Agnes Mary Clerke and Mathematics in the Eleventh Encyclopedia Britannica

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Abstract: Agnes Mary Clerke (1842–1907) was an important contributor to the discussions of Mathematics in the Eleventh Edition of the Encyclopedia Britannica. This is a survey of the Encyclopedia’s treatment of Mathematics and an appreciation of her writings.

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Introduction

It is difficult to imagine that there was once a time when one person, or one book, or even one collection of books, “knew everything.” E. T. Bell [B] wrote that Henri Poincaré did: “[he] was the last man to take practically all mathematics, both pure and applied, as his province.” The Eleventh Edition of the Encyclopedia Britannica had the audacity to “presume to define and delineate the entire (and thus complete) opus of all human knowledge.” [N] Its 29 volumes appeared simultaneously in 1910 [EB]. There were gestures toward egalitarianism: the Encyclopedia also published various study guides that suggested articles to be read by people in various walks of life, a kind-of early 20th Century MOOC. A “Handy Volume” edition, was sold in the United States through Sears, Roebuck and Co.

Could its 29 volumes match its contemporary, Poincaré?

Encyclopedias and dictionaries are problematic for historical inquiries. At first glance these works appear to be secondary sources; this is especially true of current products. But encyclopedias are written and edited, and older editions offer a view of the intellectual
and social climates of the time of production. These works express a point of view and as such may be treated as a compendium of primary sources, which will become clear.

Some authors are identified, viz. Samuel Johnson’s *A Dictionary of the English Language* (1755), but many are anonymous, or, at best, listed in front matter only. Many authors were prominent intellectuals, so offer real insight into the era. For example, one of the *Oxford English Dictionary*’s anonymous authors was J. R. R. Tolkien [W], and the article on “Diagrams” in the Ninth Edition of *Britannica* was written by James Clerk Maxwell. This level of authority applied to encyclopedic treatments of Mathematics, as detailed below. The Eleventh *Britannica* and previous editions were written by a mix of (almost) anonymous editors and named contributors.

To further illustrate *Britannica*’s insight into intellectual life, consider that it did not shy away from editorializing then (the current online edition is far more bland), and many academic disagreements were continued on its pages. Those familiar with the Wade–Giles system of transliterating Chinese are probably unaware that there was an intense although largely one–sided rivalry between Rev. Jame Legge, the first Oxford Professor of Chinese, and Herbert Allen Giles, the first Cambridge Professor of Chinese. Giles, the aggressor in this dispute, wrote the description of Chinese characters for *Britannica*; the article contains several pointed references to a competing theory of the the construction of the characters, dismissing it as lacking in evidence, although Legge was not named.

More relevant to *Britannica*’s discussions of Mathematics is the mention in the unsigned article on the Bernoulli family that they were “driven from [Holland] by the oppressive government of Spain.” *Britannica* was a weapon of the Empire, and Spain was a recent enemy (the Battle of Trafalgar was in 1805). The “entire opus of human knowledge” valued British knowledge above all else, perhaps grudgingly admitting that other European countries had made contributions.

Who wrote about Mathematics for the Encyclopedia? It is almost axiomatic that most authors in the Eleventh *Britannica* and earlier editions were men: women in England did
not even get the right to vote until 1928. But Agnes Mary Clerke contributed at least 29 signed articles or sections of articles to the work (one suspects that there were other contributions that went unattributed; it will be seen later that Clerke was comfortable with anonymity). The list of contributors to Volume 10 of the Handy Volume Issue, in which Clerke’s articles on Lagrange and Laplace appear, has four female names; there are 210 listed contributors.

Clerke is widely celebrated for her contributions to Astronomy (see [Br1], [Br2], [M]); [Br2], written by an astronomer, details these contributions but includes very little mathematics. Clerke’s mathematical contributions and the place of Mathematics in the Eleventh Britannica are less well-known.

**Clerke and the Encyclopedia**

The biography [Br2] of Clerke by M. T. Bürke shows that Clerke’s exposure to mathematics and science, an important component of her mathematical contributions, began as a child. Clerke’s father had studied Mathematics, and her brother Aubrey also studied Mathematics at Trinity College, Dublin. Her childhood took place in a household oriented toward mathematics and science. She also knew Latin, Greek, German, French, Italian, and Spanish, in addition to, of course, English, and reviewed books in those languages for the Edinburgh Review. The Review was edited by Henry Reeve, who was a contributor to the Ninth Britannica; Brück ([Br1], [Br2]) makes the reasonable speculation that it was through Reeve that Clerke was invited to contribute.

