powerful; Marcet's *Conversations on Chemistry* was so clear in its explanations and instruction that it was adopted as the favoured introductory chemistry book across many American classrooms.⁷³ In comparison, Marcet's friend, Mary Somerville, relished the specialist aspects of her writings in natural philosophy, and contemporaries remarked that Somerville wrote so expertly that she could not be understood by an audience outside the universities.⁷⁴ John Murray was reluctant to publish any more of Somerville's mathematically complex texts after her translation of *Mechanism of the Heavens*. Publishers recognized that more money could be earned from cosy, domestic narratives rather than intimidating, specialist books, particularly if these domestic narratives could be used by readers both at home or in schools. The messages which Somerville and Marcet sent out to their readers differed greatly. Somerville, rather discouragingly, in the opening of *Mechanism of the Heavens* informed her readers that 'a complete acquaintance with physical astronomy can only be attained by those well versed in the higher branches of mathematical and mechanical science'.⁷⁵ However, the readers of Marcet's *Conversations on Botany* were told that botany 'is so simple and pleasing a study, that the youngest persons can understand it, when properly explained to them'.⁷⁶ Nevertheless, Somerville recognized the value of Marcet's books in her *Personal Recollections, From Early Life to Old Age* (1874):

So many books have now been published for young people, that no one at this time can duly estimate the importance of Mrs. Marcet's scientific works. To them is partly owing that higher intellectual education now beginning to prevail among the better classes in Britain.⁷⁷

Somerville's praise suggests that Marcet's books had been most influential on the education of the middle and upper classes; but, as we have seen, the audience for Marcet's books extended far beyond these classes and, indeed, Britain.

In Marcet's domestic sphere, household activities were assimilated with scientific explorations in order to create a space where science could be made understandable to a reader with the most limited prior scientific knowledge. However, in order to make chemistry and botany suitable subjects to be taught in the home, Marcet had to bring elements of the laboratory and its paraphernalia into the domestic setting; her characters required access to a wide variety of chemicals and botanical specimens at home, far wider than that possessed by the majority of the population. The use of affluent characters and specialist equipment are notable similarities between Wakefield and Marcet's domestic spheres, but there are also a number of significant differences between them. Marcet stressed the practical purposes of attaining a scientific education, as opposed to Wakefield's more spiritual motivations. While Wakefield emphasized the benefits of familial conversation across all age groups in her domestic sphere, Marcet's domestic sphere tended to use a limited number of characters, and the control of the lessons lay with a lone authoritative figure. In short, their imagined domestic spheres were different.

MARIA EDGEWORTH: THE PURSUIT OF AUTONOMY AND CONTENTMENT THROUGH DOMESTIC EDUCATION

In his *Emile* (1762), Jean-Jacques Rousseau argued that children should receive a private domestic education, which involved the input of the mother, rather than a public education. Rousseau considered that the education which children received in the home was more 'wholesome' and 'sensible' than that in public schools and colleges, a belief not dissimilar to Wollstonecraft's in *A Vindication of the Rights of Woman*. A preference for domestic education is just one of the many Rousseauvian themes adopted in Maria and Richard Lovell Edgeworth's treatise *Practical Education* (1798). For Maria Edgeworth, science education in the domestic sphere could introduce children to rational principles through hands-on experimentation and it could also improve a woman's performance of her duties within the home. Edgeworth used the domestic sphere in her novels, alongside her instructional books, to highlight the dangers and the moral benefits that science could bring to the household and its constituents. Her *Harry and Lucy* series provided readers with her idealized vision of a child's scientific education; in Maria Edgeworth's domestic sphere, children were permitted time to explore the world of science without adult authority, they enjoyed access to innumerable books and a range of scientific equipment, and they were taken on interesting and educational family outings.

