3

Sticking Stages Together

Here I am again, sitting on the very same chair as yesterday, looking through the very same window at the very same trees. According to stage theory, when I talk about the chair at different times, I am talking about different objects, different stages. Even perdurance theorists think that, although the chair exists at different times, it does so not by reappearing in its entirety but by having different temporal parts at different times. Both stage theory and perdurance theory contrast with endurance theory, according to which the chair and I are wholly present whenever we exist.

Perdurance and stage theorists populate the world with stages, and with collections or sums of those stages. Some collections correspond to the careers of everyday objects: there is the (I hope) long series of stages which corresponds to my life, and the fairly long series of stages which corresponds to the 'life' of this chair. What's special about those series? According to perdurance theory, I am identical to the sum of the stages in 'my series', and the chair is identical to the sum of the stages in 'its series'. According to stage theory, each of the stages in 'my series' is a person, each of them is me at a different moment. Similarly, each of the stages in 'the chair's series' is a chair, partly because it is surrounded fore and aft by stages which are chairs.

What goes for me and my chair goes for you too. According to perdurance theory you are identical to the sum of your stages; according to stage theory each of your stages is a person, is you. But what, if anything, binds your stages together to make a person? According to perdurance theory, each of *your* stages is a temporal part of a person, and each of *my* stages is a temporal part of a person. Yet we don't think that a random assortment of your stages and mine together form a person. Consider the collection made up of your stages at weekends, together with my stages on week days. The sum of *that* collection of stages isn't a person. Moreover, the sum of your weekend stages (you-at-weekends) isn't a person, either.

According to perdurance theory, some series of stages form persisting people, some series form persisting chairs, and some series don't form anything interesting, like the mixed-up collection of your stages and mine. Similarly, stage theory has it that some stages are 'the same person' as each other, like the members of 'my' series, other stages are 'the same chair' as each other, whereas other stages, the members of other more mixed-up series, do not stand in any such interesting relations to one another. What distinguishes the interesting, chair-forming, or person-forming collections of stages from the less interesting, mixed-up, or incomplete collections?

This is a pressing question—I have already invoked the notion of 'suitable relations' between stages in my exposition of stage and perdurance theories. Without some such notion, the theories would be seriously incomplete. For example, I needed to explain how a brief stage could satisfy a lingering predicate like 'is conscious', or 'is travelling to Vienna', or a historical predicate like 'originated on a banana tree'. I said that stages satisfy such predicates by standing in suitable relations to earlier and later stages which instantiate appropriate properties, like *being on a banana tree*. The restriction is crucial: the properties of the past stage have implications only for a certain restricted class of later stages, those which are suitably related to it.

I also invoked suitable relations between stages when accounting for diachronic counting, and when discussing names; the name 'Katherine' is inherited by those stages which are the same person as my present stage, stages which stand in suitable relations to my present stage. Which stages those are, which stages were me, and which will be me, is a matter of practical interest to me—I go to the supermarket today, to ensure that certain future stages will not go hungry, whilst I make no provision for the vast majority of future stages.

A restricted notion of 'suitable relations' is crucial if stage theory is to be plausible, and the same goes for perdurance theory—only suitably related stages can form an ordinary perduring thing. Endurance theorists, on the other hand, face no equivalent challenge. The transtemporal relation in question, according to endurance theorists, is just the relation of identity. Past and future objects are relevant to past- and future-tense predications about this tennis ball just in case they are identical to this very tennis ball. Nothing else needs to be said, and in this respect endurance theory is simpler than either stage or perdurance theory. Perdurance and stage theorists have extra work to do. In the present chapter I will discuss the nature of the suitable relations

between stages, relations which underpin our talk about persisting objects, including ourselves. In doing so I will rarely distinguish between stage and perdurance theories, since most of what I say applies equally to both theories. Moreover, the reader will find few criticisms of endurance theory in this chapter. The main role of the chapter is to show that perdurance and stage theories are adequate theories of persistence, genuine rivals to endurance theory.

So what relations hold between the temporal parts of a single perduring object? In stage theory terms, what relations hold between stages which are the same object? A naïve response would be that the most important relations are those of similarity. The tennis ball tomorrow is the same ball as the tennis ball today because of the similarity between the two objects. But of course there are many tennis balls tomorrow which are qualitatively very similar to this present tennis ball, even though most of them are not the same ball as this ball. Indeed, if I dunk the tennis ball into a can of paint, then relying solely upon qualitative similarity would lead an observer to make the wrong judgement about the persistence of the ball. Tomorrow's purple tennis ball is less like its earlier green self than are many other green balls tomorrow.

Introducing a requirement of spatio-temporal continuity helps. A certain ball tomorrow is spatio-temporally continuous with the tennis ball I have in my hand right now. We could in principle trace out a continuous tennis ball-filled region between the present object and the future object. But such continuity will not always guarantee the persistence of a single object. Consider a cauldron of porridge. We could trace out a continuous porridge-filled region, moving from one side of the cauldron to the other over time. But this does not guarantee that we have been following the career of a single blob of porridge, instead of highlighting different blobs at different times.

What relations underpin the persistence of a single object may depend upon what kind of object is in question. Debate is intense about whether the relations which hold between two stages of the same person are always the same as the relations which hold between two stages of the same human organism, for example. To investigate such relations is to search for 'persistence conditions' or 'criteria of identity through time' for things of various kinds. I will not undertake this detailed task; instead, in this chapter I will discuss various more abstract questions about suitable relations between stages.[1]

[1] Important work on these issues includes Hirsch (1982; 1993) and Wiggins (1967; 1980).

In earlier sections of the chapter, I will discuss a thought experiment—the rotating disc—which is supposed to tell in favour of endurance theory, for it has been thought to show that persistence through time cannot be reduced to relations between stages or temporal parts. I will argue that the 'suitable relations' which underpin the persistence of ordinary things are non-supervenient, which is to say that whether or not two stages are suitably related is not entirely determined by the intrinsic properties of those two stages, nor even by those intrinsic properties plus spatio-temporal relations between the stages. But non-supervenient relations are unmysterious, and the rotating disc does not favour endurance theory.

Stages which are stages of the same ordinary object stand in special relations to one another. What about series of stages which do not stand in such relations to one another, like the series which is made up of your weekend stages together with my weekday stages? Does such a collection have a sum, does it form a larger, temporally extended object, or is it merely a collection of individual stages? In later sections of this chapter I will be investigating the status of 'unnatural' series of stages, from both a stage theory and a perdurance theory point of view.

So this chapter has two main aims. One is to address the rotating disc argument, and thereby to say something about the suitable relations which are crucial to perdurance and stage theories of persistence. In these earlier sections, I will treat perdurance and stage theories on a par, for the target argument is perceived to be a threat to both theories equally. Because of this, I will help myself to talk about stages *of* persisting objects. But this should not be taken too literally: the stage theory view is that stages are bananas, tennis balls, and so on, not parts of those things.

The second aim of the chapter is to consider the distinction between ordinary and 'mixed-up' or 'incomplete' series of stages, and to explore some differences between stage theory and perdurance theory on this issue. In particular, I will ask whether the difference between ordinary and non-ordinary series of stages is merely a difference in our attitudes to different series, or whether our attitudes reflect some deep distinction in the world. This returns us to questions about conventionalism and realism like those I raised in the introduction—in what sense is it up to us and our concepts whether or not a person can survive into an irreversible coma?

