

Motion and Mereology in Cavendish's *Philosophical Letters*

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- Motion is a **property**, not a substance:

I want to make it clear that the motion of something that moves is, like the lack of motion is a thing which is at rest, a mere mode of that thing and not itself a substituent thing... (Descartes, *Principles*, Book II ¶25)

- Motion is **conserved**:

[W]hen one body pushes another, it could not give the other any motion except by simultaneously losing as much of its own motion, nor could it take away any of the other's motion unless its own motion increases by the same amount. (Descartes, *The World*, ch. 7)

Neither doth it agree with my reason, that one body can give or transfer motion into another body; and as much motion it gives or transfers into that body, as much loses it... For how can motion, being no substance, but only a mode, quit one body, and pass into another? One body may either occasion, or imitate another's motion, but it can neither give nor take away what belongs to its own or another body's substance... if motion doth go out of one body into another, then substance goes too; ... and then all bodies that receive motion from other bodies, must needs increase in their substance and quantity, and those bodies which impart or transfer motion, must decrease as much as they increase: Truly, madam, that neither motion nor figure should subsist by themselves, and yet be transferable into other bodies, is very strange, and as much as to prove them to be nothing, and yet to say they are something. (Cavendish, *PL* XXX)

Cavendish's argument

- (C1) Motion is **transferable**, able to be given and received. (Cartesian explanation of the conservation of motion.)
- (C2) If motion is transferable by giving and receiving, then it must be **the same motion** in the transferring and receiving bodies.
- (C3) But the notions of sameness and distinctness apply to **substances**, not modes – if so, the transfer of motion must involve transfer of substance.
- (C4) So collisions and other physical interactions that change the states of motion of objects must be accompanied by increase or decrease in mass and size. (from C1–C3)
- (C5) Changes of motion are not accompanied by changes of quantity. (GR aside)
- (C) Motion is not transferable. (*Reductio* on C1, C4, C5)

- Cavendish agrees that motion is conserved; **denies Descartes' explanation** of it.
 - His story has a tension between the assertion that motion is a mere mode, and the fact it can be given/received.
- Her alternative: think of transfers of motion like **bank transfers**. Here, no one portion of stuff is moved around: it is just that there is a general principle governing the relationship between account balances.
 - There is an explanation of why the total balance is conserved, but it is not a **mechanical** explanation – it is a regularity imposed from above.

Explanations of Conservation

- What about conservation of motion? Is it imposed from above – by God or natural law?
- Cavendish doesn't think God has a role to play in natural philosophy (*PL* 201–11); but she does think that there are regularities in nature that amount to **laws**:

I say Nature hath but one law, ... viz. to keep infinite matter in order, and to keep so much peace, as not to disturb the foundation of her government: for though Nature's actions are various ... yet those active parts, being united one infinite body, cannot break Nature's general peace. (*PL* 146)

- But, it turns out, the origin of the general peace in nature isn't governance from above, but consent from below.

Cavendish on self-motion

a watchmaker doth not give the watch its motion, but he is only the occasion, that the watch moves after that manner, for the motion of the watch is the watch's own motion, inherent in those parts ever since that matter was, and if the watch ceases to move after such a manner or way, that manner or way of motion is nevertheless in those parts of matter, the watch is made of, and if several other figures should be made of that matter, the power of moving in the said manner or mode, would yet still remain in all those parts of matter as long as they are body, and have motion in them. Wherefore one body may occasion another body to move so or so, but not give it any motion, but everybody (though occasioned by another, to move in such a way) moves by its own natural motion; for self-motion is the very nature of animate matter, and is as much in hard, as in fluid bodies... (*PL* 77–9)

Motion and Occasional Causation

- Her view is that **all motion is self-motion**.
- The explanation of the conservation of motion is not the transfer of a thing, *motion*, from one body to another, but rather the state of motion of one body **causes** or 'occasions' a change in the state of motion in another body.
 - It is something like a law of nature that when one body moves itself in a certain way, another body will **sympathetically** begin to move itself in a certain different way, subject to the **overall constraint** that the total amount of motion remains constant. The law is a regularity in the behaviour of matter; we needn't think the law is in any sense 'prior' to the behaviour.

when a body's figure is printed on snow ... it is not the body, which prints its figure upon the snow, but the snow that patterns out [i.e., copies or emulates] the figure of the body. (*PL*, 104–5)

Finite parts may consent to the rational suggestions made to them by other parts to behave in certain ways. (Detlefsen, 'Atomism, Monism, and Causation in the Natural Philosophy of Margaret Cavendish', 212)

The occasional cause rationally suggests a course of actions that the principal cause may then rationally respond to by patterning out an appropriate figure. (Detlefsen, 232)

- The occasional cause is that to which the principal cause responds; the presence and nature of the occasional cause is a **pretext** for the principal cause to do something, rather than the efficient mechanical cause of that something.