Rousseau, like Edgeworth, stressed the importance of self-reliance and on 'hardening' through experience: 'He wants to touch and handle everything; do not check these movements which teach him invaluable lessons. Thus he learns to perceive the heat, cold, hardness, softness, weight, or lightness of bodies.'⁷⁸ Inculcating this sort of independence in children flew in the face of other theorists who clung to the idea that children needed

to be instilled with the virtues of adulthood and have their vices condemned at a young age.⁷⁹ For example, Sarah Trimmer's *An Essay on Christian Education* (1812) advised that parental authority was needed when a child could 'run about from place to place, to lay hold of what he pleases, and to demand what he wants'. Trimmer feared that independence needed to be checked: otherwise it would 'produce a habit of wilfulness that will render him uncomfortable to himself and very troublesome to all about him'.⁸⁰ Edgeworth, on the other hand, argued that if children could apply their knowledge and exercise their senses through direct experience, then their interest would be held and they would be more likely to remember what they have been taught.⁸¹ This was particularly relevant in teaching chemistry to children; Edgeworth proposed that objects the 'principal properties of which may be easily discriminated by the senses of touch, taste, or smell' should be chosen.⁸²

The Edgeworths disagreed, however, with Rousseau on female education. Rousseau had written in *Emile* that 'woman is made to please and to be in subjection to men, she ought to make herself pleasing in his eyes and not provoke him to anger; her strength is in her charms, by their means she should compel him to discover and use his strength'.⁸³ Edgeworth, like Wollstonecraft and Wakefield, rejected the notion that women's education should focus on acquiring charming accomplishments; Edgeworth wrote that 'domestic happiness' ought to be preferred over training daughters in fashionable accomplishments for public admiration.⁸⁴ In Edgeworth's novel *Belinda*, published in 1801, the character of Lady Delacour blames her misfortunes on the fact that she had led 'a life of folly' and had had 'lovers in abundance'. Lady Delacour admits 'that in the midst of the utmost luxury and dissipation, she had been a constant prey to ennui; that the want of domestic happiness could never be supplied by that public admiration'. A deliberate comparison is made between the characters of Lady Delacour and Lady Anne Percival; Lady Anne is introduced to the reader as 'in the midst of her children' and is described as exhibiting 'unconstrained cheerfulness', while Lady Delacour's 'wit and gayety' seemed forced.⁸⁵ One reader of Edgeworth's works, writing under the pseudonym 'A Mother', echoed Edgeworth's sentiments in her own book on 'domestic education':

The unpardonable folly of women sneering at superior knowledge and talent in the gifted portion of their own sex, is as vulgar as it is ungenerous and unwise.⁸⁶

Edgeworth saw no reason for women to be idle at home; instead she validated the domestic sphere and celebrated women's 'private situation' as one in which women had the time for extensive reading which professional men lacked.⁸⁷ In her *Letters for Literary Ladies* (1795), Edgeworth does not challenge the notion of separate spheres for different sexes: rather, women's exclusion from the world of professional specialism allowed women to acquire the evenly developed and comprehensive knowledge necessary for meaningful conversation in the home.⁸⁸ *Belinda* sketched the ideological position that domestic life was the social ideal, and commitment to rational development of the female understanding was the surest means to happiness. It is through *Belinda*'s cultivation of her own rationality that she comes to recognize that domesticity 'could alone make her really and permanently happy'.⁸⁹ The domestic life which Edgeworth endorsed for women also entailed scientific education. In *Letters for Literary Ladies* chemistry is promoted as a science for women:

[Chemistry] is suited to their talents and to their situation. Chemistry is not a science of parade, it affords occupation and infinite variety; it demands no bodily strength, it can be pursued in retirement, it applies immediately to useful and domestic purposes.⁹⁰

The authors of *Conversations on Botany* (with Marcet likely among them) had applied the very same words to their discussion of the benefits of botanical education for women.⁹¹ *Letters for Literary Ladies* discussed scientific education and the development of rationality and reasoning within the limits of its application to the domestic sphere; Edgeworth's intent, like Marcet's, was not for women to aspire to careers in science; rather, the study of chemistry was to be applied to domestic tasks such as cookery.⁹²

