Multiple Constitution*

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Abstract

This paper outlines a novel solution to the problem of the many and a conception of ordinary objects that implies it. The solution is that many collections of particles can simultaneously constitute a single object. The proposed conception of ordinary objects maintains that they are fundamentally subjects of change: the changes an object is able to survive explain its constitution.

1 Introduction

The problem of the many (henceforth **PM**) presents a serious threat to the coherence of our ordinary conceptual scheme: a contradiction follows from seemingly innocuous premisses, all motivated from within that scheme. In this paper I outline a novel solution to **PM** according to which objects can be simultaneously constituted by many collections of particles. To support this proposal, I develop a conception of objects that implies it. On this view, objects are fundamentally subjects of change: the changes an object can survive are explanatorily prior to its constitution. From this perspective, **PM** arises and objects are multiply constituted because the changes that objects survive are too coarse-grained to distinguish between many different collections of particles in respect of their constituting the relevant object.

§2 introduces the constitution relation that will be central to my discussion. §3 outlines **PM**, an adequacy condition on candidate solutions, and my proposed solution. §4 outlines my conception of objects and uses it to argue for my solution

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to **PM**. §5 develops the view further in response to some objections. §6 uses a discussion of mereology to offer a diagnosis of my solution's near-absence from the literature on **PM**. §7 concludes.

2 Constitution

This section introduces the notion of constitution on which my discussion will focus.

Ordinary objects, the most familiar inhabitants of the macroscopic world,[1] are made out of other things. Statues are made out of clay, houses are made out of bricks, and humans are made out of organs, which are made out of tissue, which is made out of cells, which are made out of particles. My primary concern will be the sense in which one object is made out of many particles. Let us regiment this by saying that objects are *constituted* by (many) particles. And if x is one of the particles that constitute y, say that *x partially constitutes y*.

How do constitution and partial constitution differ from the more familiar notions of parthood and fusion? There are certainly similarities between these pairs of relations: constitution and fusion have a plural argument position and a singular argument position; partial constitution and parthood have two singular argument positions. (More on plurals shortly.) The difference is that fusion is defined in terms of parthood, whereas constitution is used to define partial constitution. That is, the difference concerns whether the plural-singular relation is defined from the singular-singular relation or conversely. I want to consider the sense in which individual objects are made from many particles in as theoretically neutral a setting as possible. The best approach is therefore to treat the plural-singular relation as primitive, rather than defined, without foreclosing the possibility of analysing it via a singular-singular relation later, as in standard mereology. Hence my focus on constitution. §6 discusses the connections between these relations in more detail.

Two questions arise. Firstly, are there any most fundamental particles, or might there be an infinite series of levels of increasingly fundamental particles, with the inhabitants of each level made out of those in the next? One can avoid taking a stand on this issue by selecting some level to serve as fundamental relative to the present discussion, and restricting one's quantifiers over particles to inhabitants of this level. Secondly, might material reality's ultimate constituents not be individual particles but, say, regions of spacetime or non-individual stuff? One can avoid taking a stand here too. Even if particles are not ontologically basic, discourse about them is surely legitimate: not all meaningful discourse, or even all metaphysical disputes, need be conducted in absolutely fundamental terms.[2] So one can employ

[1] Although this leaves the extension of 'ordinary object' imprecise, the idea is clear enough for present purposes. Throughout, 'object' is reserved for ordinary objects; 'entity', 'individual' etc. are used more inclusively, for any potential value of a nominal variable.

[2] On one view, fundamentality is a property of entities. On this view, fundamental ontology concerns only some of what exists. On another view, fundamentality is a property of representations. On this view, fundamental ontology ignores topics not formulable using fundamental vocabulary. It

constitutional vocabulary whilst remaining neutral about whether one's discussion is couched at an ontologically basic level. Alternatively, subsequent talk about particles can be understood as a placeholder for talk about reality's ultimate material constituents, whatever they turn out to be; my discussion should be reformulable in terms of such basic entities without significant loss.

I am using 'constitution' to denote a binary relation between many particles and a single object. I therefore require the now standard apparatus of plural quantification and reference brought to prominence by George Boolos.[3] On this view, a plural term denotes not one plural individual, but one or more of those individuals over which our singular nominal quantifiers range. Likewise *mutatis mutandis* for plural variables. When α is a singular term/variable, $\ulcorner\alpha\alpha\urcorner$ and $\ulcorner$the αs$\urcorner$ will serve as plural terms/variables. I will also make liberal use of talk about collections; although syntactically singular, this should be understood as semantically plural talk about the elements of those collections.

Typically, some particles constitute an object without any one of them constituting that object. So the constitution relation is *collective* in its plural argument position. In this respect, constituting an object is akin to jointly writing a book or being arranged in a circle: in this collective sense, Russell did not write *Principia Mathematica* and neither did Whitehead, though Russell and Whitehead together wrote *Principia*; likewise, some chairs can be arranged in a circle without any one of those chairs being arranged in a circle.

Objects are typically constituted by different particles at different times. So constitution should be relativised to a time. Temporal relativisation will, however, often be omitted for simplicity.

The constitution relation between particles and objects is less general than our ordinary notion of "being made out of" in at least three respects:

(1) A jumper can be made out of (some) wool, or a statue can be made out of (some) clay. So a fully general constitution relation can hold between the denotation of a mass-noun and an object. Adequate treatment of this case requires more detailed investigation of the semantics and metaphysics of mass-nouns than is appropriate here. So I ignore it henceforth.

(2) A jumper can be made out of a single woolen thread, or a statue out of a piece of clay. So a fully general constitution relation can hold between an object and another object. This case raises too many complexities and controversies to be considered here. Even the formal properties of object-object constitution—e.g. transitivity and asymmetry—are controversial.[4] So I ignore it henceforth.

(3) A jumper can be made out of many woollen threads, or a statue made out of many pieces of clay. So a fully general constitution relation can hold between

is not obvious to me that ontologists limit their interests in either of these ways.

[3] (Boolos, 1984). A useful overview is (Linnebo, 2010).

[4] Even if, say, the thread-jumper relation appears asymmetric (transitive), it may be a restriction (resp. the ancestral) of an underlying symmetric (resp. non-transitive) relation.

a collection of objects and a single object. Given the following plausible principle, I can harmlessly ignore this case in the sequel:

- For any objects xx and object y: xx constitute y iff y is constituted by the collection zz of all particles u such that: u partially constitutes something amongst xx.

My primary concern is not a fully general notion of "being made out of", but just the sense in which objects are made out of collections of particles. Some restriction in scope is needed to reduce complexity, simplify exposition, and permit detailed discussion within a single paper. The restrictions introduced here will hopefully not generate distortions later.

The logical and terminological preliminaries are now complete. Let us continue to **PM**.

3 The Problem of the Many

Contemporary discussion of **PM** was initiated by Peter Unger.[5] I focus throughout on one representative instance of **PM** concerning Tibbles the cat. The problem is that the following are jointly inconsistent:

Solitude Tibbles is the one and only cat on his mat.

Abundance Many collections of particles on Tibbles' mat are equally good, and good enough, candidates to constitute cats.

Equality If many collections of particles are equally good, and good enough, candidates to constitute cats, then each of those collections constitutes a cat.

Unique Constitution (UC) Tibbles, like every other cat, is constituted by exactly one collection of particles.[6]

Abundance, **Equality** and **UC** jointly imply that many cats are on Tibbles' mat, contrary to **Solitude**.[7, 8] Something has to give. But what?

[5] (Unger, 1980)

[6] As stated, **UC** is false. Suppose some F-particles constitute Tibbles, and that each F-particle is made from two G-particles. Then surely Tibbles is also constituted by the G-particles from which the relevant F-particles are made, *contra* **UC**. So the particles relevant to **UC** should be restricted to either (i) absolutely fundamental particles (if such there be), or (ii) the elements of some relatively fundamental decomposition of reality into non-overlapping particles. These qualifications are left tacit in the sequel. See also §2.

[7] Note that since "a" candidate collection is not one plural individual but many particles, **PM** cannot be resolved by restricting constitution or fusion. **PM** does not presuppose a plenitudinous ontology.

[8] Does **PM** require the assumption that a cat is located where its constituent particles are located? No. Drop the restrictions to Tibbles' mat and suppose Tibbles is the only cat ever to exist. This affects neither the coming motivations for **Solitude**, **Abundance**, **Equality** and **UC**, nor their mutual inconsistency.

Solitude seems innocuous: surely there often is just one cat on a given mat. The motivation for **Abundance** is that Tibbles' boundary, like that of any other typical cat, is indeterminate. Suppose one collection of particles is a better candidate to constitute a cat than any other. Then that collection and no other does constitute a cat: the best candidate wins. So Tibbles' boundary is that of this privileged collection, and therefore not indeterminate. Since Tibbles' boundary is indeterminate, the supposition is false and **Abundance** is true. **Equality** seems justified because one way for the xs to be better candidates to constitute a cat than the ys is for the xs but not the ys to constitute a cat; for then the xs would be more cat-constituter-like than the ys. Finally, **UC** is a natural assumption about constitution: how could different collections of particles simultaneously constitute the same cat? Because these motivations turn on no peculiarity of Tibbles or of cats, the problem generalises to all ordinary material objects, including ourselves. And because these motivations flow from our ordinary conception of cats, **PM** presents a serious threat to our ordinary conceptions of macroscopic reality and our own place within it. Something has gone badly wrong.[9]

Although several responses to **PM** already exist, none is entirely satisfactory.[10] Rather than evaluate these proposals in detail, I want to explore an unjustly neglected alternative. More options are needed, and my goal is to outline one such so that it can stand for evaluation alongside the competition. In doing so, I hope to reveal that the range of available positions is wider than is sometimes assumed, and to thereby help alleviate (or at least expose) a metaphysical myopia afflicting much contemporary thinking about objects and constitution. To take one example, symptomatic of this myopia, variants of my solution are absent from Brian Weatherson's helpful *Stanford Encyclopedia* survey article on **PM**.[11] This affliction is identified and discussed in §6.

