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Jane Marcet and the limits to public science

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Abstract This essay examines Jane Marcet's 1806 *Conversations on Chemistry* in the context of a newly emerging ideology of science. As part of this emergence, a new public for chemistry had to be formed and clearly demarcated from that of 'public men' of science. Although this essay examines Marcet's relation to Humphry Davy's public lectures on chemistry, it focuses on the encouragement she received from the highly intellectual Geneva elite, to whom she was related. Comparing her work to the influential *Bibliothèque britannique* founded by members of this elite, it asks why a group of patrician intellectuals would want to cultivate women's interest in chemistry and encourage the popularization of science in the aftermath of a revolution which threatened their national identity and power. It suggests that the answer may lie in the recourse to science to establish moral and political authority in the aftermath of this very revolution.

Jane Marcet (1769–1858) played a seminal role in popularizing the newly emerging disciplines of chemistry and political economy. Her 1806 *Conversations on Chemistry* went through sixteen editions in England and America and three acknowledged French translations. Remaining one of the most influential nineteenth-century textbooks in Britain and the United States, it reached students in prominent women's seminaries and earned the praise of more than one eminent scientist for the clarity and thoroughness of its exposition.[1] Marcet's 1816 *Conversations on Political Economy* was the first explicit attempt to render the subject accessible to the general public. It had a significant impact on many subsequent efforts, including those by Harriet Martineau and Millicent Garrett Fawcett. Less famous but equally influential are Marcet's other introductory books on botany, natural philosophy and mineralogy and her ventures, under the auspices of the Society for the Diffusion of Useful Knowledge, into didactic literature for the working classes and subsequently into works on history and science for children.[2]

Regardless of the variety of the subject matter and the different audiences addressed, Marcet's works are all characterized by her dedication to accuracy, precision and intellectual honesty. The copious notes she took on the most recent developments in the sciences and the voluminous correspondence she conducted with well-known men of science of the day to verify her explanations attest to these qualities.[3] Her own contemporaries, including novelist Maria Edgeworth and natural philosopher Michael

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1 For a discussion of the reception of *Conversations on Chemistry* in the United States and France, see M. S. Lindee, 'The American career of Jane Marcet's *Conversations on Chemistry*, 1806–1853', *Isis* (1991), **82**, 8–23. This article does not mention the role of the *Bibliothèque britannique* in introducing the work to French-language audiences, a point I hope to highlight here.

2 For a complete list of her works, see B. Polkinghorn, *Jane Marcet: An Uncommon Woman*, Aldermaston, 1993, 133–4.

3 Much of this material is preserved at the Archives Marcet, Fondation Guy de Pourtalès, Etoy, Switzerland (hereafter AM/FGP). I am grateful to Yvonne de Pourtalès for facilitating my access to it.

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Faraday, lauded her efforts in popularizing the new sciences. The latter, for instance, attributed his own interest in science to her *Conversations on Chemistry* and maintained a lifelong friendship with her.[4] Recent historians of science have reiterated this praise, contributing to her reputation as the most celebrated writer in a generation of women involved in presenting new scientific disciplines to a non-specialized reading public.[5]

Like other early women pedagogues, Marcet's primary interest in the dissemination of science lies in her desire to make it more accessible to women.[6] This interest cannot, however, be separated from the role this dissemination played in extending Enlightenment values to a larger public and from the impact this extension has on shaping the contours of emerging scientific disciplines. In response to the backlash that followed the French Revolution, reforming intellectuals worked to give a new social role to science. Although they were careful to insist on the public role of chemistry and its relevance to everyday life, they nevertheless drew clear boundaries between professional and general appreciation of the discipline. By exploring the social and intellectual context in which Marcet began her work, this article will examine the formation of these boundaries.[7] Situating her work in an international political economy of knowledge, it will focus on Britain's Royal Institution, whose public lectures on chemistry first aroused Marcet's interest in the subject, and on the encouragement she received from the highly intellectual Geneva elite, to whom she was related by birth and by marriage. Despite the geographic distance and the wartime embargo of the Napoleonic years, British and continental savants were nevertheless linked by a personal network of friendship and by a common shared scientific ideology: they were committed to promoting useful knowledge and to offering it as an alternative to political unrest. By examining this international intellectual network and its interest in Marcet's work, I hope to suggest that the debate on the education of daughters informed that on the formation of more 'reasonable' citizens.

Jane Marcet's Geneva background

Jane Marcet was born in 1769 to the Swiss (but not Genevan) Haldimand banking family settled in England (her mother was in fact English).[8] In 1799 she married Alexandre Marcet (1770–1822), a Geneva-born chemist and doctor who left for Edinburgh following the 1793 revolution in Geneva to undertake a course in medicine. When in 1798 the French annexed

4 See the claim made in L. Pearce Williams, *Michael Faraday: A Biography*, London, 1965, 19–20. Throughout his life Faraday acknowledged Marcet's influence. For instance, responding to her request for a ticket to attend his lecture in May 1846, Farady wrote, 'I do not send you a ticket because I wish you to understand that on mentioning your name You & a friend with you shall *always* pass here. I so have given order.' Cited in F. A. J. L. James (ed.), *The Correspondence of Michael Faraday*, 3 vols., London, 1996, i, 509.

5 See the account of Marcet's work given in D. Knight, 'Accomplishment or dogma: chemistry in the introductory works of Jane Marcet and Samuel Parkes', *Ambix* (1986), **33**, 94–8, which compares it favourably with that of her contemporary Samuel Parkes.

6 For an account of this tradition, see B. Gates, and A. B. Shteir, 'Introduction: charting the tradition', in *Natural Eloquence: Women Reinscribe Science* (ed. B. Gates and A. B. Shteir), Madison, 1997, 3–24.

7 In so doing, this essay seeks to complement the discursive approach adopted by G. Myers, 'Fictionality, demonstration, and a forum for popular science: Jane Marcet's *Conversations on Chemistry*', in *Natural Eloquence: Women Reinscribe Science* (ed. B. Gates and A. B. Shteir), Madison, 1997, 43–60.

8 Biographical information on Marcet is derived from Polkinghorn, op. cit. (2) and supplemented by my own research.

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his native country, he decided to settle in London. Descended from Huguenot refugees to the Protestant oligarchic republic, Alexandre belonged to a patrician family endowed with civic and political rights, denied to other increasingly dissatisfied social groups. As historians of the Republic have argued, eighteenth-century Geneva was marked by the unsatisfactory resolution of a series of political crises over access to these very rights.[9] Despite growing population pressures and debates over political representation, ruling patricians held ferociously to their privileges, refusing to integrate the *bourgeois*, *citoyens* and *habitants* into the political and civic process.[10] They thereby opened the way to a highly volatile distribution of power and to the 1793 events identified as the Terror, which was by no means as bloody as its French counterpart.

Although Alexandre's departure from Geneva for Edinburgh was precipitated by political events, he was nevertheless following a long tradition of intellectual exchanges between two great centres of Protestant learning. He carried letters of introduction to the Scottish moral philosopher Dugald Stewart from his brother-in-law and Academy of Geneva Professor Pierre Prevost (1751–1839)[11] and to the Scottish chemist Joseph Black from Jean De Carro (1770–1851), Louis Odier (1748–1817)[12] and Professor Marc-Auguste Pictet (1752–1825).[13]

The intellectual leanings of Alexandre's immediate family and friends are characteristic of Geneva's ruling oligarchy, which counted within its ranks many prominent natural philosophers of the eighteenth century. Numerous recent studies have attempted to explain this predilection and to relate it to social, political and ideological factors.[14] The presence of a powerful scientific community has been attributed to the heritage of Jean Calvin's

9 For a brief English-language account of the history of eighteenth-century Geneva, see L. Kirk, 'Genevan republicanism', in *Republicanism, Liberty, and Commercial Society, 1649–1776* (ed. D. Wooton), Stanford, 1994, 270–309.

10 These terms have a very particular meaning in the context of eighteenth-century Geneva and are related to access to political and civic rights. See L. Kirk, op. cit. (9).

11 Prevost taught, at different moments, belles-lettres, moral philosophy and natural philosophy at the Academy. Known today primarily for his work in heat and magnetism, he played an important role in transmitting English culture to a francophone public: he translated the works of Hugh Blair, Thomas Malthus and Dugald Stewart. He corresponded extensively with the latter two.