Edgeworth was critical of those who used chemical experiments as a magic show; she argued that if a child were properly educated, he or she would find amusement in searching for the causes of observed effects rather than expressing blind admiration of tricks.⁹³ Edgeworth issued grave warnings about science in her novels, expressing particular concern over new dangers emerging in industrial spaces and about the disruptive potential created by new military technologies.⁹⁴ However, a more fundamental concern over the improper use of science in the domestic sphere can also be seen in Edgeworth's writing. In Edgeworth's *Forester*, published in 1801, a cat suffers a gruesome death when it knocks a bottle of sulphuric acid on to itself after the antagonist, Archibald Mackenzie, had idly removed the stopper in the domestic laboratory of the Campbell family. Similarly, in *Forester* an elderly woman passes out because of a pan of burning charcoal kept in her bedchamber—not, as an uninformed apothecary erroneously suggests, because of the proximity of a geranium. Provision of a scientific education in the domestic sphere was for Edgeworth a matter of life and death. The character of Henry Campbell in *Forester* exemplifies the finished product of an Edgeworthian education: as well as having 'more useful energy', Campbell 'was always employed, he was really independent because he had learned how to support himself either by the labours of his head or his hands; but his independence did not render him unsociable'. It is Campbell's superior knowledge that prevents the endangered elderly woman from repeating her mistake. Again, Campbell's scientific education allows him to explain the poisoning of a canary from everyday objects.⁹⁵ Accurate scientific knowledge thus illustrated, explained and limited the dangers of the domestic sphere.

Readers' responses to Edgeworth's pedagogical theories differed. *Practical Education* was commercially successful; three editions of the text were printed. However, the Edgeworths faced criticisms, particularly for ignoring the role of religion in science education,⁹⁶ even though they had explained that their silence on religious matters was necessary if they wished to address all parties rather than only one.⁹⁷ The Edgeworths did not share Wakefield's religious motivation to write about science and the domestic sphere, or indeed Sarah Trimmer's, who had insisted that 'nothing should be said to children of the principles of science, till they have been taught the first principles of religion, and have acquired a habit of thinking of God, and their duty'.⁹⁸ Trimmer's *Christian Education* also warned against the dangers of teaching chemistry and of texts which advocate experimentation.⁹⁹ Although Maria Edgeworth shared Trimmer's concerns over the safety of her readers, unlike Trimmer she faced the subject head-on and explored the dangers of experiments in her writings, so as to remedy any hazards.

For 'A Mother', seeing her children return time and again to the bookcase to read Edgeworth's books was a great comfort to her:

Very early in life, we discover which are the books that calm our feelings and fortify our virtue, and to those books we should resort, as to mental food and medicine. Miss Edgeworth's works have this effect in a very singular degree, and very young children are seen perpetually recurring to her pages.¹⁰⁰

The anonymous reader goes on to explain that instructional and rational books such as Edgeworth's, rather than books which exercised the reader's imagination, are 'most favourable to mental amelioration'.¹⁰¹ However, despite their lack of an obvious fantastical element, Edgeworth's books did attempt to combine education and entertainment. Edgeworth's *Harry and Lucy* series was written in a novelistic narrative format, taking a different approach to conversation from that taken by Marcet; Edgeworth's child characters conversed with each other far more than they did with their tutors. Edgeworth explained that this was because 'children can go on talking to one another much longer than they can bear to hear the address, however wise or eloquent, of one grown person'. In the preface of *Harry and Lucy Concluded: Being the last part of Early Lessons*, published in 1825, Edgeworth explained that the miscellaneous approach and domestic setting interspersed with trips to factories, mountains and other locations was to hold children's attention and create sufficient action. It is in accordance with Edgeworth's emphasis on immediate experience and observation that Harry and Lucy are taken out of the domestic sphere to view industrial processes first-hand. Harry claims that a trip to a cotton mill was made pleasurable by being able to recognize each part of the machinery from the engravings and descriptions which he had studied in the home.¹⁰² Despite Edgeworth's acknowledgement that a scientific education extended beyond the domestic sphere, the education which was received in the home was viewed as a building block for further studies; domestic education in science was necessary to render outings beneficial and interesting.¹⁰³

