MARIA AGNESI: FEMALE MATHEMATICIAN OF 18ᵀᴴ-CENTURY ITALY

A RESEARCH PAPER

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In the eighteenth century, Italy seems to have been the place for change, especially for great female minds like Maria Gaetana Agnesi. It was during this century that much of what had previously shaped the lives of not only Italian women, but also women across Europe, began to shift. So who was Maria Agnesi, and what role did she play in this social and professional transformation in Italy? More specifically, how could she as a woman become a distinguished mathematician and author of a calculus textbook, at a time when women were not supposed to work outside the home? To answer this, it is necessary to delve into the history of her life and compare her story to that of the lives around her. Research shows that in fact, her success is due to a combination of factors, one being her father's position at a university, which predisposed Maria to a life of education, curiosity, and a surplus of academic mentors. She was also fortunate to live and work at the time of an international debate about women's rights, that also played a large role in the Catholic Enlightenment.[1] Maria's unique circumstances, in conjunction with her own brilliance, help to explain how she was able to achieve so much and raise the bar for all women.

To fully understand the context of Maria's accomplishments, one should investigate what the norm for females in Europe was prior to the start of the eighteenth century. According to Truesdell's (1989) study on Agnesi, it was not altogether uncommon for daughters of the wealthy to be educated at home by

1. Massimo Mazzotti, *The World of Maria Gaetana Agnesi, Mathematician of God* (Baltimore: The Johns Hopkins University Press, 2007), 124.

private tutors.[2] However, this education was merely an expression of the family's

wealth in most cases, and it was certainly not undertaken to ensure a successful

career for the young woman, as would likely have been the case for men.[3]

Traditionally, men considered women to be inferior both physically and mentally.

Ancient Greek theory even suggested that every female was a biological mistake. In

the home, females were expected to be "merely childbearers and housekeepers".[4] In

lower income families, women sometimes worked outside the home doing weaving,

sewing, embroidery, and the like. As a general rule, females were under the

authority of their fathers, who ultimately chose who, when, and if they would marry.

Should they choose not to marry, women often had the opportunity to join a

convent.[5] These ideals had defined life for females for years, and it was not until

around the 15th century that Christine de Pizan, who boldly argued that women

were in fact superior to men, brought them into question.[6] Although some social

changes were already beginning to take shape in Italy by the 18th century, Maria

Agnesi was born into a very special set of circumstances that would allow for her an

even brighter future.

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2. C. Truesdell, "Maria Gaetana Agnesi," *Archive for History of Exact Sciences* 40, no. 2 (1989): 113-41.

3. Paula Findlen, Wendy Roworth, and Catherine Sama, eds., *Italy's Eighteenth Century: Gender and Culture in the Age of the Grand Tour* (Stanford: University Press, 2009), 19.

4. Maria Gaetana Agnesi, *The Contest for Knowledge,* ed., Rebecca Messbarger, trans. Paula Findlen (Chicago: The University of Chicago Press, 2005), xii.

5. *Ibid.*, xix.

6. *Ibid.*, xxii.

She was born Donna Maria Gaetana Agnesi, as the first child to Pietro Agnesi Mariami and Anna Brivia.[7] Her father held the position of chair at the University of Bologna, and was thus highly educated. In fact, Pietro was well known among scholars and very wealthy. As we might expect from someone of such a social class, Pietro lived in a home that most would classify as a palace, surrounded himself with all the finer things in life, and carried himself like a nobleman. He spared no expense, and this rang especially true in the case of his firstborn, Maria, for whom he hired the best private tutors that money could buy.[8] It did not take long before she was speaking not only the native Italian language, but also French (some speculate by as early as three).[9] It was soon clear that Maria was a child prodigy. By the age of eleven, she was also fluent in Latin, Greek, German, Spanish, and Hebrew.[10] Maria's younger sister Teresa was a well-versed composer and harpsichordist, and as the girls grew in knowledge and stature, their father began to showcase their talents at functions much like dinner parties. He would invite scholars and men of importance to his glorious home and invite them to engage in conversation with Maria. She never failed to impress with her profound knowledge and understanding of not only philosophical ideas, but also her beautiful use of the Latin language and her ideas in the fields of mathematics and science.[11] On 10 December 1739, when Maria was about 21, the royal prince of Poland was one of the guests invited to the

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7. Lynn Osen, *Women in Mathematics* (Cambridge, MA: MIT Press, 1974), 35-48.

