# EMPIRICISM & 'EMPIRICAL PHILOSOPHY'



Thomas Hobbes (1588-1679)

One of the most remarkable features of the developments in England was the way in which the pioneering scientific work was influenced by certain philosophers, and vice-versa. The most important philosopher was Francis Bacon, who was also politician of great importance in the courts of Elisabeth I and James I. He felt strongly that to obtain knowledge of the world, one had to proceed by first organizing empirical facts/data, then formulating a theory, and then testing it by means of experiment. He clearly recognized that this was an "inductive" process, ie., that repeated tests of a theory gave inductive evidence for its truth. His ideas were very influential, first on the founders of the Royal Society in 1662 (particularly on Newton), and later on writers from Voltaire and Kant to Charles Darwin.

Francis Bacon (1561-1626)

Thomas Hobbes was the first philosopher to advocate an entirely materialistic philosophy, explicitly rejecting the idea that mind was a distinct entity or substance. All processes, including psychological ones, were purely physical motions of matter (an idea inspired by his visit to see Galileo). These 2 philosophers reflected and inspired a strong empirical streak in 17$^{th}$ century England, of great importance for subsequent developments.

# BACONIAN EMPIRICAL PHILOSOPHY



Bacon believed in something that has been called "Immaculate Perception" – 'all depends on keeping the eye steadily fixed upon the facts of nature and so receiving their images simply as they are.'

**Or, to put it another way:**

'One method of delivery alone remains to us which is simply this: we must lead men to the particulars themselves, and their series and order; while men on their side must force themselves for a while to lay their notions by and begin to familiarize themselves with *facts'*.

**However, it should be noted that:**

Human understanding is "like a false mirror, which, receiving rays irregularly, distorts and discolours the nature of things by mingling its own nature with it".

**Thus, science is a combination of empirical observation and reasoning:**

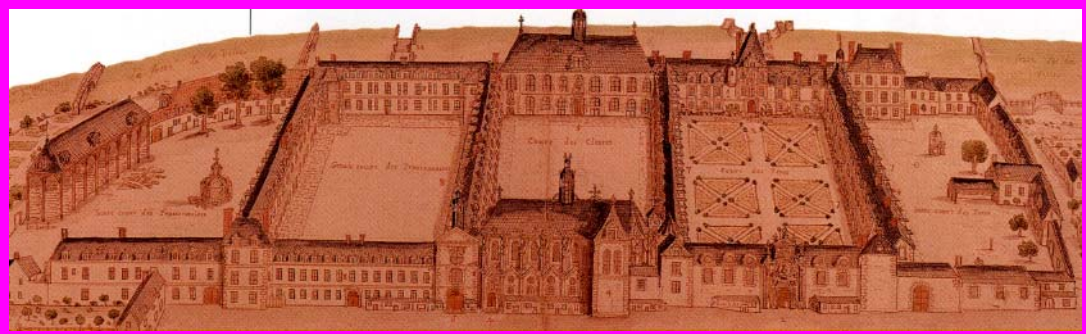
"But the bee takes a middle course: it gathers its material from the flowers of the garden and of the field, but transforms and digests it by a power of its own. Not unlike this is the true business of philosophy; for it neither relies solely or chiefly on the powers of the mind, nor does it take the matter which it gathers from natural history and mechanical experiments and lay it up in the memory whole, as it finds it, but lays it up in the understanding altered and digested. Therefore from a closer and purer league between these two faculties, the experimental and the rational (such as has never yet been made), much may be hoped."

# CARTESIAN Philosophy (I)

Descartes
(1596-1650)

**Probably the 2 most important influences on Descartes's life were his education at the Jesuit college of LaFleche, and his decision to move to Holland in 1628 (where he lived from 1628-49, and wrote all his great works). He died in Sweden shortly after going there to tutor Queen Christina, apparently because of the climate.**

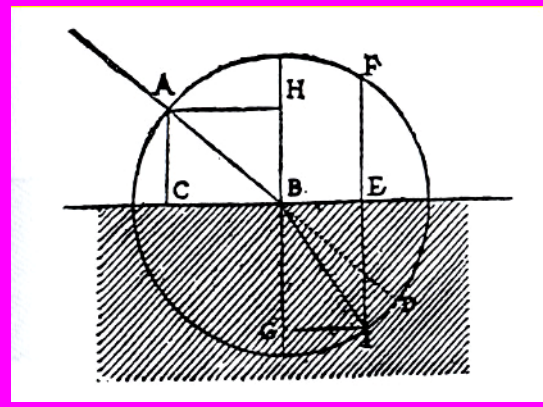
**In philosophy he is best known for his work on the theory of knowledge (published in 1637 and 1641) which tried to derive an understanding of the world starting from an indubitable premise (the famous "cogito ergo sum"); for this he is considered the father of modern philosophy. In mathematics he made the crucial link between algebra and geometry, by inventing coordinate geometry- this, along with the integral & differential calculus, set off the development of modern mathematics.**