3.1 Non-supervenient Relations

What sorts of relations hold between stages of the same object? Many relations are wholly determined by the intrinsic properties of the relata. If height is an intrinsic property, then relative height is one of these relations: whether Jill is taller than Jack is wholly determined by their heights. Other relations seem at first not to be wholly determined by the intrinsic properties of the relata, but can in fact be analysed in terms of intrinsic properties once additional places in the relation are recognized. Whether Jill is closer to average human height than Jack is not wholly determined by their intrinsic properties, but it seems likely that it *is* wholly determined by the intrinsic properties of Jill, Jack, and the other human beings.

Other relations, however, are not wholly determined by the intrinsic properties of the relata, not even when we include 'hidden' relata. The relation of being a certain distance apart is like this. The distance between Jill and Jack is not wholly determined by their intrinsic properties: there could be exact intrinsic replicas of Jill and Jack who were further apart. Their separation is not determined by purely intrinsic properties even if we take space–time points to be 'hidden' relata, for Jill's being located at point P is not wholly determined by the intrinsic properties of Jill and of P. So facts about such spatio-temporal relations between objects are not determined by facts about the intrinsic properties of their relata: such relations are 'non-supervenient'.[2]

Paul Teller suggests that non-supervenient relations of a different kind can explain otherwise mysterious connections between quantum objects (Teller 1986, 1989). More-or-less simultaneous measurements on pairs of spatially separated photons give results which cannot be explained by the intrinsic states of the particles just before measurement. This might be evidence of a near-instantaneous causal connection between the intrinsic properties of the two photons. Teller prefers to account for the correlations by positing a relation between the particles which is non-supervenient, in the sense explained above. Unlike the relation of separation, this is not a straightforward spatio-temporal relation, and in what follows I shall use the term 'non-supervenient relation' to refer to non-spatio-temporal non-supervenient relations,

[2] We have already encountered non-supervenient relations, in Chapter 1, where I considered the different relations which might hold between objects and times according to the relations-to-times solution to the problem of change.

like those Teller discusses. I will argue that there are non-supervenient relations between stages which are stages of the 'same' object, or, in perdurance theory terms, between temporal parts of persisting objects.

3.2 The Homogeneous Disc Argument: Exposition

Imagine a perfectly homogeneous disc, made of smooth stuff not atomistic matter.[3] For every moment, record all the information about the state of the world at that moment, but without recording information about relations between objects which are wholly present at different moments. Call this record the 'holographic representation' of the world.[4] Now, the holographic representation will reveal that at every moment there is a homogeneous disc in a particular spot, but it will not reveal whether that disc is rotating about a vertical axis through its centre. Yet its rate of rotation seems to be an intrinsic property of the disc. So the persisting disc seems to have an intrinsic property which is not determined by the intrinsic properties of its instantaneous stages. I think that the best response to this homogeneous disc argument is to accept that there are non-supervenient relations between stages. There are other possible responses to the argument, and I shall discuss these below.

If the homogeneous disc argument is successful, then it tells against the doctrine of Humean Supervenience, according to which 'all there is to the world is a vast mosaic of local matters of particular fact, just one little thing and then another', together with spatio-temporal relations between these 'local qualities' (Lewis 1986*c*: ix–x). If, as I suggest, there are non-supervenient relations between the stages of a single persisting object, these non-supervenient relations hold independently of the local matters of particular fact and spatio-temporal relations which are supposed to determine what goes on in the world. Humean Supervenience is at stake in the rotating disc argument, and for this reason there have been various attempts to resist the argument. Before considering different non-Humean responses to the argument, I will first defend the argument against a variety of Humean objections.

[3] The argument is published in Armstrong (1980) and was the subject of lectures by both Kripke and Armstrong during the 1970s.

[4] The term 'holographic' is supposed merely to indicate the richness of the representation; no closer analogy to real holograms is intended.

3.3 The No-difference Objection

The argument supposes that there are two possible worlds, discernible only in that one contains a rotating homogeneous disc, whilst the other contains a stationary homogeneous disc. The argument is that a certain kind of record, a 'holographic representation', could not capture the difference between these two possible worlds. The holographic representation records all and only the information about the world as it is at every moment, without recording information about relations between objects existing at different moments. The argument is supposed to establish that there are facts about the world which cannot be captured by such a moment-by-moment representation.

The no-difference objection to the homogeneous disc argument is the claim that, contrary to supposition, there *is* no difference between these two possible discs, and thus, *a fortiori*, there is no difference which goes uncaptured by the holographic representation. The claim is not that both discs are stationary, for it would be arbitrary to pick out zero as the common value of angular velocity. Rather, the claim must be that, for a homogeneous disc in such circumstances, there can be *no fact of the matter* as to whether it is rotating. This option—biting the bullet—is perhaps the most attractive for the defender of Humean Supervenience. The holographic representation records all the Humeanly acceptable facts; if those facts do not determine facts about rotation in such peculiar situations, then there are no facts about rotation in such situations. There is nothing incoherent, I think, about this response, but it has some peculiar consequences.

If there is no fact of the matter about whether a given disc is rotating, then there is no fact of the matter about what would have happened if someone had touched the disc, or had splashed paint onto it. For each disc, it is true that if someone had measured the angular velocity of that disc, then she would have obtained some determinate result. But in neither case is there some determinate result that would have been obtained had someone measured the angular velocity of the disc. The result of any possible measurement of angular velocity is undetermined.

The same goes for counterfactual measurements of indeterministically evolving quantities (Redhead 1987: 92–5). Wearing green trousers, I record the determinate time, t_1, at which an atom indeterministically

decays. If I had performed the experiment in red trousers, I would also have obtained a determinate result, but there is no fact of the matter as to what it would have been, despite the apparent irrelevancy of my trousers. The class of possible worlds indiscernible up until t_1 from the actual world, except in the matter of my trousers, contains worlds in which the atom decays at t_1, but also worlds in which it does not. The time of decay is an indeterministic matter, so nothing which happens before t_1 makes the atom decay at t_1 or prevents it from decaying at t_1.

Where there is indeterminism, such indeterminacy about counterfactual measurements is unmysterious. But what of the discs? The no-difference objection supposes that, for any homogeneous disc, a measurement of angular velocity *would* give a determinate result, but that there is no fact of the matter as to what that result would be. Yet neither rotation nor measurement of the disc is supposed to be an indeterministic process. This indeterminacy is rather peculiar, to say the least.