The lesson I want to draw from **PM** is that we should reject **UC** and endorse:

Multiple Constitution (MC) Tibbles is constituted by many collections of particles.[12]

On this view, many different collections of particles can simultaneously constitute a single object. **Abundance** and **Equality** imply that many collections of particles on Tibbles' mat all constitute cats. So **Solitude** implies that these collections all constitute the same cat, namely Tibbles. This is consistent with (and implies) **MC** whereas it is inconsistent with **UC**.

[9] Unger originally accepted the incoherence of our ordinary conceptual scheme (Unger, 1980). His most recent discussion of **PM** concludes instead that we are not material objects, but simple immaterial souls for which **PM** cannot arise (Unger, 2006a, ch7); see (Bynoe & Jones, 2012) for discussion.

[10] Perhaps the most popular solution to **PM** is (Lewis, 1993). Criticisms of Lewis have concerned: *de re* thought (McGee & McLaughlin, 2000); self-reference (Hawthorne, 2006a); freewill and our capacity to make genuine choices (Hudson, 2001) (Unger, 2006a, ch7); quantified claims about indeterminacy (Sattig, 2010, §7.2). For alternative proposals, see (Quine, 1981b), (van Inwagen, 1990, ch17), (Johnston, 1992), (Lowe, 1995), (Markosian, 1998), (Hudson, 2001), and (Sattig, 2010).

[11] (Weatherson, 2009)

[12] The qualifications in note 6 protect **MC** from triviality.

To make things a little more concrete, suppose that a particular hair h is Tibbles' only borderline part. Let the T^+s be the particles that constitute Tibbles taken as including h; let the T^-s be the particles that constitute Tibbles taken as excluding h. Then **MC** amounts to:

- The T^+s constitute Tibbles and the T^-s constitute Tibbles.

I will examine this response to **PM** in the remainder, leaving the simplifying supposition about h in force throughout.[13]

It is worth emphasising an adequacy condition on solutions to **PM**: an adequate solution should comprise a theoretically unified whole. We should aspire to more than a mere technical fix or ad-hoc collection of theses unified only by their role in blocking **PM**. Every solution will reject **Solitude**, **Abundance**, **Equality** or **UC**. An adequate solution will explain why we should reject one principle rather than another. That explanation should emerge naturally from a background conception of objects and constitution. Compare the set-theoretic paradoxes: a consistent modification of naïve set-theory provides an adequate solution to the paradoxes only if motivated by a background conception of set, as ZF is motivated by stage-theory.[14] §4 outlines a conception of object and argues from it to **MC**. My proposal therefore satisfies this adequacy condition and provides a theoretically unified solution to **PM**.

Neglect of this adequacy condition has led some astray. W.V.O.Quine connects realism with bivalence, and bivalence with determinacy, including determinacy in constitution. He concludes that realists must reject **Abundance**.[15] But since one can consistently retain bivalence and constitutional determinacy by rejecting **Solitude**, **Equality** or **UC**, Quine's proposal does not satisfy this adequacy condition: realism about objects and constitution does not explain why we should reject one principle rather than another.

Ned Markosian also rejects **Abundance**.[16] He begins by denying that there is a finite non-trivial account of the conditions under which a collection has a fusion. Call this view brutalism. Brutalism is consistent with: exactly one collection of particles on Tibbles' mat have a fusion, and thereby a better claim to constitute a cat than any other such collection, though nothing informative can be said about why it's one collection rather than any other. So Markosian suggests endorsing

[13] Distinguish my proposal from: Tibbles is constituted only by the plural union uu of the candidate collections. This view says that exactly one collection of particles constitutes Tibbles, whereas my proposal is that many do. Note that if only uu constitute Tibbles, the other collections are not equally good candidates, contrary to **Abundance**. My proposal does not even imply that uu do constitute Tibbles. This is a good thing; for there is no *a priori* guarantee that the union of all candidates to constitute an object is also a candidate to constitute that object. Although the union of the T^+s and the T^-s—i.e. the T^+s themselves—is a candidate, it is not guaranteed that the analogous claim holds in every case. The underlying logical point is that $R(xx, z) \wedge R(yy, z)$ does not imply $R(xx \cup yy, z)$.

[14] (Boolos, 1971)

[15] (Quine, 1981b). Quine may also be interpreted as rejecting **Equality**. Likewise for Markosian below. Nothing above turns on this.

[16] (Markosian, 1998)

that claim and rejecting **Abundance**. But brutalism is compatible with the negations of **Solitude**, **Equality** and **UC**. So Markosian's proposal does not satisfy the adequacy condition: brutalism does not explain why we should reject one principle rather than any other.[17] Indeed, I know of no extant solution to **PM** that satisfies this adequacy condition.[18] This counts strongly in favour of my proposal.

The closest extant solutions to **MC** are due to E.J. Lowe and Mark Johnston.[19] I will focus on Lowe. Although Lowe explicitly rejects **MC**,[20] his view is difficult to interpret. And the best interpretation postulates equivocation on 'constitutes', with **UC** determinately true on one reading and **MC** determinately true on the other.

Following Lewis, Lowe invokes the apparatus of supervaluation, positing many sharpenings of the natural object-language in which **PM** is couched.[21] Supertruth (superfalsity) is defined as truth (falsity) on each sharpening. Determinate truth (falsity) is identified with supertruth (superfalsity). Indeterminacy thus becomes lack of supertruth-value. Lowe then claims that one individual on the mat is significantly more cat-like than any other: only this individual substance has, e.g., the history, persistence conditions and modal profile of a cat; everything else on the mat is a particle or mere aggregate thereof. 'Tibbles' refers to this individual on each sharpening, though it is indeterminate which particles constitute it. This indeterminacy is accommodated by a sense of 'constitutes' on which its extension varies across sharpenings: on each sharpening, one candidate counts as constituting Tibbles, different candidates on different sharpenings. In this sense: (i) **Solitude** and **UC** are determinately true; (ii) either **Abundance** or **Equality** is determinately false; (iii) it is indeterminate which particles constitute Tibbles. In another sense however, 'constitutes' marks only metaphysically significant distinctions between how collections of particles relate to an object. Because the differences between the candidates do not bear significantly on how they relate to Tibbles—their relations to Tibbles are of the same underlying kind—this delivers a sense in which each candidate counts as constituting Tibbles on each sharpening. So: (i) **UC** is determinately false and **MC** is determinately true; (ii) **Solitude**, **Abundance** and **Equality** are all determinately true; (iii) there is no indeterminacy in Tibbles' constitution.[22]

Lowe's proposal fails the adequacy condition outlined above. His guiding claim is that a uniquely most cat-like individual is on Tibbles' mat. This is compatible with

[17] Notice that I didn't motivate **Abundance** by appealing to the existence of a finite non-trivial account of when a collection has a fusion.

[18] A possible exception is (Lewis, 1993), when set against the backdrop of Lewis' wider linguistic and metaphysical views.

[19] (Lowe, 1995), (Johnston, 1992).

[20] (Lowe, 1995, pp180–181)

[21] (Lewis, 1993)

[22] Why does Lowe need the second sense of 'constitutes'? Because as Lewis points out, stating the problem requires a sense in which the candidates are all equally good candidates to constitute cats (Lewis, 1993, pp173-4, 179–80). Couldn't Lowe invoke a metalinguistic (better: metasemantic) account of their equally good candidature? Not whilst recognising that the differences between how the candidates relate to Tibbles are not metaphysically significant, and using 'constitute' to express the fundamental sense in which objects are made out of particles.

the negations of **Abundance**, **Equality** and **UC**. So Lowe does not explain why we should reject one of those principles rather than another. Furthermore, Lowe simply builds **Solitude** into his guiding claim, rather than explaining why we should accept it. The next section develops a view that avoids these problems, though which clearly belongs in the same tradition as Lowe's.

4 A conception of objects

My goal is a theoretically unified response to **PM**. This section proceeds by describing a conception of objects and constitution that justifies rejecting **UC** in favour of **MC**. The next section considers some objections.

4.1 The basic idea

My proposal is guided by the idea that objects are fundamentally subjects of change. Call the changes an object can survive its *characteristic changes*. The suggestion is that an object's fundamental nature or essence is given by its characteristic changes. An object is thus fundamentally a participant in the sort of event that results from the occurrence of its characteristic changes. This section elaborates this thesis.

One natural development of this suggestion invokes a *sui generis* four-place relation of ontological dependence: *x's having F ontologically depends upon y's having G*.[23] My suggestion is that an object *o*'s having a contingent intrinsic, temporal or constitutional property *F* depends upon, or is grounded in, *o*'s having characteristic changes *G*.[24] Given an appropriate notion of essence, this goes hand-in-hand with the idea that an object's essence is its characteristic changes.[25]

One might doubt whether our grasp of essence, dependence and grounding is robust enough to provide a secure theoretical foundation, regarding them merely as picturesque heuristics. I cannot fully alleviate these doubts here. But one way to approach these notions is via their methodological role and the constraints they place on those who employ them. Claims about grounding, essence and dependence constrain the explanations available to the theorist. When one type of object, property, fact or whatever is said to depend upon another, the theorist making that claim is thereby committed to explaining all (or maybe just all the central) features of the dependent in terms of that on which it depends, and not to explain features of the latter in terms of the former. Similarly, attributing an essence to a thing brings an obligation to explain key aspects of the thing's behaviour in terms of its having that essence. That is the theoretical import of grounding, dependence and essence.[26]

[23] A close relative invokes a dyadic relation between states of affairs.

[24] This could be extended to modal, teleological, aesthetic,…properties, but that goes beyond the scope of a response to **PM**.

[25] See (Fine, 1994) for more on essence, and (Fine, 1995) for the essence-dependence connection.

[26] (Stalnaker, 2012, pp113–125) defends a similar approach to views that allow quantifiers to range over things that do not exist. In brief: no high-level theoretical commitments without methodological consequences.

