

The Remarkable Mrs. Somerville

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Abstract

As a woman growing up in the late eighteenth century, Mary Somerville (1780-1872) was denied access to most formal education and getting a university education was completely out of the question. Yet her interests in nature, science, and mathematics, coupled with an intense curiosity and tenacious desire to learn led her to eventually be known and respected by scientists, mathematicians, and intellectuals in both Britain and France. She is one of the important woman in the history of mathematics, even though she did not publish original work. However, she was a talented writer, producing several significant works, including *Mechanism of the Heavens*, a translation and amplification of Laplace's great work, and, at the end of her life, a series of *Personal Reflections*. Reading through her reflections gives an interesting glimpse into her personality, her opportunities for social networking, and some of what motivated her work. This paper introduces Mary Somerville and provides glimpses into the circumstances that led her to write her first book, *Mechanism of the Heavens*.

As is true for nearly every woman in the history of mathematics, Mary Somerville (1780-1872) was a most remarkable person. Denied both a formal early education and the opportunity to attend university, she diligently nurtured her passion for mathematics and science to become the author of important books [4, 5, 6] and earn a respected place among the scientific elite of her era [2, 1, 7]. Her broad interests also included painting and music, and she must have been a lively conversationalist; a popular dinner guest, she tells about a number of social engagements, both at home and abroad, in her personal reflections. Her friends in Britain included John Herschel, Thomas Young, Michael Faraday, William Whewell, Ada Lovelace, and Charles Babbage, among others, and when she was abroad she conversed with people like Laplace, Poisson, and even Lafayette. She had occasion to meet Princess Victoria and was present at Victoria's Coronation. In short, from rather plain beginnings, she became a person with significant intellectual standing and accomplishment.

Fortunately, Mary Somerville gives us a glimpse into her life through a collection of personal reflections published shortly after her death [3]. Although there has been a great deal of scholarship published about her, she is still a stranger to many people. Therefore, in what follows I would like to offer a brief introduction, based on her own words, to her early life, leading up to the publication of her first book. I hope you will find her story interesting enough to inspire you to learn more about her life and accomplishments.

Although Mary Somerville is often referred to as a mathematician, she actually produced very little original mathematics. Her major scientific contributions consist of four substantial works primarily designed to introduce science and mathematics to a broad, general audience. It is helpful to keep in mind that these works were written to disseminate scientific results, often requiring the use of technical mathematics, by a person who was essentially an amateur mathematician/scientist, all while she was also running her household, raising and helping to educate her children, and dealing with all the uncertainties and challenges that life brings. Although we cannot consider any of these works in detail, we will draw significantly on her fifth major work, a series of personal reflections, published shortly after her death.

Her first book, *Mechanism of the Heavens* [3], was published in 1831 and intended as a translation and amplification of Laplace's *Mécanique Céleste*. Because this text was written for a general audience but requires a substantial knowledge of mathematics (including many results in the calculus) and science, she begins with a seventy page Preliminary Dissertation. Kathryn Neeley [2] points out that as Mary Somerville was writing this book she was confronted with the significant problem of how to make the material both relevant and interesting to the reader (page 101). Neeley describes how, "These seventy pages exemplified the abilities and qualities of her writing that were to be her greatest strengths throughout her career—the capacity to help the reader visualize the view of the natural world that emerged from physical science, an ability to associate that view with elevated feeling and beauty, a capacity to achieve clarity and precision without providing overwhelming amounts of detail, and an ability to connect esoteric theories to problems of everyday life. In the process, she created a powerful interpretive frame for science and articulated the intellectual foundations on which the remainder of her scientific work and writing would be built." The book was a resounding success and was quickly adopted as a textbook at Cambridge.

Her second work, *On the Connexion of the Physical Sciences* [4], followed shortly after the first, appearing in 1834. As Richard Holmes writes in *The Observer*, she surveyed what then existed of contemporary science, chemistry, physics, and astronomy, and described the unity of their underlying principles and methodology. He goes on to say that, "As a result of a positive review by William Whewell, FRS, the future master of Trinity College, Cambridge, the inclusive term "scientist" was coined. Amazingly, the word had not yet existed before 1834." The book had 10 editions and Holmes claims that it shaped ideas in science for the next half century.

Referring to her third book, *Physical Geography* (1848), Neeley states that, "Her objective was to discern the most important connections and thus to determine the principles that shaped the land and explained the distribution of animal and vegetable life on land and water [5]." Her final work, *On Molecular and Microscopic Science*, was published in 1869. She started writing the book in her 79th year and it gave her an opportunity to return to a discussion of the material world, the place where her initial interest in science was awakened.

