# Maria Gaëtana Agnesi

**Born: 16 May 1718 in Milan, Habsburg Empire (now Italy)**
**Died: 9 Jan 1799 in Milan, Habsburg Empire (now Italy)**

**Maria Gaetana Agnesi** was the daughter of Pietro Agnesi who came from a wealthy family who had made their money from silk. Pietro Agnesi had twenty-one children with his three wives and Maria was the eldest of the children. As Truesdell writes in [16], Pietro Agnesi:-

*... belonged to a class intermediate between the patricians and the merely rich. Such a bourgeois could have a household fit for a lord, comport himself like a knight, mingle freely with some nobles, occupy himself with the finer things of life, be a patron of men of talent.* [*Pietro Agnesi*] *did just that...*

Some accounts of Maria Agnesi describe her father as being a professor of mathematics at Bologna. It is shown clearly in [12] that this is entirely incorrect, but the error is unfortunately carried forward to [1] and will also be seen in a number of other places.

Pietro Agnesi could provide high quality tutors for Maria Agnesi and indeed he did provide her with the best available tutors who were all young men of learning from the Church. She showed remarkable talents and mastered many languages such as Latin, Greek and Hebrew at an early age. At the age of 9 she published a Latin discourse in defence of higher education for women. It was not Agnesi's composition, as has been claimed by some, but rather it was an article written in Italian by one of her tutors which she translated and [16]:-

*... she delivered it from memory to an academic gathering arranged by her father in the garden...*

In 1738 she published *Propositiones Philosophicae* a series of essays on philosophy and natural science. The volume contained 191 philosophical theses which Agnesi would defend in disputes with specially invited audiences of important international and national people who her father would invite to his house. In [4] de Brosses describes one such evening which took place on 16 July 1739:-

*... I was brought into a large fine room, where I found about thirty people from all countries of Europe, arranged in a circle and Mlle Agnesi, all alone with her little sister, seated on a sofa. She is a girl of about twenty years of age, neither ugly nor pretty, with a very simple and very sweet manner. ... Count Belloni, who took me, wanted to make a public show. He began with a fine discourse in Latin to this young girl, that it might be understood by all. She answered him well, after which they entered into a dispute, in the same language, on the origin of fountains and on the causes of the ebb and flow which is seen in some of them, similar to tides at sea. She spoke like an angel on this topic, I have never heard anything so pleasurable. ...*

*She is much attached to the philosophy of Newton, and it is marvellous to see a person of her age so conversant with such abstract subjects. Yet however much I was amazed at her learning, I was perhaps more amazed to hear her speak Latin with such purity, ease and accuracy...*

It might look as if this were an extremely distasteful affair, with Agnesi's father showing off his daughter's talents like a circus act. To some extent this must be the case, but it is fair to say that shows of this type were relatively common at the time. Certainly, although Agnesi always acted in total obedience to her father's wishes, she was not very happy with the spectacle that he put on. Again we quote [4] where de Brosses wrote:-

*She told me that she was very sorry that the visit had taken the form of a thesis defence, and that she did not like to speak publicly of such things, where for every one that was amused, twenty were bored to death. ... I was*

*much annoyed to hear it said that she wished to enter a convent, and it was not through need, for she is very rich.*

In [16] Truesdell explains further about her wishing to become a nun:-

*She did ask her father's permission to become a nun. Horrified that his dearest child should desire to leave him, he begged her to change her mind. She agreed to continue living in his house and caring for him on three conditions: that she go to church whenever she wished, that she dress simply and humbly, that she abandon altogether balls, theatres, and profane amusements.*

Agnesi concentrated her efforts on studying religious books and learning mathematics. Around this time she wrote a commentary on de L'Hôpital's *Traité analytique des section coniques* but it has never been published. Learning mathematics without proper instruction is an almost impossible task and only a few have ever achieved great things in this way. Agnesi was fortunate, however, in her bid to learn mathematics for a monk, Ramiro Rampinelli, a mathematician who had been a professor at both Rome and Bologna, arrived in Milan and became a frequent visitor to the Agnesi house. With Rampinelli's help Agnesi studied Reyneau's calculus text *Analyse démontrée* (1708). Agnesi understood the debt she owed to Rampinelli and in the preface to her famous book *Instituzioni analitiche ad uso della gioventù italiana* she wrote:-

*With all the study, sustained by the strongest inclination towards mathematics, that I forced myself to devote to it on my own, I should have become altogether tangled in the great labyrinth of insuperable difficulty, had not [Rampinelli's] secure guidance and wise direction led me forth from it ...; to him I owe deeply all advances (whatever they might be) that my small talent has sufficed to make.*

Rampinelli encouraged Agnesi to write a book on differential calculus. She wrote the book in Italian as a teaching text which, according to the preface, attempted to present the material:-

*... endowed with proper clarity and simplicity..., which proceeds with that natural order which provides, perhaps, the best instruction and the greatest light.*

Agnesi, with her father's money, was able to arrange for the private printing of the book in her own home where she could supervise the whole operation herself. However, she wished to obtain more input from leading mathematicians so, on the 20 July 1745, she wrote to Riccati. It was Rampinelli who suggested that Riccati might offer Agnesi advice and he had clearly contacted Riccati, who had been one of his own teachers, and Riccati had agreed to read the final draft of Agnesi's book and make suggestions.