Articles in the Edinburgh Review were unsigned, so did not contribute to Clerke’s public renown. Her first was ostensibly a review of Leopoldo Franchetti e Sidney Sonnino, *La Sicilia nel 1876* but given the running title “Brigandage in Sicily.” She also cited Relazione della Giunta per l’Inchiesta sulle condizioni della Sicilia nominata secondo il disposto dell’Articolo 2 della Legge 3 Luglio 1875 [Report of the commission to investigate the condition of Sicily created following the promulgation of Article 2 of the law of July 3, 1875]. Clerke’s
review is quite opinionated and includes quotes from Cicero and Shakespeare.

Most notable about Clerke’s first publication was how modern it seems. Her discussion of Sicilian society necessarily includes material about the various *mafia* and their local control, and it reads like Mario Puzo’s *The Godfather* [P] and movies like *Prizzi’s Honor* [Pr]. This speaks to her ability to find the essence of a subject, that is, what is likely to be regarded as important at a later date.

**Mathematics in the Encyclopedia**

Searching the Eleventh to understand its treatment of Mathematics, one sees several different styles of article. Some are straightforward, but some are surprising.

Olaus Magnus Friedrich Henrici’s article on “Calculating Machines” reads like a more modern textbook, including the now–common usage of the royal “we,” as in “We now give an example…” As to depth, it includes derivations of the integrals involved.

The article “Groups, Theory Of” provides another illustration of how deep the Encyclopedia’s content could be. It is wedged between “Ground Squirrel” and “Grouse,” which some might find amusing, but it was written by William Burnside, who is well-known for his contributions to the theory of groups in general. The choice of topics is enigmatic. There is no concept in the article corresponding to an abstract group; groups are described as transformations of sets of objects. Surprisingly, it begins with a development of the theory of continuous groups, which Burnside attributed to Sophus Lie, including derivations and a detailed discussion of the one-parameter subgroups generated by an infinitesimal operation, although he did not use the word “exponential.” Then Burnside outlined the concept of factor groups, not using the word “normal,” and immediately proceeded to discuss composition series. One might judge it too terse to learn from. It is interesting to note that, unlike Giles, Burnside was generous in his acknowledgement of the contributions of others.

Another interesting example is the article “Fourier’s *sic* Series” by Ernest William
Hobson. One supposes that Burnside, who made major contributions to the Representation Theory of Groups, could have written this article. Hobson, who was on the faculty at Cambridge, began by introducing the concept of pointwise convergence of a series of functions, then went on to introduce uniform convergence. The corresponding article in the contemporary online Britannica does use the word “convergence” but does not draw the distinction between pointwise and uniform convergence.

Evidently Britannica authors approached writing with different ideas about the interest and experience of the readers; this is not unusual in Mathematics even today. Agnes Mary Clerke had a clearer concept of her readers in mind.

Clerke’s Influence and the Modern Encyclopedia

Clerke wrote the articles on Lagrange and Laplace for the Encyclopedia. These were fairly long and included hints about personalities (Bell [B] did this, too). Clerke’s articles on Lagrange and Laplace focus on their contributions to Astronomy and Celestial Mechanics. She did not include Lagrange’s Theorem on the order of subgroups. (Burnside derived the theorem in the article on groups, but did not use Lagrange’s name.) While she discussed Lagrange’s contributions to the Calculus of Variations, she did not discuss the technique of Lagrange multipliers.

Clerke’s article on Laplace was mixed in its judgments. Her judgment of Laplace’s popular Exposition du système du monde (Paris, 1796) was “The style is lucid and masterly, and the summary of astronomical history with which it terminates has been reckoned [no attribution; one suspects this is the judgment of Clerke herself] one of the masterpieces of the language.”

But she wrote of Laplace’s entry into politics “genius degraded to servility for the sake of a ribbon and a title.” She also quotes Napoleon’s judgment “He brought into the administration the spirit of the infinitesimals.”

One must bear in mind that the Encyclopedia, like the OED and, conjecturally, the
Bible (see, e.g., the article on Julius Wellhausen in the Eleventh), is a large work compiled from the contributions of many authors, and as such is subject to wide variability in style, depth, and outlook. The editors presumably insured that the outlook was consistently pro-British, but as seen with Burnside’s appropriate citation of Lie this could not have been excessively rigid. The editors’ oversight could not ensure consistency of depth or style. (The variation in style and the personal nature of many articles is one of the sources of pleasure in reading Britannica.)