How does this work in the case of motion?

But to return to motion, my opinion is, that all matter is partly animate, and partly inanimate, and all matter is moving and moved, and that there is no part of nature that hath not life and knowledge, for there is no part that has not a commixture of animate and inanimate matter; and though the inanimate matter has no motion, nor life and knowledge of itself, as the animate has, nevertheless being both so closely joined and commixed as in one body, the inanimate moves as well as the animate, although not in the same manner; for the animate moves of itself, and the inanimate moves by the help of the animate, and thus the animate is moving and the inanimate moved; not that the animate matter transfers, infuses, or communicates its own motion to the inanimate; for this is impossible,... (*PL*, 97–8)

- This links with another theme in Cavendish: the denial of atomism in favour of the infinite divisibility of matter.
 - Indeed, there is a direct argument: if there were atoms – **objects without proper parts** – they would have only one part, and would **not** be ‘partly animate, and partly inanimate’, given this assumption:

(PAM) If x is partly animate, x has an animate part.

- There are two further arguments that Cavendish gives for this anti-atomic conclusion (following Detlefsen): a direct argument from the premise that **matter is infinitely divisible into extended parts**, and a rather more subtle argument from the premise that an atomic world would be inherently disorderly, without the regularities we see in nature.
 - The present passage is linked to that latter argument; Cavendish thinks that atomic self-movers can act on a frolic of their own, with potential for disorder; she seems here to conceive of atomism as opposed to **holism** rather than a merely mereological doctrine – see Detlefsen, §5.

Mereology without atoms – gunk

- (Partial Order)** Parthood is reflexive, antisymmetric, and transitive.
- (Weak Supplementation)** If x is a proper part of y , then there is part of y that doesn't share any parts with x .
- (Maximal Common Part)** If x and y share any part, there exists a maximal common part.
- Atomless mereologies are consistent.
 - For example, let the domain be rational open intervals of the form $(\frac{n}{m}, \frac{n'}{m'})$ of non-zero size, and let (proper) parthood be interpreted by the (proper) subset relation.
 - Then parthood is a partial order, and weak supplementation and maximal common part both hold.
 - And this is atomless, since every object in the domain is a superset of some other object in the domain.

- All motion is self-motion, though it may be proximately occasioned by the motion of other pieces of animate matter.
- But there is also inanimate matter, which is not capable of self-motion, but only ‘moves by help of the animate’.
- This picture gives us two puzzles:
 1. If motion that is not self-motion is problematic for Descartes, how does Cavendish’s model of inanimate matter being moved passively by animate matter fare any better?
 2. Given that Cavendish could solve the problem with Cartesian conservation of motion just by postulating animate matter, why does she also include inanimate matter in her ontology?
- I have little to say about the second puzzle, except to hypothesise that perhaps the relative proportion of animate/inanimate matter in some thing might explain the apparent differences in ‘life and knowledge’ between, e.g., people and rocks. Detlefson says: every thing is ‘limited in its ability to move by inanimate matter’ (229).

The Blending Theory

- The answer to the first puzzle seems clear in Cavendish's text: the animate doesn't move the inanimate by transfer, but by **inextricability**: the inanimate matter is so mixed up or **blended together** with the animate matter that it is dragged along with it when the latter moves itself.
- The postulation of gunk alone won't give us the blending theory; we need the animate and inanimate parts of matter to be **distributed** in the right way.
- Nolan proposes that a blend is such that 'every part of the blend which fills a region occupied by the mixture contains parts of all the original substances mixed' (Nolan, 'Stoic Gunk', 170).
 - This is his reconstruction of the Stoic notion of a blend (like water in wine), as opposed to a mere juxtaposition (like lentils and grains of wheat). Many have noted the affinities between Cavendish and the Stoics.