Riccati replied quickly to Agnesi's first letter and promised to pass the text to his two sons, Vincenzo Riccati and Giordano Riccati, so that they could also comment on the work. Once Agnesi received Riccati's comments on the first part of the text she organised printing of that part while later parts were sent to Riccati also for him to comment on. By 1747 Agnesi was sending Riccati later parts of the book and explaining to him that printing of the earlier parts was nearly complete.

Riccati wrote to Rampinelli on 1 February 1747, offering Agnesi his some of his earlier work on integration for inclusion in her book. Agnesi included the work with proper acknowledgement to Riccati. In her letters Agnesi tried to get Riccati to reply more quickly giving his notes on her draft since the printer had other work to undertake, and she wrote to Riccati saying that:-

*... if it becomes necessary to suspend the printing again, I do not know when I could start it anew, because even now it has been extremely difficult for me to continue with printing the first part (which soon will be finished).*

The first volume of Agnesi's famous two volume work *Instituzioni analitiche ad uso della gioventù italiana* was published in 1748 while Agnesi continued corresponding with Riccati over the material for the second volume

which was published the following year. The work was to bring her much fame. A report on it made by a committee of the Académie des Sciences in Paris states:-

*It took much skill and sagacity to reduce, as the author has done, to almost uniform methods these discoveries scattered among the works of modern mathematicians and often presented by methods very different from each other. Order, clarity and precision reign in all parts of this work. ... We regard it as the most complete and best made treatise.*

Pope Benedict XIV wrote to Agnesi saying that he had studied mathematics when he was young and could see that her work would bring credit to Italy and to the Academy of Bologna. Soon after this he appointed Agnesi to the position of honorary reader at the University of Bologna. Then Agnesi was approached by the president of the Academy of Bologna and three other professors of the Academy and invited to accept the chair of mathematics at the University of Bologna. Indeed, shortly after this, Agnesi received a letter from Pope Benedict XIV written on 26 September 1750:-

*We have had the idea that you should be awarded the well known chair of mathematics, by which it comes of itself that you should not thank us by we you...*

It is probable that Agnesi neither accepted nor rejected this offer. As Truesdell writes in [16]:-

*In October [Agnesi] received a papal rescript confirming her appointment. She had already devoted herself to a holy, retired life; while her name remained on the rolls of the university for forty-five years, she never went to Bologna.*

This does explain the confusion which appears in many accounts as to whether Agnesi ever held a chair of mathematics. Frisi, who was a school friend of one of Agnesi's brothers, visited the Agnesi house after the time that her book was published. He describes in [5] how her father imposed severe constraints on her, and she chose to inhabit rooms of the house away from where the rest of the family lived and there she helped old women who were ill. However [5]:-

*... she immediately, with no apparent difficulty, gave way to her father's wishes ..., taking part in the usual academies in his house with such grace and penetration, propounding or answering questions, problems, and scientific doubts...*

After the death of her father in 1752, Agnesi devoted herself entirely to charitable work. She [16]:-

*... resumed her study of Catholic doctrine and her costly acts of piety towards the poor and suffering, the hopelessly ill and the demented. First in her late father's house and afterwards in other places she established a hospice for old infirm women.*

Agnesi spent all her money on this charitable work and she died in total poverty in the poorhouse of which she had been the director.

The treatise *Instituzioni analitiche ad uso della gioventù italiana* contains no original mathematics by Agnesi. Rather the book contains many examples which were carefully selected to illustrate the ideas; one review calls it an:-

*... exposition by examples rather than by theory.*

The book includes a discussion of the cubic curve now known as the 'witch of Agnesi'. There has been much argument over the reason why the curve is called a 'witch'. The curve was discussed by Fermat and, in 1703, a construction for the curve was given by Grandi. In 1718 Grandi gave it the Latin name 'versoria' which means

'rope that turns a sail' and he so named it because of its shape. Grandi gave the Italian 'versiera' for the Latin 'versoria' and indeed Agnesi quite correctly states in her book that the curve was called 'la versiera'.

John Colson, who had translated Newton's *De Methodis Serierum et Fluxionum* from Latin to English for publication in 1736, translated Agnesi's *Instituzioni analitiche ad uso della gioventù italiana* into English before 1760 (the year of Colson's death) although his English translation was not published until 1801. Colson mistook 'la versiera' for 'l'aversiera' which means 'the witch' or 'the she-devil'. See [17] for a detailed description of how the curve has become known as the 'Witch of Agnesi'.

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