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The Problem of Material Constitution

Michael C. Rea

There are various puzzles that set our intuitions about composition and identity against one another. Four that are particularly well known are the Growing Argument (also known as the Paradox of Increase), the Ship of Theseus Puzzle, the Body-minus Argument (usually presented by way of Peter Geach's story about Tibbles the cat), and Allan Gibbard's puzzle about Lump1 and Goliath (a piece of clay and a statue, respectively). Such puzzles have received a great deal of attention in the literature over the past thirty years, and there is an impressive and growing variety of solutions available for each of them. Surprisingly, however, no one has really discussed how all of the different puzzles, and their solutions, are interrelated. On the surface, they seem to raise different problems; but clearly the puzzles *are* related somehow. They raise similar questions and generate similar sets of possible solutions. But, as yet, nothing has been said about how far the similarities extend.

What I intend to show is that there is *one* problem underlying these four familiar puzzles (and their many variants). This problem I will call "the problem of material constitution." I say it *underlies* the four puzzles for the following reason: every solution to the problem of material constitution is equally a solution to each of these four puzzles, though not vice versa. One might therefore view each of the four puzzles as a more or less imperfect statement of the problem of material constitution. I have chosen these puzzles in particular because they are the most widely discussed¹ and because they are typically treated in isolation from one another. They have been used as points of departure in discussing a variety of different topics (for example, contingent identity, arbitrary undetached parts, temporal parts, indeterminate identity, mereological essentialism, and so on); but it is not always obvious how or whether these different discussions are related to one another. Thus my aim in showing that one problem underlies these puzzles is to reveal the common thread that unifies this group of otherwise ap-

¹Though the Growing Argument is not nearly as widely discussed as the other three.

parently disparate discussions. Moreover, once it is clear what the common problem is, it will be possible to provide an exhaustive taxonomy of solutions—something which thus far has not been available.²

In what follows, I will show that there are five individually plausible and jointly incompatible assumptions underlying each of the puzzles under consideration. The problem of material constitution just is the fact that these five assumptions are both plausible and incompatible.³ I will begin by providing a very general statement of the problem. I will present the five assumptions and provide a short argument showing how they conflict with one another. Then, in subsequent sections, I will go on to show how these assumptions underlie each of the four puzzles. I will conclude by providing an exhaustive taxonomy of possible solutions to the problem.

1. The Problem Stated

First, some terminology. Following Peter van Inwagen, let us take ‘the *ps*’ as a plural variable—a term of collective reference that refers neither to the *set* containing the *ps*, nor to any *object* whose parts are the *ps*. (For example, ‘the present citizens of the United States’ refers collectively to everyone who is presently a citizen of the United States; it does not refer to the set that contains all of the present citizens of the United States, nor does it refer to the scattered object, if such there be, that is composed of them.) ‘The *ps*’, in the expression ‘the *ps* compose *x*’, will thus refer collectively to all of the *ps*, *whatever they are*, that together compose the object *x*; and let us say that ‘the *ps* compose *x*’ is an abbreviation for ‘the *ps* are all parts of *x* and no two of the *ps* overlap and every part of *x* overlaps at least one of the *ps*’.⁴ Further, let us say that if the *ps*

²Of course, there are many *lists* of possible solutions for particular puzzles available. (See, for example, Burke 1994a; Doepke 1982; Heller 1990, 3–4; and Simons 1987, 119–120.) But no one has provided the kind of exhaustive *taxonomy* of solutions to the problem of material constitution that I will offer at the end of this paper. On the distinction between a list and a taxonomy, see note 32.

³All four puzzles raise the problem within the context of an ontology of three-dimensional enduring objects; but only the fourth raises the problem within the context of an ontology of four-dimensional perduring objects. I defer detailed discussion of this point to the end of section 4.

⁴See van Inwagen 1990, 23ff. It will be convenient to think of the relevant *ps* in the puzzles discussed in this paper as particles (the one exception

compose x and the ps compose y , then x constitutes y .⁵ Finally, in the following assumptions let F be a schematic letter that takes as substitution instances nouns such as ‘human being’, ‘ship’, ‘cat’, ‘statue’, and so on, and let R be a schematic letter that takes as substitution instances relations such as ‘is at all times composed by’, ‘is at all times composed by some proportion of’, and so on.

