

Astronomy 350L (Spring 2005)



The History and Philosophy of Astronomy

(Lecture 12: Descartes)

Instructor: Volker Bromm TA: Amanda Bauer

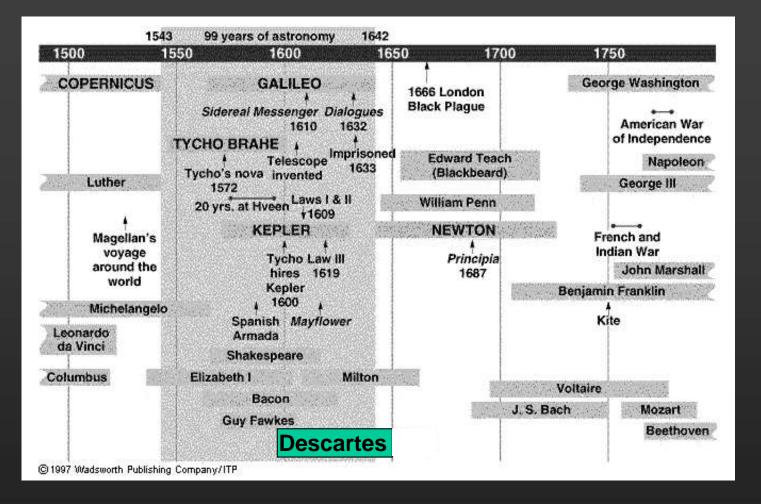
The University of Texas at Austin

Rene Descartes: The First Modern Philosopher



- 1596 (La Haye) 1650 (Stockholm)
- founder of modern philosophy
 method of radical doubt
 - mind hady dualiam
 - mind-body dualism
- invented analytical geometry (Cartesian coordinates)
- Importance for astronomy:
 - mechanistic universe
 - infinite universe

Descartes: Timeline and Context

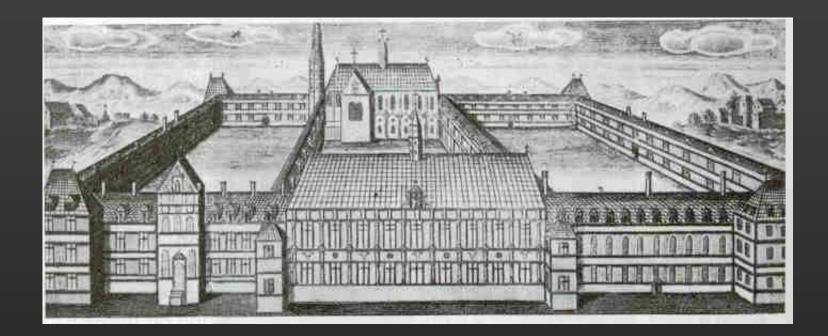


- setting the intellectual stage for Newton
- younger contemporary of Galileo and Kepler

Descartes: Geography of his Life

NORWAS UNITED KINGDOM Calais, ODunkerque THE NETH Lilleo BELGIUM Strait of Dover Arras[®]Douai Meuse English Channel Cherbourg Le Havre Amiens® St.-Lo Caen® ©Rouen Reims Metz R GDXC HIMA USSIA Rhine Gulf of St.-Malo Brest St.-Malo Versailles PARIS O Brest St.-Malo OLe Mont-St.-Michel Seine sur-Marne Nancy Stras Colmar Alençon Chartres Quimper OTroyes (VOSGES® Loriento Rennes® St-Nazaire Angers © Blois Loire Dijon Belfort Saôn Nantes Tours Bourges Besancon Poitiers FRANCE Lake JURA ROMARIA Geneva La Rochelle BLACK Clermont-Ferrand BBU Annecyo SEA Limoges North Atlantic Mont Bla BUL GARIA Lyon Angoulême St.-Étienne Ocean Gironde iRO Periqueuxo Bordeaux Dordogre MASSIF CENTRAL Grenoble KN EMPLE Cahors Rhône CÉVENNES GREEC Durance Agen^O - Garonne Avignon Toulouse Nimeso Bay of Biscay Cannes ® Biarritz Toulouse Montpellier[©] Aix-en-Provence S O Marseille © Carcassonne Toulon Pauo Lourdes Gulf of Lion Cors 250 500 miles ANDORRA Perpignan Aja PYRENEES

School in La Fleche (1606-14)



- newly established elite school, run by Jesuits
- Curriculum:
 - Latin
 - scholastic philosophy
 - state-of-the-art mathematics

A Restless Early Life

- 1615- 16: University in Poitiers (law degree)
- 1618: joins Dutch army (as engineer)
- 1619: joins Bavarian army (30 Years War)
- 1622-28: lives in Paris
- Also: extensive travel throughout this period

Descartes in Paris (1622-28)



• Paris: the hotspot of the Age!

