Nicole d'Oresme

French scholar **Nicole d' Oresme** (1323 – July 11, 1382) helped to lay the foundations that led to the creation of analytic geometry. He translated Aristotle's work on astronomy into French and in his commentaries and his own astronomical works he reformulated Aristotle's doctrine of natural place making other worlds conceivable. He taught that this conclusion was valid providing only those heavier bodies were located more centrally than lighter bodies. In principle, since there could be many centers, there could be many different world systems. In economics he was the precursor of the science of political economy. His economic views are found in a *Commentary on the Ethics of Aristotle* (1370), written in both French and Latin. The French version of his *Commentary on the Politics and the Economics of Aristotle* appeared in 1371. He also wrote a "Treatise on the first Invention of the Currencies."

Oresme was born near Caen, France. After studying theology in Paris, he became grand master of the Collège de Navarre at Paris in 1356, which had opened in 1304 through the generosity of Jeanne de Champagne, wife of King Philip the Fair. It was open, without concern for age or family, to any French student who wished to study grammar, logic, or theology. In 1362, Oresme became canon of Rouen, and, in 1364, dean of the chapter of Rouen. In 1377, he was named Bishop of Lisieux. He was held in high esteem by King Charles V, who caused Oresme to write many of his works in French to encourage a taste for learning in the kingdom.

Oresme's major contributions to mathematics are found in the unpublished *Tractatus de figuratione potentiarum et mensurarum*. An abridgement of this work was printed, in 1482, as *Tractatus de latitudinibus formarum*. In this work, Oresme was the first to make a logical connection between

geometry, numbers, and algebra, predating René Descartes in inventing coordinate geometry. It is conceivable that Descartes was influenced by Oresme's work, for printed copies of it were available in Descartes' time. Oresme found the logical equivalence between tabulating values and graphing them. He constructed a graph of velocity in respect to time for an object moving with constant acceleration. He marked moments of time, which he called *longitudes*, along a horizontal line and for each moment of time he drew a rectangular bar, or *latitude*, whose length represented the object's velocity. In modern terminology, a length proportional to the *longitudo* was the abscissa of a given point, and a perpendicular at that point proportional to the *latitudo,* was the ordinate. Oresme didn't graph curves other than lines, because algebra hadn't developed far enough.

In his unpublished manuscript *Algorismus Proportionum*, Oresme made the first known use of fractional exponents, expressing $2^{1/2}$ as ½ 2^{p}, and $9^{1/3}$ as 1/3 9^{p}. He also wrote $|1^{p}$ ½ $|4$ and $|$ p.1/1.2$|4$ for $4^{3/2}$, stating the value to be 8. Oresme is also credited for the rules of exponents, $x^m x^n = x^{m+n}$ and $(x^m)^n = x^{mn}$, which he illustrated with specific examples and applications. He even went so far as to suggest that irrational powers were possible. Oresme also worked on infinite series, becoming the first to prove that the harmonic series diverges. That is, the infinite series $1 + 1/2 + 1/3 + 1/4 + 1/5 + \ldots + 1/n + \ldots$ has no finite sum. In music, strings of the same material, same diameter, and same torsion, whose lengths are proportional to terms in a harmonic sequence $\{1, 1/2, 1/3, \ldots 1/n \ldots\}$, produce harmonic tones.

Oresme differed with the theory of a stationary Earth as proposed by Aristotle. Two hundred years before Copernicus, Oresme taught that the Earth moved and denounced astrology. He geometrically proved the Merton theorem which states that the space transversed in a given period by a body with uniformly accelerated motion is the same as if the body moved uniformly at its speed for the middle instant of the period. Oresme invoked the law of economy in defending his hypothesis of the heavens.

The principle, also known as *Ockham's Razor*, named for William of Ockham (1285 – 1347/49), gives precedence to simplicity, that is, the simplest explanation is to be preferred if there are two competing theories of something.

Oresme suggested that if the earth rotated on its axis, it would not be necessary to assume that the fixed stars rotate at some tremendous speed daily around the Earth. He affirmed that empirical evidence couldn't settle the claim that the Earth does not move. He suggested that if gravity - in Aristotle's sense, that is, the tendency of the Earth to move toward the center - was regarded as the attraction of Earth to Earth, then Earth could revolve around the Sun and things would still fall in a straight line. If the water and the air moved with the Earth, this would explain why the motion of the Earth did not cause huge floods and winds. Nevertheless, in the end Oresme compromised his work by teaching that good Christians should accept the Church's interpretation of the scriptures, namely that the earth is stationary. Perhaps he was demonstrating that discretion is the better part of valor.

Quotation of the Day: "The perfection of the heavenly spheres does not depend upon the order of their relative position as to whether one is higher than another." – Nicole d' Oresme