René Descartes

Born: 31 March 1596 in La Haye (now Descartes),Touraine, France
Died: 11 Feb 1650 in Stockholm, Sweden

René Descartes was a philosopher whose work, *La géométrie*, includes his application of algebra to geometry from which we now have Cartesian geometry.

Descartes was educated at the Jesuit college of La Flèche in Anjou. He entered the college at the age of eight years, just a few months after the opening of the college in January 1604. He studied there until 1612, studying classics, logic and traditional Aristotelian philosophy. He also learnt mathematics from the books of Clavius. While in the school his health was poor and he was granted permission to remain in bed until 11 o'clock in the morning, a custom he maintained until the year of his death.

School had made Descartes understand how little he knew, the only subject which was satisfactory in his eyes was mathematics. This idea became the foundation for his way of thinking, and was to form the basis for all his works.

Descartes spent a while in Paris, apparently keeping very much to himself, then he studied at the University of Poitiers. He received a law degree from Poitiers in 1616 then enlisted in the military school at Breda. In 1618 he started studying mathematics and mechanics under the Dutch scientist Isaac Beeckman, and began to seek a unified science of nature. After two years in Holland he travelled through Europe. Then in 1619 he joined the Bavarian army.

From 1620 to 1628 Descartes travelled through Europe, spending time in Bohemia (1620), Hungary (1621), Germany, Holland and France (1622-23). He spent time in 1623 in Paris where he made contact with Mersenne, an important contact which kept him in touch with the scientific world for many years. From Paris he travelled to Italy where he spent some time in Venice, then he returned to France again (1625).

By 1628 Descartes tired of the continual travelling and decided to settle down. He gave much thought to choosing a country suited to his nature and chose Holland. It was a good decision which he did not seem to regret over the next twenty years.

Soon after he settled in Holland Descartes began work on his first major treatise on physics, *Le Monde, ou Traité de la Lumière.* This work was near completion when news that Galileo was condemned to house arrest reached him. He, perhaps wisely, decided not to risk publication and the work was published, only in part, after his death. He explained later his change of direction saying:-

... in order to express my judgement more freely, without being called upon to assent to, or to refute the opinions of the learned, I resolved to leave all this world to them and to speak solely of what would happen in a new world, if God were now to create ... and allow her to act in accordance with the laws He had established.

In Holland Descartes had a number of scientific friends as well as continued contact with Mersenne. His friendship with Beeckman continued and he also had contact with Mydorge, Hortensius, Huygens and Frans van Schooten (the elder).

Descartes was pressed by his friends to publish his ideas and, although he was adamant in not publishing *Le Monde*, he wrote a treatise on science under the title *Discours de la méthode pour bien conduire sa raison et*

chercher la vérité dans les sciences. Three appendices to this work were *La Dioptrique, Les Météores,* and *La Géométrie.* The treatise was published at Leiden in 1637 and Descartes wrote to Mersenne saying:-

I have tried in my Dioptrique and my Météores to show that my Méthode is better than the vulgar, and in my Géométrie to have demonstrated it.

The work describes what Descartes considers is a more satisfactory means of acquiring knowledge than that presented by Aristotle's logic. Only mathematics, Descartes feels, is certain, so all must be based on mathematics.

La Dioptrique is a work on optics and, although Descartes does not cite previous scientists for the ideas he puts forward, in fact there is little new. However his approach through experiment was an important contribution.

Les Météores is a work on meteorology and is important in being the first work which attempts to put the study of weather on a scientific basis. However many of Descartes' claims are not only wrong but could have easily been seen to be wrong if he had done some easy experiments. For example Roger Bacon had demonstrated the error in the commonly held belief that water which has been boiled freezes more quickly. However Descartes claims:-

... and we see by experience that water which has been kept on a fire for some time freezes more quickly than otherwise, the reason being that those of its parts which can be most easily folded and bent are driven off during the heating, leaving only those which are rigid.

Despite its many faults, the subject of meteorology was set on course after publication of *Les Météores* particularly through the work of Boyle, Hooke and Halley.

