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ZIMMERMAN AND THE SPINNING SPHERE

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Some of us like to think that we can distinguish two possibilities: first, that a sphere of non-particulate, homogeneous, perduring matter spins; and second, that an exactly similar sphere, in exactly similar surroundings, is stationary; and further, that both spheres inhabit possible worlds where Humean supervenience prevails.[1]

Our thesis that there are two such possibilities is neutral on many questions: whether perdurance—persistence as understood by the metaphysic of temporal parts—is the only intelligible kind of persistence, and whether it is the only kind ever found in actuality; whether spheres of non-particulate homogeneous matter are possible, and whether they are actual; whether Humean supervenience is necessary or contingent and, if contingent, whether it holds in actuality.

If we are wrong, there are several alternative morals: so much the worse for the idea that two such possibilities can be distinguished; or so much the worse for the metaphysic of temporal parts; or so much the worse for Humean supervenience.

But before we face this choice of evils, let us carry on exploring the possibility that we are not wrong: some Humean difference between the cases, some difference in the spatiotemporal arrangement of local qualities, does indeed make the difference between the two cases. The best bet is a suggestion of Denis Robinson in 'Matter, Motion, and Humean Supervenience'.[2] Thus: the local quality that does the job is a vector field that pervades the spheres. The difference between the spinning and stationary spheres is at bottom a difference in the spatiotemporal direction that the vectors point.

Let's grant that a vector quality associated with a spacetime point (or a point-sized bit of matter) shall count as local. Otherwise classical electromagnetism would be a problematic case for Humean supervenience, and we wouldn't want that.

The difference between the spinning sphere and the stationary sphere is a difference in the shape of the world-lines of persisting point-sized bits of matter. If the sphere is spinning, they are helical: some persisting matter is first on the east side, then the west side, then the east side again, ... If the sphere is stationary, they are straight, parallel to one another in a timelike direction.

1 In recent times, the problem is known from two sources: D.M. Armstrong, 'Identity Through Time' in Peter van Inwagen, ed., *Time and Cause* (Dordrecht: D. Reidel, 1980), originally presented at the Australasian Association of Philosophy Conference, 1976; and Saul Kripke, unpublished lectures given in 1978 and 1979. But, as Dean Zimmerman has reminded us, the problem was discussed half a century earlier in C.D. Broad, *Mind and Its Place in Nature* (London: Routledge and Kegan Paul, 1925), pp. 36f.

2 *Australasian Journal of Philosophy* 67 (1989), pp. 394–409. See also Sydney Shoemaker, 'Identity, Properties, and Time', *Midwest Studies in Philosophy* 4 (1979), pp. 321–342; and Michael Tooley, 'In Defense of the Existence of States of Motion', *Philosophical Topics* 16 (1988), pp. 225–254.

There are convincing arguments that, under perdurance, the most important sort of glue that unites the successive stages of the same persisting thing is causal glue. The world-lines of bits of matter are therefore the lines of causal dependence. So if the sphere is spinning, the causal lines are helical; whereas if the sphere is stationary, the causal lines are straight.

Now suppose the causal lines are governed by a vector field in such a way that the direction of the causal lines through any spacetime point within the sphere is given by the vector at that point. Then the spin of the sphere is necessarily determined by the lines of persistence, which are necessarily determined by the causal lines, which are lawfully determined by the vector field—and thus our problem is solved.[3]

Dean Zimmerman raises an objection.[4] Not just any old vector field will make the difference between a spinning and a stationary sphere. After all, there might be more than one vector field pervading the sphere. We need to identify the *right* vector field; and the right vector field is the one that occupies the right nomological role. So we need to state a law that characterises the right vector field.

Shall we state the law like this: the vector is that property of an object such that

> its possession by an object at each instant of an interval, together with [the object's] location at the beginning of the interval and the length of the interval, determines where *that very same object* will be at the end of the interval (Zimmerman, op. cit., p. 282)?

No; this is circular. It presupposes that we are already given the lines of persistence through time. But our plan was to define persistence in terms of the causal lines governed by the vector field that obeys the very law that we are now attempting to state.

Or, instead of saying 'that very same object', we shall say instead 'that very same causally connected chain of momentary point-sized matter stages'? — No; the circularity is similar to the previous case, expect that now we are presupposing that we are already given the relevant causal lines. We are not: under Humean supervenience, all that we are given is the spatiotemporal arrangement of local qualities.