Now for the problem. Intuitively, the problem of material constitution arises whenever it appears that an object a and an object b constitute one another and yet are essentially related to their parts in different ways. The puzzles under consideration in this paper are all stories in which something like this is the case; and they are troubling because it seems we can account for the relevant appearance only by somehow denying that it is veridical or by sacrificing some intuition about composition or identity—for example, by giving up our natural assumption that distinct objects cannot share all of the same parts at the same time, or that identity is necessary.

At the core of each of the puzzles are five assumptions. Informally, they are: (i) there is an F and there are ps that compose it, (ii) if the ps compose an F , then they compose an object that is essentially such that it bears a certain relation R to its parts, (iii) if the ps compose an F , then they compose an object that can exist and *not* bear R to its parts, (iv) if the ps compose both a and b , then a is identical with b , and (v) if a is identical with b then a is necessarily identical with b . Let us call these assumptions, respectively, the Existence Assumption, the Essentialist Assumption, (with apologies to Frankfurt) the Principle of Alternative Compositional Possibilities (or PACP for short), the Identity Assumption, and the Necessity Assumption. We can state them more formally as follows:

Existence Assm.:

$(\exists x)(\exists ps)(\exists t)(x \text{ is an } F \ \& \ \text{the } ps \text{ compose } x \text{ at } t)$

Essentialist Assm.:

$(\forall x)(\forall ps)(\forall t)[x \text{ is an } F \ \& \ \text{the } ps \text{ compose } x \text{ at } t \supset (\exists z_1)(\text{the } ps \text{ compose } z_1 \text{ at } t \ \& \ \Box(\forall qs)(\forall t)(\text{the } qs \text{ compose } z_1 \text{ at } t \supset z_1 \text{ bears } R \text{ to the } qs))]$

being the Ship of Theseus puzzle, where for purely heuristic reasons it is more convenient to think of the relevant ps as planks of wood).

⁵Note that constitution, as I define it, is a symmetric relation. This is nonstandard, but it is convenient in the present context and I see no compelling reason for understanding constitution as antisymmetric.

PACP:

$(\forall x)(\forall ps)(\forall t)[x \text{ is an } F \text{ \& the } ps \text{ compose } x \text{ at } t \supset (\exists z_2)(\text{the } ps \text{ compose } z_2 \text{ at } t \ \& \ \diamond(\exists qs)(\exists t)(\text{the } qs \text{ compose } z_2 \text{ at } t \text{ and } z_2 \text{ does not bear } R \text{ to the } qs))]$

Identity Assm.:

$(\forall x)(\forall y)(\forall ps)(\forall t)(\text{the } ps \text{ compose } x \text{ at } t \ \& \ \text{the } ps \text{ compose } y \text{ at } t \supset x = y)^6$

Necessity Assm.:

$(\forall x)(\forall y)[x = y \supset \Box((x \text{ exists} \vee y \text{ exists}) \supset x = y)]$

As I said earlier, the problem of material constitution just is the fact that these five assumptions are both individually plausible and jointly incompatible. The following argument shows that they are incompatible with one another:

- (1) S is an F and the *ps* compose S at *t*. (Instantiation of Existence Assm.)
 - (2) There is a *z*₁ such that the *ps* compose *z*₁ at *t* and, necessarily, for all *qs* and *t*, the *qs* compose *z*₁ at *t* only if *z*₁ bears R to the *qs*. (From 1, Essentialist Assm.)
 - (3) There is a *z*₂ such that the *ps* compose *z*₂ at *t* and, possibly, there are *qs* and *t* such that the *qs* compose *z*₂ at *t* and *z*₂ does not bear R to the *qs*. (From 1, PACP)
 - (4) The *ps* compose *Z*₁ at *t* and, necessarily, for all *qs* and *t*, the *qs* compose *Z*₁ at *t* only if *Z*₁ bears R to the *qs*. (Instantiation of 2)
 - (5) The *ps* compose *Z*₂ at *t* and, possibly, there are *qs* and *t* such that the *qs* compose *Z*₂ at *t* and *Z*₂ does not bear R to the *qs*. (Instantiation of 3)
 - (6) *Z*₁ = *Z*₂ (From Identity Assm., 4, 5)
 - (7) Possibly, *Z*₁ exists or *Z*₂ exists and *Z*₁ ≠ *Z*₂. (From 4, 5)
 - (8) *Z*₁ ≠ *Z*₂. (From 7, Necessity Assm.)
- ** Contradiction (6, 8)

