

## Principles of Cartesian Physics

I. Body is just extension.

(it is not essentially solid or heavy)

(nor does it have any sensible qualities)

This is because our senses were given to us to tell us what is good or bad for the mind/body union, not to tell us about the essences of things

So when investigating the nature of body, we need to rely on the understanding, or clear and distinct perception, alone

But we can clearly and distinctly conceive body without having to include any sensible quality or anything like weight or hardness

We cannot, however, conceive body without conceiving extension

So we must conceive body as extended, but need not conceive it as having any other quality

## An Objection

Bodies that take up the same extension in space can have different weights

e.g., an iron ball and a wooden ball

The same body can take up different extensions

e.g., a volume of air in nature and then that same volume compressed in a piston cylinder

Even the wax changes size with heating

So shouldn't we think that body is something other than extension, because body can stay the same while the extension changes

and bodies can be more or less while the extension remains the same

(so perhaps we should distinguish the quantity of a body, like air, from the extension it takes up, and even consider that same quantities different substances may be present in the same extension)

## Descartes's reply

I cannot conceive how the quantity of a body could be altered unless stuff was taken out of it or added into it

This means only intelligible way to account for variations in density is to suppose them due to the more or less porous structure of different materials.

So nothing about the phenomena of rarefaction and condensation requires the supposition of empty space.

## An important footnote

Descartes wanted to deny that there is any such thing as empty space

So the pores still have to be full of material

It is just that the material in the pores is moving through, and not with, the porous body

compare swinging a sieve and a frying pan through the air

## Principles of Cartesian Physics, cont.'d

II. Extension is always the extension of some body.

(There is no such thing as empty space.)

This is because extension is a mere mode of a thing, not a thing.

As a mode, it cannot exist on its own.

There can be no extension that is not the extension of some thing.

“Nothing” can have no extension.

## The argument from the container:

Were a container to contain a vacuum

there would be nothing between its walls.

But if there were nothing between its walls they would be together.

So there is no way a vacuum can exist.

## An objection

Bodies can be supposed to be annihilated or to move away while the place they occupied remains unoccupied

## Descartes's reply

The distinction between the extension of a body in a place (internal place) and the place it occupies (external place) is merely “conceptual.”

Internal place is defined by the outer surface of the body in the place and so is something that exists only relative to the body.

External place is defined by the common, shared, surface of the inner body and the surrounding bodies, and is something that exists only relative to the more remote landmark bodies with reference to which that surface is located.

The internal and external surfaces are in fact identical and distinguished only by the bodies relative to which they are defined.

## How place comes to be distinguished from the surface of any body

Replacement of the surrounding bodies does not lead us to think the external place has changed as long as the enclosed region continues to have the same relation to landmark bodies.

Even change of shape does not lead us to think the place has changed as long as the relation to landmarks remains the same.

So we come to define places relative to those bodies we take to be at rest and so use as landmarks.

But there are no bodies really at rest, and no ultimate reference frame for motion.

So depending on which ones we pick, places are defined differently.

This makes “external place” a merely ideal thing, not a real thing, and the network of external places or “absolute space” is similarly ideal



## Consequences of (I) identification of the nature of body with extension and (II) identification of extension with body