Or shall we say instead 'that very same chain of matter stages connected by lines of perfect qualitative similarity'? — No. This time, the problem is not circularity, but rather the fact that in non-particulate homogeneous matter, chains connected by lines of qualitative similarity run every which way. So the supposed law need not be obeyed at all.

Zimmerman is right: these formulations won't work, and for the reasons he gives. Well then, how else can we state the law that characterises the vector field that governs the causal lines that define the lines of persistence that determine whether the sphere is spinning or not?

It seems to me that Robinson's paper already affords a good answer to Zimmerman's challenge. We should

[3] I skip a subplot. In the situation as I've described it, what best deserves the name 'velocity'? The slope of the doubly derivative lines of persistence? Or the slope of the underlying vector field? Since these two slopes will be everywhere equal, the question is scarcely an urgent one. I leave it unexplored.

[4] Dean W. Zimmerman, 'Temporal Parts and Supervenient Causation: The Incompatibility of Two Humean Doctrines', *Australasian Journal of Philosophy* 76 (1998), pp. 265-288.

see the collection of qualities characteristic of the occupation of space by matter as in some sense jointly self-propagating; the fact of matter occupying space is itself causally responsible, modulo whatever destructive forces there may be in that matter's environment, or whatever self-destructive tendencies it may have, for the matter going on occupying space in the near neighbourhood immediately thereafter. Such a process must be directed.. . .

[The posited vectors] figure causally in determining the direction of propagation of [themselves as well as] other material properties. (Robinson, op. cit., pp. 406–7.)

The law that characterises the vector field is a law of propagation of matter. Roughly, the law says that if there is matter at a spacetime point, and if the vector associated with that matter points in a certain direction, then at the next moment matter will appear at the place toward which that vector was pointing.

That's not quite right. In the first place, we need to make the law defeasible: as Robinson says, we should allow it to be overridden by destructive forces or self-destructive tendencies. But we are not required to write this part of the law in detail. To characterise the right vector field, in case there are more candidates than one, it will suffice to specify what *sort* of law the field is supposed to obey.

In the second place, we may if we like follow Robinson in identifying the propagation of matter with the propagation of some distinctive bundle of qualities (including our vector quality along with the rest). But this, however desirable, seems to me to be an optional extra so far as the problem before us is concerned.

In the third place, we had better not presuppose that there is a next moment. Our spheres might perhaps be in a world where time is discrete, like the frames of a movie. Or they might not. For a world of continuous time, the law of propagation might go something like this.

Let p be any spacetime point, and let t be any smooth timelike trajectory through spacetime with p as its final limit point. Let each point of t before p be occupied by matter with its vector pointing in the direction of t at that point. Then, *ceteris paribus*, there will be matter also at p.

What is not said, and what may not be said at this stage of the game if we are to avoid the circularities Zimmerman warns us against, is that t follows a causal line or a line of persistence. The matter that occupies t serves simply as a substitute for the matter at the previous moment. That said, let us return to the simpler case of discrete time.

The law does not say, of course, that given a matter-occupied point and its vector, matter will appear at the next moment at the place toward which that vector was pointing *and nowhere else*. Because, of course, the vectors from other bits of matter may be aimed at other places; and indeed, in the case both of the spinning and of the stationary spheres, every place in the appropriate region will be the target of some vector or other. For each place at the next moment, our law identifies a prior condition that is sufficient, but not necessary, for the appearance of matter at that place. And that is enough to govern the lines of causal dependence: each momentary bit of matter appears because of one previous bit of matter rather than any other.

A Robinson-style law of propagation answers Zimmerman's challenge: it does not presuppose that we are already given either the lines of persistence or the causal lines.

Robinson, in the passages I cited, does indeed mention causation. But his mention of causation (at that stage of the discussion) is inessential, and so does not result in circularity. His law of propagation need not be stated in terms of causation. It can instead be stated just as a law of succession, and that is how I have stated it.[5]

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[5] Some would indeed to prefer to state this law, or any law, in causal terms; because they think that otherwise we lose the distinction between laws and mere regularities. But it is unlikely that anyone of this persuasion would wish to solve the spinning sphere problem within the constraints of Humean supervenience. More likely, such a one would start with the lines of unreduced, non-local, singular causation.