Saint Vincent, Gregorius | Encyclopedia.com

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(*b*. Bruges, Belgium, 8 September 1584; *d*. Ghent, Belgium, 27 January 1667)

mathematics, astronomy.

Nothing is known of Gregorius' origins. He entered the Jesuit *collège* of Bruges in 1595 and from 1601 studied philosophy and mathematics at Douai. In 1605 he became a Jesuit novice at Rome and in 1607 was received into the order. his teacher Christoph Clavius recognized Gregorius' talents and arranged for him to remain in Rome to study philosophy, mathematics, and theology. When Galileo compared his telescope with those of the Jesuits in 1611, Gregorius hinted that he had doubts about the geocentric system, thereby displeasing the scholastically oriented philosophers.

After Clavius died in 1612, Gregorius went to Louvain to complete his theological studies, and in 1613 he was ordained priest. After being assigned to teach Greek for several years, first in Brussels, then in Bois-le-Duc ('s Hertogenbosch, Netherlands [1614]), and in Courtrai (1615), he served for a year as chaplain with the Spanish troops stationed in Belgium. He then became lecturer in mathematics at the Jesuit college in Antwerp, succeeding François d'Aguilon (*d*. 1617). Gregorius' *Theses de cometis* (Louvain, 1619) and *Theses mechanicae* (Antwerp, 1620) were defended by his student Jean Charles de la Faille, who later made them the basis of his highly regarded *Theoremata de centro gravitatis* (1632).

Established as a mathematician at Louvain in 1621, Gregorius elaborated the theory of conic sections on the basis of Commandino's editions of Archimedes (1558), Apollonius (1566), and Pappus (1588). He also developed a fruitful method of infinitesimals. His students Gualterus van Aelst and Johann Ciermans defended his *Theoremata mathematica scientiae staticae* (Louvain, 1624); and two other students, Guillaume Boelmans and Ignaz Derkennis, aided him in preparing the *Problema Austriacum*, a quadrature of the circle, which Gregorius regarded as his most important result. He requested permission from Rome to print his manuscript, but the general of the order. Mutio Vitelleschi, hesitated to grant it. Vitelleschi's doubts were strengthened by the opinion that Christoph Grienberger (Clavius' successor) rendered on the basis of preliminary material sent from Louvain.

Gregorius was called to Rome in 1625 to modify his manuscript but returned to Belgium in 1627 with the matter still unsettled. In 1628 he went to Prague, where he suffered a stroke. Following his recovery, his superiors granted his request that a former student. Theodor Moret, be made his assistant. His poor health forced Gregorius to decline an offer from the Madrid Academy in 1630. The following year he fied to Vienna just ahead of the advancing Swedes, but he was obliged to leave behind his scientific papers, including an extensive work on statics. A colleagure, Rodrigo de Arriaga, rescued the studies on the conic sections and on methods of quadrature. Gregorius, who meanwhile had become a mathematician in Ghent (1632), did not receive his papers until 1641. He published them at Antwerp in 1647 as *Opus geometricum quadraturae circuli et sectionum coni*. His *Opus geometricum posthumum ad mesolabium* (Ghent, 1668) is an unimportant work, the first part of which had been printed at the time of his death.

Gregorius' major work is the *Opus geometricum* of 1647, misleadingly entitled *Problema Austriacum;* it is over 1,250 folio pages long and badly organized. It treats of four main subjects. Book I contains various introductory theorems on the circle and on triangles as well as geometrically clothed algebraic transformations. Book II includes the sums of geometric series obtained by means of transformation to the differences of the terms. Among the applications presented in this book is the step-by-step approximation of the trisection of an angle through continuous bisection, corresponding to the relationship $1/2 - 1/4 + 1/8 \mp \ldots = 1/3$. Another is the skillful treatment of Zeno of Elea's paradox of Achilles and the tortoise. In book VIII it is shown that if the horn angle is conceived as a quantity, the axiom of the whole and the parts no longer holds.

Book III–VI are devoted to the circle, ellipse, parabola, and hyperbola, and to the correspondence between the parabola and the Archimedean spiral (today expressed as $x=r$, $y=r\phi$). These books contain various propositions concerning the metric and projective properties of conic sections. Their scope far exceeds that found in older treatments, but their presentation is unsystematic. Common properties are based on the figure of the conic section pencil $y^2 = 2\,px - (1-\epsilon^2)x^2$, where ϵ is the parameter. (This figure had appeared in 1604 in a work by Kepler.) By inscribing and circumscribing rectangles in a geometric series in and about a hyperbola, Gregorius developed a quadrature of a segment bound by two asymptotes, a line parallel to one of them, and the portion of the curve contained between the two parallels. The relation between this procedure and logarithms was first noted by Alfonso Antonio de Sarasa (1649).

Book VII contains Gregorius' remarkable quadrature method. It is a summation procedure—the so-called *ductus plani in planum*—related to the method of indivisibles developed by Bonaventura Cavalieri, although the two are mutually independent. Gregorius' method, however, is some what better founded. In modern terms it amounts to the geometric interpretation of cubatures of the form $\int y(x).\ z(x).\ dx$. It touches on considerations related to the then-unknown *Method* of Archimedes, considerations that, in book IX, are applied to bodies of simple generation. A section of book VII deals with "virtual" parabolas, expressible in modern notation as

Book X is devoted to the quadrature of the circle, which here is based on cubatures of the following type:

given that x≠y and $0 \leqq x-c > x+c \leqq a$ and $0 \leqq y-c > y+c \leqq a$. The crucial element of the argument is the false assertion that from $X_2/Y_2 = (X_1/Y_1)^n$ it follows that $X_3/Y_3 = (X_2/Y_2)^n$. The result is the appearance in the calculations of an error of integration, first detected by Huygens (1651). The error arose from the geometric presentation of the argument, which made it extraordinarily difficult to get an overall grasp of the problem. This error considerably damaged Gregorius' reputation among mathematicians of the following generation. But their reaction was unfair, for his other results show that he was a creative mathematician with a broad command of the knowledge of his age. Although Gregorius basically despised algebraic terminology, he was, as his students recognized, one of the great pioneers in infinitesimal analysis.

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