Descartes in Paris: Centralization of Power



• Cardinal Richelieu (1585-1642)

- rise in power
- becomes Chief Minister
- creates centralized (abolutistic) French State
- founds Academie Francaise ("guardian" of French language)

Descartes: A Desire for Calm and Peace



- after having seen the world, Descartes wants quiet time to think and write
- decides to leave bustle of Paris behind
- move to Netherlands (sedentary 2nd half of his life)

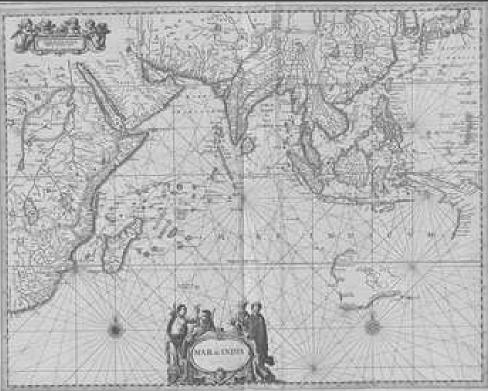
Descartes in the Netherlands (1628-49)



• A young, vibrant nation: most tolerant place in Europe then!

Descartes in the Netherlands (1628-49)





• A superpower of the 17th century!

The Dutch Golden Age (Arts and Sciences)



The Night Watch, Rembrandt (1606-69)

The Philosopher: A New System

DISCOURS DE LA METHODE Pour bien conduire la raifon, & chercher la verité dans les ficiences. PLUS LA DIOPTRIQVE. LES METEORES. ET LA GEOMETRIE. Qui font des effais de cete METHODE.



A LEYDE De l'Imprimerie de IAN MAIRE. CIOIDC XXXVII. Auec Prinilege.

• *Discours de la Methode* (Discourse on the Method, 1637)

• Radical doubt:

- nothing is certain, but:
- Cogito, ergo sum
 (I think, therefore I am)
- Dualistic philosophy (mind-body)
- First truly original philosophical system since antiquity

The Philosopher: Radical Doubt

- Destruction of all previous certainties
- I cannot be sure of what my senses tell me (after all, I could be dreaming...)
- But: I cannot doubt one thing: That I doubt (think)!
- Thus: My thinking proves my existence!



I think, therefore I am!

The Philosopher: Prove God's Existence

- I know that I am not perfect, but I have the idea of a perfect being in my mind!
- This perfect being cannot be the same as me, as I myself am surely imperfect!
- This perfect being would not be perfect if it did not also exist!



The perfect being (God) exists!

Prove Existence of Outside Objects

- In my thinking, I clearly conceive of objects in the outside world!
- God, being perfect, would not deceive me!



- But this outside world is very different from the thinking mind!
- There are two kinds of substance!

Cartesian Dualism

thinks
free thought/will

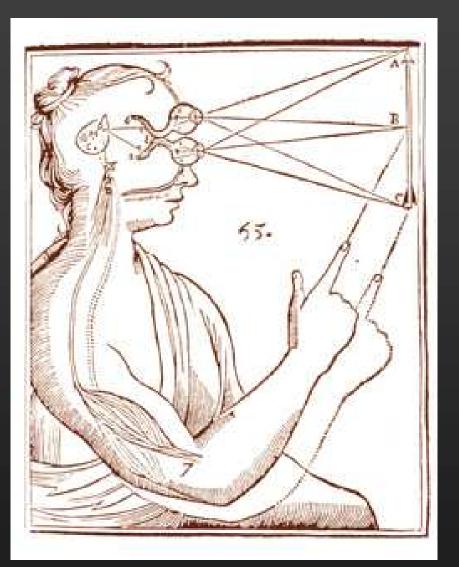
Mind

Bodies

- has "extension" (length, breadth, width)
 - behave according to laws of physics (determinism)