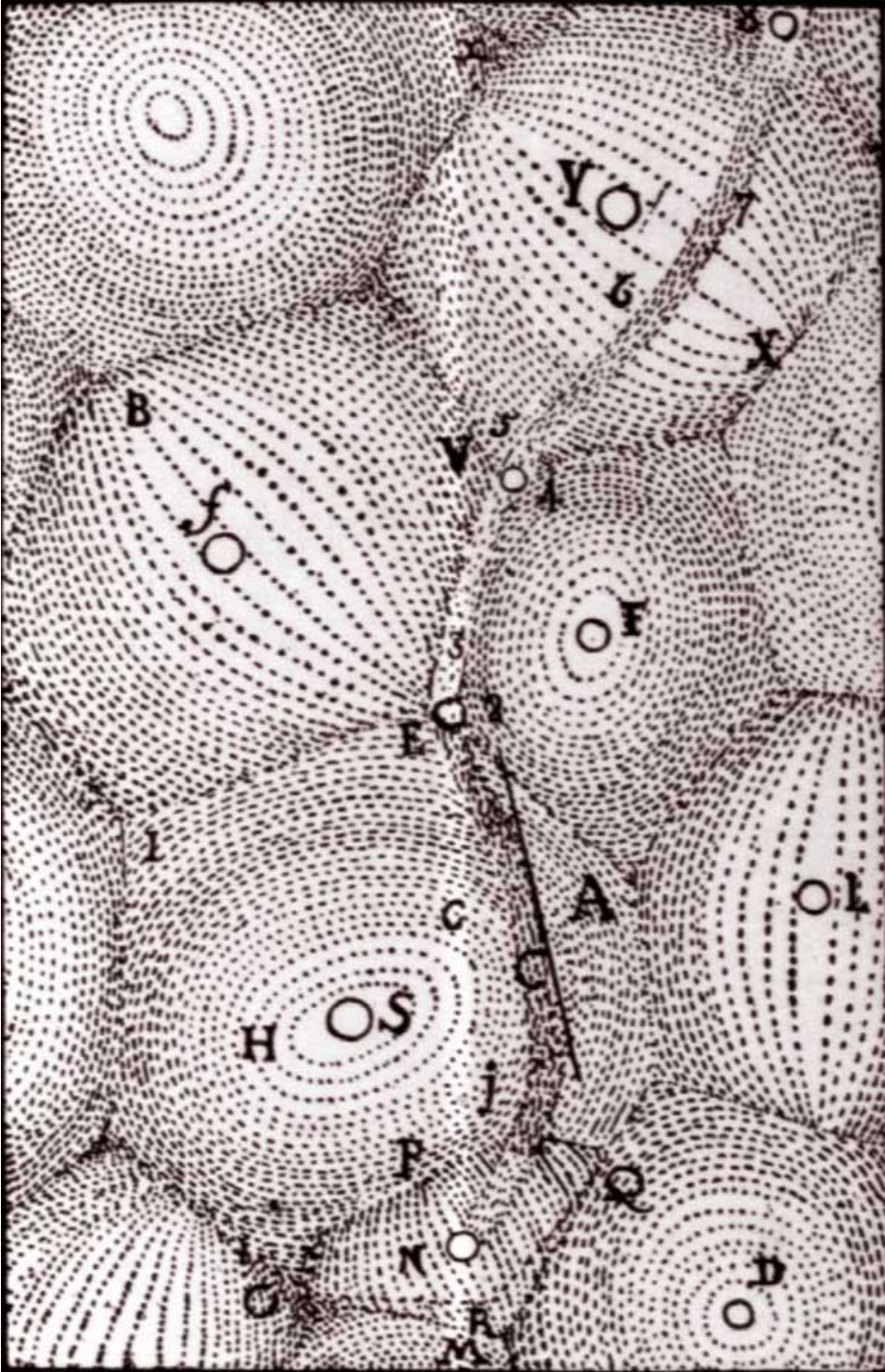
We shouldn't need to do any more to understand what bodies are and how they behave than to understand

- the principles of geometry, which tell us how bodies can be shaped and divided
- the laws of motion and collision

Everything is made of the same kind of stuff.

There are no differences between different kinds of materials that are not reducible to differences in how fundamentally identical component particles are shaped and moving.

Since there is no empty space, all motion must be circular.



Since God

- recreates the world from moment to moment
- is supremely constant in all his operations

The same quantity of both matter and motion is conserved in the universe.

So as much motion as one body loses in collision it must transmit to another.

The quantity of motion is simply the product of speed and volume of the body.

So:

What was once in motion retains that motion unless it collides with something.

What was once at rest remains at rest unless something hits it.

Circular motion is always the product of collision.

This is because God preserves the direction of motion as well as its quantity

And it is also confirmed by experience of how rotating bodies move when released from what constrains them to orbit around a point

## Descartes's mechanical account of the evolution of the universe

God could have just created a block of matter and then injected motion into it.

The injected motion would have caused the matter to divide into particles of three types:

- gross
- intermediate
- subtle

Vortices of intermediate matter carry gross matter around and account for all the phenomena of gravitation, magnetism, etc.

Motions of subtle matter account for light

Connections of gross matter arise naturally and account for the formation of planets and the evolution of life.

But not everything can be accounted for by “top-down” means.

## Descartes’s Scientific Method

Metaphysical First Principles



Laws of Nature



← Gap

Specific Laws ← Hypotheses



Sensory Experience