I have now stated the problem of material constitution in its most general form, and I have claimed that the above five assumptions underlie each of the four puzzles under consideration. In the following four sections, I will justify this claim.

⁶This thesis is alternatively referred to as “mereological extensionality” (see Simons 1987, 28) and it is commonly expressed by the claim “constitution is identity.”

2. The Growing Argument

The Growing Argument has its origin in the fifth century B.C. in the writings of the comic playwright Epicharmus. The scene in which it appears depicts a person who, hoping to collect a debt from a friend, receives instead a philosophical argument. The upshot of the debtor's argument is that since a person is identical with the aggregate of particles that constitutes him or her, any addition of particles will result in a new person (since it will result in a new aggregate); but, of course, he (the debtor) has undergone many such additions since the debt was contracted, so he cannot now be considered the *same* person as the one who contracted the debt. Consequently, he does not owe any money.⁷ Slightly different versions of this argument have been discussed by many philosophers throughout history.⁸ The basic line of reasoning, however, is just this: Just as adding to a given quantity of objects yields a new quantity, adding parts to a human being yields a new human being; hence, growth is impossible. Let us now identify the assumptions of the Growing Argument.

In order to even get started, the argument must make an Existence Assumption: it must assume that there are such things as human beings and things that compose human beings. (Above, it is particles that are said to compose human beings; but, of course, the paradox arises no matter what we take the *ps* to be.)

The argument also makes an Essentialist Assumption. As I have presented the argument, it assumes that where there is a human being composed of particles, there is an aggregate of particles (an

⁷My summary is based on David Sedley's reconstruction of the scene in question (1982, 255-75; see 271 n. 1 for the list of sources on which his reconstruction is based). I am grateful to Brad Inwood for drawing my attention to this article.

⁸For instance: Aristotle (*De Generatione et Corruptione*, 321a), the Academics and the Stoics (Long and Sedley 1987, 166-75), Abelard (Henry 1972, 118ff.), John Locke (1975, 328ff.), G. W. Leibniz (1981, 237-38), David Hume (1978, 255ff.), Thomas Hobbes (1839, 135-38), and more recently Roderick Chisholm (1976, 157-58). According to Sedley (1982), the first systematic treatment of this argument came in the writings of the Stoics as they sought to combat various paradoxes raised by the Academics. It was in the course of these discussions that the Ship of Theseus paradox and the Body-minus Argument were introduced. For more on the history of this argument in ancient philosophy, I strongly recommend Sedley 1982 and Long and Sedley 1987.

object such that, necessarily, it exists and has its constituent particles as parts just in case those particles exist) that constitutes him or her. This entails (though it is not entailed by) the claim that there is an object composed of those particles that cannot gain or lose material parts—in other words, there is an object such that, necessarily, for all qs and t , the qs compose z at t only if z bears R_1 to the qs , where R_1 is defined as follows:

z bears R_1 to the $qs =_{DF}$ there is no time t such that z exists and the qs do not compose z at t .

And since this latter claim is all that is required to show that growth is paradoxical, we can, for convenience, let R_1 stand as our substitution instance for R .

