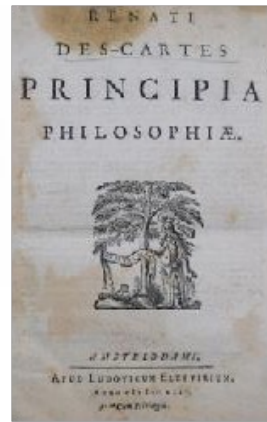


07. Descartes (1596-1650)

1. Cartesian Metaphysics

Principia Philosophiae (The Principles of Philosophy) (1644).

1. Cartesian Metaphysics
2. Descartes on Space
3. Descartes' Theory of Motion



- Three things exist:
 - *minds* = thinking substance
 - *bodies* = extended substance
 - *God* = infinite substance
- *Complete* separation of mind from body.
- Natural philosophy is concerned *only* with body: No active principles, substantial forms, final causes, occult properties, spirits, *etc.* in Nature.
- Only extended bodies in motion *via* contact forces (*i.e.*, efficient causes).

The essence of body is extension



"...the nature of matter or body, considered in general, does not consist in its being hard, or ponderous, or coloured, or that which affects our senses in any other way, but simply in its being a substance extended in length, breadth, and depth... nothing remains in the idea of body, except that it is something extended in length, breadth, and depth; and this something is comprised in our idea of space, not only of that which is full of body, but even of what is called void space."

- Extension is *essential* to the concept of matter:
 - You *cannot* understand other properties of matter without presupposing extension.
 - You *can* understand extension without presupposing other properties.

Example: World in which bodies move away from approaching hands.

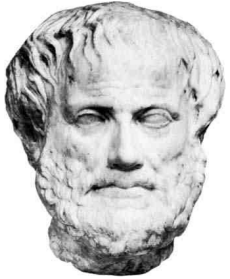
- No concept of hardness of a body in such a world.
- Yet concept of body would still be understandable.
- Thus concept of body is independent of concept of hardness.

2. Descartes on Space

- *matter = pure extension = space*
- Recall:



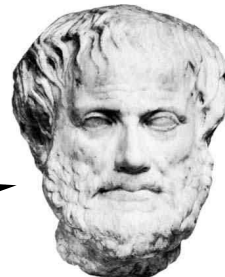
*space = substratum in which Forms are impressed
= not separate from material things
≈ pure unadulterated matter (?)*



*space = innermost motionless surface of containing object
= separate from contained object*

- Common to all three: Space cannot exist apart from matter.
- But Aristotle objects to space = matter:

Different objects can occupy the same place at different times. Thus place must be separate from matter.



Descartes' Response: Relational Account of Place

- Semantic Resolution: Two senses of "extension":
 - (i) Extension as "something particular" (inseparable from a particular object).
 - (ii) Extension as "something general" (separable from a particular object).
 - Sense (i) denotes the "internal place" of a particular object (its matter).
 - Sense (ii) denotes the "external place" of a particular object.



When Aristotle refers to "place" he's referring to (ii).

- Ontological Resolution: An object does not have a unique external place. External place is a *relational* concept:



"Nothing has a permanent place except as determined by our thoughts."

"...motion [in the strict sense] is simply the transfer of one body from the vicinity of the other bodies which are in immediate contact with it, and which are regarded as being at rest, to the vicinity of other bodies. But it often happens that, in accordance with ordinary usage, any action whereby a body travels from one place to another is called 'motion'; and in this sense it can be said that the same thing moves and does not move at the same time, depending on how we determine its location."



- So: Whether different objects occupy the same place at different times depends on how we determine their location with respect to other objects.

Example:

- With respect to the Earth, Rogers Hall does not change its external place (and so cannot come to be located in another Rogers Hall-shaped place at some future time).
- With respect to the Sun, Rogers Hall is changing its external place (and so can come to be located in another Rogers Hall-shaped place at some future time).

One Consequence:

"It follows from this that in the strict sense there is no motion occurring in the case of the earth or even the other planets, since they are not transferred from the vicinity of those parts of the heaven with which they are in immediate contact, in so far as these parts are considered as being at rest."



- The Earth is motionless with respect to the inner surface of celestial matter surrounding it.
- But: The Earth *is* in motion about the Sun with respect to the fixed stars.