Like Wakefield's and Marcet's characters, Edgeworth's Harry and Lucy come from a privileged household; they have access to scientific instruments such as a portable barometer and hygrometer. It has been suggested, again, that *Harry and Lucy* invokes authority, rather than experience, as the source of learning;¹⁰⁴ yet Harry shows his autonomy by climbing a ladder on to the church roof to take readings using his portable barometer, and he is left doing the calculations once back on the ground. Harry's tutors encourage him to use scientific equipment, rather than watch an adult use it, and to work out his enquiries alone so as to inspire him to be independent. The character's decisions and actions truly reflect the Edgeworthian educational method; Harry has a direct involvement in the experiment and is granted autonomy from any adult involvement. Lucy, too, professes when using the air pump that 'there is nothing like working oneself; it fixes a thing so well in my memory I remember the look and touch of things much better afterwards'. It is only as a safety precaution that Harry and Lucy's father carried out an experiment for them which involved sulphuric acid. It could be said that Edgeworth did remove authority from the mother of Harry and Lucy by putting the father in charge of the experiment, when Marcet had entrusted experiments to the knowledgeable Mrs B in *Conversations on Chemistry*. Following the principles laid out in *Practical Education* and *Letters for Literary Ladies*, Lucy did receive a scientific education in *Harry and Lucy*. However, Lucy's scientific education was calculated to make her a better companion to a future husband and to ensure she was always self-improving. She is warned by her mother never to boast of her knowledge for that will make her 'troublesome and disagreeable'.¹⁰⁵ Harry did not receive the same warning.

The term 'pioneer' has been assigned to Maria Edgeworth for her theories on women's scientific education.¹⁰⁶ However, Edgeworth was not breaking new ground when she emphasized that scientific education for women was, first and foremost, to benefit their performance in the domestic sphere. While defending the virtues of rational improvement and understanding, Edgeworth tended to be accommodating of women's domestic situation and of the status quo. Prior to the Edgeworths' *Practical Education*, pedagogues had expressed their preference for home education above the public school to meet the needs of each individual child. In Maria Edgeworth's domestic sphere, the basic principles, dangers and usefulness of science could all be discovered, tested and put into practice. Children could experiment and learn with relatively little interference from family members and educational authorities such as the governess. A woman's happiness came from being able to apply knowledge, including scientific knowledge, to the domestic sphere in order to improve herself, her family and her home.

CONCLUSION

In this paper I have examined some of the different ways in which female writers placed 'familiar science' within the domestic sphere, commented on authors' varying motivations for writing in these ways and explained how the domestic sphere took on subtle but significant differences in each case. The case studies suggest that these varied writings, and inferred motivations, reflected wider contemporary debates. What role should religion play within scientific education? Should children be educated at home or in a public institution? Why should women be educated on scientific subjects at all? I have argued that the books under scrutiny projected the idea that a wealthy household, with educated occupants and a range of tools to work with, created the ideal variety of domestic sphere from which to provide women and children with a scientific education. None of my key authors actively encouraged women to embark on scientific careers, beyond the home and into the public sphere. Wakefield pictured women engaging with science within the domestic sphere for the benefit of their families. Marcet used a country house as her setting: her female readers were not leaving the domestic sphere to pursue scientific subjects. Edgeworth depicted the happiness which women could achieve if they were simultaneously rational and oriented towards the home.

The authors discussed in this paper advocated hands-on experimentation in the domestic sphere and paid tribute to contemporary science throughout their works. These writers made the presumption that their readers would have access to the same diverse set of tools and specimens as their privileged characters. Certainly these characters belonged to the wealthy and educated classes: they dwelled in expansive, rural homes under the instruction of a knowledgeable governess, or received their education from devoted parental tutors. Despite some similarities, the domestic sphere as imagined in familiar science texts was not an unchanging and uniform space. Each writer's domestic sphere was different, reflecting authors' divergence in the use of educational tropes, in their religious affiliations and in the roles assigned to their imagined tutors and learners.

