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CSHPM Notes bring scholarly work on the history and philosophy of mathematics to the broader mathematics community. Authors are members of the Canadian Society for History and Philosophy of Mathematics (CSHPM). Comments and suggestions are welcome; they may be directed to either of the column's co-editors:

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Where does the historian of mathematics turn for sources? There is the published record, where authors typically present a definitive view of their research at that stage of their intellectual journey. Such public documents allow for tracing both individual and social developments of mathematics. But we see only what the authors wish to show the public.

Behind the published works may be an archive or *Nachlass*. Here the historian can find drafts, diaries, notebooks, scribbled calculations, correspondence: the unpublished artefacts that may enable a finer, more detailed understanding of the author's intellectual journey, the false starts, the explorations before the public unveiling of the final product. But then there is the question of curation. We see what was chosen to be retained by the principals or their executors.

What does the historian seek? If mathematics is viewed as part of intellectual history, then the historian seeks novelty. What new ideas, theorems, definitions did the subject produce? What is new must then be explained both internally and in terms of its context and significance. Those who did not contribute significantly to the development of mathematics in this narrative become marginalized.

Significance depends on what the historian seeks. If we aim to understand the place of mathematics in a culture, perhaps we should study mathematics education. Who learned mathematics, what did they learn, how did they learn it, where did they learn it, and who was left out? In this case, much of the published record is in the form of textbooks, although these must be evaluated judiciously. Not every student studies, let alone retains, all the material in a text. Much of the history of mathematics education focuses on institutions, since it is the schools, universities, and academies that record and preserve their records. Studies of an individual's education are more difficult to accomplish and rely on the random survival of the kinds of ephemera most people (or their executors) discard. At a deeper level is the question of what the mathematics they learned actually meant to people — how did they perceive and respond to it?

These pathways to history assume the historian has a research agenda. Armed with questions, the historian turns to particular kinds of resources to find answers, or at least a fuller understanding and maybe better questions. Often, however, archives contain hidden gems and sometimes they throw up something completely unexpected, surprise source material that provokes its own questions.

I have had this experience myself. Rummaging around in the catalogue of the National Archives at Kew one day, I stumbled across an entry for a "treatise on mathematics" from the early 19th century by a female author I had never heard of. I yield to no one in my ignorance, but further research revealed that she was completely unknown to the history of mathematics. No questions we had asked and no answers we had sought had ever unearthed her. Such finds are archival gold. I was intrigued. Who was this woman? Why did she care about mathematics? What had she done? How had it lain undiscovered for two hundred years?



Figure 1. Rachael Frances Antonina Lee, sculpted by John Bacon the Younger, c. 1820. The Metropolitan Museum of Art.

Please allow me to introduce Rachael Frances Antonina Lee (née Dashwood) (1774–1829) and her mathematics. She was an intelligent, forceful and somewhat eccentric woman, who unfortunately attracted notoriety. RFA, as we shall call her, was the illegitimate daughter of Francis Dashwood, Baron Le Despencer, one of the most illustrious rakes in 18th-century England, a period that had no shortage of claimants to the title. At various times he was friend of the Prince of Wales, Chancellor of the Exchequer, devotee of the arts, and reviser of the *Book of Common Prayer* with Benjamin Franklin. He died when his daughter was six.

Dashwood left his children, RFA and her older brother Francis, well provided for. Her mother remarried, and the children were packed off to school, Francis to Eton, and RFA to an upscale convent, the Abbaye Royale de Panthémont in Paris, until its closure in 1789. Presumably, she was mostly educated in the accomplishments suitable to her class.

Back in England, the teenage RFA attempted relationships with several young men, but these suitors were rejected by her mother as insufficiently eligible. Eventually, she eloped to Scotland with Matthew Lee, whose only redeeming feature was his extreme good looks.

The marriage was a disaster and the couple soon separated, although it took the lawyers two years to sort out the financial arrangements. RFA was now in a socially anomalous position and her circle contracted. Worse was to come. Ten years later, she was at the center of a sensational abduction-and-rape case. The tabloid press of the era recounted every salacious detail with their customary disregard for veracity. The subsequent trial of her abductor collapsed on a technicality and RFA's reputation was in ruins. She rarely appeared in public again.

RFA thenceforth lived a secluded and peripatetic life. She studied, read, and wrote incessantly. Her main interests seem to have been theology and philology, especially of ancient languages. The high spot was the publication of the first edition of her *Essay on Government* in 1808, shortly after her estranged husband committed suicide. At around the age of forty, she turned her pen to mathematics.