3. Descartes' Theory of Motion

(i) Bodies are individuated through motion:

"All the properties we distinctly perceive to belong to [matter] are reducible to its capacity of being divided and moved according to its parts; and accordingly it is capable of all those affections which we perceive can arise from the motion of its parts. For the partition of matter in thought makes no change in it; but all variation of it, or diversity of form, depends on motion."



corpuscularianism

- extended, infinitely divisible corpuscles.
- motion in a plenum.

vs

atomism

- pointlike, indivisible atoms.
- motion in a void.

(ii) Motion is caused by God:

- Instigated at creation.
- Constantly maintained *via* imposition of a principle of conservation of quantity of motion, and by three "Laws of Nature".

"Now as far as the general cause [of motion] is concerned, it seems clear to me that this is no other than God himself. In the beginning <in his omnipotence>, he created matter, along with its motion and rest; and now, merely by his regular concurrence, he preserves the same amount of motion and rest in the material universe as he put there in the beginning. Admittedly motion is simply a mode of the matter which is moved. But nevertheless it has a certain determinate quantity; and this, we easily understand, may be constant in the universe as a whole while varying in any given part... For we understand that God's perfection involves not only his being immutable in himself, but also his operating in a manner that is always utterly constant and immutable... From God's immutability we can also know certain rules or laws of nature, which are the secondary and particular causes of the various motions we see in particular bodies."



- God constantly imposes conservation principle and laws on bodies at every instant.
 - *Not an Absentee Landlord who sets up universe and then retires to Florida...*
 - *Cartesian physics = complete removal of all active principles from physical world; replaced with one big, external, principle (God).*

(iii) Conservation Principle:

The total quantity of motion of bodies in the universe is conserved.

- Due to "immutability and constancy" of God.
- Quantity of motion = *size* × *speed*
- Qualifications: For Descartes,
 - *Size and mass are not distinct.*
 - *Speed and velocity are not distinct.*
 - *Thus quantity of motion is not identical to momentum (mass × velocity).*

(iv) Three Laws of Nature ("secondary" causes of motion):

First Law of Nature

"Each and every thing, in so far as it can, always continues in the same state; and thus what is once in motion always continues in motion."



Second Law of Nature

"All motion is in itself rectilinear; and hence any body moving in a circle always tends to move away from the centre of the circle which it describes."



Third Law of Nature

"If a body collides with another body that is stronger than itself, it loses none of its motion; but if it collides with a weaker body, it loses a quantity of motion equal to that which it imparts to the other body."



- Law 1 says motion and rest are *states* of a body.
- Law 2 says natural motion of a body is in a straight line.
- Law 3 describes how the motion of bodies, as described by Laws 1 and 2, can be reconciled when they come into contact.

Motion need not have an immediate cause in contact with moving body.

Circular motion is not natural.

(v) Consequences of motion in a plenum:

- All motion is *relative*: a body moves only with respect to another.
- All motion is "circular" in the sense of movement along a closed curve in the plenum in which one body displaces another immediately adjacent to it.

"It has been shown.. that all places are full of bodies...From this it follows that no body can move except in a complete circle of matter or ring of bodies which all move at the same time."



- Result: Unnatural circular movements generate centrifugal pressures.
- In particular: Motion in the solar system is due to vortices of matter.