In these terms, my proposal requires that an object's intrinsic, temporal and constitutional profiles be explained by its characteristic changes, and not conversely. The suggestion is not that characteristic changes are the sole explanatory factor; otherwise objects could have no contingent properties, assuming that essence, and hence characteristic change, is non-contingent. Rather, an object's characteristic changes combine with the contingent distribution of matter, property- and relation-instances, and event-types across space and time to explain why the object has the history (including constitutional history) that it does.[27] Whether or not this exhausts the content of the claims about dependence and essence with which this section began, it surely follows from them. Residual doubts about these notions may be alleviated by observing that any concept with these theoretical consequences could be invoked instead.

So, when an object o's putatively having an intrinsic, constitutional or temporal property F cannot be explained in terms of o's characteristic changes (together with other contingent features of reality), o lacks F. When such an explanation can be given, o has F. Likewise *mutatis mutandis* for quantified claims about such properties. §4.3 argues that **MC** can be explained in this manner and **UC** cannot, and hence that **MC** is true and **UC** is false.

This is not a proposal about all material individuals, but only the paradigmatic sorts of ordinary object for which **PM** is problematic. The view is consistent with, e.g., portions of matter and aggregates of particles being subject to different orders of explanatory priority; in those cases, constitution plausibly explains characteristic change. This might naturally be labelled a difference in ontological category.[28]

What exactly are the characteristic changes of, say, cats? §5.2 says a little more about this. But it may be helpful to distinguish two kinds of view now. On one view, characteristic changes are fundamentally macroscopic, in the sense of being changes in the object itself, rather than in its particulate parts. These are the changes a cat undergoes when it walks, pounces, digests etc. Although these kinds of behaviour have microphysical correlates, the first view says that changes involving the cat itself are what determine its history, rather than microphysical correlates thereof. On the second view, characteristic changes are fundamentally changes in particles; they are the microphysical correlates of macroscopic activity. Hybrid views are also possible. Luckily, I do not need to decide between these views here. What will matter to my argument is not the precise nature of characteristic changes, but their relative coarse-grainedness in the sense of being insensitive to distinctions between

[27] This is a key theme from the neo-Aristotelian view in (Wiggins, 2001, esp. chs2–4).

[28] Why is **PM** only problematic for ordinary objects? Because we're only entitled to the claims that generate **PM**, **Solitude** in particular, for reasonably familiar kinds of thing. It is not obvious that an abundance of, say, cat-like portions of matter on Tibbles' mat conflicts with our ordinary conception of reality or is otherwise objectionable. I claim that the things for which **PM** arises belong in a single category to which my proposal applies. But I remain neutral about how far beyond paradigmatic ordinary objects this category extends. Do such strange things as in-cars and out-cars belong in this category? (Hirsch, 1982, pp32–33) I am inclined to think so (at least, if in-cars exist), but nothing turns on it here.

the candidates to constitute an object. However, this coarse-grainedness fits most naturally with the first, macroscopic view, and that is where my sympathies lie.

How does this help with **PM**? More detail follows, but an overview may be helpful. On my proposal, **PM** arises because Tibbles' characteristic changes are too coarse-grained to distinguish between the T^+s and the T^-s in respect of their constituting Tibbles: those collections are just too similar. Any explanation in terms of Tibbles' characteristic changes for why the T^+s constitute Tibbles also applies to the T^-s, yielding an explanation for why the T^-s constitute him. Likewise *mutatis mutandis* for an explanation of why the T^-s constitute Tibbles. At least one such explanation is correct: Tibbles is constituted by (at least) one of those collections of particles. But since Tibbles' characteristic changes cannot distinguish between these explanations, and it is in terms of those changes that Tibbles' constitution must be explained, it follows that both the T^+s and the T^-s do constitute Tibbles. So **UC** is false and **MC** is true. The next section elaborates the view further. §4.3 applies it to **PM** in more detail.

4.2 Kinds and paths

This section develops my proposal by discussing the connection between an object's characteristic changes and kind.

A useful notion is that of an object's path through space and time. Paths and characteristic changes go hand-in-hand: each path p corresponds to a class of (types of) characteristic changes, namely those changes an object o would have to survive in order for p to be o's path. Natural and non-arbitrary paths correspond to natural and non-arbitrary classes of changes. Gruesome and gerrymandered paths correspond to gruesome and gerrymandered classes of changes. Talk about paths and the features that characterise them thus provides an alternative way of describing characteristic changes.

Paths pass through regions at times. I will focus on the sense in which a path can pass through a region r at a time t without thereby passing through any proper subregion or superregion of r at t. In this sense, passing through is akin to exact occupation in the theory of location. Note however that an analogue of the following gloss on exact occupation is inappropriate here: x exactly occupies r at t iff x fills and fits within r at t. There are two reasons for this. The first is pragmatic: my solution to **PM** will require Tibbles' path to pass through several regions at a time, one for each candidate to constitute him at that time, and this appears to conflict with the gloss. The second reason is conceptual: my proposal requires that constraints on paths, including any that emerge from this gloss, be explicable via the characteristic changes of their occupants, and no such explanation has yet been provided.

An object's characteristic changes and path are not arbitrary, they depend on what kind or sort of thing it is.[29] The characteristic changes of a cat differ from

[29] This is a second key theme from (Wiggins, 2001). See also note 27.

those of, say, a squid or a pencil.[30] The relationship between kinds and characteristic changes can be understood in two ways. On one view, kind-classifications are notational variants on classifications by characteristic changes. On the other view, kind is a richer notion that determines an object's characteristic changes. The second view allows for kind-classifications more fine-grained than the first. Nothing that follows turns on which view is correct.

Each kind K privileges a class of paths appropriate to Ks; call these the *K-paths*. The individual Ks correspond one-one to K-paths: each K occupies exactly one K-path, and each K-path is occupied by exactly one K. What happens within an object's path at t determines its intrinsic properties and constitution at t. An object's path thus determines its history.

How do kinds privilege paths? Well, associated with each kind K is a cross-time relation R_K on regions: R_K holds from a region r at a time t to a region r' at a time t'. This relation picks up on the contingent distribution of matter, property- and relation-instances, and event-types across space and time to determine which paths are K-paths. Think of R_K as codifying the characteristic changes of Ks, and as thereby delineating the spatial and temporal boundaries of events of the sort that result from the occurrence of those changes.

How does R_K delineate the K-paths? A natural first suggestion is:

- For any regions r, r' and times t, t': some K-path passes through both r at t and r' at t' iff R_K holds from r at t to r' at t'.

Although this principle rules out many paths, it doesn't settle which paths are K-paths. Suppose that R_K holds (i) from r at t to r' at t', and (ii) from r' at t' to r^* at t^*. Then the principle implies that some path corresponds to (i) and some path corresponds to (ii). But the principle is silent about whether the same path corresponds to (i) and (ii), even if R_K also holds from r at t to r^* at t^*. More structure must be imposed on the relationship between R_K and K-paths.

We want to use the characteristic changes of cats, as codified by R_K, to select the K-paths from amongst the totality of paths. So let f_K be the (partial) two-place function from regions r and times t to paths such that:

- $f_K(r, t)$ is defined iff R_K holds from r at t to some r' at some t'.
- Path $f_K(r, t)$ passes through r at t.
- f_K satisfies:

(K=) $$\forall r, r', t, t'[f_K(r, t) = f_K(r', t') \leftrightarrow R_K(r, t, r', t')]$$

[30] One might doubt that cats and squid have different characteristic changes. Maybe all living things have the same characteristic changes, with non-persistence features differentiating their paths. If so, then the relation I will shortly invoke to characterise paths should be understood to incorporate this non-persistence information.

Because R_K codifies the characteristic changes of Ks, the first bullet says that f_K maps r, t to a path iff the kinds of change that Ks survive are occurring in r at t; i.e. iff some K-path passes through r at t. So by the second bullet, f_K maps r, t to a path that passes through the same region (r) as a K-path at t. And (K=) says that f_K maps r, t and r', t' to the same path iff R_K holds from r at t to r' at t'; i.e. iff the characteristic changes of Ks are as they would have to be in order for a K in r at t to be in r' at t'. So I propose identifying the K-paths with the values of f_K. On this view, the structural relationships between R_K and K-paths are captured by f_K and (K=). Let p be a path that passes through r at t. Then p is a K-path iff, for any region r' and time t': p passes through r' at t' iff R_K holds from r at t to r' at t'. That is how R_K delineates the K-paths. Note finally an important consequence of this view: if cat-paths p and q pass through the same region at some time, they pass through exactly the same regions at all times; "they" are not two paths, but one. I will make use of this fact shortly.[31]

This proposal is silent about modal variation in K-paths. It is intended to apply only within a world w, to delineate w's K-paths on the basis of w's distribution of matter, property- and relation-instances, and event-types across space and time. But it is surely contingent which paths are K-paths. Tibbles could have continued sleeping this morning, rather than chasing a mouse. In that case, he would have occupied a different path than he actually does; this path would then have been a cat-path, even though it actually isn't. Moreover, if Tibbles had continued sleeping this morning, no cat would have occupied his actual path, which would therefore not have been a cat-path. So the proposal must be enriched to accommodate modal variation in the K-paths.

The K-paths are determined by R_K and f_K. So contingency in the K-paths should result from contingency in R_K and f_K.[32] The extensions of contingent relations and the values of contingent functions (for given arguments) vary across worlds. My original proposal should now be modified so that f_K is a contingent two-place function from regions r and times t to paths such that:

- For any world w: $f_K(r, t)$ is defined at w iff R_K holds in w from r at t to some r' at some t'.
- For any world w: path $f_K(r, t)$ passes in w through r at t.
- f_K satisfies:

$$\forall w, r, r', t, t' (\text{At } w[f_K(r, t) = f_K(r', t')] \leftrightarrow \text{At } w[R_K(r, t, r', t')])$$

[31] K-paths can be modelled as classes of pairs $\langle r, t \rangle$ of regions r and times t. R_K can be modelled by a dyadic relation on such pairs. Then (K=) implies that R_K is an equivalence relation. On my proposal, K-paths are therefore modelled by equivalence classes under R_K of $\langle r, t \rangle$ pairs.