The domestic sphere was sometimes depicted as a place of religious practice: Wakefield, consistent with Quaker beliefs, created a domestic sphere where children benefited from direct experience of science and the natural world to cultivate more general habits of observation and reflection. However, when Marcet and Edgeworth promoted scientific

education in the domestic sphere, their sights were set on utility more than religious practice. Scientific knowledge is learnt with the intention of being applied to household tasks such as cookery, gardening and the education of others.

Varied hierarchical distinctions existed within these imagined domestic spheres. Wakefield's characters tend to start their educational journey with very little scientific knowledge, only to learn and develop their skills to a point where they are able to convey their acquired knowledge to another beginner. This is most evident in those texts which adopted the format of a familiar conversation within the entire family as members contribute their own knowledge and thoughts to the discussions. Under these circumstances, the boundary between the teacher and learner is blurred; these books promoted the notion of sharing knowledge among non-elites without one teacher, or one figure, dictating what will be learnt. On the other hand, readers of Marcet are presented with a domestic sphere where the control of the lessons, the experiments and the conversation at hand is clearly delineated. Perhaps this explains why *Conversations on Chemistry* was favoured by American schools. Unsurprisingly, Edgeworth's philosophy that the curriculum should be tailored to meet the needs of the individual child was hard to maintain in a public school.

Pupils had varying degrees of autonomy in their studies within the domestic sphere: some were permitted an active role in their education, while others appear to be more passive. In Marcet's *Conversations* series, her pupil characters, Emily and Lucy, appear to hang on every word that the knowledgeable Mrs B says. The authoritative Mrs B never leaves, and rarely ceases guiding, her young pupils in their scientific pursuits at home. The children of the Harcourt family in Wakefield's *Mental Improvement* admit that they prefer conversation with their parents over the instruction of a governess. In Wakefield's depicted domestic sphere, being immersed in enlightening conversation as a family was an educational necessity for children. In contrast, Edgeworth's Harry and Lucy express an interest in learning without excessive interruptions from any authority figures; they are permitted more time to roam the domestic sphere with a degree of autonomy and in solitude while pursuing their scientific studies. In short, domestic settings abounded as spaces for familiar science in this period—but they were as varied as they were many.

Towards the middle of the nineteenth century, educational books in the dramatic and novelistic familiar format declined in popularity as they were coded as 'feminine' and tagged as 'non-science'. It has been argued that texts such as Lydia Becker's *Botany for Novices*, published in 1864, gave female readers a much wider field for knowledge, well beyond home and mother, with no geographical or mental restrictions.¹⁰⁷ However, the domestic sphere is not so limiting, or homogeneous, when what it could offer is taken into consideration. Authors presented their readers with domestic spheres that could feature a headstrong mother, sister or governess as a scientific authority; a space to put different teaching methods into practice; and children of both sexes taking an active role in their education by collecting specimens, dissecting plants, using specialist equipment and tools, and carrying out chemical experiments.