12 De Carro and Odier were Geneva-born, Edinburgh-educated medical doctors, who played, as Alexandre himself, a significant part in introducing the smallpox vaccine to the continent. See M. A. Barblan, 'La santé publique vue par les rédacteurs de la Bibliothèque britannique (1796–1815)', *Gesnerus* (1975), **32**, 129–46.

13 Pictet was a natural philosopher who wrote a book on fire. His scientific, cultural and political activities will be discussed below. Alexandre Marcet's private diaries provide further information on his contacts in Edinburgh. See AM/FGP, Alexandre Marcet's Memorandum (hereafter AMM) 1794 # 1. See also H. Sigerist (ed.), *Letters of Jean de Carro to Alexandre Marcet, 1794–1817*, Baltimore, 1950, 21–2, 26.

14 See, among others, C. Montandon, *Le Développement de la science à Genève aux XVIIIe et XIXe siècles: le cas d'une communauté scientifique*, Vevey, 1975; S. B. Taylor, 'The Enlightenment in Switzerland', in *The Enlightenment in National Context* (ed. R. Porter and M. Teich), Cambridge, 1981, 72–89; and J. Trembley, *Les Savants genevois dans l'Europe intellectuelle: du XVIIe au milieu du XIXe siècle*, Genève, 1988. Although it focuses on the early part of the century, M. Heyd, *Between Orthodoxy and the Enlightenment: Jean-Robert Chouet and the Introduction of Cartesian Science in the Academy of Geneva*, The Hague, 1982 provides an informative account of the institutional, political and intellectual background. See also J. G. A. Pocock, *Barbarism and Religion*, 2 vols., Cambridge, 1999, i, 50–72. Despite the differences between nearby Lausanne and Geneva, discussions of Swiss Protestant influence on the historian Edward Gibbon and the question of a 'Protestant Enlightenment' are relevant to the promotion of science in the Calvinist Republic.This account relies heavily on Montandon.

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Academy, to the arrival in the late seventeenth century of a highly qualified Huguenot community with a powerful international network, and to the support of local wealth derived from ventures in banking and international finance. Geneva's Protestant culture, with its insistence on work and on individual quest for truth, played an important role in promoting a rational and empirical appreciation of God's creation.

In contrast to neighbouring France, where science was more often than not the domain of the politically and socially disenfranchised, Geneva's social and political system reinforced the development of science among the ruling classes. Consider the local pedagogical practices. Unlike French aristocrats, Geneva patricians were personally responsible for the education of their children. This involvement must have played an important part in the transmission of intellectual values, cultural capital and the infrastructure necessary for scientific experimentation (the laboratories of certain families were better endowed than those of the Academy until well into the nineteenth century). Significantly, in a number of these patrician families, girls were often educated alongside their brothers, even though they were not destined to excel in the same public fashion (Marcet's own work appeared anonymously for a number of years).[15] Exposing patrician women to natural science played an important role in consolidating intellectual capital within the very restrictive oligarchic circles.[16] As mothers, they were able to reinforce the process of socialization. As wives, they were able to contribute to and participate in their husbands' work: Albertine de Saussure (1766–1841), daughter of the geologist Horace-Bénédicte de Saussure (1740–99), is said to have written her husband's, Jacques Necker's (1757–1825), lectures when he was named to her father's former chair at the Academy.[17] The women's educational background also rendered Geneva's salons far more stimulating than those in Paris. The latter's exhibitionism and intellectual shallowness remained an object of derision for more than one intellectual patrician visiting the French capital.[18] Finally, because of the high percentage of endogamous marriages, when intellectual transmission could not take place between father and son, it nevertheless rarely moved beyond immediate social circles and went instead to the son-in-law.

The strong system of patronage that governed intellectual transmission counterbalanced the free and open educational system established under Jean Calvin. But if existing social inequalities were certainly reinforced, the myth of a meritocratic society was never really questioned. On the contrary, existing reigning disparities were 'naturalized': the absence

15 For an account of the scientific education of daughters in patrician families, see the passing mention in C. Renevey Fry and J. Michaëlis (eds.), *En attendant le prince charmant*, Genève, 1997, 22–90 and the cursory summary in C. Campbell Orr, 'Albertine Necker de Saussure, the mature woman author, and the scientific education of women', *Women's Writing* (1995), **2**, 141–53.

16 The initiation of aristocratic and patrician women into natural sciences is not unique to Geneva and is in many ways characteristic of science in the eighteenth century. See L. Schiebinger, *The Mind Has No Sex? Women in the Origins of Modern Science*, Cambridge, MA, 1989, 37–66; and P. Findlen, 'Translating the new science: women and the circulation of knowledge in Enlightenment Italy', *Configurations* (1995), **2**, 167–206.

17 The claim made by the Geneva political economist J. C. L. Sismondi is cited in E. Causse, *Madame Necker de Saussure et l'éducation progressive*, Paris, 1930, 57.

18 See the comments made by Albertine de Saussure and her mother cited in E. Causse, op. cit. (17), 59–93. See also the comments made by Pierre Prevost cited in A. Cherbuliez, *Discours sur la vie et les travaux de feu Pierre Prevost, Ancien Professeur de Philosophie à l'Académie de Genève, Prononcé à Genève, à la Cérémonie des Promotions, le 12 août 1839*, Genève, 1839.

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of non-patrician families in the higher ranks of university scholars was attributed to 'natural' inferiority and not to social causes. This process was further intensified through the political limitations placed on non-patricians that prevented them from pursuing and realizing the Protestant values of a quest for truth and a sense of duty. Denying *citoyens* and *bourgeois* the right to political representation, the oligarchy discouraged them from reflecting on the common good and hence from pursuing their sense of duty to God and mankind. By curtailing civic responsibility in non-patricians, it also hampered the development of these values elsewhere, including scientific activity. Yet the absence of these aspirations and qualities was again attributed to natural and not social differences, allowing patrician intellectuals to cultivate an image of themselves as intellectually and morally superior citizens. The socio-political system and the scientific structures thus mutually acted upon each other to create a ruling class with a strong intellectual grounding and with an image of itself as an enlightened ruler.

Although this interaction between civic and intellectual life results from the particular circumstance of Geneva, the rise of a scientifically oriented political elite also reflects on the increasing authority and legitimacy accorded to science in the aftermath of the French Revolution and on the growing tendency to appeal to practical solutions in response to social disorder. Not surprisingly, this changing profile of the public man and the legislator has also been identified among the 'scientific Whigs' of Edinburgh and the founders of London's Royal Institution.[19] Needless to say, strong social and intellectual ties existed between these three intellectual communities, and a close examination of their respective histories reveals many similarities. Because of their Protestant background and despite linguistic and geographic differences, Geneva intellectuals upheld the British model against that of their powerful Catholic neighbour. Geneva savants were far more appreciative of the tradition of natural theology than was the case in France, and the English utilitarian and empirical tradition strongly counter-balanced French rationalism.

This influence is partly due to the educational exchanges between the two Protestant centres of knowledge. Throughout the eighteenth century, patrician families sent their sons to Britain as part of their education and, in the absence of a local medical school, many Geneva doctors were trained in Edinburgh. There they encountered a student body whose social profile was not unlike theirs. In addition to a shared Calvinist background, both Scottish and Genevan students originated from a landed gentry increasingly forced to seek new means of financial support. If, as Richard Sher has argued, the professional background of Scottish gentlemen is a crucial aspect of the Scottish Enlightenment, it is equally characteristic of Geneva intellectual life.[20] Even those who were subsequently to become natural philosophers were first trained as lawyers and clergymen.

The impact of the French Revolution on Geneva and the subsequent French annexation did little to sever the strong ties with Britain. Many moderate reformers forced into exile

19 On the Royal Institution, see M. Berman, *Social Change and Scientific Organization, The Royal Institution, 1799–1844*, London, 1978, although its socially deterministic model is being contested (see note 60 below). On the 'scientific Whigs', see L. S. Jacyna, *Philosophic Whigs: Medicine, Science and Citizenship in Edinburgh, 1789–1848*, London, 1994; and S. Collini, D. Winch and J. Burrow, *That Noble Science of Politics: A Study in Nineteenth-Century Intellectual History*, Cambridge, 1983, 23–62.

20 For the 'professional background' of the Scottish Enlightenment, see R. Sher, *Church and University in the Scottish Enlightenment*, Edinburgh, 1985.