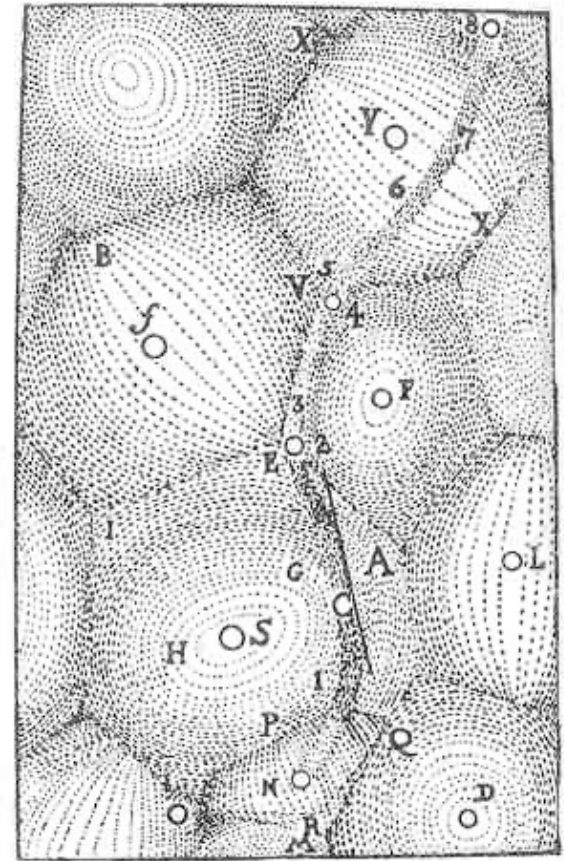
"Let us suppose... that the whole of the celestial matter in which the planets are located turns continuously like a vortex with the sun at its centre. Further, let us suppose that the parts of the vortex which are nearer the sun move more swiftly than the more distant parts, and that all the planets (including the earth) always stay surrounded by the same parts of celestial matter. This single supposition enables us to understand all the observed movements of the planets with great ease, without invoking any machinery."



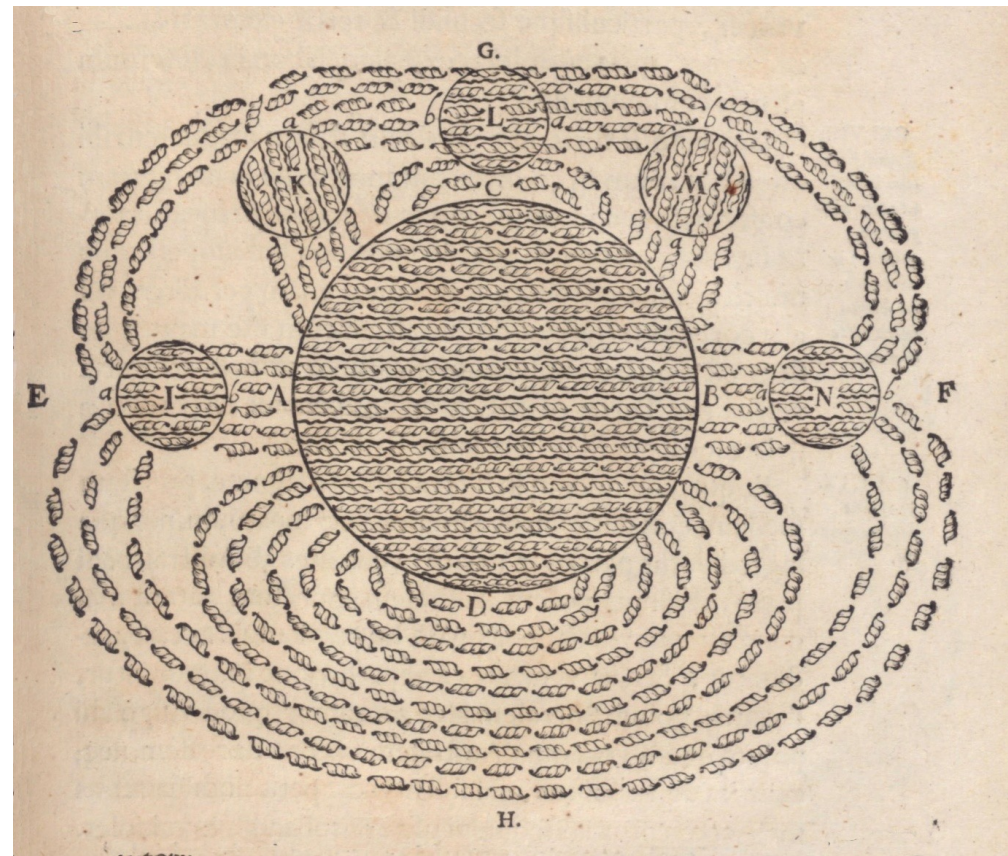
- The universe as a system of interlocking vortices of matter.

