RENÉ DESCARTES

French rationalist philosopher, soldier and mathematician **René Descartes** (March 31, 1596 – February 11, 1650) is considered the father of modern philosophy. He developed a dualistic system in which he distinguished radically between the mind and matter. As a mathematician, he founded analytic geometry, reformed algebraic notation and ushered in the era of modern mathematics.

Descartes was born in La Haye, near Tours. At the age of eight he was sent to a Jesuit boarding school at La Flèche, where he stayed for eight years. Because of his poor health, he was allowed to lie in bed in the morning until 11 o'clock, a habit that he adhered to until the last year of his life. Despite being an excellent student, he later observed that all his studies did was convince him of how little was certain and how little he knew. He concluded that he would not find understanding through the scholastic philosophy of his Jesuit teachers. He vowed to accept nothing as true unless he could find it for himself in the great book of the world. To this end Descartes joined the military in 1618 and traveled throughout Europe for the next ten years as a seeker of truth in the study of pure mathematics. He set for himself the task of establishing a new school of philosophy based on mathematics, the only certainty.

In 1626, Descartes settled in Paris where he spent his time in the construction of optical instruments. Two years later he moved to Amsterdam where he lived for twenty years. Soon after arriving in Holland, he began work on his major treatise on physics, *Le Monde*, which embodied his attempt to give a physical theory of the universe. When he learned of Galileo's condemnation to house arrest after recanting his astronomical conclusions, he did not wish to come into conflict with the church, so Descartes abandoned plans to publish it, and its appearance was delayed until after his death. He turned

his attention to composing a treatise on universal science entitled *Discours de la méthode pour bien conduire sa raison et chercher la verité dans les sciences* (A Discourse on the Method of rightly controlling the Reason and seeking Truth in the Sciences), which he worked on intermittently for eighteen years. His masterpiece, containing three appendices: *La Dioptrique, Les Météores*, and *La Géométrie*, was published in 1637.

La Dioptrique, a work on optics, contained little that was new. *Les Météores*, a work on meteorology, was an attempt to give the study of weather a scientific basis, but it contained many assertions that are incorrect and could have easily been shown to be so had Descartes only resorted to experimentation. The third appendix is the one on which Descartes' fame rests. It first deals with problems that can be solved by constructions employing only ruler and compasses, and then moves on to consider various types of curves. It is with *La Géométrie* that Descartes earns credit for inventing analytic geometry, but Pierre de Fermat deserves at least a share of the recognition.

Analytic geometry is not merely the application of algebra to geometry; Archimedes and others had done that. The great advance made by Descartes was the method he found whereby any curve can be represented by means of some relationship between the lengths of two straight lines. The lengths of these two straight lines are known today as coordinates, although Descartes did not use this term, its invention being due to Leibniz. The introduction of Descartes' analytic geometry led to today's familiar notion that a point in the plane can be completely determined if its distances, say x and y, from two fixed lines drawn at right angles in the plane are given, with the convention, familiar in modern times, of positive and negative values. Indeterminate equations of the form $f(x,y) = 0$ are satisfied by an infinite number of values of x and y. These values of x and y determine the coordinates of a number of points that form a curve, of which the equation $f(x,y) = 0$ represents some geometrical property. Today a plane in which the points are assigned coordinates in this way is called a Cartesian plane.

Descartes taught that in order to investigate the properties of a curve it is sufficient to select, as a definition, any characteristic geometrical property, and express it by means of an equation between the coordinates of every point on the curve, in other words, to translate the definition into the language of analytic geometry. The equation thus obtained contains implicitly every property of the curve, and any particular property can be deduced from it by ordinary algebra without troubling oneself with the geometric figure. Descartes showed that the points in which curves intersect could be determined by finding the roots common to their equations.

Descartes divided curves into two classes, geometrical and mechanical. He defined geometrical curves to be those that can be generated by the intersection of two lines each moving parallel to one coordinate axis with "commensurable" velocities, that is, the ratio of these velocities is an algebraic function as, is the case with the ellipse and the cissoid. Mechanical curves are those in which the ratio of the velocities of the two lines is "incommensurable", that is, a transcendental function, as, for example, the cycloid and the quadratrix. He also proposed that the tangent to a point of a curve is the limiting position of secants to the point.

Descartes' other writings include *Meditations on First Philosophy*, published in 1641. He began by methodically doubting knowledge based on authority, the senses and reason, in the hope of arriving at something indubitable. He reached this in his famous declaration "Cogito, ergo sum"("Je pense, donc je suis," "I think, therefore I am"). He set himself the task of building upon this foundation, deducing from it other propositions, just as self-evident. His plan was to produce a philosophical system on which all could agree as completely as they did with Euclidean geometry.

Descartes' physical theory of the universe, embodying most of the results of the unpublished *Le*

Monde, is found in his *Principia Philosophiae*, published in 1644. Resting on a metaphysical basis and a mathematical foundation, it consisted of four parts, *The Principles of Human Knowledge, The Principles of Material Things, Of the Visible World* and *The Earth.* As a study of mechanics Descartes' *Principia* was not outstanding. He made many arbitrary assumptions about the universe, the objects in it and their behavior, not supported by investigations or experiments. Despite the crudeness of the work, he must be given credit for offering a fresh approach to astronomy by attempting to explain the phenomena of the whole universe by the same mechanical laws which experiment shows to be true on the earth.

In 1649 Queen Christina of Sweden persuaded Descartes to go to Stockholm as her private tutor in mathematics and philosophy. The young monarch had energy to burn and insisted that all who worked for her share her ability to endure lack of sleep, little food and the cold. Descartes, who liked to sleep in, was awakened at 5 a.m. to begin his royal employer's lessons. The winter of Descartes' stay in Sweden was the worst in memory. His constitution could not withstand both the constant demands of his royal patron and the cold northern climate. At age 54, Descartes died of pneumonia.

Quotation of the Day: "It is not enough to have a good mind. The main thing is to use it well." – René Descartes