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settled in London, where an expatriate Geneva community had already sought refuge following earlier political troubles. Etienne Dumont (1759–1829), Jeremy Bentham's translator and editor, and the diplomat and financier Francis d'Ivernois (1757–1842) are among the more famous. Other Geneva-based intellectuals, including the novelist Germaine de Staël, looked to England as an alternative to growing French imperialism. This was certainly the case of Marc-Auguste Pictet, professor at the Academy of Geneva, minister in the Imperial French government, and editor of *Bibliothèque britannique*, one of the most influential French-language journals during the war years. Although certainly a financial venture, the journal was also a key vehicle for the dissemination of British culture to the continent at a time when a strict embargo against British goods – and ideas – was enforced. The foundation of the journal and its continued existence, it has been argued, is 'symptomatic of powerful Anglo-Genevan ties…[and of] Geneva's refusal to bow to the fate reserved for it by its own and Britain's common enemy'.[21] Equally important is the journal's role in promoting new approaches to the sciences, not unlike those defended by the Proprietors of the Royal Institution. It is hardly surprising then that Pictet, in his account of his 1802 visit to Great Britain, praises the foundation of such institutions. The geography of his tour, which included centres of scientific learning in England, Scotland and Ireland, provides revealing indications of his political and intellectual sympathies among the enlightened landed gentry.[22]

The question nevertheless remains as to why a group of patrician intellectuals, including Pictet, would want to cultivate women's interest in chemistry and to encourage the popularization of science, particularly in the aftermath of a revolution which threatened their own national identity and their political power base. I would like to argue that the French Revolution incited them to justify their claims for 'natural' social differences and for their moral superiority by gesticulating towards the promotion of intellectual and political values amongst other groups. As before, this promotion was by no means as democratic as they claimed: patrician intellectuals played an important role in shaping the contours of the knowledge that was to be disseminated. It is here that I seek an explanation for their role in encouraging Marcet's work. As I shall argue below, this effort must be compared with other attempts at promoting and popularizing the new science and at promoting science as a new form of legislative and moral authority. By examining the limits these intellectuals imposed on women's access to chemistry, I hope to understand similar limits placed on chemistry's new public.

The rise of 'public' science (1): chemical conversations between the sexes

As the title of Marcet's work suggests, the book stages conversations between a female tutor, Mrs B, and her two female students, tellingly named Emilie and Caroline (Emilie is the feminine form of the hero of Rousseau's influential pedagogical reflections; Caroline is the name often given to a more frivolous female student). Mrs B exposes recent

21 D. M. Bickerton, *Marc-Auguste and Charles Pictet, the 'Bibliothèque britannique' (1796–1815) and the Dissemination of British Literature and Science on the Continent*, Genève, 1986, 23–4.

22 See M.-A. Pictet, *Voyage de trois mois en Angleterre, en Ecosse, et en Irlande pendant l'été de l'an IX (1801 v. st.)*, Genève, 1802.

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developments in chemistry, and the questions the young students ask call attention to particular issues and problems. There is, of course, nothing new in this recourse to dialogue to convey knowledge, dating as it does to the days of Plato. But 'conversations' also take on a particular meaning in the context of the polite culture of the eighteenth and early nineteenth centuries, where they evoke not so much what is transmitted as the art of doing so; where they refer less to the science of education than to social skills. If knowledge is essential for the courtier's conversation, even more so is the disposition of his words, which must derive primarily from a common and familiar idiom. Bernard le Bovier de Fontenelle had these distinctions in mind when he made one of the first attempts to popularize science in his 1686 *Entretiens sur la pluralité des mondes*. Wishing to 'discuss philosophy in a manner which is not philosophical',[23] he abandoned the ancient languages of Latin and Greek for modern French. Wanting to combine the useful and the agreeable, he presented his philosophical system in the form of a fictional conversation with a woman.

Yet, as historians of the eighteenth century have claimed often enough, Fontenelle addresses a woman not so much because women are his primary audience but because their education renders them more representative of the general reading public, with its limited knowledge of classical languages.[24] The conversation between the socially inferior philosopher and the aristocratic marquise marks the social acceptance of natural philosophy and launches its debut as a form of polite learning and a topic for social conversation. As such, Fontenelle's fictional female conversationalist does not only inaugurate the popularization of scientific knowledge. She also continues to demarcate what Anthony La Vopa has called the 'invisible social boundaries' between specialized and general learning.[25] In her conversation, the scientific knowledge of the Academician is forsaken in favour of a common ground for people from all walks of life. It thereby stakes a clear claim on natural science as a public science. Clearly, however, the need for a specialized community who can produce, generate and determine the contours of this public knowledge is by no means forsaken.[26]

Despite attempts to render science part of polite culture and sociability, it remained, as Jan Golinski has argued in his recent study on the history of chemistry in eighteenth-century Britain, fraught with the tension between its claim to be 'public culture', accessible to everyone, and its rhetorical form, which in fact excluded certain groups.[27] The highly equivocal meaning of 'public science' provides one way of appreciating this tension. For if 'public science' evokes an official, institutional and recognized knowledge, theoretically open to all, its very accessibility may incite a tendency towards vulgarization and over-simplification. This ambivalence raises the question of how public should 'public science' really be. Chemistry's inauguration into public culture merely created a paradoxical

23 '[T]raiter la Philosophie d'une manière qui ne fût point Philosophique'. B. Fontenelle, *Entretiens sur la pluralité des mondes* (ed. Alexandre Calame), Paris, 1966, 4. This translation and all that follow are mine.

24 See M. Delon, 'La marquise et le philosophe', *Revue des sciences humaines* (1981), NS, **182**, 65–78.

25 A. La Vopa, 'Conceiving a public: ideas and society in eighteenth-century Europe', *Journal of Modern History* (1992), **64**, 79–116.

26 See B. M. Stafford, *Artful Science: Enlightenment Entertainment and the Eclipse of Visual Education*, Cambridge, MA, 1994 on the didactic practices of the Enlightenment.

27 J. Golinski, *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760–1820*, Cambridge, 1992.

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situation, not unlike that encountered in Geneva. On the one hand, it upheld the ideology of an open science. On the other, it practised exclusion through forms of social reproduction (as in the patronage enforced at the Academy of Geneva and in the male social clubs where it was discussed) and through its rhetorical strategies (heavily indebted to the more masculine culture of classical learning and gentlemanly exchanges). Recent studies have demonstrated how such social and rhetorical practices have contributed to women's disappearance from modern scientific institutions.[28] What I would like to suggest is that in addition to this literal expulsion, women also became figures for the exclusion of other publics. The female public demarcates, in other words, not only a sexual difference but also a difference between a desired 'public science' (which is official and recognized) and an undesired 'public' for science. In other words, by addressing a feminine audience, changing scientific practice could affirm its accessibility and social stature. At the same time, it could exclude any further participation in intellectual and professional activity by drawing attention to undeniable difference, be it sexual or social. For as in the case of Fontenelle's earlier ventures, the contradictory gestures of exclusion and inclusion addressed not only women of the landed gentry, but also men of lower social ranks.

To what extent then were British and Genevan women of Marcet's generation actually encouraged to converse intelligently on chemistry? The answer is mitigated. Most British conduct books in the second half of the eighteenth century seem to be against any lessons on the subject. Hester Chapone, for instance, urges women to steer clear of the 'pedantry', 'severity' and 'preciseness' associated with scholars of the 'abstruse sciences'.[29] Although less adamant, Hannah More is still not entirely favourable. In her 1808 *Coelebs in Search of a Wife* she anticipates the response that a lady reader fresh from the Royal Institution might make upon hearing how Milton's Eve is banished from 'Raphael's fine lecture on astronomy'.[30] Avoiding the more central issue of the first mother's exclusion from a divine conversation on science, More's narrator indicates instead the advantage to Eve's absence during the second part of the conversation when Adam recounts their first sexual encounter.

Numerous examples of women instructed in natural philosophy and chemistry nevertheless suggest that these interdictions were often transgressed. Samuel Parkes's *Chemical Catechism*, published in 1806, the same year as Marcet's *Conversations on Chemistry*, was initially written for his daughter, even if the preface, addressed to the parents of sons, erases this fact.[31] Although a review article of Marcet's book regrets that English women do not excel as much in introductions to chemistry as they do in works of the imagination, it clearly indicates that hers is not the first of its kind.[32] Richard Lovell Edgeworth strongly recommended the work in preparation for professional medical

28 See L. Schiebinger, op. cit. (16); and D. Outram, 'Before objectivity: wives, patronage, and cultural reproduction in early nineteenth-century French science', in *Uneasy Careers and Intimate Lives: Women in Science, 1789–1979* (ed. P. G. Abir-Am and D. Outram), New Brunswick, 1987, 19–30.