- *Smaller particles move away from vortex centers.*
- *Resulting pressure causes larger particles to move towards vortex centers.*
- *And: The earth is at rest with respect to the plenum particles in its immediate vicinity; yet it can still be said to orbit the sun!*

"...motion [in the strict sense] is simply the transfer of one body from the vicinity of the other bodies which are in immediate contact with it, and which are regarded as being at rest, to the vicinity of other bodies. But it often happens that, in accordance with ordinary usage, any action whereby a body travels from one place to another is called 'motion'; and in this sense it can be said that the same thing moves and does not move at the same time, depending on how we determine its location. *It follows from this that in the strict sense there is no motion occurring in the case of the earth or even the other planets, since they are not transferred from the vicinity of those parts of the heaven with which they are in immediate contact, in so far as these parts are considered as being at rest.*"



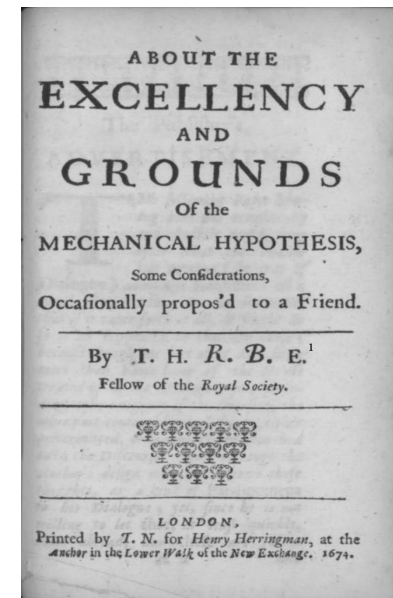
- Mechanical basis for light.
 - *Constant outward pressure of smaller particles from Sun due to centrifugal effects.*
- Mechanical basis for magnetism.
 - *Screw-shaped particles passing through pores in a magnet and iron.*
 - *Air between magnet and iron is driven out, causing them to move together.*



- Boyle's *About the Excellency and Grounds of the Mechanical Hypothesis* (1674).
 - *Two "catholic principles" of the "mechanical philosophy": matter and motion.*
 - *Denial of action-at-a-distance.*
 - *Rejection of final causes.*



Robert Boyle
(1627-1691)



- Mechanical biology



"I want you to consider that all these functions in this machine follow naturally from the dispositions of its organs alone, just as the movements of a clock or another automat follow from the disposition of its counter-weights and wheels; so that to explain its functions it is not necessary to imagine a vegetative or sensitive soul in the machine, or any other principle of movement and life other than its blood and spirits agitated by the fire which burns continually in its heart and which differs in nothing from all the fires in inanimate bodies." (*Treatise on Man*, 1664.)

"The body of man is a hydraulic machine contrived with the most exquisite art, in which there are numberless tubes properly adjusted and disposed for the conveyance of fluids of different kinds. Upon the whole, health consists of regular motions of the fluids, together with a proper state of the solids, and diseases are their aberrations."



Richard Mead
(1673-1754)

- Complete separation of *minds* ("spirits", hidden principles, occult forms, etc.) and physical *bodies*.
- Physical bodies are to be given *mechanical explanations* in terms of cause/effect relationships mediated through contact forces.

Extreme Example #1:
Vivisection of living
(mindless) animals is
permissible...

"I advise those who are not versed in Anatomy, before they commence the perusal of these observations, to take the trouble of getting dissected in their presence the heart of some large animal possessed of lungs, (for this is throughout sufficiently like the human)." (*On the Motion of the Heart and Blood*, 1628.)



Extreme Example #2

- 1950's. Behaviorism paradigm in psychology.

Claim: Learning proceeds by *reinforcement*

- positive reinforcement establishes behavior
- negative reinforcement eliminates behavior

- Extreme form: All human behavior can be explained in terms of *purely observable* responses to reinforcement.

- In particular: *There are no such things as unobservable mental/cognitive states.*

- Thus: "x feels pain" means "x exhibits certain behaviors"

Question: How should we perform operations on newborns?

- Extreme behaviorist:

- *Newborns cannot verbally communicate.*
- *To say "Newborn is in pain" means "Newborn exhibits certain behaviors".*
- Thus: *Just use muscle relaxant as anesthetic.*

Skinner, B. F. (1953)
*Science and Human
Behavior*