[32] Since functions are just a type of relation, contingent functions are no more objectionable than contingent relations. Contingent relations can be modelled by functions from worlds to relations, and contingent functions by functions from worlds to functions. Thanks to Josh Parsons for discussion of contingent K-paths.

This last says that f_K maps r, t and r', t' to the same path in w iff R_K holds in w from r at t to r' at t'. The K-paths in w are exactly the values of f_K in w. Note that this is silent about when the same K occupies K-paths drawn from different worlds. It is also silent about whether worlds can differ only in respect of which Ks occupy which paths. My original proposal is obtained by fixing on a single target world w. To simplify discussion, however, I will largely ignore modal concerns in the sequel, and focus instead on applying the original proposal within a single world.

Four brief comments follow, by way of further clarification.

First comment: since each K occupies exactly one K-path, and each K-path is occupied by exactly one K, R_K captures the (intra-world) identity conditions for Ks. When R_K holds from r at t to r' at t', not only is some K in r at t and some K in r' at t'; one and the same K is in both r at t and r' at t'. And if one K is in both r at t and r' at t', then R_K holds from r at t to r' at t': a single K-path passes through those regions at those times. Relatedly, since Ks are located in space exactly when their paths pass through some region or other, R_K also captures the existence conditions of Ks.

Second comment: despite being formally permissible, we should not identify Ks with either K-paths or classes of pairs of regions and times.[33] Ordinary objects are not abstracta, set theoretic constructions, or paths through space and time. Objects are the occupants of paths, the spatiotemporally located and causally efficacious loci of our interaction with concrete reality.[34]

Third comment: my proposal is independent of the epistemological and metaphysical picture associated with neo-Fregean foundations for mathematics.[35, 36] Principles like (K=) play a key role in such approaches, where they are called "abstraction principles". Within my proposal, a more appropriate label is Timothy Williamson's: (K=) is a two-level identity criterion.[37]

Fourth comment: the explanatory primacy of paths undermines the most powerful objection to coincident entities, namely the grounding problem.[38] The problem is that coincident objects are very similar—they are in the same place at the same time and constituted by the same particles—and yet not completely similar.

[33] An alternative identifies Ks with pairs of K-paths and R_K. This allows distinct objects of different kinds to share a path. The remarks in the text apply to this proposal too. See also note 31

[34] I thus reject the identification of objects with filled regions of spacetime. Maybe a variant proposal could accommodate that view. I will not attempt to develop one here.

[35] The classic neo-Fregean text is (Wright, 1983).

[36] This differentiates my proposal from a superficially similar one in (Simons, 2000), (Simons, 2008). Simons uses principles like (K=) in which the quantifiers range over occurrents, to capture the supposed ontological dependence of continuants on occurrents. My proposal is silent about this putative dependence and Simons does not discuss **PM**.

[37] (Williamson, 1990, ch9)

[38] (Bennett, 2004) gives a nice overview of the problem. A variant is sometimes raised by asking how objects can coincide without "crowding each other out"; an example is (Sider, 2001, pp141, 154–5). I do not know whether my proposal addresses this because I do not understand the objection. One does not get a statue and lump of clay to coincide by pushing them together, but by making one from the other. Why should objects crowd each other out when one is made from the other?

A particularly pressing case arises when coincident objects have different futures. How is this possible, given their present similarity? Note first that the paths of different kinds of object are determined by different relations. There is no mystery about how relations can share some but not all relata. So there is no mystery about how a K-path and a K'-path can intersect and then later come apart. Since kinds and paths are explanatorily prior to history and constitution, there is no mystery about how objects of different kinds can coincide and then later not do so. This strategy will not extend to coincidence between objects of the same kind, a phenomenon that even prominent defenders of coincidence like David Wiggins reject.[39] It does, however, seem likely that intensional differences between the characteristic changes of different kinds can explain modal differences between contingently permanently coincident members of those kinds. This may even extend to non-modal differences between necessarily permanently coincident objects of different kinds. However, the ultimate viability of these strategies turns upon broader issues in the metaphysics of modality that I cannot discuss properly here.

4.3 Constitution, Solitude and Multiple Constitution

This section puts the conception of objects developed in the preceding two sections to work resolving **PM**.

The motivating thought behind my proposal is that objects are fundamentally subjects of change, different kinds of change for different kinds of object. This manifests as the explanatory primacy of paths over constitution. How exactly does this explanation go? The natural suggestion is:

Path-Con For any particles xx, object o and time t: xx constitute o at t iff, for some region r, (i) o's path passes through r at t, and (ii) xx occupy r at t.

Occupation here is exact occupation: xx exactly occupy r iff xx both fill and fit within r. Exact occupation is collective: xx can exactly occupy r without anything amongst xx exactly occupying r. The region that xx exactly occupy is the union of those regions occupied by things amongst xx (perhaps supplemented with a way of filling in any gaps).

Truths about constitution, including **UC** and **MC**, should be explicable via **Path-Con** and the characteristic changes of cats. I will exploit this to argue for **MC**.

Let us apply the view described in the preceding section to cats. R_C is the relation that codifies the characteristic changes of cats. f_C is the (partial) function from regions r and times t to the cat-path (if any) that passes through r at t. R_C and f_C satisfy this instance of (K=):

(C=) $$\forall r, r', t, t'[f_C(r,t) = f_C(r',t') \leftrightarrow R_C(r,t,r',t')]$$

(C=) captures the structural relationships between R_C, cat-paths and f_C.

[39] (Wiggins, 1968). (Fine, 2000) describes putative cases of extreme forms of same-kind coincidence.

Let r^+ and r^- be the regions occupied now, at t_{now}, by the T^+s and the T^-s respectively, when hair h is a borderline part of Tibbles. I will argue that Tibbles' path now passes through both r^+ and r^-. Because the T^+s and the T^-s now occupy r^+ and r^- respectively, it then follows by **Path-Con** that both of those collections now constitute Tibbles.

Suppose Tibbles' path passes through only one region at any time prior to t_{now}: there was never more than one candidate to constitute Tibbles until now; i.e. **PM** did not arise before now. This unrealistic supposition will be dropped shortly. Let t_{early} be an earlier time, say, several months prior to t_{now}; let r_{early} be the region through which Tibbles' path passes at t_{early}. The question is this: how should Tibbles' path be extended from t_{early} to t_{now}, in order for the result to be a cat-path?[40] The T^+s and the T^-s are the only candidates to constitute Tibbles at t_{now}, and **PM** does not arise before t_{now}. So there are two ways of extending Tibbles' path to t_{now}. On one, Tibbles' path passes through r^+ at t_{now}. If that yields a cat-path, then the T^+s now constitute Tibbles. On the other, Tibbles' path passes through r^- at t_{now}. If that yields a cat-path, then the T^-s now constitute Tibbles. I will argue that both ways of extending Tibbles' path to t_{now} result in cat-paths, and hence that both the T^+s and the T^-s now constitute Tibbles.

Tibbles' path passes through r_{early} at t_{early}. It continues from then to pass through at least one of r^+ and r^- at t_{now}. That is, R_C holds from r_{early} at t_{early} to at least one of r^+ and r^- at t_{now}. Does R_C holds from r_{early} at t_{early} to only one of r^+ and r^- at t_{now}? It appears not. Surely the characteristic changes of cats cannot privilege one of r^+ and r^- over the other in respect of now containing a cat that was in r_{early} at t_{early}. What's now going on in those regions, the particles in them, and the paths connecting them to r_{early} at t_{early}, are so similar that the characteristic changes of cats cannot distinguish between them. So R_C holds from r_{early} at t_{early} to both or neither of r^+ and r^- at t_{now}. By hypothesis, R_C holds from r_{early} at t_{early} to at least one of those regions at t_{now}. So R_C holds from r_{early} at t_{early} to both of r^+ and r^- at t_{now}. So by (C=): f_K maps r_{early}, t_{early} to the same cat-path as both r^+, t_{now} and r^-, t_{now}; i.e. one single cat-path passes through r_{early} at t_{early} as well as through both r^+ and r^- at t_{now}. Since Tibbles' path passes through r_{early} at t_{early}, his path also passes through both r^+ and r^- at t_{now}. So by **Path-Con**: both the T^+s and the T^-s now constitute Tibbles. So **UC** is false and **MC** is true.

Furthermore, we may legitimately assume, the path of any cat on Tibbles' mat passes through at least one of r_{early}, r^+ and r^- at the relevant times: there are no other candidates. The last section pointed out that if cat-paths p and q pass through the same region at some time, then $p = q$. Since path-occupancy one-one correlates cats with cat-paths, it follows that exactly one cat is on Tibbles' mat: **Solitude** is true. **Abundance** holds because the T^+s and the T^-s do constitute cats. And (the relevant instantiation of) **Equality** holds because its consequent is true. So my conception of objects implies my solution to **PM**.

[40] If Tibbles persists beyond t_{now}, then extending Tibbles' path only as far as t_{now} will not yield a cat-path, but only a restriction of a cat-path. I ignore this complication henceforth.

The preceding argument assumed that there is only one candidate to constitute Tibbles at t_{early}, and hence that his path then passes through only one region. Let us drop this unrealistic assumption. The argument was underwritten by the following thought: the T^+s and the T^-s are now too similar for the relatively coarse-grained characteristic changes of cats to distinguish between them. On my conception of objects, this amounts to: R_C cannot distinguish r^+ from r^- at t_{now}. So in particular, R_C cannot distinguish r^+ from r^- in respect of its holding from them at t_{now} to r_{early} at t_{early}. This motivating thought is indifferent as to whether some other region r^*_{early}, nearly coincident with r_{early}, is as good a candidate as r_{early} for having a cat-path—indeed, Tibbles' cat-path—pass through it at t_{early}. In other words: the argument is indifferent as to whether some particles in r^*_{early} at t_{early} are also candidates to constitute Tibbles at t_{early}. A parallel argument therefore concludes that R_C holds from r^*_{early} at t_{early} to both r^+ and r^- at t_{now}. So by (C=): f_K maps r^*_{early}, t_{early} to the same cat-path as r^+, t_{now} and r^-, t_{now}. So by the argument two paragraphs ago and the transitivity of identity: f_K maps r^*_{early}, t_{early} to the same cat-path as r_{early}, t_{early}. So Tibbles' path passes through both r_{early} and r^*_{early} at t_{early}, as well as through r^+ and r^- at t_{now}. So by **Path-Con**: Tibbles is multiply constituted at t_{early}—by the particles then in r_{early} and also by those in r^*_{early}—as well as at t_{now}. Since cats correspond one-one with cat-paths, there is no threat here to Tibbles' being the only cat on his mat at t_{early}.