Jesuit college at La Fleche

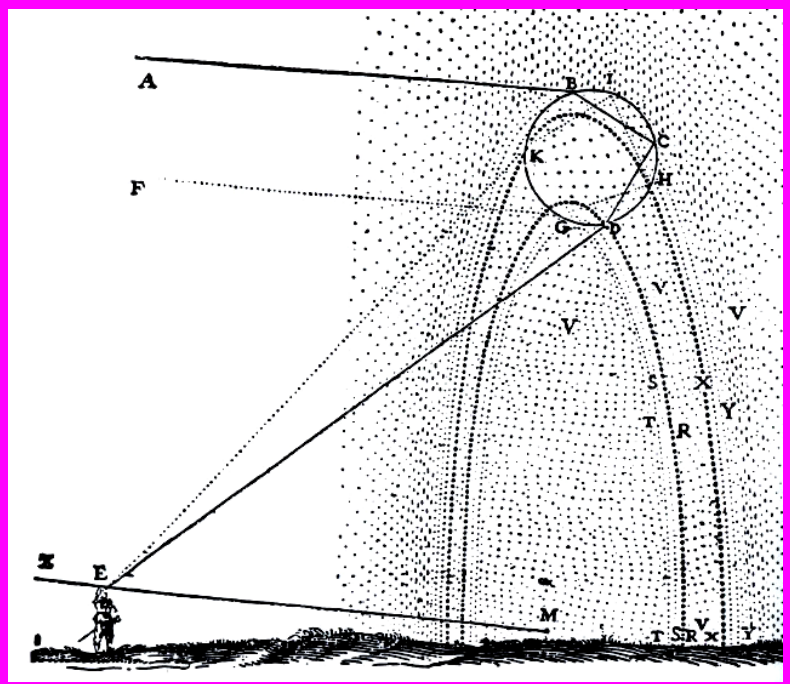
'Christina & her Court' (Dusmenil le J)

# Descartes' Scientific Work (I)



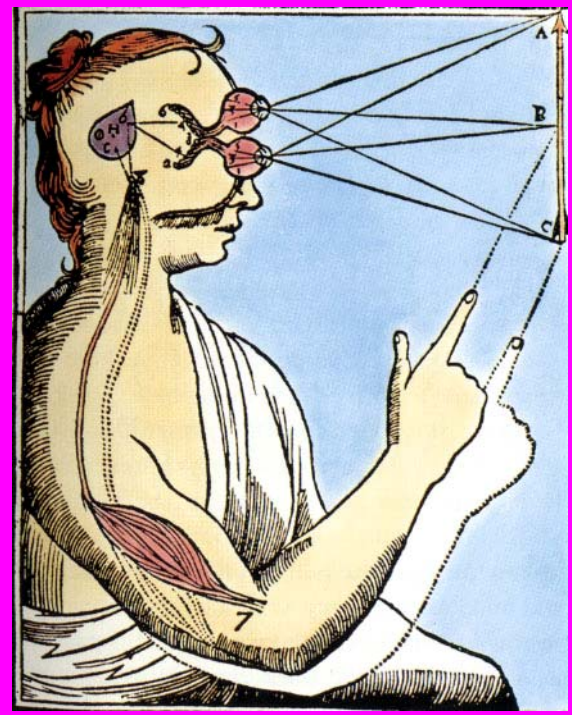

Descartes also did much scientific work, both in optics and human anatomy. The impact of this work was greatly blunted because he refrained from publishing most of it (it was published after his death). The work was written in the period 1629-33, but he stopped the work almost as it was finished when he heard of the trial and condemnation of Galileo.

The optical work is interesting because he gave correct explanations of many optical phenomena (including the rainbow- see figure below left). He understood the laws governing refraction already in 1627 (although they had previously been discovered by Snell in 1620), and his mathematical talents enabled him to deduce many of their complex consequences, starting from the basic formulation shown above.