The final work on our list, *Personal Reflections*, also appeared in 1873 [7], but it is, as the title indicates, a personal history and not a scientific work. The edition that is most readily available was edited by her daughter, who included a number of helpful comments and explanations. This book, being much more personally oriented than the others, provides interesting details about her thoughts and activities and gives her opportunity to insert opinions and commentary about both events and people she meets throughout her life. It also provides a glimpse into the scientific community in the nineteenth century.

Along with details about her life, Somerville also offers interesting, even if relatively unimportant asides. Descriptions of dinner parties and trips to the theater are included, as well as personal commentary about other people, some of which is amusing as well as insightful. For instance, she describes an aging professor who kept trying to dye his hair until it eventually acquired a purple hue, while also encouraging Mary to bring young women around to see his experiments. Despite his heroic efforts, he never succeeded in attracting any young admirers. Through such reflections we are given insights into her life and personality. While she is generally gracious in her descriptions of others, she also comes across as a person with strong opinions and principles, even if they are contrary to the expectations of society. This can be seen in an incident that occurred after her first husband died. She says, "I forgot to mention that during my widowhood I had several offers of marriage. One of the persons whilst he was paying court to me, sent a volume of sermons with the page ostentatiously turned down at a sermon on the Duties of a Wife, which were expatiated upon in the most illiberal and narrow-minded language. I thought this as impertinent as it was premature; sent the book back and refused the proposal." (See [7, p. 87].)

Her reflections also contain many incidents where she is either encouraged or criticized. It is interesting to

note that encouragement came primarily from men, often prominent men who have established reputations for scholarship. On the other hand, most of the criticisms about her adopted life come from other women and often because she is not following a typical role for a woman in her society.

Mary Somerville's early life was spent in Burntisland, a small coastal town in Scotland, located across the Firth of Forth from Edinburgh. In her early years she was apparently given little parental direction or schooling and spent many hours by herself, exploring the coast and acquiring an appreciation for nature. Her father, a naval officer who eventually rose to the rank of Admiral, was away from home for long periods. She describes how the freedom she had as a child would soon change. "When I was between eight and nine years old, my father came home from sea, and was shocked to find me such a savage. I had not yet been taught to write, and although I amused myself reading the "Arabian Nights," "Robinson Crusoe," and the "Pilgrim's Progress," I read very badly, and with a strong Scottish accent; so, besides a chapter of the Bible, he made me read a paper of the "Spectator" aloud every morning, after breakfast; the consequence of which discipline is that I have never since opened that book" [7, p. 19]. Mary is soon sent off to boarding school for some formal education, but she is utterly wretched. Not only feeling out of place academically but also out of her social class, she returns home after one year.

Throughout the history of her early childhood, Mary often comments on the issue of education. She is especially critical about the lack of opportunity for most girls and young women, but also indicates a dissatisfaction with the prevailing attitude in society toward educating girls. In bad weather, when she was trapped indoors, Mary took to reading on her own, but even this was criticized. For instance, "My mother did not prevent me from reading, but my aunt Janet, who came to live in Burntisland after her father's death, greatly disapproved of my conduct. She was an old maid who could be very agreeable and witty, but she also had all the prejudices of the time with regard to women's duties and said to my mother, "I wonder you let Mary waste her time in reading, she never shews (sews) more than if she were a man" [7, p. 27].

At the age of 13, Mary is sent back to school to practice writing and learn some basic arithmetic. She also begins to play the piano, initiating a lifelong interest in music. During that same year, primarily through a visit to her aunt and uncle, she begins to see an opportunity to take up more formal learning on her own. She describes her uncle, Dr. Somerville, who is also the father of her future husband, as a kindly man and the first person to really approve of her thirst for knowledge. Somehow she finds the courage to tell him about her desire to study Latin and to her surprise, he heartily encourages her. She describes this as one of the happiest periods of her childhood.

Throughout her reflections, Somerville inserts comments related to beliefs or positions she would hold later in life. For instance, she recalls a visit to another uncle, this one in Edinburgh, where she is able to attend school. She states that she made great progress in her writing and arithmetic but soon forgot it for lack of practice. It was there that she began to form her own opinions, even if they were opposed to those held by her family. A common theme is the discrimination against women in education. She relates, "From my earliest years, my mind revolted against oppression and tyranny, and I resented the injustice of the world in denying all those privileges of education to my sex which were so lavishly bestowed on men" [7, p. 45]. In spite of her lack of educational opportunity, an unusual event involving number puzzles would kindle Mary's interest in mathematics.