Let n be the smallest number of candidates there ever are to constitute Tibbles. One might object that (C=) is consistent with the existence of n cat-paths, and hence also n cats, on Tibbles' mat. Notice that this is no threat to **MC**, but only to **Solitude**; for whenever more than n candidates are on the mat, the objection implies that some of the n cats will be multiply constituted. The objection also relies on considering only the structural connections that (C=) imposes on cat-paths, f_C and R_C, neglecting the non-structural content of R_C itself. R_C codifies the characteristic changes of cats. In order for two cats to be on the mat at, say, t_{now}, one cat-path must then pass through r^+ and another through r^-. So R_C must now distinguish between r^+ and r^-. That is, the characteristic changes of cats must now distinguish between the T^+s and the T^-s. But that is simply not plausible given how similar those collections now are. How could the characteristic changes of cats privilege just one of those collections as the present constituter of a cat in r_{early} at t_{early}? **PM** only arises because the determiners of cat-locations cannot make such fine-grained distinctions; otherwise **Abundance** would fail. This undermines the objection. My proposal grants that the determiners of cat-locations are relatively coarse-grained, and that **Abundance** holds for that reason. This coarse-grainedness is then put to work bundling up the many candidates into one cat. The very phenomenon that generates **PM** thereby provides the key to resolving it.

We have seen that my neo-Aristotelian conception of objects implies my solution to **PM**. My proposal therefore satisfies the adequacy condition described in §3: it is a unified whole. The next section develops the view further in response to some objections. §6 examines the relationship between constitution and mereology, given

my solution to **PM**, and offers a speculative diagnosis of that solution's near-absence from the literature.

5 Objections and further developments

This section develops my proposal further in response to some objections.

5.1 Multiply located cats

On my proposal, Tibbles' path typically passes through many regions at a time, and path-occupancy provides the most basic way in which objects are in space. Doesn't it follow that Tibbles is multiply located, that he is in many places at a single time? And isn't that impossible?

There are two objections here. The first is linguistic: ordinary English sentences like 'Tibbles is in only one place at a time' should be true, and my proposal makes them false. To make it stick, this objection must be supplemented; my proposal about the metaphysics of objects must be connected with the semantics of ordinary locational discourse. Two such semantic analyses are available, one of which defuses the objection.

Let LOC be the property such that:

- For any region r and time t: r has LOC at t iff Tibbles' path passes through r at t.

Since Tibbles' path passes through many regions whenever he is multiply constituted, many regions have LOC at each such time. Let $\text{LOC}_1, \text{LOC}_2, \ldots$ be the properties obtainable by restricting the extension of LOC to a single region at each time. Regimenting English locational discourse using the two-place predicate 'x occupies r', the two rival semantic analyses of the one-place predicate 'Tibbles occupies r' are:

A1 At each time t, 'Tibbles occupies r' is coextensive with LOC.

A2 At each time t, 'Tibbles occupies r' is coextensive with LOC_n.

'Tibbles occupies no more than one region at a time' is false on **A1** and true on **A2**. The objection therefore succeeds if **A1** is true, and fails if **A2** is true. So, which view is correct?

On the one hand, LOC is more natural than any LOC_i.[41] Insofar as assignments of natural semantic values provide better candidate interpretations than assignments of less natural values, **A1** is favourable to **A2**. On the other hand, **A1** makes many English sentences untrue that **A2** makes true. General principles like 'Nothing occupies more than one place at a time' provide one type of example. Another involves definite descriptions of locations: **A1** but not **A2** makes 'the place where Tibbles is sitting' improper, and hence any sentence featuring it untrue. Insofar

[41] Natural in the sense of (Lewis, 1983).

as assignments that make true more sentences that ordinary speakers by-and-large hold true provide better candidate interpretations than assignments that make true fewer such sentences, **A2** is favourable to **A1**.

These conflicting metasemantic pressures must be reconciled. We cannot settle this without more detail about meaning-determination. It does, however, seem reasonable to weight truth-maximisation over naturalness here, and hence to favour **A2** over **A1**; in which case, the linguistic objection fails.

One might object to **A2** that selection of some $\textsc{loc}_i$ over any other $\textsc{loc}_j$ as the semantic value of 'Tibbles occupies r' would be arbitrary and unmotivated. This can be resisted in (at least) two ways. Firstly, the function from use to meaning is unknown, and possibly unknowable because we lack independent means to calibrate a method of testing hypotheses about it.[42] So it would be arbitrary and unmotivated to endorse an instantiation of **A2**. But it does not follow that instantiations of **A2** are arbitrary and unmotivated in any deeper sense incompatible with their truth, as opposed to their assertability or knowability. Secondly, we might accept that many different assignments of semantic value to 'occupies' fit our meaning-determining linguistic behaviour equally well, one such assignment for each $\textsc{loc}_i$. The result will plausibly be indeterminacy in location-ascriptions; it will be indeterminate which instantiation of **A2** is true.[43] Given **A2**, my proposal therefore explains indeterminacy in ordinary locational discourse.

The second version of this multiple-location objection is metaphysical: the *location* relation should hold between Tibbles and only one region at a time, whereas Tibbles' path passes through many regions at a time. The response to the linguistic objection weakens this metaphysical objection by accommodating the linguistic evidence for it. My proposal does, however, require some re-conceptualisation of our intuitive picture of how objects are in space. Path-occupancy provides the primary sense in which objects are in space. Tibbles' path passes through many regions whenever **PM** arises. So my proposal delivers a strong sense in which Tibbles is multiply located whenever **PM** arises. The many regions in which Tibbles is located are, however, nearly coincident and differ by less than the contextually salient threshold for relevance to our ordinary practical and linguistic interests. That is why **Abundance** is not an unremarkable commonplace, but the source of a surprising puzzle. So this re-conceptualisation is consistent with our ordinary experience of objects and their locations, the primary data of metaphysics.

5.2 What is R_C?

This section considers the following objection: I have not said enough about R_C to imbue my proposal with content. The objection might be strengthened by claiming that I cannot say anything detailed, informative and true about R_C, and hence that I cannot make my proposal substantive.

[42] (Williamson, 1994, pp205–9).

[43] The logico-semantic upshot of this indeterminacy is a further issue I remain silent about here.

The objection fails. §4.3 showed that the explanatory primacy of paths and characteristic changes has non-trivial consequences. Furthermore, (C=) and **Path-Con** together impose non-trivial structural constraints on the paths and constitution of cats. But this is not purely structural content; for R_C codifies the characteristic changes of cats. That is, R_C holds from r at t to r' at t' iff the characteristic changes of cats are as they would have to be in order for a cat in r at t to be in r' at t'. My proposal therefore has non-trivial structural and non-structural content.

The objection might be nuanced in response. The nuanced complaint is not that my proposal lacks content, but that since I have given no specific details about R_C and the characteristic changes of cats, my proposal is overly unspecific and indefinite. This nuanced objection comes in two varieties.

The first variety requires a finite non-trivial explicit definition of R_C. But there is no reason to expect, and I have said nothing to suggest, that the vocabulary of English or any other natural language will be rich enough to provide this. This expressive deficit is no threat to regarding the bearing of R_C as a substantive and well-understood matter. This can be strengthened by invoking the fact that the cats form a natural kind. On broadly externalist views about the semantics of natural kind-terms, this undermines one key (and perhaps the only) motivation for believing an informative explicit definition of R_C to be possible; for on such views, no explicit definition is needed to fix an extension for 'cat'.[44] One might respond by denying that the cats form a natural kind. What motivates this response? Presumably, it's the absence of cats from fundamental physics. But that motivation is suspect: why should all natural kinds, or even all fundamental/basic kinds, appear within (or be definable in the language of) physics? We can (and in my view should) reject this impoverished form of physicalism and allow that the cats form a natural kind. Note also that rejecting this narrow physicalism does not bring commitment to immaterial substances: concreteness does not imply definability in the language of physics.

This externalist strategy will not extend to objects of non-natural kinds, such as artefact kinds. But I invoked externalism only as one way of motivating the claim that we have no right to expect an informative explicit definition of R_C. That claim does not require externalism, and other motivations for it may also cover non-natural kinds. One strategy begins by noting that our grasp of R_C is a largely practical matter, manifested in, e.g., our capacity to track cats through a diverse range of circumstances.[45] An argument from our grasping R_C to the possibility of our explicitly defining it therefore involves assimilating this practical capacity (knowledge-how) to propositional knowledge-that. This intellectualist view is highly controversial.[46] But without it, our grasping R_C is neutral regarding the possibility of our informatively explicitly defining R_C. Absent an alternative reason to believe that

[44] (Wiggins, 2001, pp7–12, 77–86)

[45] Here is a third theme of (Wiggins, 2001, pp2, 3, 7, 18–20 and elsewhere). See notes 27, 29.

[46] (Stanley & Williamson, 2001) defend this approach to knowledge-how; for discussion, see (Koethe, 2002), (Rumfitt, 2003), (Devitt, 2011).

such a definition is possible, this first version of the nuanced objection is unmotivated. I do not know what such a reason might be.

The second version of the nuanced objection does not require an explicit definition of R_C. Only some general guidance about the characteristic changes of cats is required. This is readily provided, e.g.: cats survive through walking, pouncing, eating, sleeping and purring; they do not survive through squashing, burning, starvation and drowning. There is no threat here to regarding my gloss on R_C as substantive. So this objection also fails.

5.3 A Problem of the Many Paths?

Does **PM** recur at the level of cat-paths? This section argues that it does not.