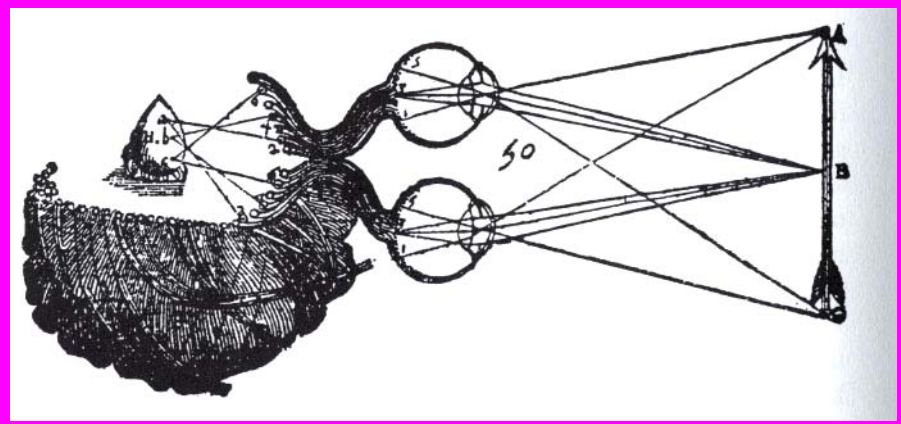


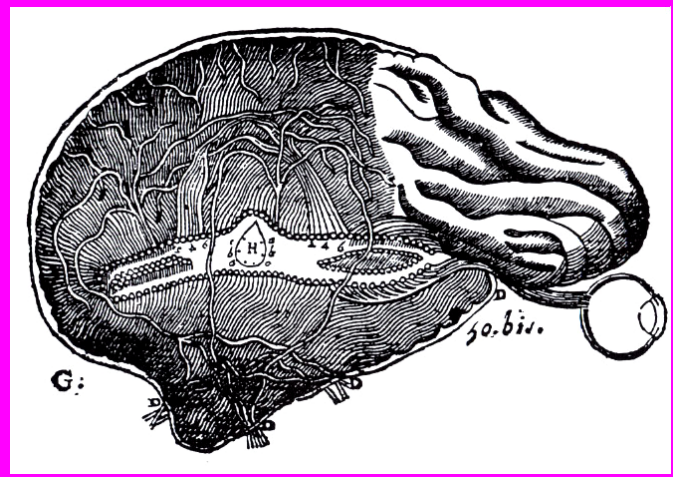

Descartes also tried to give a general theory of dynamics, both for objects on earth and in the heavens- this is discussed in more detail in the course notes. Although his ideas were very persuasive at the time, the methodology is now viewed as fundamentally flawed. This is because despite the apparent generality of the principles he promoted, there was never any attempt to give a quantitative application of them to, eg., planetary motions- from this point of view he was no better than the Greeks. In the end his views were quite incorrect.

# Descartes' Scientific Work (II)



Descartes' interest in human anatomy came partly from his interest in perception, & partly from a desire to understand the relation between mind and matter- a dichotomy which he formulated, & which since has become a part of our mental furniture. A deterministic Cartesian dualism between mind & body (ie, matter), apparently requires some synchronous mechanism to keep them correlated. Descartes unravelled some of the mechanisms involved in visual perception, as we see in the drawings here from his "Treatise on Man". Notice also his interest in the brain as the organ connected with perception, memory, etc (but not the 'soul'). His main object was to show how one could give a mechanistic understanding of physiological processes- although most of these processes, from respiration and digestion to reproduction, were already known in some detail, they had been explained in terms of 'souls', instead of mechanically. This was an important step forward.





# Descartes' Scientific Work (III)

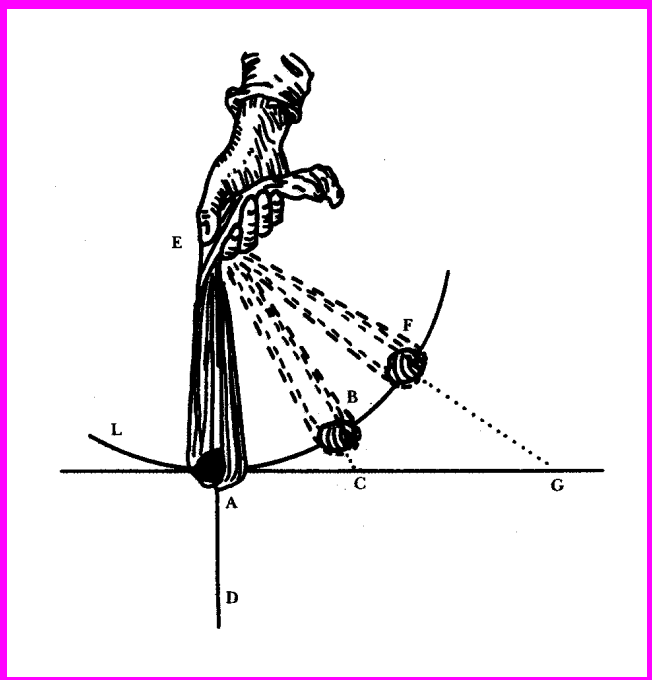
**Descartes understood that the principal problem to be solved in physics was- how to explain dynamics. He started from 1st principles:**