29 H. Chapone, *Letters on the Improvement of the Mind, Addressed to a Young Lady*, 2 vols., London, 1787, ii, 121.

30 H. More, *Coelebs in Search of a Wife* (ed. Mary Waldron), Bristol, 1995, 11.

31 Knight, op. cit. (5).

32 [Anonymous], 'Conversations on chemistry, etc.', *Bibliothèque britannique* (1806), 363–83, 363.

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training.[33] Yet he also encouraged his own non-professional daughters to pursue studies in chemistry. Maria Edgeworth's private letters reveal how seriously the family pursued chemical experiments proposed by different didactic manuals,[34] and her father is said to have presented another daughter with Marcet's *Conversations on Chemistry* at the youthful age of nine, something which 'shock[ed]' the author herself.[35] Nor was this encouragement always limited to familial circles. Erasmus Darwin, R. L. Edgeworth's friend and fellow member of the Lunar society, included an outline in chemistry among the subjects to be taught in *A Plan for the Conduct of Female Education in Boarding Schools* (1797).[36]

Some knowledge about chemistry may well have been the rule among the daughters of the highly intellectual Geneva patricians.[37] Here too the encouragement was not entirely uncontested. Alexandre Marcet reports the experience of a family friend and fellow exile from Geneva, Mrs Schmidt-Meyer, whose husband and brother ridicule her attempts to discuss chemistry and physics by claiming that 'a woman should be satisfied by learning how to make pudding and by learning just a little bit of history and geography'. She nevertheless defends an education for women which forsakes the sublime deeds of a distanced past in favour of 'sciences [that are] relevant to all details of everyday life'.[38]

In Great Britain, Maria Edgeworth's 1795 *Letters for Literary Ladies* echoes Mrs Schmidt-Meyer's comments and openly vindicates introducing women to chemistry. Transposing her father's private letters to Thomas Day into a public defence for a woman's education in chemistry, Edgeworth presents an exchange of letters between a disciple of Geneva's Jean-Jacques Rousseau's sexually differentiated approach and a father who upholds women's rationality. The former believes that women's education should prepare them for marriages where they submit to the dictums of their more knowledgeable and rational husbands. He therefore denies his daughter both knowledge of the world and training in using her mind. Whereas his correspondent does not challenge the belief that the husband should have the last word, he nevertheless asserts that women should be trained to think for themselves. After arguing that he wishes to give his daughter 'the habit of industry and attention, the love of knowledge, and the power of reasoning' through the study of science,[39] he vaunts the specific advantages of chemistry even more:

> Chemistry is a science well suited to the talents and situation of women; it 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: and whilst the ingenuity

33 R. L. Edgeworth, *Essays on Professional Education*, London, 1809, 206

34 A. J. C. Hare (ed.), *The Life and Letters of Maria Edgeworth*, 2 vols., London, 1894, i, 34–5.

35 M. Edgeworth, *Letters from England, 1813–1844*, (ed. Christina Colvin), Oxford, 1971, 65.

36 E. Darwin, *A Plan for the Conduct of Female Education in Boarding Schools*, Derby, 1797.

37 See Renevey Fry and Michaëlis, op. cit. (15), 22–90 and the cursory summary in Campbell Orr, op. cit. (15). Valerie Cossy has called my attention to a journal kept by Pierre Prevost's brother which documents his efforts in educating his son. It also occasionally alludes to his daughter's initiation into natural philosophy.

38 '[U]ne femme devoit se contenter d'apprendre à faire des puddings en y joignant tout au plus un peu d'histoire et de géographie'; 'sciences qui s'applique [*sic*] à tous les détails de la vie'. AM/FGP, Alexandre Marcet's notebooks (hereafter AMN) # 2, f. 136.

39 M. Edgeworth, *Letters for Literary Ladies, to which is added An Essay on the Noble Science of Self-Justification* (ed. C. Connolly), London, 1993, 20–1.

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> of the most inventive mind may in this science be exercised, there is no danger of inflaming the imagination, because the mind is intent upon realities, the knowledge that is acquired is exact, and the pleasure of the pursuit is a sufficient reward for the labour.

This eloquent plea to extend the boundaries of women's knowledge nevertheless sets new limits by insisting on the ends of women's education. Edgeworth is less interested in producing female chemists than in using chemistry to ensure that women cultivate their rational faculties and curtail their frivolities. The woman who pursues chemistry is not a woman of display; she is domestic and useful. Focused on the details and variety of chemical activity, her mind is not likely to wander into the dangerous world of the imagination. Although 'the pleasure of the pursuit' is emphasized, so too are the labour and productivity inherent in the activity. But its utility lies less in a particular chemical end-product than as a means to exercise the mind towards a general end. Women's induction into chemistry, in other words, was not meant to prepare them for public office or medical practice. Instead, they were taught to enjoy the pleasures of the rational mind and to participate in the conversational world of learning, halfway between domestic seclusion and public societies.

Jane Marcet undertakes this delimited initiation into the pleasures of the rational mind in her 1806 *Conversations on Chemistry*. In the preface, she invokes the inspiration for her work. Although she lays 'no real claims to the title of chemist', she nevertheless notes how Humphry Davy's lectures at the Royal Institution authorize her efforts. 'She felt encouraged', she writes, 'by the establishment of those public institutions, open to both sexes, for the dissemination of philosophical knowledge, which clearly prove that the general opinion no longer excludes women from an acquaintance with the elements of science'.[40] Yet despite this recognition of women's inherent rationality and of the sexually egalitarian practice of certain scientific institutions, Marcet also acknowledges that women members of the public had difficulty following the lectures, something she did not encounter thanks to her previous exposure. Earlier conversations with a 'friend on the subject of chemistry' had prepared her for distinguished lectures on it. Which is why, she explains, when seeking for a mode to present knowledge to a specifically female readership, unacquainted with 'abstract ideas' or 'scientific language', she turns to the 'familiar conversation', thereby tracing 'the steps by which she had acquired her little stock of chemical knowledge…to record, in the form of dialogue, those ideas which she had first derived from conversation'.[41]

If this juxtaposition between familiar conversation and abstract ideas certainly evokes Fontenelle's earlier *Entretiens*, the intervening hundred years have reconfigured the genre. The setting has been transposed from 'the salons to the domestic routines of an emergent middle-class'.[42] It is no longer a philosopher who entertains a marquise, but rather a woman who speaks to two young girls. Although not the students' mother, Mrs B certainly belongs to what Mitzi Myers has called the 'mentorial tradition of the moral mother'

40 J. Marcet [Anonymous], *Conversations on Chemistry*, London, 1806, pp. vii–viii.

41 Marcet, op. cit. (40), pp. iii, ix.

42 A. B. Shteir, 'Editor's introduction', in *Priscilla Wakefield's Mental Improvement* (ed. A. B. Shteir), East Lansing, 1995, p. xvii.

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present in much of the didactic literature for young women.[43] Not only is her intellectual authority more important than her moral authority, her scientifically informed and serious comments also demarcate her from Fontenelle's French philosopher. Whereas he spices philosophy with pleasure, moving from his abstraction down to the marquise's concrete experience, Marcet traces the steps from her concrete experience in conversation up to the lofty heights of philosophical chemistry.

This detour away from French frivolity is one of the qualities admired by Marcet's Geneva mentors. Commenting on both the first English edition and on the extracts that appeared in the Geneva-based journal *Bibliothèque britannique*, Alexandre's brother-in-law, and Academy of Geneva Professor, Pierre Prevost compares it favourably with Fontenelle's earlier venture:

> It cannot be denied that they [*Entretiens*] are witty; but the affectation of gallantry which predominates is childish when dealing with this subject! I find it in bad taste, no matter what is said. And since his physics is bad, it is a waste of time…You will make a far better genre fashionable: because only that which is reasonable is good. And only that which unites grace and charm with reason is perfect.[44]

Prevost invokes here the changing direction scientific popularization must take, moving away from the gallantry of Parisian salons towards more austere and authoritative works, grounded in reason. He certainly does not deny the importance of an elegant and cultivated style that conforms to rhetorical conventions. Elsewhere in his letter he complements Marcet on it, invoking his own experience as a translator as a point of comparison. Yet, echoing Edgeworth's comments on the relevance of chemistry for forming rational women, Prevost's primary concern is to avoid the dangers of seduction and pleasure. Reason plays a key role in containing any wayward potential. These concerns are all the more important when considered in the aftermath of the French Revolution, when the seductive dangers of bad philosophy were blamed for causing social disorder. They are equally relevant to the explosive potential of fashionable and frivolous women, to whom I shall shortly return, sitting in Davy's Royal Institution audience.

