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(*b*. Cremona, Italy, 1 October 1671; *d*. Pisa, Italy, 4 July 1742)

mathematics.

At the age of sixteen, Grandi entered the religious order of the Camaldolese and changed his baptismal name of Francesco Lodovico to Giodo. His appointment in 1694 as teacher of mathematics in his order's monastery in Florence led him to study Newton's *Principia*. In order to understand it, he was obliged to increase his knowledge of geometry, and made such rapid progress that he was soon able to discover new properties of the cissoid and the conchoid and to determine the points of inflection of the latter curve. When in 1700 Grandi was called to Rome, Cosimo de' Medici encouraged him to stay in Tuscany, by making him professor of philosophy at Pisa. In 1707 he received the honorary post of mathematician to the grand duke, in 1709 he was made a member of the Royal Society of London, and in 1714 he became professor of mathematics at Pisa. Grandi's voluminous scientific correspondence preserved in the library of the University of Pisa testifies to the esteem he enjoyed among the mathematicians of his time.

Grandi also did successful work in theoretical and practical mechanics; his studies in hydraulics evoked considerable interest from the governments of central Italy (for example, the drainage of the Chiana Valley and the Pontine Marshes).

As a collaborator in the publication of the first Florentine edition of the works of Galileo, Grandi contributed to it a "Note on the Treatise of Galileo Concerning Natural Motion," in which he gave the first definition of a curve he called the *versiera* (from the latin *sinus versus*): Given a circle with diameter *AC*, let *BDM* be a moving straight line perpendicular

to *AC* at *B*, and intersecting the circumference of the circle at *D*. Let point *M* be determined by length *BM* satisfying the proportion *AB: BD=AC:BM*. The locus of all such points *M* is the *versiera*;[1] for a circle of diameter a, tangent to the x-axis at the origin, its Cartesian equation is $x^2 y = a^2 (a - y)$. The curve is more commonly known as the "witch of Agnesi" as the result of a mistranslation and a false attribution to Maria Gaetana Agnesi, who referred to it in her treatise *Istituzioni analitiche ad use della gioventu italiana* (1748). Although Fermat had already investigated this particular equation,[2] Grandi's study extended to the more general family of curves of the form

where *m* and *n* are positive integers (1710). In an unpublished treatise Grandi also studied a curve known as the strophoid.

Grandi's reputation rests especially on the curves that he named "rodonea" and "clelia", after the Greek word for "rose" and the Countess Clelia Borromeo, respectively. He arrived at these curves in attempting to define geometrically the curves that have the shape of flowers, in particular the multileaved roses. They are represented in polar coordinates by equations of the form

in which *R* is a given line segment and *a* a positive integer. Grandi communicated the most significant properties of these curves to Leibniz in two letters dated December 1713 but did not make them generally known until ten years later in a memoir presented to the Royal Society of London. He later explained his complete theory in a special pamphlet (1728). Whereas analytic geometry now teaches the study of curves with given equations, Grandi here solved the inverse problem of determining the equations of curves having a preestablished form. The clelias are curves inscribed in a spherical zone, and their projection on a base plane of the zone yields the rodonea.

The *Acta ertuditorum* of 4 April 1692 contained, under a pseudonym, the problem of constructing in a hemispheric cupola four equal-sized windows such that the remaining area of the cupola is quadrable. This is known as Viviani's problem, after Vincenzo Viviani who suggested it. It is an indeterminate problem and was solved shortly afterward by Leibniz and by Viviani himself;[3] Grandi also devoted a memoir to it (1699).

The curve

or

called the logarithmic or logistic curve, was studied by Evangelista Torricelli as early as 1647; Huygens revealed its most important properties in a communication read before the Paris Academy in 1669. In 1701 Grandi demonstrated the theorems enunciated by Huygens.

On a more general level, Grandi's treatise on quadrature of 1703, in which he abandoned the Galilean methods of Cavaliers and Viviani in favor of those of Leibniz, marks the introduction of the Leibnizian calculus into Italy. Grandi was also the author of several noteworthy and popular textbooks.

NOTES

1. Cf. also Grandi's *Quadratura circuli et hyperbolae*.

2. Cf. *Oeuvres de Fermat*, Charles Henry and Paul Tannery, eds. (Paris, 1891–1922), I, 279–280.

3. Vincenzo Vivani, *Formatione e misura di tutti i cieli* (Florence, 1692).

BIBLIOGRAPHY

I. Original Works. Grandi's writings include *Geometrica divinatio Vivianeorum problematum* (Florence, 1699); *Geometrica demonstratio theorematum Hugenianorum circa logisticam seu logarithnticam* (Florence, 1701); *Quadratura circuli et hyperbolae* (Pisa, 1703, 1710); *De infinitis infinitorum et infinite parvorum* … (Pisa, 1710); "Florum geometricarum manipulus," in *Philosophical Transactions of the Royal Society* (1723); *Flores geometrici ex rhodonearum et cloeliarum curvarum descriptione resultantes* … (Florence, 1728); *Elementi geometrici piani e solidi di Euclide, posti brevemente in volgare* (Florence, 1731); *Istituzioni di aritmetica pratica* (Florence, 1740); and *Istituzioni geometriche* (Florence, 1741).

II. Secondary Literature. Grandi's letters to Leibmz are in *Leibnizens mathematische Schriften, herausgegeben von C. J. Gerhardt*, 7 vols, and supp. (Berlin and Halle, 1848–1863), IV, 221, 224. There are three works of value by Gino Loria: *Curve sghembe speciali algebriche e trascendenti*, 2 vols (Milan, 1930), I 94, 419 ff.; and *Storia delle matematiche*, 2nd ed. (Milan, 1950).

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