In her writings, Mary gives the impression that she would not be a teenager who enjoys attending tea parties and other formal events. However, it was at a "required" tea party that Mary met a Miss Ogilvie, a woman who impressed Mary with her sewing. After Mary asked about it, Miss Ogilvie referred her to a fashion magazine which, unlike such magazines today, also included a variety of number puzzles. Mary recounts "At the end of a page I read what appeared to me to be simply an arithmetical question; but on turning the page I was surprised

to see strange looking lines mixed with letters, chiefly X's and Y's and asked; "What is that?" "Oh," said Miss Ogilvie, "it is a kind of arithmetic; they call it Algebra; but I can tell you nothing about it." And we talked about other things; but on going home I thought I would look if any of our books could tell me what was meant by Algebra" [7, p. 46].

Given her natural curiosity, Mary wanted to learn more about this exotic "arithmetic" but could find nothing about algebra in the books available to her. She decided to look further and eventually was able to acquire copies of Euclid and of Bonycastle's *Algebra*, getting what she "so long earnestly desired" [7, p. 52]. Since she couldn't just drop her responsibilities at home, she had to give up sleep to study, that is, until the servants told about her using more than her share of candles. As a result, her candle was taken away as soon as she went to bed. Nevertheless, she persevered and found ways to continue studying this exciting new subject.

At the age of 24, Mary married Samuel Grieg, a man who does not share her passion for mathematics or science. This marriage lasts for three years until Grieg's death. Curiously, she doesn't mention him again in her reflections, but it's clear that her life is then changed. For one thing, she is now a mother with the responsibility of young children, but she also appears to have the benefit of at least some financial independence, allowing her to pursue her studies more openly. "I was much out of health after my husband's death, and chiefly occupied with my children, especially with the one I was nursing; but as I did not go into society, I rose early, and, having plenty of time, I resumed my mathematical studies. By this time I had studied plane and spherical geometry, conic sections, and Fergusson's 'Astronomy.' " [7, p. 77].

Having made impressive progress studying mathematics, she decides to start reading Newton's *Principia*, but encounters difficulties. Perhaps realizing she needed help, Mary makes the acquaintance of Mr. Wallace, a mathematics teacher at a military college, who would eventually become a professor of mathematics at the University of Edinburgh. Wallace agrees to correspond with her about solving problems and probably provided some needed motivation and support along the way. She recounts, "At last I succeeded in solving a prize problem! It was a diophantine problem, and I was awarded a silver medal cast on purpose with my name, which pleased me exceedingly" [7, p. 78].

This encouragement seems to have inspired her to keep working, and Wallace assists her by providing a reading list of books in higher mathematics, including Lacroix's *Algebra*, as well as his *Differential and Integral Calculus*, Euler's *Algebra* and his *Isoperimetrical Problems* (in Latin), Lagrange's *Theory of Analytical Functions*, and other works by authors like Biot, Poisson, and Laplace. Although this list seems daunting, Mary approached the challenge of reading these books with great enthusiasm. "I was thirty-three years of age when I bought this excellent little library. I could hardly believe that I possessed such a treasure when I looked back on the day that I first saw the mysterious word "Algebra," and the long course of years in which I had persevered almost without hope. It taught me never to despair" [7, p. 79].

Mary is delighted with these books and pursues her studies with vigor, even though there is criticism at home: "I was considered eccentric and foolish, and my conduct was highly disapproved of by many, especially by some members of my own family, as will be seen hereafter. They expected me to entertain and keep a gay house for them, and in that they were disappointed. As I was quite independent, I did not care for their criticism" [7, p. 79].

Continuing her work, Mary embarks on another classic, and decides to begin reading Laplace. Along the way she makes the acquaintance of Professor Playfair, who will become another helper and encourager. She characterizes Playfair as "gravely cheerful, perfectly amiable, and though he was respected and loved, could be a severe critic."

Not surprisingly, Laplace must have given her quite a challenge, as she appears to briefly question her ability, but soon regains the confidence to continue. "I had now read a good deal on the higher branches of mathematics,

but as I never had been taught, I was afraid that I might imagine that I understood the subjects when I really did not; so by Professor Wallace's advice I engaged my brother to read with me, and the book I chose to study with him was the *Mécanique Céleste*. Mr. John Wallace was a good mathematician but I soon found that I understood the subject as well as he did. I was glad, however, to have taken this resolution, as it gave me confidence in myself and consequently courage to persevere. We had advanced but little in this work when my marriage to my cousin, William Somerville (1812), put an end to scientific pursuits for a time" [7, p. 82].