Despite Marcet's desire to stamp her work with seriousness, to avoid the seduction of philosophy in favour of the clarity of reason and to contain the frivolity of chemistry's female public, like Edgeworth she too sets boundaries on the kind of knowledge that the amateur female chemist should acquire. When Caroline objects to studying sciences which 'are confined to the minutiae of petty details', Mrs B warns against assimilating chemistry to the 'narrow precincts of the apothecary's and perfumer's shops' and against 'confin[ing] [it] to works of art'. Chemistry has its place, she insists, in elucidating the mysteries of nature and herein lies its relevance for women; 'without entering into the minute details of practical chemistry,' Mrs B tells her students, 'a woman may obtain such a knowledge of the science as will not only throw an interest on common occurrences of life, but will

43 See M. Myers, 'Impeccable governesses, rational dames, and moral mothers: Mary Wollstonecraft and the female tradition in Georgian children's books', *Children's Literature* (1986), **14**, 31–59.

44 'On ne peut nier qu'il n'y ait de l'esprit; mais que toute cette affectation de galanterie qui y regne est puérile dans un tel sujet! Je la trouve de mauvais goût, quoiqu'on en puisse dire. Et comme sa physique est fort mauvaise, c'est un ouvrage perdu … Vous mettrez à la mode un beaucoup meilleur genre: car il n'y a de bon que ce qui est raisonnable. Et il n'y a de parfait que ce qui unit à la raison la grace & l'agréement.' Letter to Alexandre Marcet, 13 August 1806, Bibliothèque publique et universitaire de Genève (herafter BPU/Ge), MS Fr 4735, ff. 65–6.

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enlarge the sphere of her ideas, and render the contemplation of nature a source of delightful instruction'. In addition to this discourse derived from natural theology, Marcet also reiterates a focus on useful chemistry. Given the 'innumerable inventions and discoveries…[which] have so greatly stimulated industry and facilitated labour, as…to increase the luxuries as well as the necessaries of life', she writes, not only does the chemist examine the natural universe; his laboratory also produces and improves human artefacts.[45]

If Mrs B wants her students to appreciate chemistry's relevance to the 'necessaries of life', she nevertheless cautions against intruding on these domains. The 'minutiae of petty details' involved in the preparation of medicines, she insists, 'properly belongs to professional men, and is therefore the last I should advise you to study'. Marcet's conversation thus both popularizes the new science and demarcates the boundaries between specialized and general knowledge. Women are only granted the knowledge required to recognize the relevance of chemistry but not enough to exercise the science or the art. Although they are certainly solicited to become chemistry's appreciative new public, they are not invited to become its public spokespersons and to exercise a legislative role in determining the contours it will take.

Marcet's attempt to delimit the dangerous seduction of (bad) philosophy and to contain women's public knowledge appears in her explicit reference to the way in which she derives her own understanding of chemistry. Consider the 'friend' Marcet mentions in her preface. She may well be referring to her husband, or so claims Auguste De La Rive (1801–73), an eminent Geneva savant and rector of the Academy, who wrote her obituary (although significantly he speaks of her 'master').[46] Alexandre's private notebooks and correspondence indicate how closely involved he was in the production of the book. Among other things, he corrected different drafts and invited other colleagues, of whom more below, to do so as well. This involvement implies that Marcet's friend is not simply her husband but the entire scientific community in which he worked. In this sense, Marcet's interest in chemistry cannot be reduced to a mere fashion, as was the case with other, more prominent ladies who attended Davy's public lectures at the Royal Institution. On the contrary, monitored by professional men of science, her didactic project was clearly integrated into their activity.

In more than one way, Alexandre Marcet's biography strongly parallels that of the emerging professional chemist, from whose terrain Mrs B excludes women. Divested from his financial base as a result of the Geneva Revolution, his interest in chemistry was not purely intellectual. Until his wife inherited a substantial fortune from her banker father, he was obliged to work. He taught chemistry to the medical students at St Guy's, in one of the first attempts to extend William Cullen's Edinburgh approach to the London metropolis. He also attempted to commercialize mineral spring water. The promotion of the therapeutic value of waters by referring to the authority of chemical analysis is another recognized moment in the emergence of professional chemists.[47] A close friend of Edward

45 Marcet, op. cit. (40), 2–5.

46 Marcet, op. cit. (40), 4; A. De La Rive, 'Madame Marcet', *Bibliothèque universelle* (1859), 1–21, 5.

47 N. G. Coley, 'Physicians and the chemical analysis of mineral waters in 18th-century England', *Medical History* (1967), **26**, 123–44.

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Jenner, Marcet played an important role in introducing the smallpox vaccine to the continent, relying on his childhood friends from Geneva to do so.[48] Here he was motivated as much by financial as by ideological interest. By promoting a solution to widespread disease, he insisted on the relevance of medical and scientific knowledge and hence of the social role of practitioners. By interacting with an international community despite nationalist enmities, he promoted an image of professional men of science as offering more satisfactory solutions to human misery than politicians. Needless to say, many of Alexandre's British-based friends and colleagues, including George Pearson (1751–1828), William Saunders (1743–1817) and John Yelloly (1774–1842), have similar profiles.[49] They all undertook scientific projects that were at once intellectual, financial and ideological.

These professional men of science were eager to promote, as Humphry Davy was doing, a new ideology of science. They wanted both to ensure the social acceptability of their more specialized science and to determine the contours in which general knowledge would circulate. They wanted to lift the apparently more practical science of chemistry from a mere craft to the status of a philosophical and legislative authority. They also wanted to determine and monitor who exactly would be allowed to enter into those authoritative ranks. Before turning to this exclusion, I would like to examine more closely the rise of a new ideology of chemistry and the men involved in promoting it. The account of how the study of chemistry was slowly integrated into the curriculum of the rational middle-class woman needs, in other words, to be complemented by summarizing the now well-documented account of chemistry's increasingly important role in the formation of public men.[50]

The rise of 'public' science (2): chemistry and the wise legislator

Under the auspices of the Royal Society, chemistry had long been relegated to a subsidiary branch of natural philosophy. Its theoretical independence and its inclusion amongst the polite knowledge of the gentleman was further contested because of its long affiliation with the practical arts and techniques of the professional apothecary, the doctor and the pre-industrial artisan. Tensions amongst natural philosophers in the course of the eighteenth century opened the way for the emergence of chemistry as a distinct branch of knowledge. During his tenure at the University of Edinburgh, William Cullen exploited this opening and insisted that the study of chemistry be integrated into medical education. He thereby contributed to the development of one of the most celebrated and systematic academic training programmes in Europe.

48 See the preface to G. Miller, *Letters of Edward Jenner, and Other Documents Concerning the Early History of Vaccination*, Baltimore, 1983; and Sigerist, op. cit. (13).

49 Like their friend and colleague, all three men were educated at Edinburgh, moving to London to pursue careers in medicine and chemistry. Pearson shared Alexandre's interest in commercializing spring water and in promoting the smallpox vaccine. Saunders (who also taught at St Guy's) and Yelloly, along with Alexandre, were founding members of the Royal Medical and Chirurgical Society. See *DNB* entries. Golinski, op. cit. (27), 236–87 discusses the profiles of professional chemists, mentioning in passing some of Alexandre's friends.

50 The following account of the rise of philosophical chemistry in the British tradition relies heavily on A. L. Donovan, *Philosophical Chemistry in the Scottish Enlightenment: The Doctrines and Discoveries of William Cullen and Joseph Black*, Edinburgh, 1975; R. Bud and G. K. Roberts, *Science versus Practice: Chemistry in Victorian Britain*, Manchester, 1984, 19–47; and Golinski, op. cit. (27).