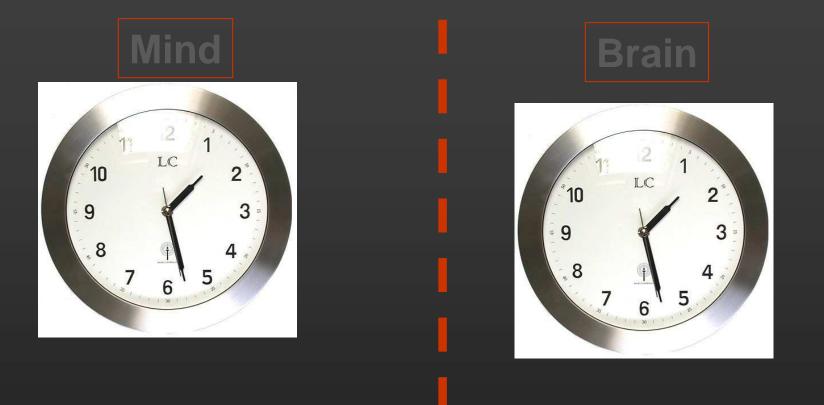
• Two realms of reality are fundamentally different and independent!

Cartesian Dualism



- The human body is a machine
- But the brain then is also part of this machine
- Big Q: How does the mind interact with the brain?

Mind-Body Interaction: Clock Analogy



- Mind and body only appear to interact, but are really pre-set in parallelism!
- What about free will? (Brain follows deterministic laws...)

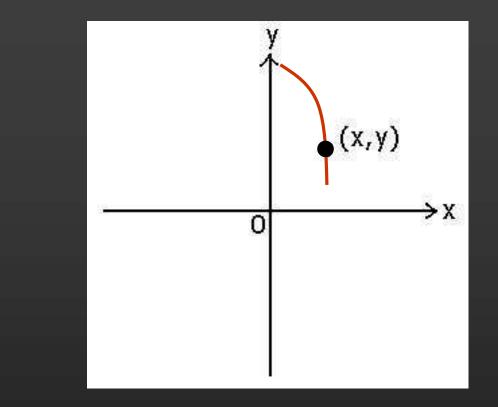
The Mathematician: Analytical Geometry

GEOMETRIE. LIVRE PREMIER.

Des problesmes qu'on peut construire sans y employer que des cercles & des lugnes drostes.

Ou s les Problefmes de Geometrie fe peuvent facilement reduire a tels termes, qu'il n'eft befoin par aprés que de connoiftre la longeur de quelques lignes droites, pour les conftruire.

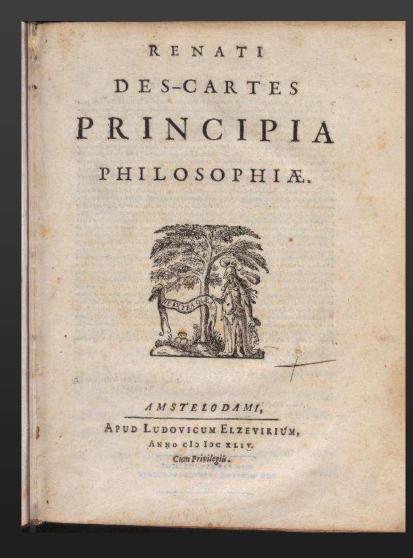
Et comme toute l'Arithmetique n'est composée, que Commée de quatre ou cinq operations, qui font l'Addition, la le calcul Souftraction, la Multiplication, la Diuision, & l'Extra-thmetiction des racines, qu'on peut prendre pour vne espece que fe apporte de Diuision : Ainsi n'at'on autre chose a faire en Geo-aux opetations de metrie touchant les lignes qu'on cherche, pour les pregeomeparer a estre connuës, que leur en adiouster d'autres, ou trie. en oster, Oubien en ayant vne, que se nommeray l'vnité pour la rapporter d'autant mieux aux nombres . & qui peut ordinairement estre prise a discretion, puis en ayant encore deux autres, en trouuer vne quatries qui soit à l'vne de ces deux, comme l'autre est a l'vnité, ce qui est le messe qui soit a l'vne de ces deux, comme l'vnité