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NOTES

- 1 The proposal that there were fixed and separate 'public' and 'private/domestic' spheres has been questioned. See Leonore Davidoff and Catherine Hall, 'Introduction to the second edition of *Family fortunes*', abridged in *The cultural history reader* (ed. Peter McCaffery and Ben Marsden), pp. 14–28 (Routledge, Abingdon, 2014); Leonore Davidoff and Catherine Hall, *Family fortunes: men and women of the English middle class, 1780–1850* (Hutchison Education, London, 1987).
- 2 M. O. Grenby, 'Children's literature, the home and the debate on public versus private education, ca 1760–1845', *Oxford Rev. Educ.* **41**, 464–481 (2015).
- 3 Mary Wollstonecraft, *The vindication of the rights of women* (Penguin, Harmondsworth, 1972; first published 1792), pp. 150–152.
- 4 The reasons why women chose to become popular science writers are explored in Bernard Lightman, *Victorian popularizers of science: designing nature for new audiences* (University of Chicago Press, 2007), pp. 95–167.
- 5 See Donald L. Opitz, Staffan Bergwik and Brigitte Van Tiggelen (eds), *Domesticity in the making of modern science* (Palgrave Macmillan, Basingstoke, 2016). For the significance of venues other than the domestic for scientific participation, see, for example, Anne Secord, 'Science in the pub: artisan botanists in early nineteenth-century Lancashire', *Hist. Sci.* **32**, 269–315 (1994).
- 6 For a discussion of everyday objects in scientific lessons see Melanie Keene, 'Domestic science: making chemistry your cup of tea', *Endeavour* **32**, 16–19 (2008); and for further discussion of domestic science see Melanie Keene, *Science in wonderland* (Oxford University Press, 2015).
- 7 Introductory science texts had begun to appear in bookshops by 1730. See Marion Amies, 'Amusing and instructive conversations: the literary genre and its relevance to home education', *Hist. Educ.* **14**, 87–99 (1985).
- 8 For the readers and audiences of popular science see Jonathan R. Topham, "'Popular science" in early nineteenth-century Britain', in *Science in the marketplace: nineteenth-century sites and experiences* (ed. Aileen Fyfe and Bernard Lightman), pp. 135–168 (University of Chicago Press, 2007).
- 9 For the terms 'popularization' and 'popular science' see Roger Cooter and Stephen Pumfrey, 'Separate spheres and public places: reflections on the history of science popularization and science in popular culture', *Hist. Sci.* **32**, 237–267 (1994).
- 10 See Melanie Keene, 'Familiar science in nineteenth-century Britain', *Hist. Sci.* **52**, 53–71 (2014).
- 11 Barbara T. Gates and Ann B. Shteir (eds), *Natural eloquence: women reinscribe science* (University of Wisconsin Press, Madison, 1997); Barbara T. Gates, *Kindred nature: Victorian and Edwardian women embrace the living world* (University of Chicago Press, 1998); Graeme Gooday, *Domesticating electricity: technology, uncertainty and gender* (Pickering & Chatto, London, 2008); Suzanne-Le-May Sheffield, *Three Victorian women naturalists* (Routledge, New York, 2001); Ann B. Shteir, *Cultivating women, cultivating science* (Johns Hopkins University Press, Baltimore, 1996).
- 12 For Wakefield's private life see Bridget Hill, 'Priscilla Wakefield as a writer of children's educational books', *Women's Writ.* **4** (1), 3–15 (1997), at pp. 10–11.
- 13 Recent scholarship has challenged the perception that educators of the nineteenth century were merely 'dreary didactics' whose works forced the child's fantasy novel and fairy-tales off the nursery bookshelf. See, for example, Keene, *Science in wonderland*, *op. cit.* (note 6), pp. 1–20.
- 14 Priscilla Wakefield, *Domestic recreations: or, dialogues illustrative of natural and scientific subjects*, 1st edn (Darton and Harvey, London, 1805).
- 15 Wakefield, *op. cit.* (note 14), p. 14.