8. Truesdell, "Maria Gaetana Agnesi," 115.

9. *Ibid*., 116.

10. *Ibid*.

11. Osen, *Women in Mathematics*, 35-48.

Agnesi home. A local newspaper later published a description of the night: "The first subject of debate was the ebb and flow of the tides; 'Donna Maria Gaetana… explained in purest Latin all the systems, with profound theory undoing all objections made to her and valorously defending the system of the famous Mr. Newton.'"[12] So it is clear that Maria was well acquainted with theories and ideas of other mathematicians, and these circumstances undoubtedly helped to account for her recognition throughout Italy at the time, but Maria quickly became known as a mathematician in her own right.

During her years of private tutoring, Maria became very familiar with the work of great mathematicians and philosophers that had come before her. Many of Agnesi's tutors were professors or clergymen and had to be away for long periods of time. Consequently, Maria spent much of her time independently studying the writings assigned to her.[13] In this way, Maria is known to have spent hours analyzing the work of Isaac Newton, Pierre de Fermat, René Descartes, Leonhard Euler, and many other groundbreaking mathematicians.[14] She took pride in her knowledge of analytical geometry and even greater pride in her understanding of the new subjects of integral and differential calculus. It became her goal to create a user-friendly introduction to these topics,[15] which she began as a project to teach her younger brothers.[16] This ten-year project resulted in the world's first

12. Truesdell, "Maria Gaetana Agnesi," 119.
13. Mazzotti, *The World of Maria Gaetana Agnesi, Mathematician of God,* 44.
14. Osen, *Women in Mathematics,* 35-48.
15. Mazzotti, *The World of Maria Gaetana Agnesi, Mathematician of God,* 104.
16. Osen, *Women in Mathematics,* 35-48.

comprehensive calculus textbook and the first textbook ever authored by a woman, *Instituzioni analitiche ad uso della gioventi italiana* (*Analytic Institutions for the Use of Young Italians*).[17] In 1801, John Colson made an English translation of *Instituzioni analitiche* called *Analytic Institutions*, which consisted of four books, "The Analysis of Finite Quantities," "The Analysis of Quantities Infinitely Small," "Of the Integral Calculus," and "The Inverse Method of Tangents," respectively.[18] Within the first book lies perhaps her most famous problem, the "Witch of Agnesi."[19] This curve was studied by others before her,[20] and has been called "rather useless" by modern commentators.[21] Essentially, the curve is formed by extending a secant line on a circle to meet the tangent line, which extends from the maximum point on the circle, making a right triangle. The curve traced out by the point of the right angle as the secant line moves around the circle is the "Witch," which is so named because of Colson's mistranslation of the Italian word, *l'avversiera*, which actually means "to turn."[22]

Mathematically, *Analytic Institutions* takes a geometric approach to solving algebraic and calculus problems. For example, in the first and second books of the text, Agnesi shows how to construct and solve equations using geometry, and also demonstrates the concept of infinitesimals in a similar manner. She placed

17. Mazzotti, *The World of Maria Gaetana Agnesi, Mathematician of God,* xi.
18. Maria Gaetana Agnesi, *Analytical Institutions: In Four Books,* ed. John Hellins, trans. John Colson (London: Taylor and Wilks, 1801), xxv-xxvii.
19. *Ibid.,* 222.
20. Osen, *Women in Mathematics,* 35-48.
21. Mazzotti, *The World of Maria Gaetana Agnesi, Mathematician of God,* xi.
22. Osen, *Women in Mathematics,* 35-48.

particular emphasis on the use of Cartesian geometry, although this may have been considered somewhat old-fashioned in that time.[23] The original Italian version of the book was printed privately in the Agnesi home,[24] and quickly became recognized by Pope Benedict XIV, who was so impressed that upon reading it, he appointed Maria to the well-known position of chair of mathematics at the University of Bologna.[25]

Maria's abundant success made her the ideal "poster child" in the international debate about higher education for women. This was highly appropriate because even at the young age of nine she was advocating higher education for women at public debates.[26] She became living proof that a woman could do great things when given the opportunity to be educated. On the other side of the debate, protestors made claims like that of Antonio Conti, a respected polymath of the day. He suggested that women simply could not reason like men because the female body was "less vigorous" than the male body and that based on behavioral observation, women should be open to explore literature, poetry, history, and fine arts, but should steer clear of mathematics and science.[27] As Maria scaled the climb to fame, she encouraged women to follow in her footsteps and work toward the common goal of higher education. In the opening pages of her textbook, she reiterates this idea: "Indeed, I am fully convinced, that in this age, … every