Moreover, the no-difference objector must allow that if the disc *had* been measured, then it *would have had* a determinate angular velocity, even before the measurement. If she denies this back-tracking counterfactual, and supposes that measurement would have created new determinacy, then she produces a bizarre classical analogue of the quantum measurement problem. So whether a homogeneous disc has a determinate rate of rotation at a given moment counterfactually depends upon whether that rate is measured at any time in the future. Recall that, in this context, a 'measurement' need not involve any conscious observer, or special apparatus. Any event which makes the disc slightly inhomogeneous—the landing of a speck of dust on the disc, for example—would give the disc a determinate rate of rotation for all time.[5]

I have been considering this strange indeterminacy for the disc, but matters are even worse for wedges or segments of the disc. A segment has determinate rotation or rest if and only if the others do too. Whether or not a particular segment has a rate of rotation at all, whether or not there is a fact of the matter as to where that segment is in the future, depends upon whether the rate of rotation of any *other*

[5] Kripke argues that the same problems arise even for inhomogeneous discs: why should we suppose that the disc and speck are both rotating, rather than just the speck? I shall ignore this complication, which reinforces the rotating disc argument which I am presently defending.

segment is measured, upon whether a speck of dust ever falls upon another segment.[6]

What is the appeal of Humean Supervenience—what makes it worth denying that there are facts of the matter about rotation for homogeneous discs? One motivation is parsimony, the thought that if it is unnecessary to believe in anything beyond the Humean facts, then we should not do so. Of course, we cannot use this familiar form of argument unless we agree about what it is necessary to believe in. I have suggested that it is necessary to believe in something beyond the Humean facts, in order to avoid the odd consequences of supposing that there are no facts about rotation for homogeneous discs, but any such argument is hostage to the possibility that someone will simply accept the 'odd' consequences of the position.

3.4 Holographic Difference Objections

The homogeneous disc argument attempts to show that there can be differences between worlds without differences in their holographic representations. I have just rejected the suggestion that there is no real difference between the two worlds in question, that there could be worlds which simply failed to determine facts about rotation. The second type of objection is that there *is* a difference between the two holographic representations after all, one which underpins the difference in facts about rotation. I will consider, in turn, the suggestions that the representations can capture differences in angular velocity, differences in causes of rotation, and differences in effects of rotation between the two discs.

3.4.1 Differences in Angular Velocity

The difference in angular velocity between the two discs allegedly goes unregistered by the holographic representations, but why not simply include instantaneous angular velocities in the representations?[7] The holographic representation, as I defined it, includes all and only those

[6] Craig Callender (2001) suggests that a suitably Humean account of laws of nature can account for the way in which facts about rotation can depend upon facts about other objects, or about the future.

[7] Dean Zimmerman's discussion of this issue is detailed and helpful (Zimmerman 1998).

facts which can be recorded without recording facts about relations between objects wholly existing at different times. Can't we include the instantaneous velocity of a disc-segment without entailing anything about objects existing at other moments?

Prima facie, angular velocity is excluded from the holographic representation on the following grounds. To say that something is stationary, for example, is to say that at the next moment it will be in the same place. To say that a disc-segment is rotating at a certain rate is to say something about where it will be at future moments. Wesley Salmon cautions us that

> [i]t is important to note . . . that this notion [of instantaneous velocity] is defined by a limit process, so the value of the velocity at an instant depends logically upon what happens at neighboring instants . . . Although instantaneous velocity does characterize motion at an instant, it does so by means of implicit reference to what goes on at neighboring times. (Salmon 1970: 24.)

To include angular velocity in the holographic representation is to reject Salmon's claim that attributions of velocity involve 'implicit reference to what goes on at neighboring times'. There are two main motivations for rejecting Salmon's claim, but I shall argue that neither is compelling. The first concerns Zeno-type paradoxes, the worry that if we cannot attribute instantaneous velocity to objects considered as they are at a moment, then we cannot explain how motion is possible. The second thought is that the possession of a certain instantaneous angular velocity by a segment at a moment does not entail anything *categorical* about objects at other times, for there may be all sorts of accelerations and forces at play. To say that something has zero velocity is to say only that it will be in the same position a moment later *if* no net forces act upon it. I shall deal in turn with these motivations for including instantaneous angular velocity in the holographic representation.

The Zeno worry is as follows. We must be able to attribute instantaneous velocity to objects regardless of what goes on at other times, else we could never distinguish between stationary and moving objects, which would be absurd. I agree that this result would be absurd, but I *can* distinguish stationary from moving objects: I allow that we *can* attribute instantaneous velocity to objects, and I certainly do not claim that things are always instantaneously at rest. The existence of instantaneous angular velocity is not at question here, merely its admissibility to the holographic representation.

Perhaps this seems disingenuous. After all, I claim that to attribute angular velocity to a disc-segment at a moment is to say something about other times. Were a stage of the segment not surrounded before-and-after by other stages, then there would be no fact of the matter as to whether it was rotating. But this does not entail that 'really' the stage has no determinate rate of rotation when it *is* surrounded by other stages. Were this table-leg not appropriately connected to other legs and to a table-top, it would not be part of a table. But this does not entail that 'really' the leg is not part of a table when it *is* thus connected. To think otherwise is mere prejudice against relations, a prejudice which begs the question in this context. My claim that velocity is a matter of relations between objects existing at different times does not downgrade or ignore velocity. Nor does it entail that everything has an instantaneous velocity of zero.

We have seen something like this already, in Chapter 2. Recall that, according to stage theory, satisfying a sortal predicate like 'is a banana' is partly a relational matter. A single isolated stage could not be a banana, because in order to be a banana a stage must be suitably related to other stages with appropriate properties. Discovering something about the nature of that 'suitable relation' is the business of this chapter. According to stage theory, what it takes to be a banana, and what it takes to have an instantaneous velocity are both relational matters, but no less real for all that.

The second argument for including angular velocity in the holographic representation runs as follows. An instantaneous angular velocity, of course, has effects on displacement, consequences for later stages of the object. But we should not *identify* an instantaneous angular velocity with its effects on displacement, since these effects will depend upon whether any net forces are acting. An instantaneous velocity, angular or linear, is a disposition, which produces different behaviour under different circumstances. We should not mistake the disposition for its particular, contingent display, and the disposition itself may be included in the holographic representation.

I agree that there is both less and more to instantaneous angular velocity than the actual spatio-temporal relations between successive stages. Less, because these relations are a function of applied forces as well as initial velocity. More, because the instantaneous angular velocity also grounds counterfactual conditionals of the form 'if a net force F had been applied to the disc then . . .' But these conditionals concern what goes on at other times, even if they say nothing

categorical. Classical mechanics is the device we use for establishing such conditionals, which relate locations at different times to net forces applied, given initial velocity. Take a particular disc-segment stage. The positions of various future stages depend upon the position of that initial stage, in a way conditioned by net forces acting and by the initial velocity. To attribute instantaneous velocity to the present stage is to say something partial and conditional about certain future stages, and not about others. It is to say something about how future states of a persisting object will vary according to the forces which apply.

Michael Tooley (1988) has an interesting alternative account of instantaneous velocity, but even Tooleyan velocities are ineligible for inclusion in the holographic representation.[8] He surveys different possible accounts of velocity, and concludes that there are two principal contenders. The first is a Russellian view, according to which velocity is a limit notion, the rate of change of position of an object. This is the kind of account towards which Salmon gestures in the quotation I gave above. It is clear that the Russellian view makes instantaneous velocity inadmissible to the holographic representation. Tooley offers an alternative account of velocity, according to which velocity is a theoretical quantity. It is whatever plays the role accorded to velocity by the laws of motion. This account is 'in a sense, along Russellian lines, *except that* it treats velocity as a theoretical property of an object at a time, and one that is *causally related* to an object's position at different times, rather than as a logical construction out of them' (Tooley 1988: 237). Could this kind of instantaneous velocity be included in the holographic representation?