One type of reason to think that **PM** recurs at the level of paths invokes higher-order vagueness, the putative phenomenon of borderline cases to the borderline cases. I will, however, set higher-order vagueness aside and assume a well-defined and determinate range of candidates to constitute Tibbles. There are two reasons for this. Firstly, although §3 justified **Abundance** by appealing to indeterminacy in Tibbles' boundaries, it is controversial whether this is the only such justification, and Unger himself denies that it is.[47] It is an open question whether **PM** ultimately involves vagueness, or whether vagueness-specific phenomena like higher-order indeterminacy, should be treated separately. Secondly, the existence and coherence of higher-order vagueness are both controversial.[48] Even setting worries about its coherence to one side, it is controversial whether higher-order vagueness can do the work of explaining seamless transition that motivates introducing it.[49] So even if higher-order vagueness is relevant to my discussion, serious work is required before it can bear argumentative weight here. Let us therefore consider a different reason for thinking that a version of **PM** afflicts cat-paths.

Tibbles' path p_{T} passes through both r^+ and r^- at t_{now}. Let p be the path that differs from p_{T} only by not passing through r^+ at t_{now}. The similarity between the T^+s and the T^-s that generates **PM** might also seem to suggest that p is a cat-path, given that p_{T} is. Since each cat-path is occupied by exactly one cat, it would follow that two cats are on Tibbles' mat, and hence that my proposal does not solve **PM**, but merely relocates it. This section responds to this objection.

Luckily for me, p is not a cat-path. Cat-paths are the values of f_K. Because f_K satisfies (C=), cat-paths that pass through the same region at some time pass through exactly the same regions at all times; in which case, "they" are not two cat-paths, but one. Now, p and p_{T} both pass through r^- at t_{now}. But only p_{T} passes through r^+ at t_{now}. Since p_{T} is a cat-path—as was argued in §4.3—it follows that p is not a cat-path. So the objection fails. The structural conditions my proposal imposes on cat-paths preclude the possibility of overlapping cat-paths on Tibbles' mat.

[47] (Unger, 2006a, pp369–70, 394–96, 468–69)
[48] An excellent recent discussion is (Wright, 2010)
[49] (Graff-Fara, 2003)

A variant problem arises. p is a path, and very similar to p_{T}. Since p_{T} is a K-path for some kind K of object—i.e. *cat*—doesn't it follow that p is too, though for some other kind K'? Members of K' will be very similar to cats. Call them 'schmats'. Cats and schmats are so alike that motivations for **Solitude** should carry over to:

Schmolitude Tibbles is the one and only cat-or-schmat on his mat.

If schmats exist, then **PM** has only been relocated.

This variant problem is importantly different from the original one. This new problem concerns an abundance of hitherto unrecognised kinds of object, whereas **PM** concerns only an abundance of cats. **PM** arises because the T^+s and the T^-s are so similar that they are equally good candidates to constitute cats. Do these same similarities also make them equally good candidates to satisfy 'the xs constitute an object of some kind' when the two corresponding existential claims must be witnessed by different kinds? Not obviously. Factors relevant to the existence of kinds may differ from those relevant to the existence of cats; indeed, they probably will. Belief in the existence of Ks should align with the utility of Ks in systematising, explaining, and predicting the behaviour of external reality. Cats are undeniably important to this project; schmats are not. No systematic, explanatory or predictive utility comes from admitting a kind of object whose characteristic changes distinguish between the T^+s and the T^-s, but are otherwise just like those of a cat. The similarity between the T^+s and the T^-s that generates **PM** thus militates against regarding schmats as contributing to this theoretical project. **PM** therefore does not recur at the level of paths.

5.4 Inherited properties

Objects inherit many properties from their constituent particles. Intuitively, Tibbles has his particular mass and shape because he is constituted by some particles that (collectively) have that mass and shape. I will focus on mass as a representative example. There is a *prima façie* problem here for my proposal. Since the T^+s and the T^-s have different (collective) masses, it seems to follow from **MC** that Tibbles has different and incompatible masses, which is impossible. This section responds by outlining a suitable account of property-inheritance. This account also answers the following sceptical question: what is so special about Tibbles' path, in virtue of which it deserves that title? Wouldn't any permutation of cats across paths be equally acceptable? The answer is that Tibbles' path is uniquely privileged in determining what is true of him when.

5.4.1 Four kinds of property

This section narrows the scope of my account of inheritance. Four types of properties of objects will be distinguished on the basis of their inheritance from particles. Three will be excluded from my account. I do not claim that the four are exhaus-

tive, or that there are only three exemptions. But they are some of the more obvious cases.

The first type of property are like mass-properties and shape-properties: Tibbles has a mass and shape because he is constituted by some particles with that very mass and shape. This is the simplest case, of what we might call *direct inheritance*.

The second type of property are not inherited. Modal and historical properties provide examples. Tibbles does not inherit his characteristic changes or properties like *being possibly squashed* and *having once been scattered* from his constituent particles. Such "hypothetical" properties that "look outside their instances" are hereby excluded from my discussion, so that it concerns only "categorical" properties.[50]

The third type of property correspond to large-scale properties of Tibbles' constituent particles. Examples include *purring* and *being hungry*. Other candidates involve functional, teleological, aesthetic, representational and semantic properties.[51] Some (though maybe not all) of these properties are systematically connected in a law-like manner to properties of particles, though they are not possessed by particles themselves. These systematic connections create logical space for an analogue of the initial problem about mass. However, the problem does not arise because the connections are with large-scale properties of particles: the comparatively small-scale differences between Tibbles' candidate constituters cannot correspond to differences in whether he is, say, hungry or purring. Like the second type of property, I exclude such properties from the coming discussion.

The fourth type of property, like the third, is not directly inherited from Tibbles' constituent particles; they are, however, systematically connected to properties of particles in such a way that analogues of the initial problem about mass can arise. Examples may include colour-properties: although cats can be ginger, one might doubt whether their constituent particles can be (collectively) ginger. Suppose Tibbles' borderline hair h is his only non-ginger hair. Then whether Tibbles is ginger turns on whether the T^+s or the T^-s constitute him. On my proposal, both collections constitute him. It seems to follow that he is both wholly ginger and partly non-ginger, which is impossible. The simplest strategy is to provide a separate account of this indirect inheritance to parallel the account of direct inheritance below, though I cannot go into detail here.

5.4.2 Four options

Consider these inheritance principles:[52]

Naïve Tibbles has ϕ iff the particles that constitute him have ϕ.

[50] It is doubtful whether categorical properties exist. Even paradigmatic cases concern an object's behaviour across a range of counterfactual circumstances, and should therefore count as hypothetical. What matters for my purposes is only the exclusion of certain clearly non-inherited properties, rather than the metaphysical gloss by which it is effected.

[51] (Fine, 2003)

[52] Alternatives are possible, though these are the most obvious and promising candidates.

Supervaluation Tibbles has ϕ iff every collection of particles that constitute him has ϕ.

Subvaluation Tibbles has ϕ iff some particles that constitute him have ϕ.

Relativisation Tibbles has ϕ relative to the xs iff the xs both constitute him and have ϕ.

This section defends **Relativisation**.

On my proposal, 'the particles that constitute Tibbles' is improper and instantiations of **Naïve** therefore untrue. An alternative is needed.

The T^+s and the T^-s have different masses. So **Supervaluation** implies that Tibbles does not have any particular mass. This makes it unclear in what sense Tibbles is really a material object. One might respond by applying **Supervaluation** to determinable properties alongside their determinates: since the T^+s and the T^-s are massive, Tibbles is also massive, despite lacking any particular mass. Three problems arise. Firstly, it is doubtful whether we should believe in both determinates and determinables; for what theoretical work is there for determinables that their determinates cannot do? Secondly, this damages our ordinary conception of the determinate/determinable contrast: what is having a determinable, if not having one of its determinates? Thirdly, this does not address the initial problem: the sense in which Tibbles is a material object remains obscure, given that he has no determinate mass-property. We should reject **Supervaluation**.

Subvaluation implies that Tibbles has the mass of the T^+s and also the mass of the T^-s, and hence that he has incompatible masses. Since these are distinct determinates of the same determinable, this undermines our ordinary understanding of both the determinate/determinable contrast and property-incompatibility. Since no alternative understanding is available, we should reject **Subvaluation**.

Relativisation modifies the logical form of Tibbles' possession of inherited properties, by relativising instantiation to collections of particles that constitute him. Note that instantiation is relativised, not the property instantiated; for that would lead to an unattractive dualism of dyadic object-masses and monadic particle-masses. Let m^+ and m^- be the masses of the T^+s and the T^-s respectively. **Relativisation** implies that Tibbles has m^+ relative to the T^+s and m^- relative to the T^-s. Since Tibbles does have m^+ (relative to the T^+s), this avoids the objection to **Supervaluation**. Since Tibbles does not have m^+ and m^- *simpliciter*, but only relative to the T^+s and T^-s respectively, this avoids the objection to **Subvaluation**. **Relativisation** is therefore preferable to these rivals.

How should we understand relativised instantiation? There are two options. According to the first, the right hand side of **Relativisation** analyses its left hand side: Tibbles' having ϕ relative to the xs is analysed as the xs constituting Tibbles and having ϕ. One might object that, like **Supervaluation**, this robs Tibbles of each determinate mass: Tibbles himself does not have a mass, but is merely related to some particles with that mass. Calling this relation 'constitution' does not help; for

what is so special about constitution, as opposed to any other relation, that warrants ascribing m^+ to Tibbles on the basis of his being constituted by the T^+s? This certainly does not settle the issue. One might regard this not as a problem, but as a robust metaphysical basis for the thought that objects change their mass by changing the mass of their constitutents. But let us consider an alternative account of relativised instantiation instead.

This alternative denies that 'o has ϕ relative to the xs' is analysed by 'the xs both constitute o and have ϕ'. Instead, relativised instantiation is included in the primitive ideology—expressive resources—of the theory of instantiation. On this view, relativised instantiation is a *sui generis* mode of fact-formation, one that takes an object, property and some particles to form a complex fact. **Relativisation** expresses a(n instance of a) law governing this mode of fact-formation. I now consider two objections to this suggestion.