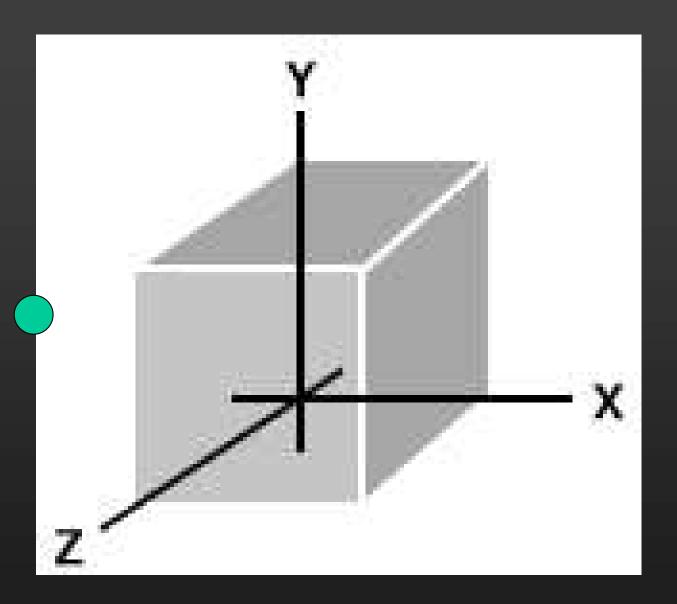
merge geometry and algebra!

• (Cartesian) Co-ordinates!

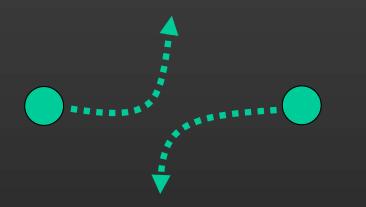
The Scientist: Matter in Motion



- Principia Philosophiae
 (Philosophical Principles, 1644)
- Theory of matter, space, and motion
- A mechanical system of the universe (matter in motion)
- An infinite universe

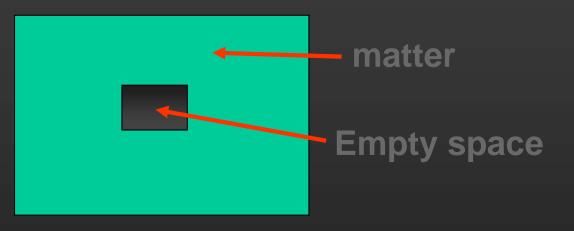


• begin with empty ("undressed") space of geometry!

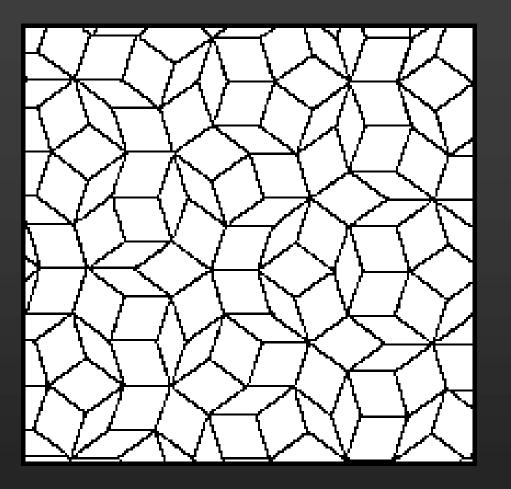


• Direct collisions can change motion!

- There can be no vacuum!
- Assume for the moment that there were empty space!

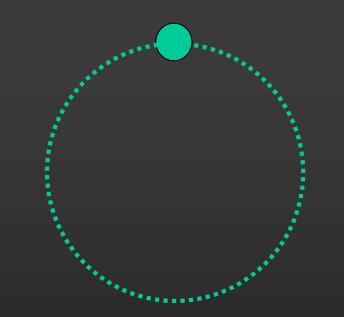


- But: Portion of empty space has "extension"!
- Thus (according to Descartes): There must also be matter (whatever has extension is matter, and vice versa!)



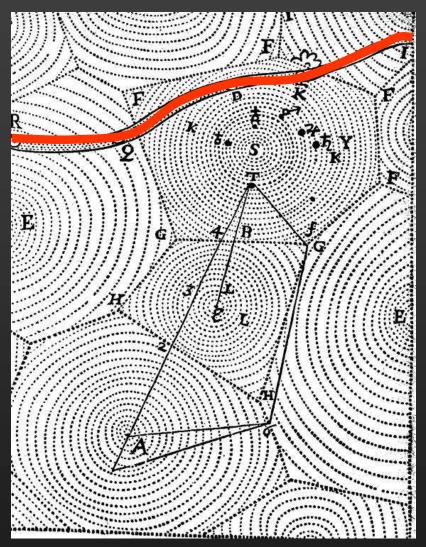
space is densely packed with material particles!
No gaps between! ----> World is a *plenum*!

Motion in Completely Filled Space



particle experiences pushes from adjacent particles!
path is bent into closed (~circular) shape!