I am sympathetic to the idea that velocity is something that interacts with applied forces and initial position to determine future position, that velocity thus has a causal role. Nevertheless, as I argued above, velocity is not an intrinsic property of stages. Velocity interacts with applied forces to determine future positions, but future positions of what? The velocity of a given stage helps determine the positions of certain future stages, and not of others. Certain futures stages are such that *those very stages* would have had different locations had the present stage had a different velocity. Zimmerman makes a related point when he says that the fact that Tooley's velocity is abstracted from the laws of motion makes it unsuitable for inclusion in the holographic

[8] See Zimmerman (1998) for further discussion.

representation, for those laws of motion presuppose facts about persistence (Zimmerman 1998, 1999; Lewis 1999*b*).

Again, it helps to imagine an isolated stage. Such a stage could not have a Tooleyan velocity, even though Tooleyan velocity is not identified with rate of displacement. In such a case it would be undefined what the Tooleyan velocity was, since the laws of motion for persisting objects would not apply to the isolated stage. Angular velocity cannot be included in the holographic representation, for it is not an intrinsic property of stages, whether we see it in Russell's way, or in Tooley's way. So neither the Zeno worry nor the dispositional nature of velocity gives us reason to suppose that instantaneous angular velocity is admissible to the holographic representation. A specification of the angular velocity of a segment at a moment entails something about what goes on at other times, albeit something conditional, and thus is inadmissible to a holographic representation.

3.4.2 Differences in Causes of Rotation

There are, however, other ways of differentiating the holographic representation of the spinning-disc world from that of the stationary-disc world, by including either the causes or the effects of rotation. Both Harold Noonan and Denis Robinson remark that there must have been some cause of the difference between the two discs (Noonan 1988: 96; Robinson 1989: 405–6). This interaction between the disc and some other object could be included in the holographic representation and could thus distinguish the representations of the two worlds.

There are two things to be explained: that each disc has a determinate rate of rotation, and that they have different rates of rotation. The latter may be explained by the fact that one disc was shoved when the other was not, *provided* we can assume that before the shove both discs had some determinate angular velocity. Shoving and dampening do not cause rotation or rest *per se*, just changes in rate of rotation. What, in the holographic representation, can explain the determinacy of the pre-shove state? It cannot be the subsequent shove, since only one of the two discs is shoved.[9]

Ultimately, something about the way in which the discs first came into existence must have made their initial angular velocity determinate,

[9] And recall my earlier objections to the idea that earlier velocity is made determinate by later measurement.

and thus amenable to change by subsequent applied forces. So, to be effective, the objection from causes must be that a homogeneous disc *could not* simply appear, or always have existed, but must rather have been produced by some holographically recordable process which determined its initial angular velocity.

Understanding the real form of the objection from causes makes it less plausible. It may seem obvious that if one disc were not given a distinguishing shove, then the two discs would have the same angular velocity. It is less obvious that, as the objector from causes must claim, a homogeneous disc could not simply appear or always have existed. But let us accept the objection, and suppose that there must have been some holographically recordable aspect of the production of the discs which gave them *determinate* initial angular velocities, and some simultaneous or subsequent difference in applied forces which gave them *different* angular velocities.

So the two worlds have different holographic representations. Nevertheless, there are facts about these worlds which go uncaptured even by these enriched holographic representations: we cannot identify the difference between the discs with the cause of that difference. Robinson makes a similar point, noting that, if we suppose everything to be captured in the holographic representation, then we must suppose that the result of any later measurement of angular velocity would be a direct causal consequence of the initial shove, since there are no intervening differences between the two discs. He calls this 'action at a (temporal) distance' (Robinson 1989: 406). 'Initial shove' differences do not capture the full difference between rotating and stationary discs. They make a historical difference between the discs at any moment, and a difference in counterfactual measurement results, but they leave an explanatory gap, since the former cannot explain the latter in any unmysterious way. If we accept the demand for explanation—and the Humean might not—then there is still something missing from the picture.

If we posit non-supervenient relations between the stages of a segment then we *can* explain how the results of any measurement performed on the disc right now are a direct consequence of the present state of the disc, not of its historical properties. The successive stages of a segment stand in non-spatio-temporal non-supervenient relations to one another. In conjunction with applied forces, spatio-temporal relations between these 'specially related' stages—and not those between other stages—determine the rate of rotation of the

segment and thus the disc. So far as the holographic representation tells us, there are no present differences between the discs at any moment. But there are relational differences which do not show up in the representation. These differences are direct causes and explanations of the actual and counterfactual differences in measurement results. I can feel the disc moving because the stage I am touching is specially related to an earlier stage which was elsewhere, rather than to one which was here.

Teller introduced non-supervenient relations between distant elements of a quantum system instead of positing mysterious causal influences between these elements. Such influences would be mysterious principally because they appear to travel faster than light. Direct causal connections between the initial shove and the present measurement of rotation would not be mysterious in this respect. But there is a second, lesser mystery in the quantum case: any causal influence between the distant elements of the system appears to be transmitted directly, without any intervening disturbance. This mystery has a direct parallel in the homogeneous disc: if the holographic representation is complete, there is a direct causal influence between the initial shove and the later measurement result, without any intervening differences between the rotating and the stationary discs. Non-supervenient relations provide the required intervening differences.

The objection from causes is less plausible than it seemed, since it must suppose that differences in the holographic representation can explain why the discs have any determinate rate of rotation at all, as well as the difference in their rates of rotation. But even if we accept that there are such differences between the holographic representations of the two worlds, these alone cannot explain the direct consequences of, for example, touching the discs. I have shown how non-supervenient relations can be of assistance here. In a later section I will argue that, given that the holographic representation is incomplete, positing non-supervenient relations is not just one way of completing the picture, it is the best way.

3.4.3 Differences in Effects of Rotation

I am considering possible objections to the homogeneous disc argument, objections which attempt to differentiate between the two holographic representations. I have dismissed the suggestion that angular velocity be included in the representation, and I have limited

the role of initial causes. Finally I want to consider differences in the holographic representations brought about by the effects, rather than the causes, of the rotational differences between the two discs.

There are differences between an object rotating and the same object stationary. If the coffee in a cup is rotating, it has a concave surface; stationary coffee is flat. Such differences in shape are admissible to the holographic representation, and might seem to distinguish the rotating from the stationary coffee without any need for non-supervenient relations or the like. The main problem with this response is that not all objects fit this pattern. We may take it that a concave cup of coffee is rotating, but an oblate object might be stationary or might be a rotating, bulging spherical object. Even regarding the coffee, we might think that there is nothing inconceivable about a stationary cup of coffee with a concave surface, nor, indeed, about rotating coffee with a flat surface. The difference between concavity and flatness happens to be correlated with the difference between rotation and rest, but this is a contingent matter, and should not be taken as constitutive of the difference between rotation and rest.

The adequacy of this response hinges upon the value of considering worlds unlike our own. In our world, concavity of coffee and rotation go along together: need we be concerned about possible worlds in which they come apart? I skirted a similar question above, when I agreed that we need not be concerned about perpetually existing or instantaneously created discs. More simply, we might question the relevance of stories about homogeneous discs to our actual atomistic world. The more we focus upon possible worlds very like our own, the less successful the homogeneous disc argument seems, and thus the less compelling non-supervenient relations may seem.