Most of Clerke’s articles were written for the Ninth Edition of Britannica and were reprinted in the Eleventh Edition; she died before the Eleventh appeared. She was the subject of an unsigned article in the Eleventh Britannica. The article seems confused. “English astronomer and scientific writer;” it begins, before going on to say Clerke was “not a practical astronomer in the ordinary sense.” An editor concerned with length could have omitted mention of “astronomer” rather asserting her to be such then deprecating that assertion. This theme is common in contemporaneous assessments of Clerke’s work, many of which taint the objective judgment of her work by noting that it is that of a “lady.” [Br2]

Some modern writers devalue her work, at least in the realm of Mathematics. Brück [(Br1), [Br2]) speculates about Clerke’s article on Laplace, asserting that it borrowed heavily from her brother’s prize-winning essay on theoretical mechanics because “the material is treated mathematically rather than descriptively.” This judgment seems questionable on several grounds. First, the version of Clerke’s article in the Eleventh Edition (unlike many others in the Encyclopedia) contains no mathematical formulas, and does not even mention partial differential equations or integral transforms, so the assertion that the treatment is mathematical rather than descriptive does not hold up to scrutiny. The article does go into some depth in discussing Laplace’s development of probability and of generating functions, at about the same of detail as the article on Lagrange goes into his work in the theory of equations. With no other articles about pure mathematics by her with which to compare
one should probably withhold judgment in this matter.

Second, make note that an encyclopedia article is presumed to offer a summary of the its subject (although this is not always the case), and as such it would be expected that several experts might make suggestions or collaborate. The article on Astronomy, jointly signed by Clerke and Simon Newcomb, is in two sections; Clerke wrote the historical section, Newcomb the scientific. In either case her familiarity with primary sources is clear.

Another resolution of these difficulties lies in a different appreciation of Clerke as primarily a writer rather than primarily a scientist who made no claim to be a mathematician. But she would have been familiar with much Mathematics from the practice of astronomy, as made clear in her discussion of John Herschel’s career at Cambridge in [C1]. For example, this work tells the story of Herschel’s efforts (along with Peacock and Babbage) to introduce so-called continental algebraic techniques into the practice of Mathematics at Cambridge University, especially in regards to notation. In fact her story about Herschel’s characterization of the persistence of Newton’s dot notation for derivatives as “dot-age” is mentioned in Struik’s *Concise History of Mathematics* [S] although without attribution.

Contrast Clerke’s treatment of mathematical subjects to that of E. T. Bell in *Men of Mathematics* [B]. Bell included many formulas and sketches of proofs, which were appropriate in his work but many might feel inappropriate in a work for the general public. Bell had the advantage of being a single author with a clear concept of his audience. [By the way, Bell was confused about the Herschels and their rôle; his index lists two mentions of the elder Herschel, but in fact one of them applies to the younger.]

Nobody accused Clerke of being “not a member of a crime syndicate in the ordinary sense” after her article on Sicilian criminal activity. Clerke was a prolific writer, with an emphasis on astronomy. But in addition to Sicily and her many contributions to the *Edinburgh Review* she wrote about Homer [C4]. Even in that work her emphasis on astronomy comes to the fore. She included a chapter on “Homer’s Astronomy,” and the
chapter “The Dog in Homer,” while beginning with an amusing if not perhaps over-written appreciation of the animal’s good and bad points, suddenly switches to a discussion of Sirius, the Dog Star, before returning to close textual analysis. The question she addressed is whether Homer loved or hated dogs given the difference in their treatment in the *Iliad* and the *Odyssey*, and this led to speculation about the actual authors of these poems as well as other Greek verse of that era.

This discussion illustrates how Clerke could be obscure. She wrote “...the bard of Odysseus has long ceased to possess [a name]. His only appellation must remain for all time that of his hero in the Cyclops’ cave,” but she did not go on to remind the reader that Odysseus had told Cyclops that his name was “Nobody.” [H]

Clerke wrote essays about many topics, and her *Britannica* biographer praised her “remarkable skill in collating, interpreting and summarizing.” Few prolific essayists write about Mathematics. This, as much as being a successful female intellectual in an anti-feminist age, distinguishes her.

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