It is worth pointing out here that no particular definition of R is crucial to the problem of material constitution; any definition will do so long as one can tell a plausible story that makes it seem that there are (or can be) objects a and b that constitute one another, one of which essentially bears R to its parts while the other doesn't. In the context of the Growing Argument, we assume that one of the objects in question is an aggregate because that is the easiest way to show the force of the analogy with quantities. There seems to be no reason to think that the fact that quantities do not grow has any relevance to the question of whether human beings grow, unless we think that there is a sense in which a human being *is* a quantity; and there is such a sense if we think that a human being is (that is, is identical with) an aggregate of particles. But denying that there are aggregates will not solve the problem of material constitution; it will only reduce the plausibility of one story that expresses it.⁹

The Identity Assumption justifies the claim that a human being is *identical* with the object that cannot gain or lose material parts. And the Necessity Assumption is needed because, if we deny it, there is no reason to think that because a human being is at one

⁹In general, denying the Existence Assumption, the Essentialist Assumption, or the PACP for particular substitution instances of F and R will not solve the problem of material constitution. As we will see in section 6, to solve the problem without rejecting the Identity Assumption or the Necessity Assumption, one must deny the conjunction of the other three assumptions for all substitution instances of F and R . To do less is to provide, at best, an incomplete solution to the problem.

time identical with one object that satisfies the Essentialist Assumption, he or she cannot at some other time be identical with a different object satisfying the Essentialist Assumption. But, of course, the argument must reason this way in order to reach its conclusion.

These four assumptions the proponent of the Growing Argument *endorses*. The point of the argument is to show that they are incompatible with a fifth, a Principle of Alternative Compositional Possibilities. In the above formulation, the fifth assumption is that human beings grow in size; but it is worth pointing out here that in light of what we have chosen as our Essentialist Assumption, we could just as easily assume that human beings diminish or undergo replacement of their parts.¹⁰ Any of these will do, because they all entail that where there is a human being, the *ps* that compose it compose something that can exist and fail to bear R_1 to its parts. And once this assumption is in place, we have our complete set of five individually plausible and jointly incompatible assumptions. To escape the conclusion of the Growing Argument, it is necessary and sufficient to reject any one of them.

3. The Ship of Theseus

The ship on which he [Theseus] sailed with the youths and was kept safe [coming] back, the thirty-oared vessel, the Athenians preserved until the time of Demetrius of Phalerus, removing the old pieces of wood and putting in strong ones, and putting them together so that the ship was a model for the philosophers with respect to the disputed argument about growing, some of them saying it remained the same, some of them saying it did not remain the same.¹¹

The ship of Theseus puzzle is a near relative of the puzzle presented by the Growing Argument.¹² Whether or not the Ship of Theseus itself survived its many repairs, its memory at least has survived in the history of philosophy due to the ship's standard role as an illustration in discussions of identity through mereological change. As Plutarch tells us, the ship was often discussed in connection with the Growing Argument; it is mentioned in the

¹⁰Perhaps this is why the Ship of Theseus came to be discussed in connection with the Growing Argument (see Sedley 1982, 257–59).

¹¹Plutarch, *Life of Theseus*, 23 (my own translation).

¹²See Sedley 1982, 257–59.

writings of Leibniz, Hume, and Hobbes;¹³ and it has been the subject of much discussion in the contemporary literature. Hobbes is responsible for the Ship of Theseus puzzle as it is discussed today. Briefly, the puzzle is as follows.

Consider the Ship of Theseus: a wooden ship that, over the course of time, gradually undergoes the replacement of each of its constituent planks. Clearly, it seems, the ship survives each individual replacement; hence, there is good reason to think that the ship that exists once the series of replacements is complete *is* the ship we originally started out with. But now suppose someone takes the discarded planks and puts them back together in their original form as a ship:¹⁴ it seems that there is also good reason to think that *this* ship is the ship we started out with. But, of course, both ships cannot be *the* Ship of Theseus; so the question is, Which of the final two ships is identical with the original?