The defender of Humean Supervenience against non-supervenient relations cannot take this line, however. David Lewis acknowledges that the quantum situations Teller discusses may provide an empirical refutation of Humean Supervenience, but announces his determination to defend Humean Supervenience from attempted philosophical, or *a priori*, refutations (Lewis 1986*c*: xi ; 1994: 474). It would be *ad hoc* to invoke empirical considerations when they favour Humean Supervenience, whilst ignoring those which undermine the doctrine. Explanatory considerations provide another reason to take notice of other possible worlds, and to avoid identifying rotation with its contingent causes and effects. Otherwise, as we saw above, we are unable

to explain those effects, except by imagining that the result of measurement today is a direct causal consequence of a shove many years ago. Part of what we hope for from a *measurement* result is that it be correlated with some present feature of the object measured.

There is a third reason for acknowledging worlds in which rotating coffee is flat, worlds in which discs appear out of thin air, or worlds in which there are homogeneous discs. Although these worlds differ from our own in various ways, they are nevertheless worlds in which there is rotation and rest. The 'coffee' world is odd precisely because coffee *rotates* there without becoming concave. Similarly, an object's being atomistic is not a pre-condition of its rotating, and a disc's origins do not, in general, affect whether it can have a determinate rotation. So these worlds are relevant to our discussion of rotation. An atomistic disc rotates in the same way as a smooth disc, although rotation is more easily detected in the former case, if we have a powerful microscope to hand. If we agree that rotation is not determined by intrinsic properties of stages in non-atomistic worlds, then we should also accept this for our own world.

Craig Callender objects to this line of argument, saying that although our notion of rotation may not tie it to any single effect of rotation, we cannot reasonably suppose that there could be rotation without any of the effects of rotation (Callender 2001). Not, at least, without begging the question against Humean Supervenience, for bare facts about rotation are inevitably non-supervenient. It is true that those who have a prior commitment to Humean Supervenience cannot accept that there could be differences in rotation without any Humean differences. But for those who are undecided, it is perfectly reasonable to suppose that there could be such differences in rotation.

First, such rotation need not be *undetectable*, rotation which cannot show up in Humeanly acceptable ways. The argument depends only upon the possibility of *undetected* rotation. Second, the argument does not presuppose that there could be a single object which was unaffected by whether or not it is rotating. Instead it supposes only that there could be indistinguishable objects one of which was rotating and the other not. That's to say, we need not accept that there could be a sphere which did not bulge when it rotated. All we need accept is that there could be a stationary oblate object and an oblate object which would be spherical if it were not rotating, without there being any non-Humean difference between these two things. The

presupposition of the rotating disc argument, though it rules out Humean Supervenience, is not so science-fictional as it might first seem.

3.5 Non-supervenient Relations, and Alternatives

The homogeneous disc argument is powerful, and is relevant to the actual world. In this section I want to show how non-supervenient relations can explain the phenomena highlighted by the homogeneous disc argument. I will also argue that these relations provide the best explanation of the phenomena, better than a range of alternatives. I claim that there are relations between the distinct stages of a persisting object which are not determined by the intrinsic properties of those stages. What motivates my claim? Opting for non-supervenient relations is the natural 'least move' in response to the homogeneous disc argument, since the holographic representation captures exactly those properties of the stages which underdetermine these relations.

Series of stages which are stages of the same object are distinguished from other series as follows. The state of a later stage depends, counterfactually and causally, upon the state of earlier stages, in a way in which it does not depend upon stages of other objects. Non-supervenient relations ground these dependencies. Seeing this allows us to spell out the connection between the rate of rotation of the disc and the nature of its segments. Any given stage of a disc segment is linked by special relations to some later stages, and not thus linked to others. If a stage is thus linked to stages in the same place at later moments, the disc is at rest; if it is not, the disc is rotating.

We saw earlier that an instantaneous velocity does not guarantee any later position, but that it entails certain conditionals about the relation of later position to applied net forces. I talked of an instantaneous velocity as a disposition of a persisting object, one which could be displayed in different ways under different conditions. We can now see non-supervenient relations between stages as determining *which* later stage is conditionally dependent upon the position and velocity of a given earlier stage. In short, I claim, non-supervenient relations account admirably for the phenomena highlighted by the homogeneous disc argument.

What are these non-supervenient relations? They are the relations, whatever they are, which underpin the relation of 'immanent causation'

which holds between stages of the same object, and we can pick them out by their theoretical role. Do the relations necessarily underpin persistence and immanent causation, or could they play a different role in a world governed by different laws? There are two parts to this question. First, could the actual relations of immanent causation have held between stages of different objects? Second, could the non-supervenient relations have failed to underpin the relations which are actually the relations of immanent causation?

It certainly seems possible to imagine the relations of immanent causation holding between stages which are not spatio-temporally continuous—to imagine, for example, a banana's disappearing in one location and a qualitatively identical banana appearing in a different location. Would this be a world in which objects could move discontinuously, or a world in which the actual relations of immanent causation held between stages of different objects? I don't know what we should say about such a world: in the actual world we are guided by both spatio-temporal continuity and immanent causation (which takes in qualitative continuity and the like), so there is no clear answer about what we ought to do, or would do, if these came apart.

The second question was whether the non-supervenient relations necessarily underpinned the relations of immanent causation which transmit qualitative similarity, velocity and so on. Again, there seems to be no clear answer here, but this time because to get a clear answer we would need a clear account of causation, and the reducibility or otherwise of causal relations to non-causal relations. Indeed, this raises the question of why I have insisted upon non-supervenient relations, instead of merely saying that there are special causal relations between the different stages of a persisting object. I agree that there are 'special' causal relations between the earlier and later stages of a persisting object. But I claim that non-supervenient relations are needed in order to account for these causal relations. Consider, for example, some standard accounts of causation.

Regularity theorists claim that causation is nothing more than constant conjunction, in this case that the state of an earlier stage causes that of a later stage if and only if there is a regular correlation between states of these types. But our central problem is that, so far as intrinsic properties go, there *is* no correlation between the earlier and later stages of a particular segment which does not also hold between any arbitrary pair of stages of different segments. We accepted this when we accepted that rate of rotation was not captured by the holographic description.

The same problem arises for universals-based accounts of causation, at the other end of the metaphysical spectrum. Without non-supervenient relations, there are no universals exemplified by pairs of stages of a single segment that are not also exemplified by stages of different segments. Counterfactual accounts of causation say that a causal connection is exhausted by the counterfactuals it appears to ground. One advantage of non-supervenient relations is that they relieve any discomfort we may feel at the thought of 'bare' counterfactuals, grounded in no regularity or property of the object in question (Noonan 1988: 97). Furthermore, taking the 'special connection' between stages of a single object to be a matter of counterfactual dependence seems to get things the wrong way round. The later stage depends for its state upon that of the earlier *because* they are stages of the same object; because, according to me, they stand in a non-supervenient relation to one another.

Zimmerman argues that Humean accounts of causation are inadequate to account for the rotating disc (Zimmerman 1998). An account of causation is 'Humean' in the relevant sense if it says that there can be no causal difference without a non-causal difference. A Humean account need not be an austere regularity analysis of causation. The non-causal differences required for a causal difference may include differences in laws of nature, where laws of nature are construed in a metaphysically heavyweight manner, perhaps involving relations between universals. As we have seen, there are causal relations between certain pairs of stages (those which are stages of the same disc segment) which do not hold between other pairs of stages. And, unless we posit non-supervenient relations, there is no non-causal difference between these different pairs of stages. So, unless we posit non-supervenient relations, there seem to be causal differences without non-causal differences, and thus causation must be non-Humean.