The first objection is that, given **Relativisation**, Tibbles does not have any mass *simpliciter*, without relativisation. The objection infers from this that Tibbles does not really have any mass. What does 'really' mean here? If 'really' means *simpliciter*—i.e. without relativisation—then the objection merely expresses the view. Instead, the claim must be that there is no sense at all in which Tibbles instantiates mass-properties, if he has them only relative to his constituters. Now, **Relativisation** does imply a difference between the senses in which Tibbles has inherited and non-inherited properties. But is this difference objectionable? Does it follow that there is no sense in which Tibbles instantiates a mass? Lewis would have thought so. He complained that a similar proposal to time-index instantiation "alienates" objects from their properties.[53] This complaint was motivated by two thoughts:

(a) Instantiating a property is not analysable via the bearing of a relation—or any other "relation-like" entity—between property and bearer.

(b) Relativised instantiation is analysable via the bearing of a relation between property, bearer and index.[54]

It follows that instantiation (*simpliciter*) and relativised instantiation are fundamentally different kinds of phenomena. Furthermore, on this view relativised instantiation is analysable via instantiation *simpliciter* (in the guise of relational bearing). But why should we grant (a) and (b)? Although Lewis invoked versions of Bradley's regress and Russell's paradox to justify (a), he gave no explicit argument for (b). An argument can, however, be extracted from Lewis' reduction of instantiation to set membership: membership is not relative to times or collections of particles; so relativised instantiation is not a variety of membership; relativised instantiation must therefore be understood in some other way, and the bearing of a relation is the only obvious candidate. The upshot is that rejecting Lewis' identification of instantiation with membership allows us to reject (b).

[53] (Lewis, 2002, pp5–7)

[54] For Lewis, the relevant index was a time. For us, the index is a collection of particles that constitute the property's bearer.

Having rejected (b), and having admitted one mode of fact-formation not analysable via the bearing of relations—i.e. instantiation *simpliciter*—there is no bar to admitting another. According to (a), instantiation *simpliciter* takes an object and monadic property to form a fact, without mediation by a relation.[55] So why not also treat relativised instantiation as taking an object, monadic property and collection of particles to form a fact, without mediation by a relation? There remains a difference between the ways Tibbles has inherited and non-inherited properties. But to reject the proposal on that basis alone, without the backing of (b), is not to argue against it. Without an alternative argument for (b), there is no objection here to relativised instantiation of inherited properties.

The second objection begins with the difference in form between ordinary predications of inherited properties and the facts those predications report: ordinary predication is not explicitly relativised to constituters. Let F be a predicate ordinarily conceived as expressing an inherited property ϕ. What is F's semantic value? If objects weren't multiply constituted, F could express the property: *being an x that has ϕ relative to the particles that constitute x*. But multiple constitution creates problems: because 'the particles that constitute Tibbles' is improper, this proposal makes the predication 'F(Tibbles)' untrue. Since many attributions of inherited properties to Tibbles are true, a different approach is required.

A better suggestion mirrors **A2** from §5.1. Let f be a function that maps each object o to some particles that constitute o. Then F can express: *being an x that has ϕ relative to $f(x)$*. On this view, 'F(Tibbles)' is true iff Tibbles has ϕ relative to f(Tibbles). Since Tibbles is multiply constituted, many functions satisfy my initial description of f. Each delivers a different candidate semantic value for F. No candidate is more natural than any other, or privileged by the linguistic behaviour of ordinary speakers: they are equally good candidate values for F. Where many equally good candidate semantic values are available, vagueness arises. Borderline status is variation in truth-value under different assignments of these candidate values to the relevant expression(s).[56] So although **Relativisation** generates a mismatch between the surface form of ordinary predications and the facts they report, that mismatch also explains vagueness in ascriptions of inherited properties.

Note finally that **Relativisation** can be motivated from within my proposal, or at least accords with its general spirit. On my proposal, the coarse-grainedness of Tibbles' characteristic changes causes his path to branch through many near-coincident regions whenever **PM** arises. What happens within Tibbles' path determines his history. So if Tibbles' path branches, as my proposal says, so should his history. In particular, that aspect of his history concerning his inherited properties whose possession is determined wholly by the particles within a branch of Tibbles' path, should branch. **Relativisation** provides one way of implementing this, by relativising Tibbles' possession of inherited properties at a time to the particles then in a

[55] Analogously, no set theoretically represented relation mediates the set-member connection, on pain of inconsistency. (Lewis, 2002, p8)

[56] See also note 18.

branch of his path. **Relativisation** thus provides a natural partner for my proposal.

5.5 Ghostly objects

Ordinary objects are material objects; they are spatiotemporally located, causally efficacious, massive, and made out of matter. This last clause creates tension with my proposal. Not all paths are occupied by objects. Indeed, many paths never pass through any region with material content. A natural view is that, as a matter of metaphysical necessity, such paths are unoccupied: ordinary objects must be constituted by particles whenever they exist. The tension arises because the explanatory primacy of paths over constitution makes it unclear how I can ensure that paths without material content are not occupied by objects, other than by brute stipulation. Say that a kind of object is *ghostly* if members of that kind can sometimes (or always) be constituted by no particles. The objection is that I cannot explain the impossibility of ghostly kinds, other than via the unedifying method of brute stipulation. Two responses are available.

The first response accepts that my proposal cannot rule out ghostly kinds, but takes this as a virtue rather than a vice. Belief in *K*s should go with the utility of *K*s in systematising external reality.[57] Ghostly kinds may in principle play a useful, or even essential, role in this theoretical project. For example, admitting an appropriate ghostly kind of object may allow us to systematise a particular variety of disturbance in a field, even if those disturbances occur only in regions devoid of particles. If this turns out to be the case, then we should believe in that ghostly kind. Since this cannot be ruled out *a priori*, it is a virtue of my proposal that it can allow for ghostly kinds.

The second response is less concessive; it seeks to show that my proposal can disbar ghostly kinds. Although I have been using the cross-time relation R_K on regions to codify the characteristic changes of *K*s, this may not be the most ontologically perspicuous representation of characteristic changes. An alternative approach uses a cross-time relation S_K on collections of particles to codify the characteristic changes of *K*s: S_K holds from particles xx at time t to particles yy at time t'. This approach treats the characteristic changes of *K*s as primarily changes in their constituent particles. Let $r_{xx,t}$ be the region occupied by xx at t. Then S_K can be used to analyse R_K thus:

- For any regions r, r' and times t, t': $R_K(r, t, r', t')$ iff, for some xx, yy: (i) $r = r_{xx,t}$, (ii) $r' = r_{yy,t'}$, and (iii) $S_K(xx, t, yy, t')$.

The *K*-paths are delineated by R_K, f_K and (*K*=) as before. This modified approach to characteristic changes implies that, for any kind *K*, *K*-paths only ever pass through regions occupied by particles. Together with **Path-Con**—the principle relating paths to constitution proposed in §4.3—this rules out ghostly kinds. The present objection therefore fails.

[57] See §5.3.

This strategy can be extended to respond to another style of objection, which draws on one that Theodore Sider and Dean Zimmerman have raised against Lynne Rudder-Baker.[58] I shall consider a version of Sider's objection. Let r be a red object constituted by red particles pp; let b be a blue object constituted by blue particles qq. Initially, r and b are separated. Later, pp and qq become intermingled, and maybe even interpenetrate. This intermingling does not destroy r or b, which continue to be constituted by pp and qq respectively. Whilst intermingled, pp and qq have the same (collective) locations; so the paths of r and b then pass through just the same region. So **Path-Con** implies that r is then constituted by pp, by qq, and also by the plural union $pp \cup qq$ of all the particles, red and blue alike. But, Sider claims, r should continue to be constituted by only the red particles pp; for the blue particles qq do not become parts of r, even though r and b spatially coincide.

One could respond by rejecting Sider's claim. This case is sufficiently unlike ordinary cases of constitution that theory can be allowed to adjudicate. But even granting Sider's claim, **Path-Con** can be modified to avoid implying that qq or $pp \cup qq$ constitute r. The problem is that the right hand side of **Path-Con** is too permissive. In order for some particles to constitute an object o of kind K, it is not enough that those particles occupy a region through which o's path passes; they must do so for the right reason. The right reason involves the characteristic changes of Ks: o's path should pass through the particle's location *because* those particles stand in S_K, the relation that codifies the characteristic changes of Ks. Since r, b belong to different kinds, their characteristic changes are codified by different relations S_r, S_b.[59] That pp and qq have the same (collective) locations does not imply that they possess exactly the same properties or stand in exactly the same relations. So intermingling pp with qq does not imply that qq or $pp \cup qq$ bear S_r to anything. So this modification of **Path-Con** does not imply that r is constituted by qq, or that it is constituted by $pp \cup qq$. So this version of Sider's objection does not undermine my proposal.[60]

6 Mereology

Two kinds of relation should feature in an account of the relations between objects and particles. One is a relation with two singular argument positions, one for particles and one for objects. This is the relation that Tibbles bears to this particle in his tail, to that particle in his heart, to this other particle in his skin, and so on. The other relation has one plural argument position for a collection of particles and one singular argument position for an object. This is the relation between Tibbles and any collection of particles from which he is made. This section examines the relationship between these relations.

[58] (Zimmerman, 2002, pp603–606), (Sider, 2002, pp46–7), (Baker, 2000).

[59] If r, b belong to the same kind, then why deny that they are both constituted by $pp \cup qq$?

[60] A related worry concerns, e.g., neutrinos that pass through Tibbles' body without partially constituting him. This apparently commonplace occurrence is incompatible with the original version of **Path-Con**, but not with the modified version just described.

In §2, I took a plural-singular relation of constitution as basic and defined a singular-singular relation of partial constitution from it thus:

- x partially constitutes $y =_{\text{df}}$ x is one of some things that constitute y.