- 16 Wakefield's and writer Maria Hack's Quaker affiliations are explored in Camilla Leach, 'Religion and rationality: Quaker women and science education 1790–1850', *Hist. Educ.* **35** (1), 69–90 (2006).
- 17 Geoffrey Cantor, *Quakers, Jews and science: religious responses to modernity and the sciences in Britain, 1650–1900* (Oxford University Press, 2005), p. 232.
- 18 Priscilla Wakefield, *An introduction to botany in a series of familiar letters*, 6th edn (Darnton, Harvey and Co., London, 1812; first published 1796), pp. iii, 16 and 123.
- 19 Leach, *op. cit.* (note 16), p. 74.
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- 21 Leach, *op. cit.* (note 16), pp. 69–70.
- 22 For further information regarding women's role within Quakerism and science see Cantor, *op. cit.* (note 17).
- 23 Priscilla Wakefield, *Reflections on the present condition of the female sex; with suggestions for its improvement*, 2nd edn (Joseph Johnson, London, 1817; first published 1798), pp. 3–4, 6, 44–53 and 74.
- 24 Wakefield, *op. cit.* (note 23), pp. 74 and 108–122, esp. p. 118. It was not uncommon for women who were engaged in scientific pursuits to be accused of prioritizing study over domestic duty. See, for example, Alison Winter, 'A calculus of suffering: Ada Lovelace and the bodily constraints of women's knowledge in early Victorian England', in *Science incarnate: historical embodiments of natural knowledge* (ed. Christopher Lawrence and Steven Shapin), pp. 218–221 (University of Chicago Press, 1998).
- 25 Wakefield, *op. cit.* (note 23), p. 139.
- 26 See Aileen Fyfe, 'Reading children's books in late eighteenth-century dissenting families', *Hist. J.* **43** (2), 453–473 (2000), at p. 464.
- 27 Fyfe, *op. cit.* (note 26), p. 465.
- 28 For example, the deeply pious Anglican and educational writer, Sarah Trimmer, was encouraged by Johnson to write *An easy introduction to knowledge of nature, and reading the holy scriptures* (1781). See Helen Braithwaite, *Romanticism, publishing and dissent: Joseph Johnson and the cause of liberty* (Palgrave Macmillan, Basingstoke, 2003), pp. xii–xiii.
- 29 Braithwaite, *op. cit.* (note 28), p. 70.
- 30 See Jonathan R. Topham, 'Science, religion and the history of the book', in *Science and religion: new historical perspectives* (ed. Thomas Dixon, Geoffrey Cantor and Stephen Pumfrey), pp. 221–244 (Cambridge University Press, 2010), at p. 230.
- 31 Cantor, *op. cit.* (note 17), p. 210.
- 32 Cantor, *op. cit.* (note 17), p. 232.
- 33 Wakefield, *op. cit.* (note 20), p. i.
- 34 It has been argued that these conversations often developed from real scientific discussions. See Sam George, 'Animated beings: Enlightenment entomology for girls', *Br. J. 18th Cent. Stud.* **33** (4), 487–505 (2010), at pp. 488–489.
- 35 Harriet Martineau, *Household education* (Edward Moxon, London, 1848), pp. 189–208.
- 36 Wakefield, *op. cit.* (note 14), p. v.
- 37 Wakefield, *op. cit.* (note 18), p. iv.
- 38 Wakefield, *op. cit.* (note 20), p. 17.
- 39 Wakefield, *op. cit.* (note 18), p. 31.
- 40 For the mixed benefits of the question-and-answer format see Greg Myers, 'Science for women and children: the dialogue of popular science in the nineteenth century', in *Nature transfigured: science and literature 1700–1900* (ed. John Christie and Sally Shuttleworth), pp. 171–200 (Manchester University Press, 1989), at p. 176.
- 41 Fyfe, *op. cit.* (note 26), pp. 469–470.