If the rotating disc argument is sound, we face a dilemma: either there are non-supervenient relations between stages, as I have argued, or else causation is non-Humean. There are three reasons to favour the former option. First, I think we should be reluctant to draw general conclusions about the Humean or non-Humean nature of causation based upon consideration of the rather peculiar case of 'immanent' causation, causation between earlier and later stages of the same object. I prefer to conclude that *non*-causal relations between earlier and later stages of the same object are importantly

different from the relations between distinct objects, or between stages of distinct objects. Second, the existence of non-supervenient relations *explains* why some stages are linked by immanent causation whilst others are not. In effect, this is just to reiterate the fact that if we posit non-supervenient relations, we can retain a Humean view of causation, the idea that causal facts should be explicable in terms of non-causal facts of one kind or another.[10]

Third, non-supervenient relations can account for the possibility of uncaused, or indeterministic rotation. I will explain this point by considering Denis Robinson's notion of 'second-order quasi-qualities having the character of vectors' (Robinson 1989: 406). These qualities guide the propagation of ordinary first-order qualities, yet they are allegedly intrinsic properties of stages, and are thus eligible for inclusion in the holographic representation. This differs from the suggestion that we include instantaneous angular velocity in the holographic representation. Robinson's qualities expand the holographic representation, supposedly filling the explanatory role I reserved for non-supervenient relations.

Douglas Ehring has a powerful objection to Robinson (Ehring 1997: 111–12). He considers a homogeneous disc which rotates indeterministically: its velocity and position at one moment are not fully determined by its previous velocity and position, and by applied forces. Then the actual velocity of the disc, the question of where a given segment is from one moment to the next, is underdetermined by Robinson's vector qualities, which have only a probabilistic influence on these quantities. Yet the disc still has a determinate angular velocity. So there is a further fact of the matter about velocity, over and above the vector qualities.[11]

Ehring's scenario distinguishes velocity from its causes, by supposing it to have an uncaused element. Robinson attempts to capture velocity by attributing extra intrinsic properties to stages, but at most these can capture the causes of velocity. Non-supervenient relations, on the other hand, escape Ehring's criticism. If a homogeneous disc were moving indeterministically, non-supervenient relations would still hold between earlier and later stages of a single segment, and not

[10] Zimmerman might argue that positing non-supervenient relations amounts to a refusal to give an informative criterion of identity over time for persisting objects. I will deal with this objection towards the end of this chapter.

[11] Tooley (1988: 244) denies that objects would have velocities at all under such circumstances.

between stages of different segments. These relations would ground probabilistic conditionals relating the earlier and later stages, just as they ground non-probabilistic conditionals in the deterministic case.

As we have seen, it is the intimate connection between earlier and later stages which explains measurement results whilst escaping objections from indeterminism. This may suggest the closest connection of all, that of identity. Perhaps the segment persists by enduring through time. This is certainly a possible response to the homogeneous disc argument, but not one we are forced to adopt. If objects have stages (or temporal parts), then those stages stand in non-supervenient relations to one another, but this is not to say that those stages are identical, either 'wholly' or 'partly'. Consideration of the rotating disc does not provide evidence either in favour or against endurance theory, because the disc can be accounted for either by accepting endurance theory, or else by rejecting endurance theory and accepting non-supervenient relations.

Some have thought that the rotating disc provides a metaphysical argument against perdurance theory. By extension, the disc might be perceived as a threat to stage theory, which shares many metaphysical presuppositions with perdurance theory. We have now seen that, provided we posit non-supervenient relations between stages, there is no reason to opt for endurance theory after consideration of the rotating disc.[12] Non-supervenient relations provide an alternative both to belief in Humean Supervenience, and to endurance theory. It is perfectly possible to believe in temporal parts or stages whilst rejecting Humean Supervenience.[13] Just as Teller's non-supervenient relations give an unmysterious sense to 'holism' in quantum mechanics, my use of non-supervenient relations provides an unmysterious sense in which different stages of a single object are connected without being identical. Notice that, although I have rejected Humean Supervenience in Lewis's sense, I have not denied that causation is Humean in Zimmerman's sense—I have not claimed that the causal does not supervene upon the non-causal. Instead, I have argued that the causal does not always

[12] Ehring's response to the homogeneous disc argument is to suppose that tropes persist without having temporal parts, and that this grounds rotation and so forth. Like scepticism about temporal parts of physical objects, Ehring's response is not forced upon us by the homogeneous disc (Ehring 1997).

[13] Sally Haslanger argues convincingly that the doctrine of Humean Supervenience does not entail that objects have temporal parts (Haslanger 1994). I have tried to show that objects may have temporal parts even though Humean Supervenience is false. If I have succeeded, then the link between Humean Supervenience and theories of persistence is broken.

depend upon non-causal *intrinsic* properties of stages, together with the laws relating those properties.

3.6 Natural Objects

Stage theory focuses upon instantaneous stages, but, as we saw in Chapter 2, we need a notion of 'suitable relations' between stages in order to account for various features of our experience, and for our ways of talking about objects. The historical and lingering predicates satisfied by an instantaneous stage will depend upon the properties of other stages to which it is suitably linked. It should by now be apparent that these suitable relations will partly involve the non-supervenient relations I have been discussing in this chapter. Take a present banana; some past and future stages are more relevant to it than others are. So some series of stages are in a sense more cohesive than others, and these are series of stages linked by non-supervenient relations. The rotating disc argument shows that, if rotation is an objective matter, then there are objective differences between series of stages which correspond to ordinary objects, and those which do not. In the remainder of this chapter I will explore some consequences of recognizing this objective difference.

In his *Dividing Reality*, Eli Hirsch considers the differences between apparently 'natural' and apparently 'unnatural' ways of dividing up the world, at the level of individual objects, and also at the level of properties (Hirsch 1993). His primary interest is in whether, if there are natural divisions in reality, then our language and classification systems *ought* to reflect those divisions. This is an interesting question, and Hirsch's discussion is impressive and subtle, but it is not my main focus here. I will, however, borrow his taxonomy of different approaches to divisions in reality.

First, consider properties. We can think of properties as (at least) associated with classes of particulars. Some classes seem to us to be cohesive: the class of all green things, for example. Others seem less cohesive: the class of all things which are either green or circular. Others seem less cohesive still: the class which just contains this piece of paper, my left ear, and the number 2. What, if anything, is the difference between these more and less cohesive classes? Hirsch distinguishes three different types of answer to this question, which he calls 'ontological inegalitarianism', 'elitist inegalitarianism', and 'egalitarianism'.

Ontological inegalitarianism is the idea that cohesive, or natural classes are associated with an extra kind of entity, one which unnatural classes simply lack. An ontological inegalitarian, then, might claim that certain natural classes correspond to universals, whilst unnatural classes do not. But ontological inegalitarians have difficulties with the fact that naturalness seems to come in degrees. Not every class of particulars is either perfectly natural or perfectly unnatural. The class of all things which are either green or circular, for example, does not seem to be perfectly natural, but it does seem more natural than the class which contains just this piece of paper, my left ear, and the number 2. Ontological inegalitarians claim that natural classes are associated with certain entities (universals) whilst unnatural classes are not. But either a class has a universal associated with it, or it does not, which seems to leave no space for a sliding scale of naturalness for classes.[14]

At the other end of the metaphysical scale, egalitarianism is the claim that there is no objective difference between natural and unnatural classes, that any perceived differences are grounded in human interests or the like. Finally, elitist inegalitarianism is a middle position, according to which natural and unnatural classes are objectively different from one another, but not because a natural class corresponds to an extra entity to which an unnatural class does not correspond. Perhaps naturalness is a primitive feature of certain classes and not of others. Or perhaps we can analyse naturalness in terms of similarity: if two objects are members of the same natural class, then this makes for a genuine similarity between them, whilst co-membership of an unnatural class adds nothing to their similarity.