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The 'philosophical chemistry' Cullen promotes emerges in reference to intellectual preoccupations affiliated with the Scottish Enlightenment. Like his friend and colleague Adam Smith, Cullen was worried that excessive specialization might not only encourage over-dependence on the knowledge and authority of the specialist but also encourage a society organized around private interest and the particular concerns of craftsmen and practitioners to the detriment of the common good. To counter this tendency, he urged that the 'great number of useful facts…scattered in many different books' be 'collected and arranged in a proper order', thereby organizing them into a philosophical system.[51] As such he accords to the study of chemistry a legitimacy independent of the 'narrow plan' in which it is taught and the immediate purpose it serves. This approach to the study of chemistry combines practical information devoted to medicine and artisanal improvement with general knowledge committed to the advancement of knowledge and truth.

Cullen's success at elevating chemistry to a philosophy and an object of study for landed gentry resonates in the final decade of the eighteenth century when chemistry was one of the most popular subjects for discussion among the oppositional 'scientific Whigs' of Edinburgh. Francis Horner, the Whig politician and co-founder of the prestigious *Edinburgh Review*, intimated that the appeal of chemistry lay in its promise to develop philosophic principles and to encourage their application to other aspects of everyday life. Corresponding with his brother in 1803, he advised him how to organize his studies:

> Only remember, that an evening for your purposes, may be far more profitably employed in labouring to comprehend a general theory or exposition of great natural phenomena, or to detect the fallacy of an inaccurate hypothesis, than in watching the manipulation of a process which you perfectly understand, but which you cannot qualify yourself perfectly to execute. You have to render yourself a man of liberal information and of a cultivated understanding, not a dexterous apothecary.[52]

Writing several years after Edgeworth's *Letters* and prior to Marcet's *Conversations*, Horner invokes a similar insistence on the general skills in reasoning that chemistry will provide. Echoing their comments with respect to women's education, he appears less interested in forming professional chemists and more in pursuing chemistry as a form of mental exercise directed at developing his skills at abstraction. Significantly, this capacity will allow the intellectual faculties to extend their focus to new domains by comparing present work with 'future discoveries and improvements'. It is thus both by developing individual skills at abstraction and by recognizing its concrete application elsewhere that the study of chemistry contributes to public culture. It becomes, as Jan Golinski has argued, 'a philosophical enterprise, assuming responsibility for stimulating improvements in many arts, and forming part of gentlemanly education. …[It] take[s] its place in the public culture of scientific and moral improvement that comprised the core of the Scottish Enlightenment'.[53]

If moral improvement is achieved primarily by forestalling the dangers of intellectual dependence caused by over-specialization, the social contribution lies not only in its ability to encourage fundamental research into the nature of essential matter but also, as Horner's

51 Cited in Donovan, op. cit. (50), 39.
52 Cited in Jacyna, op. cit. (19), 45.
53 Golinski, op. cit. (27), 36.

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letter suggests, by promoting material improvement through inventions. For instance, Joseph Black's research into heat was developed in close collaboration with James Watt, inventor of the steam engine,[54] and Cullen encouraged a more 'scientific' approach to agriculture,[55] one which included both scientific techniques such as fertilizers and improved economic management of farms. Coupled with Adam Smith's parallel concerns with the parasitic nature of the landed gentry, this encouragement invites further reflection on the common origins of the professionalization of chemistry and the rise of political economy in the Scottish Enlightenment and on the continued importance of agriculture for both London's Royal Institution and Geneva's *Bibliothèque britannique*, both of whose relevance to the work of Jane Marcet I shall address shortly.

Despite the efforts and activities in Scotland, the impact of the French Revolution on British intellectual and cultural life interrupted chemistry's integration into public life. In his 1790 *Reflections on the Revolution in France*, Edmund Burke objects to how the French are 'delivered over blindly to every projector and adventurer, to every alchymist and empiric'[56] and referred explicitly to the chemist Joseph Priestley's role in recent social upheaval. In his wake, others 'charged natural philosophers with encouraging inappropriate dreams of progress and spreading social subversion'[57] and with causing disorder through 'a rigid or over-extended application of metaphysical reason'.[58] Such attacks made it particularly difficult for chemists and natural philosophers who, like Priestley, were committed to the interrelation between scientific knowledge and social reform, between chemistry and public culture. For instance, conservative opponents perceived experiments at Thomas Beddoes's Pneumatic Institution in Bristol on nitrous oxide (laughing gas) as 'symptoms of the delusion and hysteria with which the Enlightenment had culminated'.[59] It is perhaps in response to these negative attacks that his one-time student and apprentice Humphry Davy attempted to form a new audience through his efforts at the recently founded Royal Institution. It is, as we saw above, to her presence in this very audience that Jane Marcet ascribes her own interest in chemistry.

Setting the limits to 'public' science (1): Humphry Davy and the Royal Institution

The Royal Institution, founded in 1799 by a group of natural philosophers, philanthropists and improving landlords of the day, occupied an intersection between scientific, social and moral improvement which was in the clear interests of the landed gentry.[60] It had an

54 Donovan, op. cit. (50), 250–65; Golinski, op. cit. (27), 27–49.

55 Donovan, op. cit. (50), 67–9; 86–8; Golinski, op. cit. (27), 31–3; *passim*.

56 E. Burke, *Reflections on the Revolution in France* (ed. L. G. Mitchell), Oxford, 1993, 170. See also Maurice Crosland, 'The image of science as a threat: Burke versus Priestley and the "Philosophic Revolution"', *BJHS* (1987), **20**, 277–307.

57 Golinski, op. cit. (27), 176.

58 Golinski, op. cit. (27), 177.

59 Golinski, op. cit. (27), 156.

60 The following account of the Royal Institution relies on Berman, op. cit. (19). More recent accounts have criticized the excessive social determinism, arguing for greater attention to individual qualities of certain key scientists. See, for instance, D. Knight, *Humphry Davy: Science and Power*, Oxford, 1992, which calls attention to the 'romantic' quest for power in Davy's scientific practice, thereby questioning Berman's emphasis on utilitarian social control. See also S. Forgan, 'Faraday – from servant to savant: the institutional context' in

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explicit interest in promoting a programme of applied science, in demonstrating the relevance of 'new discoveries in science to the improvements of arts and manufactures, and in facilitating the means of procuring the comforts and conveniences of life'.[61] Davy's extremely successful public lectures on chemistry played an important part in satisfying the second function of the Institution: it diffused scientific knowledge to the general community, thereby renewing the tradition established in Edinburgh of making chemistry part of the polite knowledge of the gentleman and of public culture more generally.

This renewal first had to contend with public backlash. Given Davy's earlier ties to the reformist, if not radical, circles and his own personal commitment to chemistry, he worked hard to delimit the attacks on his profession. He did so partly through the Royal Institution's focus on utility. A useful science grounded in the concrete demands of everyday life could not be accused of subverting the social order through the premature application of abstract metaphysical systems. At the same time, Davy strove through his course of popular lectures to ensure chemistry had a new social status.

These efforts are not incidental to the question of women's education in chemistry. After all, Davy's attempt to refigure the image of philosophical chemistry is reiterated in an appeal to fashion and to women in particular. The latter were among the most visible members of his public lectures at the Royal Institution, the members who at any rate crowned its success. One early biographer explains how a 'talented lady, since well known in the literary world',[62] addressed a poem to the man of science, following her attendance at this course of lectures. Davy is said to have became so popular among his female followers that, 'under the auspices of the Duchess of Gordon and other leaders of high fashion…even their *soirées* were considered incomplete without his presence'.[63]

The inclusion of women did not occur without opposition.[64] Francis Horner echoed Hannah More's somewhat derogatory comments on women at the Royal Institution. Noting that the audience consisted of a 'mixed and large assembly of both sexes' in large part due to the recent and fashionable interest in the subject, he expressed his doubt about this 'incongruous union' between 'fashion and chemistry'.[65] Given a cultural imagination where women are key vehicles of fashion, it is highly likely that he was invoking the dangers of their frivolous presence amongst the ranks of otherwise serious natural philosophers.