Gunk and the Blending theory

- Here's the idea. Take a mixture which occupies some region R . A **potential sample** of the mixture is any part of the mixture which can be obtained by finitely many divisions. The mixture is a **blend** just in case every potential sample is impure, in the sense that it is partly occupied by both of the original ingredients.
 - Note we need gunk; given that Cavendish maintains all matter is extended, her mereological atoms are extended too. By dividing a putative mixture made of atoms finitely, we can reach the level of grain of those atoms, showing the mixture to be a mere juxtaposition.
- For Cavendish, on this account, all matter is a blend of animate and inanimate matter.
- So any well-behaved sample of some matter, obtained by finite division of some original portion of matter, will be partly made up of some animate matter, and partly made up of some inanimate matter.

Does the Blending Theory help?

- How does this solve the problem of motion on Cavendish's model, where all matter moves itself **sympathetically**?
 - Suppose the animate matter in a region moves itself; the inanimate matter must also move itself, because all motion is self-motion. (And how can it do that, because it is inanimate and unable to answer the reasonable demands being made on it?)
 - It simply doesn't seem to matter whether it is tangled up with animate matter or not; that would only matter if some matter was merely passively moved and dragged along as a byproduct of the motion of another portion of matter.

Is there such a thing as animate matter?

- Note the presupposition of the preceding objection: that * the animate matter in a region* denotes something.
- If Cavendish is taken literally, there is **no such thing**. Suppose we have this claim, where the quantifiers range over material things, A is a predicate meaning *animate*, and \sqsubset is the mereological proper parthood relation.

(PI) $\forall x \exists y (y \sqsubset x \wedge \neg Ay)$.

(PA) $\forall x \exists y (y \sqsubset x \wedge Ay)$.

- Combine these with the principle that there is animate matter:

(A-Purity) $\forall x \forall y ((y \sqsubset x \wedge Ax) \rightarrow Ay)$.

- Contradiction, if anything exists. We can take this as a *reductio* of A-Purity.

What becomes of Cavendish's Blending Theory?

- We *can* avoid the problem of how the inanimate matter in a region moves itself, by denying that there is such a thing.
- But can we still say that any well-behaved sample of matter moves itself by being a blend?
 - Not obviously; a blend is supposed to be something where the original parts retain their identity (as opposed to a 'fusion', where the interactions between the original parts destroy them and create a new substance).
- We must also deny some other mereological principles, in particular, this plausible restricted fusion principle:
(Mass Fusion) For any natural mass noun F , there is a thing which overlaps all the portions of F , and every part of which overlaps at least one portion of F .
 - So, e.g., Gold, the fusion of all portions of gold, exists.
- But since *animate matter* is a mass predicate, to deny that there is such a thing is to deny this fusion principle.

- Perhaps what we should deny is (PA), and (PI) for symmetry.
- At the moment their quantifiers are unrestricted: **everything** is partly animate and partly inanimate, even animate matter itself.
- But maybe what we want is: **every potential sample** is partly animate and partly inanimate.
- As long as there is a blend of animate and inanimate matter, we won't be able to take a sample which is purely animate matter, even though there is such a part.
 - Blends have pure parts, just with poorly behaved locations.
- Then the theory of motion explains only the motion of portions, not the motion of arbitrary parts.
 - Maybe this is okay, given Cavendish's general holism (and denial of DAUP – Detlefson, 204), and the fact that what we want to explain is the motion of **things**, not parts of things – the direction of explanation is top-down.

Challenge: Aspects or Parts?

although I make a distinction betwixt animate and inanimate, rational and sensitive matter, yet I do not say that they are three distinct and several matters; for as they do make but one body of nature, so they are also but one matter. (Cavendish, *Observations on Experimental Philosophy*, 206)

- Detlefson (228–9) reads this as committed to the idea that every sample of matter in a blend has animate and inanimate **aspects**, but not animate and inanimate parts.
- But we should be wary of this passage.
 1. The aspect theory doesn't require gunk, and is perfectly consistent with atomism, even Monism.
 2. The aspect theory doesn't even require blends.
- Better interpretation: Nature is one blended body; even though there are, theoretically, three parts, one cannot extract by sampling anything which is not also a blend; in that sense, there is but one matter, of a blended character.