The goal was to enable us to focus on plural-singular constitution in as theoretically neutral a setting as possible. However, I also said that we shouldn't preclude the possibility of analysing this plural-singular relation via a singular-singular relation later. Standard presentations of mereology adopt that kind of approach.[61] Those presentations use a primitive singular-singular relation of parthood to define a plural-singular relation of fusion thus:.

- x overlaps $y =_{\text{df}}$ something is part of both x and y.
- The xs are fused by $y =_{\text{df}}$ (i) each of the xs is part of y, and (ii) every part of y overlaps at least one of the xs.

Three kinds of view are about the interaction between these two pairs of relations are possible. The first takes parthood as primitive, using it to analyse constitution and partial constitution. The second takes constitution as primitive, using it to analyse parthood and fusion. The third takes both parthood and constitution as primitive. My proposal requires the second approach.

6.1 Parthood as primitive

This section argues that my solution to **PM** is incompatible with the first approach, on which constitution is analysed as fusion. The incompatibility arises from this consequence of that approach:

Necessity of Fusion for Constitution (NFC) For any particles xx and object o: if xx constitute o, then o fuses xx.

Suppose my solution to **PM** is correct, so that (i) the T^+s constitute Tibbles, and (ii) the T^-s constitute Tibbles. By (i) and **NFC**: Tibbles fuses the T^+s. So by the definition of fusion: each of the T^+s is part of Tibbles. Since the T^+s include the particles that constitute Tibbles' borderline hair h, we have: (iii) the particles that constitute h are all parts of Tibbles. But by (ii) and **NFC**: Tibbles fuses the T^-s. So by the definition of fusion: each part of Tibbles overlaps at least one of the T^-s. Since none of the T^-s overlaps any of the particles that constitute h: none of the particles that constitute h is part of Tibbles. But that's inconsistent with (iii). So my solution to **PM** is incompatible with **NFC** and hence also with any mereological analysis of constitution that implies it.

The argument for the incompatibility between my proposal and **NFC** requires very little mereological structure. It does not require that fusion is unique or unrestricted, or even that parthood is transitive. And although parthood was not

[61] The canonical discussion of mereology is Simons (1987).

modally or temporally relativised in the argument, a variant could be run with those relativisations in place. My proposal's incompatibility with **NFC** is therefore independent of any particular theory of mereology; it arises from the mereological relations amongst the candidates to constitute Tibbles together with the formal structure of fusion itself.

What this shows is that the definition of fusion incorporates significant structure: approaching the object-particle relationship from a mereological perspective, with singular-singular parthood as sole primitive particle-object relation and hence fusion as sole plural-singular such relation, brings substantive commitments.[62] **MC** is not amongst the possibilities open to one who takes that approach. Standard mereology therefore does not provide a theoretically neutral setting for systematising the relationships between reality's various organisational levels. §3 claimed that a metaphysical myopia afflicting much contemporary thought about objects and constitution is responsible for **MC**'s near-absence from the literature on **PM**. This myopia can now be diagnosed: (tacit) adherence to the order of analytic priority between the singular-singular and plural-singular exemplified by standard mereology. With that order of priority in place, **MC** is a non-starter.

I envisage two kinds of response to these claims. The first modifies the definition of fusion to restore compatibility with **NFC**. This requires a relation R with the following features: (i) R is a plural-singular relation definable from parthood and logical vocabulary; (ii) interpreting 'fusion' as R makes **NFC** compatible with my proposal. Many relations have these features, though none is what 'fusion' normally means. This reinterpretation of **NFC** therefore does no better at making it compatible with my proposal than reinterpreting 'not' as synonymous with 'necessarily' makes 3 both odd and not odd. Moreover, it is unclear how the definition of fusion might be modified in accordance with (i) and (ii) whilst retaining a claim to capture anything like our ordinary notion of being made out of.

The second response denies that the incompatibility between my proposal and **NFC** is independent of mereological setting. In response to **PM**, Hud Hudson has suggested relativising parthood to regions.[63] The definition of fusion is then modified accordingly:

- x overlaps y at $r =_{\text{df}}$ something is part of both x and y at r.
- The xs are fused by y at $r =_{\text{df}}$ (i) each of the xs is part of y at r, and (ii) every part of y at r overlaps at least one of the xs at r.

On Hudson's view, Tibbles fuses the T^+s at r^+ and the T^-s at r^-. Given the following account of constitution it follows that Tibbles fuses both the T^+s and the T^-s, as my proposal claims:

- For any particles xx and object o: xx constitute o iff o fuses xx at some region.

[62] Fusion is not the only plural-singular relation definable within mereology. But it is, as far as I can see, the only plausible such relation with which to analyse constitution.

[63] (Hudson, 2001, chs1, 2)

So Hudson's relativisation of parthood to regions allows for an analysis of constitution via fusion that's compatible with my solution to **PM**. Moreover, **NFC** comes out true on this approach.

This line of argument is broadly correct. Hudson's relativisation of parthood to regions permits a mereological analysis of constitution that's compatible with my proposal. Indeed, Hudson's solution to **PM** proposal has much in common with my owm. Both can be seen as implementations of the same basic idea: the same cat is made out of each candidate collection of particles. Hudson's implementation adds an argument position to the fundamental cat-particle relation, in order to preserve the standard mereological analysis of the plural-singular relation using a singular-singular one. This does provide a way to make my proposal compatible with **NFC**. But does this strategy provide a good response to the argument for my proposal's incompatibility with **NFC**? That depends on whether the strategy is well-motivated. And that will be so only if one of the following is true. (a) There is independent reason to defend the standard mereological order of analytic priority. (b) There is independent reason to relativise parthood to regions. I know of no argument for (a) and this is not the place to explore (b). So let us tentatively set Hudson's proposal aside, and accept my proposal's incompatibility with **NFC**, and hence also with mereological analyses of constitution.

6.2 Constitution as primitive

Two kinds of view remain. One treats both parthood and constitution as primitive. Two points tell against this approach. Firstly, fewer primitives are *ceteris paribus* preferable to more; we should take both relations as primitive only if no alternatives remain. Secondly, if parthood and constitution are equifundamental, their extensions should be modally independent, which they surely are not. Although neither point is decisive, they motivate exploring the alternative.

The remaining view takes plural-singular constitution as sole primitive object-particle relation.[64] Singular-singular parthood is analysed thus:

- For any particle x and object o: x is part of o iff x is amongst some zs that constitute o.

On this view, parthood is partial constitution. It follows that Tibbles fuses the plural union of the collections of particles that constitute him.[65] So Tibbles fuses the T^+s and no other particles. The fact that Tibbles is multiply constituted thus combines with this analysis of parthood to uniquely privilege the T^+s in respect of Tibbles' fusing them.

This resolves an alternative version of **PM**. Rather than asking which particles constitute Tibbles, we could have asked which particles he fuses. A variant problem results from replacing constitution with fusion in **Equality**, **Abundance**, **Solitude**

[64] (Fine, 2010) defends this kind of view, though he doesn't consider multiple constitution.

[65] For any x: x is amongst the plural union of the collections that ϕ iff x is amongst some yy that ϕ.

and **UC**. The solution is that this variant on **Abundance** is false: there aren't many equally good candidates to be fused by a cat because my solution to the original, constitutional version of **PM** combines with my analysis of parthood to uniquely privilege the T^+s. However, a problem now arises: why not employ a similar response to the constitutional version of **PM**? Why not claim that Tibbles is constituted only by the union of all the candidate collections?

The answer is that fusion is a defined technical notion, whereas constitution is not. Both are plural-singular relations between particles and objects. But fusion is defined using singular-singular parthood. Constitution, however, is just the ordinary notion of being made out of; it cannot be assumed without argument that it, like fusion, is definable from any singular-singular relation. The motivation for **Abundance** is that many collections of particles are so similar that they seem to be equally good candidates for having a cat made out of them. This motivation must either be accommodated or explained away. One way to accommodate it is by having many equally good candidates to be fused by a cat. But this is not the only way. My proposal accommodates the motivation for **Abundance** by having two plural-singular relations—primitive constitution and derivative fusion—and many equally good candidates to be constituted by a cat. On this view, simply to claim that only the union of these candidates constitutes a cat is to reject the motivation for **Abundance** without explaining it away. Since fusion is not used to accommodate that motivation, we can reject the fusion-variant of **Abundance** without incurring a commitment to explain anything away. Since my analysis of parthood and solution to the constitutional version of **PM** imply that the fusion-variant of **Abundance** is false, we have good theoretical reasons to reject that principle.

On this view, fusion comes apart from being made out of in at least two ways:

- Objects can fuse particles from which they are not constituted. Suppose particles xx and yy are the candidates to constitute an object o. Then on my proposal, xx and yy both constitute o. But nothing guarantees that their plural union $xx \cup yy$ are also candidates to constitute o. So nothing guarantees that $xx \cup yy$ constitute o. Given my account of parthood, however, o does fuse $xx \cup yy$; for they include exactly the particles that partially constitute o.

- Objects can be constituted by particles they do not fuse. Tibbles, for example, is constituted by but does not fuse the T^-s.

The lesson is that a description of the object-particle relationship in terms of fusion alone omits important structure. The primary plural-singular relation of constitution is connected to fusion by a definitional chain that goes via singular-singular partial constitution/parthood. Information is lost by proceeding along the chain. As a result, we cannot capture using only fusion the sense in which the T^+s and the T^-s are evenly matched in their relationship to Tibbles. Capturing that fact requires the structure of multiple constitution that focusing on fusion omits.

7 Conclusion

The presentation and defence of my proposal are now complete. **PM** is resolved by allowing ordinary objects to be multiply constituted by many different collections of particles at a time (§3). Because this solution follows from my conception of objects (§4), the result is a unified theoretical package. The package depart from more orthodox conceptions of objects in at least two ways. Firstly, objects are not fundamentally complexes of particles, but things that survive through certain sorts of change. Secondly, the fundamental relation between particles and objects is not parthood, but a plural-singular constitution relation in terms of which parthood and fusion are analysed. Even if these proposals are ultimately unsuccessful, however, I hope to have shown that the prospects for an ontology that de-emphasises constitution and mereology are better than one might otherwise have thought.

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