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(*b*. Milan, Italy, 16 May 1718; *d*. Milan, 9 January 1799)

mathematics.

Maria Gaetana Agnesi, the first woman in the Western world who can accurately be called a mathematician, was the eldest child of Pietro Agnesi and Anna Fortunato Brivio. Her father, a wealthy Milanese who was professor of mathematics at the University of Bologna, encouraged his daughter's interest in scientific matters by securing a series of distinguished professors as her tutors and by establishing in his home a cultural salon where she could present theses on a variety of subjects and then defend them in academic disputations with leading scholars. Agnesi invited both local celebrities and foreign noblemen to his soirees. During the intermissions between Maria Gaetana's defenses, her sister, Maria Teresa, a composer and noted harpsichordist, entertained the guests by playing her own compositions.

In all her discourses at these gatherings, Maria Gaetana demonstrated her genius as a linguist. At age live she spoke French fluently. At age nine, she translated into Latin, recited from memory, and released for publication a lengthy speech advocating higher education for women, By age eleven, she was thoroughly familiar with Greek, German, Spanish, and Hebrew. The disputations were conducted in Latin, but during the subsequent discussions a foreigner would usually address Maria in his native tongue and would be answered in that language. The topics on which she presented theses covered a wide range—logic, ontology, mechanics, hydromechanics, elasticity, celestial mechanics and universal gravitation, chemistry, botany, zoology, and mineralogy, among others. Some 190 of the theses she defended appear in the *Propositiones philosophicae* (1738), her second published work.

Although the 1738 compilation does not contain any of Agnesi's purely mathematical ideas, various other documents indicate her early interest in mathematics and her original approach to that subject. At fourteen she was solving difficult problems in analytic geometry and ballistics. Her correspondence with some of her former tutors indicates that, as early as age seventeen, she was beginning to shape her critical commentary on the *Traité analytique des sections coniques* of Guillaume de L'Hospital, a leading mathematician of the Newtonian era. The manuscript material that she prepared, although judged excellent by all the professors who examined it, was never published.

In 1738, after the publication of the Propositiones philosophicae, Agnesi indicated that the constant public display of her talents at her father's gatherings was becoming distasteful to her, and she expressed a strong desire to enter a convent. Persuaded by her father not to take that step, she nevertheless withdrew from all social life and devoted herself completely to the study of mathematics. In the advanced phases of the subject she was guided by Father Ramiro Rampinelli, a member of the Olivetan order of the Benedictines, who later became professor of mathematics at the University of Pavia. A decade of concentrated thought bore fruit in 1748 with the publication of her Istituzioni analitiche ad use della gioventu italiana, which she dedicated to Empress Maria Theresa of Austria. This book won immediate acclaim in academic circles all over Europe and brought recognition as a mathematician to Agnesi.

The Islituzioni analitiche consisted of two huge quarto volumes containing more than a thousand pages. Its author's objective was to give a complete, integrated, comprehensible treatment of algebra and analysis, with emphasis on concepts that were new (or relatively so) in the mid–eighteenth century. In this connection one must realize that Newton was still alive when Agnesi was born, so that the development of the differential and integral calculus was in progress during her lifetime. With the gioventu (youth) in mind, she wrote in Italian rather than in Latin and covered the range from elementary algebra to the classical theory of equations, to coordinate geometry, and then on to differential calculus, integral calculus, infinite series (to the extent that these were known in her day), and finally to the solution of elementary differential equations. She treated finite processes in the first volume and infinitesimal analysis in the second.

In the introduction to the *Istituzioni analitiche*, Agnesi—modest as she was, with too great a tendency to give credit to others had to admit that some of the methods, material, and generalizations were entirely original with her. Since there were many genuinely new things in her masterpiece, it is strange that her name is most frequently associated with one small discovery which she shared with others: the formulation of the versiera, the cubic curve whose equation is x'v = a 2 (a–r) and which, by a process of literal translation from colloquial Italian, has come to be known as the "witch of Agnesi." She was apparently unaware (and so were historians until recently) that Fermat had given the equation of the curve in 1665 and that Guido Grandi had used the name versiera for it in 1703.

Agnesi's definition of the curve may be stated as follows: If C is a circle of diameter a with center at $(O, 1/2a)$, and if the variable line OA through the origin O intersects the line $y = a$ at point A and the circle at point B, then the *versiera* is the locus of point P, which is the intersection of lines through A and B parallel to the Y axis and X axis, respectively. The curve, generated as the line OA turns (Latin *vertere*, hence the name *versiera*), is bell-shaped with the X axis as asymptote. There are interesting special properties and some applications in modern physics, but these do not completely explain why mathematicians are so intrigued by the curve. They have formulated a *pseudo versiera* by means of a change in the scale of ordinates (a similarity transformation). Even Giuseppe Peano, one of the most formidable figures in modern axiomatics and mathematical logic, could not resist the temptation to create the "*visiera* of Agnesi," as he called it a curve generated in a fashion resembling that for the *versiera*.

The tributes to the excellence of Agnesi's treatise were not numerous that its is impossible to list them all but those related to translations of the work will be noted. The French translation (of the second volume only) was authorized by the French Academy of Sciences. In 1749 an academy committee recorded its opinion: "This work is characterized by its careful organization, its clarity, and its precision. There is no other book, in any language, which would enable a reader to penetrate as deeply, or as rapidly, into the fundamental concepts of analysis. We consider this treatise the most complete and best written work of its kind."

An English translation of the *Istituzioni analitiche* was mede by John Colon, Lucasian professor of mathematics at Cambridge, and was published in 1801 at the expense of the baron de Maséres. In introducing the translation, John Hellins, its editor, wrote: "He [Colson] found her [Agnesi's] work to be so excellent that he was at the pains of learning the Italian language at an advanced age for the sole purpose of translating her book into English, that the British Youth might have the benefit of it as well as the Youth of Italy."

The recognition of greatest significance to Agnesi was provided in two letters from Pope Benedict XIV. The first, dated June 1749, a congratulatory note on the occasion of the publication of her book, was accompanied by a gold medal and a gold wreath adorned with precious stones. In his second letter, dated September 1750, the pope appointed her to the chari of mathematics and natural philosophy at Bologna.

But Agnesi, always retiring, never actually taught at the University of Bologna. She accepted her position as an honorary one from 1750 to 1752, when her father was ill. After his death in 1752 she gradually withdrew from all scientific activity. By 1762 she was so far removed from the world of mathematics that she declined a request of the University of Turin to act as referee for the young Lagrange's papers on the calculus of variations.

The years after 1752 were devoted to religious studies and social work. Agnesi made great material sacrifices to help the poor of her parish. She had always mothered her numerous younger brothers (there were twenty-one children from Pietro Agnesi"s three marriages), and after her father's death she took his place in directing their education. In 1771 Agnesi became directress of the Pio Albergo Trivulzio, a Milanese home for the aged ill and indigent, a position she held until her death.

BIBLIOGRAPHY

I. Original Works. Agnesi's main works are *Propositiones philosophicae* (Milan, 1738) and *Analytical Institutions, an English translation of the Istituzioni analitiche* by the Rev. J. Colson (London, 1801).

II. Secnodary Literature. Further information about Agnesi and her wok may be found L. Anzoletti, *Maria Gaetana Agnesi* (Milan, 1990); A.F. Frisi, *Elogio storicos di Dominia Maria Gaetana Agnesi milanese* (Milan, 1799); and A. Masotti, "Maria Gaetana Agnesi," in *Rendiconti del seminrio matematico e fisico di Milano*, **14** (1940), 1–39.

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