- 42 For example, Sarah Trimmer, *An easy introduction to the knowledge of nature and reading the holy scriptures adapted to the capacities of children*, 1st edn (J. Dodsley, T. Longman, G. Robinson and J. Johnson, London, 1780).
- 43 Wakefield, *op. cit.* (note 20), p. 67.
- 44 Wakefield, *op. cit.* (note 18), p. 23.
- 45 For Marcet's relationship with the Genevan elite see Saba Bahar, 'Jane Marcet and the limits to public science', *Br. J. Hist. Sci.* **34**, 29–49 (2001), at p. 32.
- 46 Michèle Cohen, 'The pedagogy of conversation in the home: "familiar conversation" as a pedagogical tool in eighteenth and nineteenth-century England', *Oxford Rev. Educ.* **41** (4), 447–463 (2015).
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- 50 Marcet, *op. cit.* (note 47), p. 69.
- 51 Marcet, *op. cit.* (note 47), p. 8.
- 52 Keene, 'Domestic science', *op. cit.* (note 6), p. 16.
- 53 Jane Marcet, *Conversations on vegetable physiology (comprehending elements of botany, with their application to agriculture)*, 1st edn (Longman, Rees, Orme, Brown and Green, London, 1829), vol. 1, p. 54.
- 54 Marcet, *op. cit.* (note 47), pp. 262–266.
- 55 Marcet, *op. cit.* (note 47), p. vi.
- 56 Bahar, *op. cit.* (note 45), p. 36.
- 57 Bahar, *op. cit.* (note 45), p. 38.
- 58 Marcet, *op. cit.* (note 47), p. v.
- 59 Marcet, *op. cit.* (note 47), p. 4.
- 60 Cohen, *op. cit.* (note 46), p. 458.
- 61 Greg Myers, 'Fictionality, demonstration and a forum for popular science: Jane Marcet's *Conversations on chemistry*', in *Natural eloquence: women reinscribe science* (ed. Barbara T. Gates and Ann B. Shteir), pp. 43–60 (University of Wisconsin Press, Madison, 1997), at p. 46.
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- 63 Lindee, *op. cit.* (note 62), pp. 22–23.
- 64 Myers, *op. cit.* (note 61), p. 45.
- 65 Topham, *op. cit.* (note 8), p. 157.
- 66 Marcet, *op. cit.* (note 47), p. 267.
- 67 Marcet, *op. cit.* (note 53), pp. 27–28.
- 68 Jane Marcet, Sarah Fitton and Elizabeth Fitton, *Conversations on botany*, 2nd edn (Longman, Hurst, Rees, Orme and Brown, London, 1817; first published 1817), pp. 4 and 26.
- 69 Catharine Parr Traill, *The backwoods of Canada*, 4th edn (Charles Knight, London, 1839; first published 1836), pp. 183–184.
- 70 Shteir, *Cultivating women*, *op. cit.* (note 11), p. 92.
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- 79 See Elizabeth Harden, *Maria Edgeworth* (Twayne Publishers, Boston, MA, 1984), p. 29.
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- 85 Maria Edgeworth, *Belinda* (Oxford University Press, 1994; first published 1801), pp. 32–36, 69–70 and 98.
- 86 ‘A Mother’, *Thoughts on domestic education, the result of experience* (Carter & Hendee, Boston, MA, 1829).
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- 89 Edgeworth, *op. cit.* (note 85), p. 217.
- 90 Maria Edgeworth, *Letters for literary ladies*, 1st edn (J. Johnson, London, 1795), p. 66.
- 91 Marcet, Fitton and Fitton, *op. cit.* (note 68), pp. iv–v.
- 92 Edgeworth, *op. cit.* (note 90), p. 67.
- 93 See Kathryn Scantlebury and Collette Murphy, ‘Maria Edgeworth: nineteenth-century Irish female pioneer of science education’, *Irish. Educ. Stud.* **28** (1), 103–113 (2009), at p. 108.
- 94 See Sharon Alker, ‘Explosive potential: radicals and chemistry in Maria Edgeworth’s fiction’, *Eur. Rom. Rev.* **23** (1), 1–18 (2011).
- 95 Maria Edgeworth, ‘Forester’, in *The Pickering Masters: the novels and selected works of Maria Edgeworth* (12 volumes) (ed. Elizabeth Eger and Cliona O’Gallchoir), vol. 10, pp. 169–254 (Pickering & Chatto, London, 2003), at pp. 173, 176, 180 and 183.
- 96 Scantlebury and Murphy, *op. cit.* (note 93), p. 105.
- 97 Maria Edgeworth and Richard Lovell Edgeworth, *op. cit.* (note 81), p. viii.
- 98 Trimmer, *op. cit.* (note 80), p. 254.
- 99 Trimmer, *op. cit.* (note 80), p. 309.
- 100 ‘A Mother’, *op. cit.* (note 86), p. 146.
- 101 ‘A Mother’, *op. cit.* (note 86), p. 146.
- 102 Maria Edgeworth, *Harry and Lucy concluded; being the last part of early lessons*, 3rd edn (Baldwin and Cradock, London, 1837; first published 1825), vol. 1, pp. ix, x and 159.
- 103 See Grenby, *op. cit.* (note 2), p. 472. Edgeworth promotes education in the public sphere alongside the domestic sphere in her other works.
- 104 Myers, *op. cit.* (note 40), p. 181.
- 105 Edgeworth, *op. cit.* (note 102), pp. 6–7, 13, 24–27 and 95.
- 106 Scantlebury and Murphy, *op. cit.* (note 93), p. 103.
- 107 Shteir, *Cultivating women*, *op. cit.* (note 11), p. 230.