La Géométrie is by far the most important part of this work. In [17] Scott summarises the importance of this work in four points:-

1. *He makes the first step towards a theory of invariants, which at later stages derelativises the system of reference and removes arbitrariness.*
2. *Algebra makes it possible to recognise the typical problems in geometry and to bring together problems which in geometrical dress would not appear to be related at all.*
3. *Algebra imports into geometry the most natural principles of division and the most natural hierarchy of method.*
4. *Not only can questions of solvability and geometrical possibility be decided elegantly, quickly and fully from the parallel algebra, without it they cannot be decided at all.*

Some ideas in *La Géométrie* may have come from earlier work of Oresme but in Oresme's work there is no evidence of linking algebra and geometry. Wallis in *Algebra* (1685) strongly argues the the ideas of *La Géométrie* were copied from Harriot. Wallis writes:-

... the Praxis was read by Descartes, and every line of Descartes' analysis bears token of the impression.

There seems little to justify Wallis's claim, which was probably made partly through partiotism but also through his just desires to give Harriot more credit for his work. Harriot's work on equations, however, may indeed have influenced Descartes who always claimed, clearly falsely, that nothing in his work was influenced by the work of others.

Descartes' *Meditations on First Philosophy,* was published in 1641, designed for the philosopher and for the theologian. It consists of six meditations, Of the Things that we may doubt, Of the Nature of the Human Mind, Of God: that He exists, Of Truth and Error, Of the Essence of Material Things, Of the Existence of Material

Things and of the Real Distinction between the Mind and the Body of Man. However many scientists were opposed to Descartes' ideas including Arnauld, Hobbes and Gassendi.

The most comprehensive of Descartes' works, *Principia Philosophiae* was published in Amsterdam in 1644. In four parts, *The Principles of Human Knowledge, The Principles of Material Things, Of the Visible World* and *The Earth*, it attempts to put the whole universe on a mathematical foundation reducing the study to one of mechanics.

This is an important point of view and was to point the way forward. Descartes did not believe in action at a distance. Therefore, given this, there could be no vacuum around the Earth otherwise there was way that forces could be transferred. In many ways Descartes's theory, where forces work through contact, is more satisfactory than the mysterious effect of gravity acting at a distance.

However Descartes' mechanics leaves much to be desired. He assumes that the universe is filled with matter which, due to some initial motion, has settled down into a system of vortices which carry the sun, the stars, the planets and comets in their paths. Despite the problems with the vortex theory it was championed in France for nearly one hundred years even after Newton showed it was impossible as a dynamical system. As Brewster, one of Newton's 19th century biographers, puts it:-

Thus entrenched as the Cartesian system was ... it was not to be wondered at that the pure and sublime doctrines of the Principia were distrustfully received ... The uninstructed mind could not readily admit the idea that the great masses of the planets were suspended in empty space, and retained their orbits by an invisible influence...

Pleasing as Descartes's theory was even the supporters of his natural philosophy, such as the Cambridge metaphysical theologian Henry More, found objections. Certainly More admired Descartes, writing:-

I should look upon Des-Cartes as a man most truly inspired in the knowledge of Nature, than any that have professed themselves so these sixteen hundred years...

However between 1648 and 1649 they exchanged a number of letters in which More made some telling objections, Descartes however in his replies making no concessions to More's points. More went on to ask:-

Why are not your vortices in the form of columns or cylinders rather than ellipses, since any point of the axis of a vortex is as it were a centre from which the celestial matter recedes with, as far as I can see, a wholly constant impetus? ... Who causes all the planets not to revolve in one plane (*the plane of the ecliptic*)*? ... And the Moon itself, neither in the plane of the Earth's equator nor in a plane parallel to this?*

In 1644, the year his *Meditations* were published, Descartes visited France. He returned again in 1647, when he met Pascal and argued with him that a vacuum could not exist, and then again in 1648.

In 1649 Queen Christina of Sweden persuaded Descartes to go to Stockholm. However the Queen wanted to draw tangents at 5 a.m. and Descartes broke the habit of his lifetime of getting up at 11 o'clock. After only a few months in the cold northern climate, walking to the palace for 5 o'clock every morning, he died of pneumonia.

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