Over a period of some ten years, RFA produced three drafts of a proposed 'Course of Mathematics', an unfinished and unpublished textbook of some 300 pages that covered the standard curriculum of school mathematics. Topics included the geometry of lines and circles, select extracts from Euclid, arithmetic, algebra, fractions both common and decimal, proportions, the rule of three, and the extraction of roots. RFA disclaimed much originality in the basic mathematical content. As she wrote in her preface, "In the following Course of Mathematics, many of the Laws and principles above defined previously discovered and established must necessarily be introduced. This is the Case with all Works of a similar kind." She did, however, argue that the arrangement and presentation of the results was "the result of profound meditation" and derived from "a deep investigation into the properties of Numbers."



Figure 2. A page from RFA's first draft. Provided by the author.



Figure 3. The title page of RFA's second draft. Provided by the author.

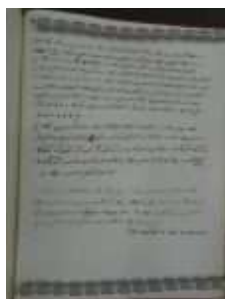


Figure 4. A page from the fair copy third draft, including a note by the copyist with date and signature in Hebrew. Provided by the author.

It is in the arrangement and presentation that RFA displays her originality in her engagement with mathematics and her mathematical philosophy or metaphysics. Declaring that mathematics begins with the notion of extension and motion of a point, she placed geometry before arithmetic, "The first and most simple idea connected with the mathematics appears to be Extension, because if there were no extension, there could not be length, breadth, and height." Numbers require division, and division presupposes the existence of something to divide, therefore extension is the more primitive concept: "Extension may therefore rationally be denominated the primary and most simple idea connected with mathematics; Extension is produced from Motion from which lines are generated."

For RFA, mathematics was grounded in a physical, Newtonian world, therefore, "motion has a tendency to be circular" due to the actions of a projectile force and perpendicular force of gravity. Thus, from a consideration of the natural world, we have lines, right angles, diagonals, and circles.

What of numbers? Taking the Biblical stance that, "All the mysteries of Nature are founded on the principle that every thing was created in number, weight, and measure," RFA began with the notion of unity, "The idea of Unity is the first which arises in tracing the origin of number." Given addition, "It is evident that all numbers, from Unity, to the most complicated are in reality produced by the addition of Unity, to which they are as one, because it is the source of them." Apart from this mechanical production, numbers, at least the first few, have metaphysical properties; "The Dual or the Number 2 is the principle of Creation in Substance; the number 3 is produced from the Unity and Dual; this is the mystical Triune which not only the Nazarenes, but also many of the ancient Philosophers particular among the Easterns, acknowledged; no other number can, in a literal metaphysical sense exist per se." Numbers beyond three are largely arbitrary.

What were her sources? Whence came her mathematics and her sense of the overall shape and significance of it? We do not know. When she wanted to learn Hebrew, she hired a tutor. Mathematics sprang forth fully formed. There is no record of any mathematics education, either institutional or with a private tutor. Her recent biographer makes but a passing mention of mathematics, implying she studied alone [2]. She could have learned the mathematical content on her own from books. For instance, by 1820 she possessed a copy of Charles Hutton's *Course of Mathematics*, which was first published in 1798 and quickly went through numerous revisions, but it is not clear which edition she had nor when she acquired it. Her style and presentation are distinctive, and clearly in her own voice (she was addicted to footnotes).

The work was never finished and never published. We know of it only through a singular accident of history. She died alone, suddenly and unexpectedly in her room in the hotel in which she was staying. She had no will and no heirs, but she was wealthy. The state swooped in and claimed everything, including every scrap of paper she had. These fill 75 boxes in the National Archives at Kew, England [1].

How unusual was she? It certainly *appears* unusual that a woman in the early years of the 19th century would have sufficient education and interest in mathematics to pursue writing a 300-page manuscript not once but through three drafts. Without the actions of the state, we would have no hint of RFA's extensive engagement with mathematics. How much other mathematics lies hidden from our usual sources?

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References

[1] [The papers of Mrs Racheal Frances Antonia Lee, the self-styled Baroness le Despenser who wrote under the nom-de-plume of 'Philopatris' \(c. 1774–1829\)](#). (1774–1829) TS 11/227–302. National Archives, Kew.

[2] Powers, Anne M. (2018) [The Female Infidel: The Vindication of Fanny Dashwood](#). Lulu Press, Inc.