Her second husband, William Somerville, the son of her encouraging uncle, appears to have been an ideal match for Mary. He was a physician who was a member of the Royal Society and engaged in scientific circles. Thus Mary was given more access to the scientific community. By all accounts, they had a compatible and happy marriage, and William was extremely supportive of Mary's pursuing her interests and continuing her work. This was evident even before they were married. 'I had been living very quietly with my parents and children, so until I was engaged to my cousin I was not aware of the extreme severity with which my conduct was criticized by his family, and I have no doubt by many others; for as soon as our engagement was known I received a most impertinent letter from one of his sisters, who was unmarried, and younger than I, saying she "hoped I would give up my foolish manner of life and studies, and make a respectable and useful wife to her brother.' I was extremely indignant. My husband was still more so, and wrote a severe and angry letter to her; none of the family dared to interfere again" [7, p. 87].

In 1816, William Somerville is appointed a member of the Army Medical Board and the couple moves to London, putting them at the center of the scientific and intellectual community. For instance, soon after arriving in London they made the acquaintance of Sir William and Lady Herschel, who were very kind to them. Their son, John, who was closer to Mary's age, had recently concluded a very successful career as a student in Cambridge. He would become a very important, supportive, and close friend to Mary for many years.

Not long after they were married, the Somervilles made a trip to Switzerland, stopping in Paris on the way. While in Paris, she and William are entertained by a notable list of important people. She relates having a long conversation with, among others, Laplace and seems especially taken with his wife.

The Somervilles continued enjoying life in London, where they were actively involved in society and seemed to know everyone of importance, although Mary doesn't provide many details about how these relationships were formed. For instance, she mentions that they frequently went to see Mr. Babbage, while he was making his calculating machines. They also continued making trips to the continent. After returning from one of these trips, Dr. Somerville received a letter from Lord Brougham who was the head of the Society of Diffusing Useful Knowledge. Brougham indicates that the Society wanted Mary to author an annotated translation of the *Mécanique Céleste*, which would be "a description of that divine work as will both explain to the unlearned the sort of thing it is-the plan, the vast merit, the wonderful truths unfolded or methodized-and the calculus by which all this is accomplished, and will also give a somewhat deeper insight to the uninitiated" [7, p. 161]. Essentially he is asking Mary, who has yet to publish anything of importance, to translate and amplify a substantial book. She eventually agrees and the result is her first book, *Mechanism of the Heavens*.

Although no doubt flattered by the proposal, she must also have been intimidated by this challenge. She was asked to translate Laplace's work, one that required sophisticated mathematics, into a book suitable for a general audience. Along with making the text accessible, she would also have to devise necessary diagrams to illustrate the text, diagrams that were not included in the original. Of course, this writing project would be taken on in addition to her regular responsibilities of raising children and running a household. In the end, she agrees to make an attempt, provided that should her manuscript be unacceptable, it would be put into the fire. Realizing the unique opportunity that was presented to her, she concluded "Thus suddenly and unexpectedly the whole character and course of my future life was changed" [7, p. 162].

Aided by her talent for writing to a general audience, as well as her singular ability to focus on the task at hand, she produced a work of around 700 pages. It was a great success, no fires were needed. Somerville received congratulatory letters from the leading figures of the day including John Herschel, with whom she apparently consulted during the writing, William Whewell, and George Peacock, whose comments were typical of those she received. Peacock writes “I consider it to be a work which will contribute greatly to the extension of the knowledge of physical astronomy, in this country, and of the great analytical processes which have been employed in such investigations. It is with this view that I consider it to be a work of the greatest value and importance. Dr. Whewell and myself have already taken steps to introduce it into the course of our studies at Cambridge, and I have little doubt that it will immediately become an essential work to those of our students who aspire to the highest places in our examinations” [7, p. 171].

She obviously appreciated these positive responses. Regarding Peacock’s letter, she writes “I consider this the highest honour I ever received, at the time I was no less sensible of it, and was most grateful. I was surprised and pleased beyond measure to find my book should be so much approved of by Dr. Whewell, one of the most eminent men of the age for science and literature; and by Dr. Peacock, a profound mathematician, who with Herschel and Babbage had, a few years before, first introduced the calculus as an essential branch of science into the University of Cambridge” [7, p. 172].

With the success of *Mechanism of the Heavens*, Mary Somerville was established as a legitimate member of the highest ranks of British scientists, and the groundwork was laid for additional books. She had come a long way from her early struggles fighting the educational discrimination she felt in her early years, and it’s gratifying to see that she was recognized and encouraged by people she highly respected.

Mary continues in her writing and active social life in London until her husband suffers a serious illness and the family moves to Italy in 1838, in hopes that a warmer climate would be beneficial for him. After William died in 1860, Mary moved her family to Naples, where she died in 1872. She is buried at the English cemetery in Naples.

References

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