23. Mazzotti, *The World of Maria Gaetana Agnesi, Mathematician of God,* 116.
24. Truesdell, "Maria Gaetana Agnesi," 125.
25. *Ibid*., 127.
26. Agnesi, *The Contest for Knowledge*, 117.
27. Mazzotti, *The World of Maria Gaetana Agnesi, Mathematician of God,* 127-128.

woman ought to exert herself, and endeavor to promote the glory of her sex, and to contribute her utmost to increase that luster."[28] She also dedicated the work to Maria Teresa, who was the grand duchess of Austria and known to be a practicing feminist.[29] Maria was fortunate to have been working in Italy during this century, because all accounts indicate that Italy (Milan, in particular) was in fact the most receptive country of women in the academies. The reason for this is still under speculation, but the fact remains that while other countries in Europe commonly barred women from pursuing degrees and positions in higher education, Italy occasionally allowed it, despite opposition.[30] One predominant theory offers that the Catholic Enlightenment is responsible for Italy's acceptance of women in this way.

The enlightened Catholic Church stressed the importance of women within the church network, and increasingly appointed them as leaders of church-run functions.[31] Another purpose of the Catholic Enlightenment was to break from the traditional social society within the church. Most agreed that in order for women to be effective participants in religion and the devotion thereof, they had to be educated in some capacity.[32] For women like Maria who promoted higher education for women, these ideas played directly into the argument for higher education, and in 1740, a priest published a collection of essays in which he legitimized higher

28. Agnesi, *Analytical Institutions*, xviii.
29. Truesdell, "Maria Gaetana Agnesi," 125.
30. Mazzotti, *The World of Maria Gaetana Agnesi, Mathematician of God,* 125.
31. *Ibid*., 139.
32. *Ibid*., 140.

education for women who met the criteria of being a "wealthy virgin," childless widow, or nun. This was because only these women could afford to spend time on the complex subjects of mathematics and science, as the rest of female society was still expected to devote their time to the family.[33] As it happened, Maria was classified as a wealthy virgin, and if there had been any doubt about her credibility as a scholar and author, this doubt would have been dispelled. Thus, Maria undoubtedly made quite the impact on the society of women during her lifetime.

Unlike many great historical figures who are only credited as such after their death, Maria Agnesi was apparently somewhat of a celebrity in her day. People would travel for miles to hear her speak, and it was no secret that she was wealthy and well educated. She was in the spotlight for much of her life, but what may be surprising is that as a young woman she wanted nothing more than to join a convent.[34] She disliked being put on display in her father's home, and preferred to spend her time alone with her studies.[35] She dedicated her life to pursuing mathematics and sciences and furthering the work of women in higher education, and was passionate about it throughout her life. She never married, and many people criticized her father for keeping her in this "social limbo" in which she was neither allowed to marry nor join a convent.[36] Maria lived humbly and obediently, and when her father died in 1752, she completely abandoned her mathematical

33. Mazzotti, *The World of Maria Gaetana Agnesi, Mathematician of God,* 137.
34. Truesdell, "Maria Gaetana Agnesi," 123.
35. Mazzotti, *The World of Maria Gaetana Agnesi, Mathematician of God,* 44.
36. *Ibid.,* 125.

work and gave up everything to help the poor and sick.[37] She died penniless at the

age of 81, while serving as the director of a church poorhouse.[38]

Today, the name of Maria Agnesi is most known to mathematicians, who

generally have a vague knowledge of her work as a feminist mathematician.[39] It is

remarkable that she was able to accomplish so much, given the circumstances of the

time period. It is clear that her achievement is a result of both her extensive

education and background in the fields of mathematics and science, and the

changing face of women's rights in Italy and Europe. A Venetian playwright

affectionately labeled the era "The Century of Women."[40] Indeed, the life and work

of a woman like Maria Agnesi constitutes such a title. She should be remembered

for her work to legitimize higher education for women and for her professional

accomplishments. This is perhaps summarized best by Truesdell: "The rule of Maria

Gaetana's life, I think, was passionate obedience."[41]

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37. Osen, *Women in Mathematics,* 35-48.
38. Truesdell, "Maria Gaetana Agnesi," 141.
39. *Ibid*., 114.
40. Findlen, *Italy's Eighteenth Century*, 18.
41. Truesdell, "Maria Gaetana Agnesi," 141.

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