Hirsch also discusses three analogous approaches to individual objects. Consider four-dimensional regions of space–time. Some of these seem to be the paths, or histories of objects, and others do not. Regions of the first kind we can call 'natural', and regions of the second kind 'unnatural'.[15] Ontological inegalitarians would claim that a natural region corresponds to an entity of some kind, whilst no unnatural region corresponds to an entity of that kind. The most obvious way to spell this out is as endurance theory. The temporal parts of a natural region are occupied successively by an enduring

[14] See Sider (1995) for further discussion of this issue.

[15] In this section I switch back and forth between talk of natural regions and talk of natural series of stages. I hope that this is not too irresponsible.

object, whilst an unnatural region is not completely occupied by any enduring object.

A perdurance theorist could also be an ontological inegalitarian. It is customary for perdurance theorists to be unrestricted mereologists, to believe that any two objects make up a third. The joint consequence of perdurance theory and unrestricted mereology is that every collection of temporal parts composes an object, and thus that there are very many persisting objects, only a small fraction of which are 'recognized' by us. However, a perdurance theorist could reject unrestricted mereology, and suppose that only certain collections of temporal parts have sums, that only certain, natural, regions of space–time are exactly occupied by objects, whilst others are not.

But, like ontological inegalitarianism about properties, both perdurance-based and endurance-based ontological inegalitarianism about individuals face problems arising from the fact that naturalness seems to come in degrees. Most objects seem to have some vagueness about their boundaries; there are regions of space–time about which it seems unclear whether they exactly contain a natural object. As we will see in the next chapter, an attractive way of accounting for this phenomenon is to say that it is unclear, or indeterminate, how natural a region has to be in order to count as containing an ordinary object. But this presupposes a sliding scale of naturalness for regions, which is difficult to understand if the naturalness of a region is supposed to consist in its being associated with an object.

In contrast to ontological inegalitarians, egalitarians about individuals claim that there is no objective difference between natural and unnatural regions, that any perceived difference simply reflects our priorities and interests. Quine may be an egalitarian of this sort, and it is a common conception that temporal parts theorists *must* be egalitarians. Goldman, drawing on evidence from cognitive science and arguing that unnatural objects exist, argues for a kind of projectivism about naturalness, combined with an error theory about our judgements that naturalness is an objective feature of some collections of stages (Goldman 1987).

But the rotating disc case causes problems for egalitarianism, as we have seen. Not all four-dimensional regions are created equal, for some contain series of stages bound together by the non-supervenient relations which determine the transmission of immanent causation, whilst others do not, and the former correspond to ordinary objects. More promising is some kind of elitist inegalitarianism, which

acknowledges an objective difference between natural and unnatural regions, without claiming that natural regions are associated with objects whilst unnatural regions are not. Elitists about properties may take naturalness as primitive, or else attempt to analyse naturalness, perhaps in terms of similarity. What about naturalness for stage series?

I, of course, have argued that non-supervenient relations best account for what I am now calling 'naturalness' for series of stages. A natural series of stages is one whose members stand in non-supervenient relations to one another. But to claim this is not simply to take naturalness of series of stages as a primitive. Admittedly, there is something slightly mysterious in the notion of non-supervenient relations, but the notion is not empty—it is characterized by its theoretical role. I have claimed that there is no supervenient relation, no spatio-temporal and no Humean causal relation which can do the job, that non-supervenient relations are a breed apart from these. And I have offered the analogy with Teller's non-supervenient relations in quantum mechanics.

Dean Zimmerman argues that perdurance theorists are obliged to provide informative criteria of identity for natural persistents. My non-supervenient relations account might, on his view, not count as sufficiently informative. What am I obliged to provide, and why? Zimmerman says:

> Since the properties of and relations among parts determine the intrinsic properties of wholes, and since being a persisting mass of K is intrinsic to things that have it, then—on a temporal parts account—being a persisting mass of K must supervene on the properties of and relations among the momentary temporal parts of any given mass of K. And the supervenience of *being some persisting K* implies that there is a necessary and sufficient condition of some sort that can be given in terms of intrinsic properties of momentary stages and relations among them. (Zimmerman 1997: 440.)[16]

Zimmerman cannot be asking under which circumstances some stages form an object since it is open to the stage or perdurance theorist to say that every series of stages forms some natural or unnatural object. Instead he is asking the stage or perdurance theorist to say something about which series of (K-)stages are natural. And of course I have done this: the answer is couched in terms of

[16] Note that Zimmerman assumes that being a persisting mass of K is neither a temporally nor a spatially maximal affair.

non-supervenient relations. Being a natural series supervenes upon properties of and relations between the stages in the series, so long as non-supervenient relations are allowed into the supervenience base. There are no grounds for demanding that the relations in question must reduce to intrinsic properties of the stages; after all, it is commonly thought that persistence is partly a matter of (non-supervenient) spatio-temporal relations between stages.[17] My analysis of naturalness is not overly mysterious, although nor is it reductive.

Is there, perhaps, an epistemic worry about non-supervenient relations? We cannot tell the velocity of a single stage simply by examining that stage alone. But that seems to be the right result: as I have already argued, an isolated stage would not have a velocity, not even a velocity of zero. What a thing is like depends in part upon its relations to other things. Non-supervenient relations provide a way of spelling out elitist inegalitarianism with respect to series of stages (or four-dimensional objects, in the context of perdurance theory). It is worth holding on to this middle ground between egalitarianism on the one hand, which flies in the face of the rotating disc argument, and ontological inegalitarianism on the other, which has problems if there are degrees of naturalness. In the remainder of this chapter I will spell out some useful consequences of recognizing an objective difference between natural and unnatural series of stages, advantages that accrue equally to stage theorists and to perdurance theorists who are willing to recognize an objective difference between natural and unnatural perduring things.

3.7 Change

Non-supervenient relations, by marking out objectively natural series of stages, allow us to quell any remaining worries about the stage theory account of change. Mellor, for example, argues that perdurance theory, and by extension, stage theory, is unsatisfactory, since it does not allow for genuine change (Mellor 1998: ch. 8). Genuine change, according to Mellor, is the possession of incompatible properties at different times by *one and the same object*, whereas both perdurance

[17] Indeed, Zimmerman motivates his requirement by arguing that the intrinsic properties of spatial wholes supervene upon the intrinsic properties of their spatial parts, with the (crucial) exception of emergent properties, if there are any.

theory and stage theory see change as the possession of different properties by different things (different temporal parts or different stages, respectively). When I grow taller, it is because one of my parts or stages is one metre tall, whilst a *different* part or stage is two metres tall.