**"God is the primary cause of motion; and He always maintains an equal quantity of it in the universe."**

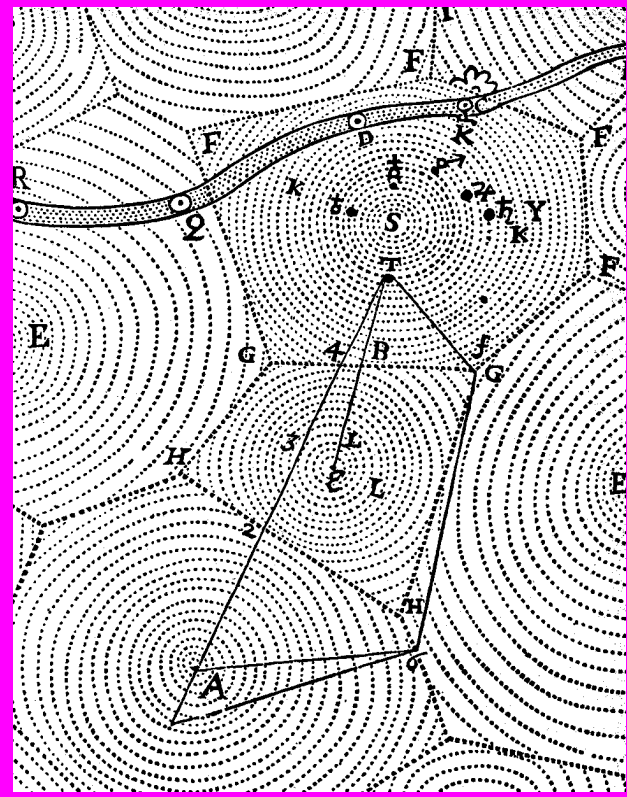
**From whence:**

**1st law of nature- each thing, as far as it is in its power, always remains in the same state; & so when it is once moved, it always continues to move**

**The 2nd law of nature- all movement is, of itself, along straight lines; & so bodies moving in a circle always tend to move away from its centre.**




Circular motion caused by force



The vortices in space

**The 3rd law: a body coming into contact with a stronger one loses none of its motion; but on contact with a weaker one, loses as much as it transfers to the weaker one**

**To explain planetary motions Descartes postulated a complex system of vortices in space- and space itself was filled with a 'microscopic dust' of particles.**

**In contrast to Galileo, many of Descartes's detailed explanations, like his 3rd law,were uninformed by observation, and incorrect.**

# SPINOZA: an Infinity of Attributes

'Jews in the Synagogue'
(etching by Rembrandt, 1648)

One of the most extraordinary thinkers in 17th century Holland was Spinoza. With Descartes & Leibniz, he was one of the 3 great 'rationalist' philosophers. Spinoza took this approach as far as anyone is likely to go- in his posthumously published work 'The Ethics' he attempted an axiomatic approach to all of metaphysics. The actual axioms & the reasoning are less interesting than the final result- a single universe which for him IS God- there is nothing else- & which possesses an infinity of 'attributes'.

Only 2 of these attributes are known to us- these being 'extension' (this includes matter- essentially he meant the physical world here) & mind. Because each was an attribute of one God, Spinoza was not advocating Cartesian dualism. In fact he was advocating a unified universe, most of which cannot be known by us. The spirit (but not the details) of Spinoza's ideas have a curious resemblance to some features of 20th century physics. However the rationalist approach was not be fruitful in the development of 17th century ideas.

Spinoza also advocated a political philosophy quite close to modern liberalism- these ideas, along with his metaphysics, were considered to be extremely subversive at that time. He was excommunicated & execrated by both Jewish & Catholic churches, for having preached universal love. Little of this affected him- nor was he interested in fame or prestige, preferring to make money grinding lenses. It is unlikely he would have survived anywhere except Holland at this time.

B. de Spinoza
(1632-1677)