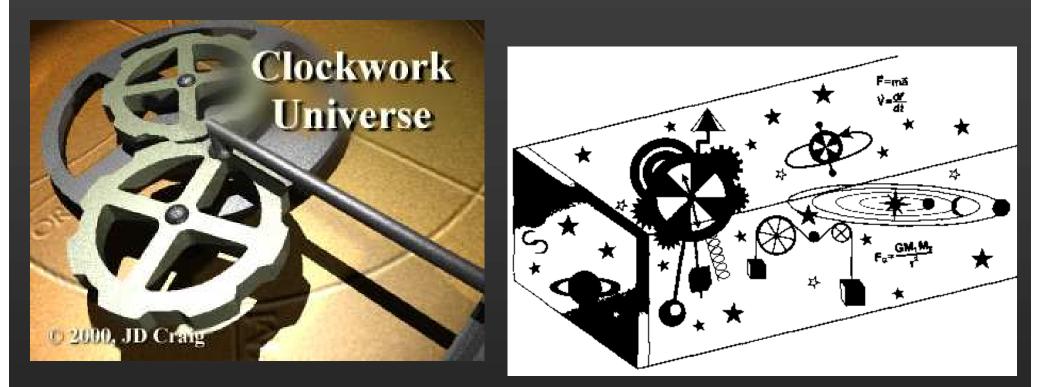
Descartes Model of the Universe



- vortex (whirlpool) cosmology!
- space/matter have no edge!
- infinity of vortices
 infinitude of Suns and Solar systems
- The universe has no center and no edge!

• Red path: Descartes' (wrong) theory for comets!

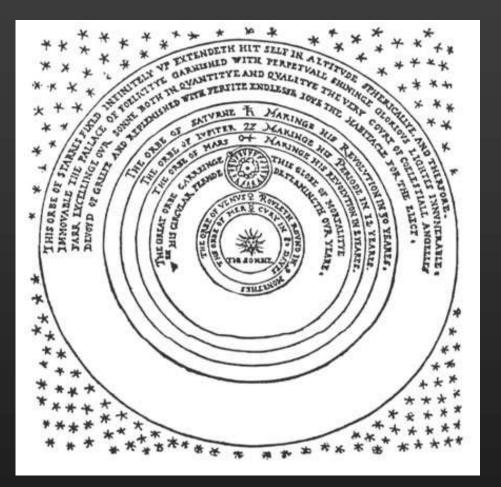
The Clockwork Universe



- Descartes establishes picture of universe governed by simple laws of motion (the "mechanical philosophy")
- Many of detailed explanations were soon found to be wrong, but overall approach became highly influential (e.g., Newton)!

Toward the Infinite Universe: Thomas Digges

popularizer of Copernican model (1576)!



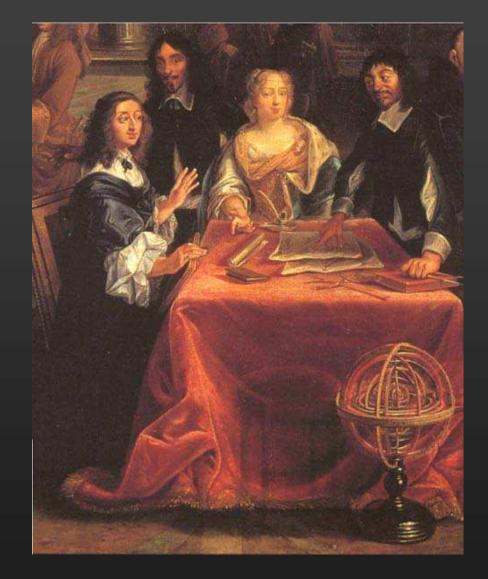
stars are not confined to a thin shell!

1663: Descartes on Index of Forbidden Books



- Index Librorum Prohibitorum
- Organized censorship
- Introduced in 1559
- Abolished in 1966

Journey's end: Move to Stockholm



- Invitation from Queen
 Christina of Sweden
- Descartes as Queen's private tutor
- Problem: Descartes has to show up at court already at 5am

Journey's end: Death in Stockholm 1650



• contracts lethal pneumonia during fierce Swedish winter!

Descartes

• Rene Descartes:

founder of modern philosophy

- a new system of philosophy
- based on method of radical doubt (Cogito ergo sum)

Cartesian Dualism

- mind vs matter
- Q: How can the brain be influenced by the mind/soul???

Cartesian model of the universe

- consists of vortices ("matter in motion")
- universe is infinite
- universe is governed by mechanical laws