Philosophy of Space and Time: Week 1

Preliminaries

- Me: James Read (james.read@kcl.ac.uk)
- Students (register, name tags)
- Setup:
  - 5 minute presentations of the readings (email to volunteer)
  - One person speaking at a time
  - Interactive!—Many backgrounds present.

Background

Substantivalism and Relationism

- *Substantivalism*: Space (or spacetime) is an entity in its own right, and (the parts of) space(time) would appear in a catalogue of the fundamental objects in the universe.
- *Relationism*: Space (or spacetime) does not exist as a basic entity in its own right. Claims about space(time) are ultimately claims about material entities and the relations they stand in.

Substantivalists: Newton, Clarke
Relationists: Descartes, Leibniz

Newton

Newton is the arch substantivalist. He lays out his conception of absolute space in the *Scholum*:

> Absolute, true and mathematical time, of itself, and from its own nature, flows equably without relation to anything external...
>
> Absolute space, in its own nature, without relation to anything external, remains always similar and immovable... (Huggett 1999: 118)

In *De Gravitatone*, Newton explicitly lays out his conception of absolute space as infinite, perfectly uniform, and Euclidean in geometrical structure. (Huggett 1999: 111-112)

Descartes

- Descartes subscribed to the modern principle of inertia: objects tend naturally to move in straight lines at constant speeds, and will continue to do so forever unless acted upon by some external influence.
- Descartes took the universe to be a vast (possibly infinite) plenum; that is, there is matter everywhere, and no 'empty space'.
- Descartes assumed that the space vacated by a moving body would immediately be filled by other matter, and since the easiest way for this to happen is for matter to move in continuous circular streams [???], he argued that after a long period of time matter would tend to congregate in a number of spherical vortices.
- Bodies can move relative to one another, but Descartes defines *true* motion as follows:

  > If, on the other hand, we consider what should be understood by *motion*, not in common usage but in accordance with the truth of the matter, and if our aim is to assign a determinate nature to it, we may say that *motion is the transfer of one piece of matter, or 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.* (Huggett 1999: 93-94)

  - According to Dainton (175): "Since he held that the material in the vortex that is in direct contact with the Earth is *motionless relative to the Earth*, given his definition of "'true motion", it follows that the Earth *does not truly move*, since it is stationary with respect to its immediate surroundings.

– Pooley demurs? (Earth does actually move relative to its surroundings, but may be "regarded as at rest").

Leibniz's Arguments Against Absolute Space

Leibniz Shifts

1. *Static shift:* An alternative world in which everything is shifted $5\mathrm{m}$ to the left.
2. *Kinematic shift:* An alternative world in which everything is moving $5\mathrm{ms}^{-1}$ to the left.

Both these shifted "Leibniz alternatives" have the following characteristics:

- All the material bodies in the universe are differently related to (Newtonian) absolute space;
- All the spatiotemporal relations between bodies are the same;
- The situations in question are exactly the same in all observable respects.

Newton admitted this—e.g. Corollary V in the *Principia*:

> The motions of bodies included in a given space are the same among themselves, whether that space is at rest, or moves uniformly in a right line without any circular motion.

The Argument from PII

Leibniz's *principle of the identity of indiscernibles* (PII) says that if two things that are qualitatively identical in all respects, then they are numerically identical. This is very controversial! (Compare the less controversial *indiscernibility of indenticals*.)

- Identity of indiscernibles: $\forall x \forall y(\forall X(Xx \leftrightarrow Xy) \rightarrow x = y)$
- Indiscernibility of identicals: $\forall x \forall y(x = y \rightarrow \forall X(Xx \leftrightarrow Xy))$

Applied to *worlds*, PII entails that there cannot be two distinct worlds W_1 and W_2 that are exactly similar with respect to all genuine properties.

If we adopt Leibniz's relational conception of space, we get the correct result: since in both cases the relative spatial relations are the same, the alleged "shifts" cannot have taken place.

Problems:

1. Why adopt the PII?
2. The argument begs the question against the substantivalist: The argument starts from the premise that the envisaged Leibniz alternatives are *indiscernible* with regard to all genuine properties. Since Newtonians hold that relations between material bodies and absolute space are real features of the world, they will simply deny the premise: the pre- and post-shifted worlds are *different*.
3. It is true that the differences are not *detectable*, but the PII is not a 'PID'.

The Argument from PSR

Leibniz also deploys arguments against Newtonian absolute space which make use of his *principle of sufficient reason* (PSR): "nothing happens without a sufficient reason why it should be so, rather than otherwise" (Alexander 1956: 25).

- E.g. with the static shift: (Dainton 179): "God had to plant the material bodies *somewhere* in space but, given the uniformity of space, what reason could he have for planting them in one collection of locations rather than another?
- Clarke: Why shouldn't the will of God be a sufficient reason?
- Leibniz in response: You're misunderstanding my principle.

- But in any case: Why PSR?

Concluding Thoughts

As Pooley states, the only good reason to move to a Leibnizian picture is *Occam's razor*. (Pooley 2013: §5)

Newton's Arguments for Absolute Space

Argument 1: The Bucket

(Dainton 186) Suppose that there is a bucket full of water, suspended by a rope (or elastic cord) from the ceiling. Twist the bucket and let the rope wind up, then release the bucket. The following sequence of events will unfold:

1. The bucket and water are initially at rest with respect to one another and the surface of the water is flat.
2. After a short while, as the twisted rope starts to unwind, the bucket begins to rotate, but the water remains stationary and flat.
3. Then, a while later, as the rotation of the bucket is gradually communicated to the water via friction, the water starts to turn, and soon is rotating at exactly the same rate as the bucket; the water is no longer flat but concave, as it rises up the sides.

Two upshots:

- Against the Cartesian conception of absolute motion—Descartes would say that the water in (3) is absolutely at rest in virtue of being stationary relative to the bucket—but this cannot be right.

- What could the water be rotating with respect to in (3) vs (1), if not absolute space?

Difficult exegetical issues—see Pooley.

Argument 2: The Globes

Newton's second argument:

> if two globes, kept at a given distance one from the other by means of a cord that connects them, were revolved around their common centre of gravity, we might, from the tension of the cord, discover the endeavours of the globes to recede from the axis of motion, and from thence we might compute the quantity of their circular motions.

(Snip the cord—indeterministic unless we have sufficient spacetime structure to underpin the difference.)—As Dainton says (188): "the relationist is thus pushed into the uncomfortable position of having to view the tension in W_2 as an entirely inexplicable occurrence."

Earman puts the argument here as follows:

(a) The best explanation of mechanical phenomena in general (and rotating phenomena in particular) utilises absolute acceleration (and absolute rotation in particular).

(b) Absolute acceleration (and absolute rotation in particular) must be understood as acceleration (and rotation) relative to absolute space.

Some, e.g. Sklar, resist the second premise. For Sklar, there is a *primitive monadic property* that bodies moving on some trajectories possess, which comes in different quantities, and inertial effects are associated with possession of this property. **But:** (problem?) This postulated property has no independent motivation.

Closing Worries

Huggett 140: But is this really an appealing position? It seems that there is an unpleasant lack of symmetry in what we have just described. Space acts on mater, keeping it on the "straight and narrow, but there is no reciprocal effect: matter can have no effect on space, because it is "always similar and immovable. Of course this is not a proof that the theory is wrong, but it does point to tension between the theory and the plausible principle that all action should be matched by some reaction.

Cf. e.g. dynamical approach in later weeks....