Horner's comments operate on two levels. They provide an attested indication of the presence of women in the public halls of science and of the concern this presence produced. But they also reflect a more general anxiety regarding the new directions science was

Faraday Rediscovered: Essays on the Life and Work of Michael Faraday, 1791–1867 (ed. D. Gooding and F. A. J. L. James), Basingstoke, 1985, 51–69. It argues that by allowing him to bifurcate from strictly utilitarian practices both in his lectures and in his 'disinterested' research, the Institute provided a privileged setting for Faraday's scientific interests.

61 T. E. Thorpe, *Humphry Davy, Poet and Philosopher*, London, 1901, 67.

62 Cited in J. A. Paris, *The Life of Humphry Davy*, 2 vols., London, 1831, i, 135.

63 Paris, op. cit. (62), 137.

64 For a more complete list of contemporary responses to women's presence at Davy's Royal Institution lectures, see G. A. Foote, 'Sir Humphry Davy and his audience at the Royal Institution', *Isis* (1952), **43**, 6–12. All of the examples provided express their concern with women's 'frivolous' presence.

65 Cited in Paris, op. cit. (62), 77.

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taking. Women's exposure to chemistry, in other words, raises the question of how public should 'public science' really be. On the one hand, chemistry's appeal indicates its accessibility, its avoidance of metaphysical language and its application to everyday life: by addressing women chemistry becomes a science for the general, uneducated public. On the other hand, scientific observers cannot help but worry whether the intellectual independence and 'philosophical' status of chemical investigations are compromised by its appeal to the frivolous female sex. Its 'public' quality jeopardizes the disinterested detachment required for the philosophical action of committed public men and wise legislators.[66]

Setting the limits to 'public' science (2): Marc-Auguste Pictet and the *Bibliothèque britannique*

It is these doubts about the potential dangers of women's fashionable exposure to chemistry that Marcet attempted to forestall by writing a companion volume to Davy's lectures. It may be for similar reasons that she was encouraged and monitored by public men of science.[67] Consider Marc-Auguste Pictet. Belonging to one of the most prominent patrician families, he was a man of science who wrote an influential book on fire, leading Clarissa Campbell Orr to name him as the model for Mary Shelley's Geneva-born man of science Frankenstein.[68] Pictet was as instrumental as Marcet's husband in the origins of *Conversations on Chemistry*. Alexandre explains that having drafted conversations on the 'elements of chemistry', Jane presented them to Pictet, then in London, who 'applauded and encouraged her to persist'.[69] Already in 1801, five years before the first edition, Pictet insisted that she publish her 'pretty and useful work' and promised that an extract would appear in his journal.[70] When the work did appear, he praised it both in his private correspondence and in the *Bibliothèque britannique*. To Pierre Prevost he wrote, 'I admire

66 See also J. Golinski, 'Humphry Davy's sexual chemistry', *Configurations* (1999), **7**, 15–41, which relates this tension to the sexual ambivalence attributed to Davy's public persona and to the problems surrounding the emerging 'scientific hero'.

67 In what follows, I limit my examples to Geneva-born men who had close ties with Alexandre's family. I do so because the particularity of Geneva's political and intellectual elite allows me to highlight the question of authority in the Napoleonic era. These examples could be multiplied by mentioning Dr Edward Jenner, promoter of the smallpox vaccine (see Miller, op. cit. (48), 87) and Jacob Berzelius, the Swedish chemist (see H. G. Söderbaum (ed.), *Jac. Berzelius Bref Correspondance entre Berzelius et Alexandre Marcet (1812–1822)*, 3 vols., Upsala, 1913, iii, 15). J. Crellin, 'Mrs Marcet's *Conversations on Chemistry*', *Journal of Chemical Education* (1979), **56**, 459–60 also mentions the help that Marcet received from her husband's British colleagues. Alexandre Marcet's private notebooks provide further names. They also indicate that his wife often attended dinners with members of the exclusive Chemical Society. See AM/FGP, AMN # 4, entry for 12 January 1806. On the Chemical Society, which counted Humphry Davy amongst its highly select adherents, see G. Averly, 'The "social chemists": English chemical societies in the eighteenth and early nineteenth century', *Ambix* (1986), **33**, 99–128.

68 C. Campbell Orr, 'Romanticism in Switzerland', in *Romanticism in National Context* (ed. R. Porter and M. Teich), Cambridge, 1988, 134–71, 157. Interestingly, Davy is often identified as the prototype.

69 See AM/FGP, AMN # 4, entry for 7 October 1805.

70 '[J]oli et utile travail'. Letter to Alexandre Marcet, 3 October 1801, Smithsonian Institution, Mss 1142A. This document is to be included in a forthcoming volume on Marc-Auguste Pictet's British correspondence as part of a four-volume series on his scientific and technical correspondence. I am grateful to René Sigrist for making his work in progress available to me.

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Mrs Marcet's art; she could give good teaching lessons to Professors.'[71] Pictet himself took those lessons from her. 'I am working on my own course on chemistry,' he wrote in an 1804 letter to Alexandre, 'based on Mrs Marcet's, and I have more than eighty auditors'.[72] With this praise, he valorizes her work above Humphry Davy's, a more obvious and prestigious model for popular lectures. Pictet's compatriot, the Geneva legal reformer Etienne Dumont, better known as editor and translator of Jeremy Bentham's work, also remarks on the clarity of her exposition by asking her to initiate his visiting nephew into the subject. The latter 'very much desires to see a few chemical experiments…I take the liberty of bringing him to dinner today to prepare him to fall in love with Caroline or Emily'.[73]

For all their praise, these public men of science nevertheless emphasize the particularly feminine nature of Marcet's venture. If Pictet insists on the usefulness of the work, he also calls attention to its agreeable qualities. Likewise Dumont's comments on her didactic skills are nevertheless couched in the language of love and pleasure, thereby reverting to Fontenelle's earlier model. Finally, the review published in *Bibliothèque britannique* closes with a clear indication of its limitations. 'The work will teach nothing to chemists', it notes, 'but it is perfect for developing a taste for science among those who are already sprouting some interest. It may suffice in the instruction of mere amateurs and in the useful preparation of those who wish to further pursue the subject'.[74] These compliments and the attention they draw to the author's sex do little to conceal the paternalism of the men of science. They also, however, indicate anxiety regarding a woman's engagement in an otherwise masculine domain. Including her within the boundaries of the profession, they nevertheless mark her as different, thereby setting clear limits to an involvement that they otherwise do much to encourage. As a woman, Marcet can pursue a 'disinterested' interest in science; she is excluded from specialist training and research. She can merely 'prepare' other men who, unlike her, may continue to study.

The discomfort this emerging class of scientists expressed towards women involves more than mere gender trouble. It is less about women's involvement in science than about the extension of the boundaries of knowledge more generally. This intersection appears when Marc-Auguste Pictet's interest in Marcet's work is considered in relation to his own contribution to the intellectual culture of the Napoleonic era, namely the journal he coedited with his brother Charles Pictet de Rochemont (1755–1824): the *Bibliothèque britannique*. This journal was devoted to promoting the new science that was based on continued observation and systematic experimentation and offered practical solutions to day-to-day problems. Like that pursued at the Royal Institution, this new science was

71 'J'ai admiré l'art de Mme Marcet: elle pourrait donner de bonnes leçons normales aux Prof.' R. Sigrist (ed.), *Marc-Auguste Pictet 1752–1825, correspondance sciences et techniques*, 4 vols., Genève, 1996, **i**, 552.

72 'Je…fais un Cours de chimie à ma façon…tiré de celui de Mme Marcet, et j'ai plus de 80 auditeurs.' Letter to Alexandre Marcet, 12 August 1804, BPU/Ge, MS Fr 666, ff. 149–50.

73 '[D]esire beaucoup de voir quelques expériences de chymie à tout hasard, je prends la liberté de vous le mener à diner aujourd'hui, pour le préparer à devenir amoureux de Caroline ou d'Emilie'. Letter to Mrs Marcet, 16 March 1802, BPU/Ge, MS Fr 666, ff. 27–8.

74 'Il n'apprendra rien aux chimistes; mais il est fait pour développer le goût de la science chez tous ceux qui en ont le germe. Il peut suffir à l'instruction des simples amateurs, et préparer utilement celle des personnes qui voudront aller plus loin.' 'Conversations on chemistry, etc.', *Bibliothèque britannique* (1806), **32**, 363–83, 382–3.

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touted as a value-free and neutral mechanism that would improve the human condition. As such, it reaffirmed the shared patrician and scientific values of a quest for truth and a sense of civic duty. Rejecting the philosophical speculations and utopian dreams associated with the French Revolution, it reinscribed the Genevan patrician-savants as the moral leaders of their community and continued to naturalize social differences by determining the contours of knowledge.