As I argued in Chapter 1, we need not allow endurance theorists to write their theory into the very definition of change; from alternative points of view, genuine change is the possession of different properties by different stages of a single object, or by different temporal parts of a single object. These alternative accounts of change are satisfactory, however, only if they can accommodate a distinction between change in a single object, and differences between successive objects. To take Mellor's example, my having a different blood group from a long-dead ancestor does not constitute a change in the world, for in this case no single object has the two different blood groups. How does this variation in blood groups between me and my ancestor differ from the variation in heights between my earlier and my later parts or stages?

Endurance theory marks a clear distinction between a difference between my ancestor and me on the one hand, and a change in me on the other: the former but not the latter involves two distinct objects. Stage theory and perdurance theory must distinguish certain series of stages or temporal parts from others, marking a distinction between stages/parts of the same object, and stages/parts of different objects. A few might see this as a purely conventional distinction, claiming that there is no deep difference between a change in me and a difference between my ancestor and me. But the rotating disc shows that in some cases at least, non-supervenient relations mark an objective difference between natural and unnatural series of stages. Just as individuals which share natural properties are genuinely similar, a natural series of stages displays genuine continuity, as opposed to disruption.

Non-supervenient relations can ground the distinction between genuine change and mere difference over time between different objects. Genuine change is the possession of incompatible properties by stages which are linked by non-supervenient relations. My present stage is not so linked to any stage of my ancestor, which is why the difference in our blood groups is not a change in anything. But I am so linked to my earlier stages, which is why my being taller than those earlier stages is a genuine change. Indeed, we can usefully recall that stage theory comes closer to meeting endurance theory intuitions

about change than perdurance theory does. After all, according to stage theory, I am not an extended four-dimensional thing, I am just my present stage, and I used to be each of my earlier stages. The things which satisfy the predicate 'is a person' are the very things that possess the incompatible height properties. This contrasts with the perdurance theory account according to which I am the sum of all those momentary things.

Moreover, stage theory marks a clear distinction between changes in persisting objects and temporal variation in events. An event, a concert for example, is a four-dimensional temporally extended thing. If it is first quiet and then loud, it has an early temporal part which is quiet and an later temporal part which is loud. This differs from the stage theory account of what it takes for *me* to be first quiet and then loud. Such an account talks of persons and not their temporal parts. First there is a stage which is me, and which is quiet. Then there is a stage which is me, and which is loud. Of course, the difference between stage theory and perdurance theory may be only a matter of semantics, but stage theory seems better to satisfy certain intuitions.[18] Those who wish to distinguish between changes in objects and temporal variation in events can thus find satisfaction in stage theory where perdurance theory disappoints.

3.8 Reference

In order to account for the rotating disc, and to provide an objective grounding for change, I have invoked a difference between natural and unnatural series of stages, and underpinned this with the notion of non-supervenient relations. This distinction between natural and unnatural series also helps explain how it is possible for us to refer to things as we do. For stage theory to be viable it must be the case that, in general, when we refer to a stage we thereby privilege a certain collection of stages which provide truth conditions for historical and lingering predications, and which are eligible to be the referent of the same term as it is used to talk about different times. Recall that in Chapter 2 I briefly discussed assigning the name 'Billy' to a banana. The namer is confronted by a banana, a stage, but somehow attaches

[18] See Chapter 2 for further discussion of the differences between stage and perdurance theories, and Chapter 1 for the endurance theory distinction between processes and persisting things.

the name in a way which allows us to use the name to talk about different stages.

Perdurance theory must provide for something similar. When a name is attached to a persisting object, there must be something which makes it determinate *which* persisting object is being named, how to trace the object backwards and forwards from the present temporal part. When a dubbing event takes place, the present stage or part is a stage or part of an enormous number of different series and four-dimensional objects, yet somehow we seem able to name a single one of these. My account of this can be anticipated. It seems that series of suitably related stages attract reference, are eligible targets of dubbing. An analogous point is perhaps more familiar from Putnam's account of natural kind terms. According to Putnam, natural kind terms are attached to kinds via dubbing of a sample, or exemplar of the kind. But any sample belongs to very many different groups of objects. It is important for the viability of Putnam's account that some groups are more eligible for reference than others, that the world itself cuts down the number of kinds we might be intending to dub (Putnam 1975).

The role I am suggesting for naturalness in making reference determinate can be seen as an externalist version of the Fregean dictum that part of the sense of a proper name is a criterion of identity for the thing in question. Here is Dummett:

> Merely to know that a name has as its referent an object with which we are confronted, or which is presented to us in some way, at a particular time is not yet to know what object the name stands for: we do not know this until we know, in Frege's terminology 'how to recognize the object as the same again', that is, how to determine, when we are later confronted with an object or one is presented to us, whether or not it should be taken to be the same object. (Dummett 1981*b*: 545.)

It is notoriously difficult to make this 'recognize' plausible when it is read epistemologically (Lowe 1989*a*: ch. 2). And it is also remarkably difficult to come up with adequate and explicit criteria of identity through time for objects of various kinds (persons are a notable case in point, as, of course, are disc segments). But the externalist version of this principle seems entirely plausible. If we are to refer to a persisting thing, there must be something that determines when we are confronted with the same thing again (however 'same' is spelt out), even if we cannot tell when that has happened. Non-supervenient relations, by marking out suitable referents, can play this role.

For David Lewis, one reason that natural *properties* are important is that they have a role in making language and thought determinate: principles of charity or humanity tell us to attribute natural properties to predicates wherever possible, and this breaks any underdetermination as to what our predicates pick out (Lewis 1983*c*; 1984). An analogous role can be played by naturalness in series of stages, by the objective distinction between natural and unnatural persistents. If Lewis is correct about predicates, then the same will be true of individual names: we should charitably assume that natural, not unnatural objects are the referents of names and other referring devices.

3.9 Personal Persistence

The message of this chapter has been that both perdurance and stage theories can and ought to recognize close connections between parts/stages of the same object, and that they can do so without taking that close connection to be the relation of identity, as the endurance theorist does. Neither perdurance theorists nor stage theorists are compelled to believe that the relationship between me at present (or my current part) and me in the future is simply on a par with the relationship between me at present and my children in the future, or indeed anyone else in the future or in the past. Indeed, this egalitarian position is inadvisable, given the rotating disc argument.

Derek Parfit offers a 'reductive' account of personal identity in terms of psychological continuity between person-stages. He thinks this view of personal identity breaks down the boundaries between the self and others, that there is little reason for me to care more about myself in the far future (were I to live long enough and change in enough ways) than about you right now (Parfit 1984: 304). This is because such psychological continuity is non-transitive, and seems to be a matter of degree. It may be (although I doubt it) that special considerations about the persistence of persons compel us to adopt Parfit's position. But not all stage or perdurance accounts of persistence can be labelled 'reductionist' or egalitarian. To deny endurance theory is not to believe that all series of stages are on a par, nor that facts about persistence reduce to or supervene upon intrinsic features of stages.

It may be that non-supervenient relations can form the basis of rational concern for one's own future, if anything can. It is, after all,

rather difficult to say why one should care about one's future self even on an endurance theory account of the self—why should identity do the job more effectively than non-supervenient relations? One concern, however, may be that, although non-supervenient relations mark out a difference between natural and less natural series of stages, there is still an alarming degree of vagueness in questions of personal persistence. The next chapter tackles questions about vagueness.

How Things Persist

Katherine Hawley

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