Consider the preface to the first issue.[75] The journal, it explains, will address a broad and varied group of common readers and hopes to make more esoteric scientific knowledge available to these amateurs. The preface justifies this extension of science beyond 'cabinets of natural philosophers and cultivated by the lone genius' before explaining how exactly it is going to do so.[76] Although it does not refute the need for a scientific elite, it nevertheless insists on making recent discoveries accessible to the educated reader and in clarifying 'what had hitherto been considered as incomprehensible'.[77] The preface thereby identifies the journal's central role in creating a language common to man of science and amateur and in facilitating public conversations between them:

> We will find a new and delightful pleasure in bringing down from the sublime heights of Mathematics truths which up till now have been inaccessible to all but mathematicians [and] in extracting from the depths of Physics and Chemistry, notions that were once thought of as belonging only to men of science and inspired respect as well as a kind of fear – hence [they invited] no interest, because they were desperately out of reach.[78]

In this attempt to locate itself halfway between the sublime and hence fearful regions of mathematics and the low ground of common knowledge, the *Bibliothèque britannique* echoes Jane Marcet's wish to facilitate the comprehension of Humphry Davy's more elusive lectures.

As with the Royal Institution in London, for the editors of the journal, this common ground is to be created by redirecting the focus of scientific knowledge so that it answers the needs and interests of amateurs. Echoing earlier comments on women's rational education, they suggest that these needs lie less in a thorough exposure to the sciences than in mental exercises that focus the attention and strengthen rational faculties. Similarly, the Pictets turn away from abstract, ungrounded and incomprehensible theoretical systems to insist instead on utility:

> The principle of UTILITY, which will be our constant compass, will not allow us to place all the sciences on the same level. Agriculture is most important, it is also the first art. There is one other science whose principles we would like to propagate: the one whose most precious lessons are

75 Contributions to the *Bibliothèque britannique* were unsigned. Assuming that the preface was co-written by both of its editors, the Pictet brothers, I refer to them here as joint authors. Marc-Auguste was nevertheless more actively involved in the scientific work, Charles in the more literary sections. See Bickerton, op. cit. (21).

76 '[C]abinets des savants et cultivés par le génie seul'. In Marc-Auguste-Pictet [Anonymous], 'Préface', *Bibliothèque britannique* (1796): 1–10, 3.

77 '[C]e qu'on avoit regardé comme incompréhensible'. In Pictet, op. cit. (76), 5.

78 'Nous trouverions même un plaisir piquant et nouveau, à faire descendre de la sublimité des Mathématiques, des vérités jusqu'alors inaccessibles à d'autres qu'aux Mathématiciens; à extraire des profondeurs de la Physique ou de la Chimie, des notions qu'on regardoit comme appartenant exclusivement aux savans, et qui inspiroient du respect et comme une sorte d'effroi, nul intérêt par conséquent, parce qu'on désespéroit d'y jamais atteindre.' Pictet, op. cit. (76), 5.

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> enclosed by the works of the English and Scottish moralists. No other philosopher has been able to develop this instinct of justice and to direct the ardent and blind desire for happiness towards which all hidden springs of the human heart are bound.[79]

The Pictets articulate here a clear hierarchy of knowledge. By identifying agriculture as both a science and an art, they insist on the necessary dialogue between the advancement of knowledge and its application to practice. At the same time, by emphasizing the work of British moralists, the Pictets uphold the continued interest in establishing generalizing and philosophical principles that will allow for a continued dialogue between distinct specializations. This 'moral' science, emerging out of a British common sense and utilitarian tradition, also has its place in avoiding 'the errors of a false philosophy, and the evils which afflict humanity',[80] a philosophy obviously associated with French metaphysics and its role in producing the recent disorder. In a gesture not unlike the Scottish school's, whose work the Pictets obviously have in mind, they affirm the need for theoretical abstraction and generalization. Evoking the principles of utility and practical application, they clearly distance themselves from the inappropriate French theorization. This more grounded science is deemed all the more important in a world where the authority of government has been overturned in the name of human happiness. The Pictets, in other words, want to maintain the invisible boundaries of knowledge by excluding the dangerous and incomprehensible excess of human desire for a utopian future. Although clearly committed to the dissemination of useful knowledge, they want to determine the contours of that usefulness.

It is in this light that I understand Marc-Auguste Pictet's praise for Jane Marcet's 'pretty and useful work' in chemistry and later in political economy. Marcet undertakes her work in order to extend the canon of polite knowledge, making chemistry as much part of the socialite's cultural baggage as history had been earlier. In the process, she contributes to transforming the flighty aristocrat into a rational and focused bourgeois mother, a transformation that is essential for the emergence of the legislative authority of the new science. But thanks to this success, her work also becomes an important mechanism for disciplining other potentially explosive social forces. For in the context of the changing knowledge wars of Napoleonic Europe, Marcet's contributions rapidly become something else. Not only did she complement her continued interest in the sciences as demonstrated in her publications on natural philosophy (1819), mineralogy (1822) and botany (1829, 1839) with her more celebrated espousal for political economy (1816). (Not surprisingly, here too she was closely abetted by male specialists, notably David Ricardo and Thomas Malthus, as well as by other liberal reformers both in England and in Geneva.) More significantly, in an attempt to forestall the social turmoil caused in the aftermath of the war years, she also moved away from feminized polite society towards an explicitly working-

79 'Le principe d'UTILITE, qui sera notre boussole constante, ne nous permet point au reste, de mettre toutes les sciences sur la même ligne; l'agriculture tient à nos yeux le premier rang, elle est aussi pour nous le premier des arts. Il est encore une science dont nous désirons particulièrement de propager les principes, c'est celle dont les ouvrages des Moralistes Anglais et Ecossais renferment les précieuses leçons: personne, mieux que ces Philosophes, n'a su développer et cultiver cet instinct de justice, et diriger ce désir ardent et aveugle de bonheur auquel tendent tous les ressorts secrets, du coeur humain.' Pictet, op. cit. (76), 6–7. Original emphasis.

80 '[L]es erreurs d'une fausse philosophie, et les maux dont l'humanité est affligée'. Pictet, op. cit. (76).

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class audience. She abandoned 'conversations', a format more adapted to polite society, for fables, deemed more appropriate for the uneducated masses.

The underlying political dimension to her work appears in the support she received from, and appreciation expressed by, her peers. Writing in early 1816, Maria Edgeworth encouraged Marcet to finish her *Conversations on Political Economy* on the grounds that 'a better defence it would be against riots & insurrections & perhaps against revolutions than a standing army – People cannot be *dragooned* but they must be reasoned into just opinions'.[81] Similarly, commenting on the origins of her work in her obituary, Auguste De La Rive ignores the different reading publics Marcet addresses and most notably the fact that her explicit audience was women of the higher social ranks. Instead he situates her project in an attempt to demystify scientific inventions, amongst which is Watt's steam engine. What Marcet deemed the 'innumerable inventions and discoveries' of practical science play a key role in the industrial revolution and in the social upheaval it provokes. Hence the importance of 'educating' a 'crowd stupefied by discoveries and inventions of which it remains the astonished and ignorant witness'.[82] Rendering science 'public' would certainly play a role in 'reasoning' with the startled masses without however relinquishing legislative authority. Hence too, as De La Rive writes, her decision to write *Conversations on Political Economy*: she had a 'a great science to present and a great cause to make triumph'.[83]

It is in this particular form of educational practice that Marcet assumes a semi-professional status. We need to read Marcet's works against their conflicting objectives and the way in which they set in place public conversations – or 'invisible social boundaries' of knowledge – thereby legislating the question of who has the right to know what.

81 Quoted in H. W. Häusermann, *The Genevese Background*: *Studies of Shelley*, *Francis Danby*, *Maria Edgeworth*, *Ruskin*, *Meredith*, *and Joseph Conrad in Geneva* (*with hitherto unpublished letters*), London, 1952, 81. Original emphasis.

82 '[F]oule frappée de l'éclat des découvertes dont elle était le témoin étonné et ignorant'. In De La Rive, op. cit. (46), 7.

83 '[U]ne grande science à exposer et une grande cause à faire triompher'. In De La Rive, op. cit. (46), 12.

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