The answer to this question is often seen to depend upon whether “continuity of matter” or “continuity of form” is more important as a criterion for reidentifying objects; and the puzzle is typically seen to arise from the fact that we have intuitions that pull us in both directions.¹⁵ But, to my mind, treating the problem this way—as a problem about “identity criteria”—does not really cut to the heart of the issue. Rather, it seems that the central question here really is, *How is the Ship of Theseus related to its parts?* For the importance of a criterion of reidentification for a given object depends largely upon how that object is related to its parts. For example, if the Ship of Theseus cannot undergo part replacement (for example, if it is a mere aggregate of planks) then perhaps the “continuity of matter” criterion will be more important. On the other hand, if it is the kind of object that *can* survive complete replacement of its parts, then perhaps the “continuity of form” criterion will be more important.¹⁶

¹³Leibniz 1981, 231–32; Hume 1978, 255ff.; Hobbes 1839, 135–38.

¹⁴This is Hobbes’s contribution. See Hobbes 1839, 135–38.

¹⁵See, for example, Dauer 1973; Davis 1973; Hirsch 1982, 68–71; Lowe 1983; Scaltsas 1980 and 1981; and Smart 1972 and 1974.

¹⁶This oversimplifies a bit because it does not account for positions according to which neither criterion is more important. For instance, one might hold that at the beginning of the story, ‘the Ship of Theseus’ refers ambiguously to two co-located objects, one of which has some proportion of its parts essentially and the other of which does not. On this view, neither criterion would be more important.

In this way, the Ship of Theseus puzzle is just like the Growing Argument. We might well have said that the central question in the Growing Argument is, *How is a human being related to its parts?* For the argument reaches its conclusion only because we have intuitions that suggest that a human being is a mere aggregate of particles *and* intuitions that suggest that a human being can survive various kinds of mereological change; and once we have determined how a human being is related to its parts, we will have taken the first crucial step toward solving the problem.¹⁷ Likewise, the Ship of Theseus puzzle is puzzling precisely because it appeals to similarly conflicting intuitions. Of course, the Ship of Theseus puzzle does not explicitly assume that wherever we find a ship composed of planks, we find an aggregate that is essentially composed of those planks; but obviously we must have *some* intuition that suggests that the ship cannot undergo full replacement of its parts—otherwise the plank-hoarder's ship¹⁸ would no longer be a viable candidate for the name 'Ship of Theseus'.¹⁹

Thus it seems that the best way to solve the Ship of Theseus puzzle is to treat it as an instance of the problem of material constitution rather than as a puzzle about identity criteria. To confirm this, I will show that underlying the puzzle are the five assumptions outlined in section 1 and that rejecting any one of them will suffice to provide an answer to the question, Which of the final two ships is the Ship of Theseus?²⁰

¹⁷It is only the first step because (unless we just deny that there are human beings) we must still account for the relation between a human being and the aggregate of particles that constitutes him or her (for example, by denying that there are aggregates, by saying that a human being is co-located or contingently identical with an aggregate, etc.).

¹⁸The plank-hoarder's ship is the ship that (at the end of the story) is composed of all of the planks that originally composed the Ship of Theseus. The other ship is the continuously repaired ship.

¹⁹Earlier I said that each of the puzzles under consideration in this paper presents us with a scenario in which it appears that an object *a* and an object *b* share all of the same parts and yet are essentially related to those parts in different ways. In the other puzzles, it is obvious what the relevant *a* and *b* are. Here it is not so obvious, but in light of what has just been said it should be clear that my view is that the plank-hoarder's ship and the original Ship of Theseus are the *a* and *b* in this puzzle. I see it this way because the parts that compose the plank-hoarder's ship are the same parts that composed the original vessel, and I take it that the point of the story is to evoke our intuitions that these objects bear different relations to those parts.

²⁰A caveat: It should be noted that a four-dimensionalist's response to

The Existence Assumption is that there are ships and *ps* that compose ships (the Ship of Theseus is our instance). If this assumption is false, then it will be because there are no ships, or because ships are not composite entities. In either case, the appropriate response to the question is to say that it is unanswerable: the puzzle needs to be restated in terms that do not presuppose the existence of ships that have proper parts.

To identify the Essentialist Assumption, it will be helpful first to identify the PACP. It seems that the Ship of Theseus story is puzzling in part because we assume that ships can undergo complete part replacement. Indeed, if we deny this, then we know immediately that the continuously repaired ship is *not* the Ship of Theseus. Hence, if we deny the PACP then we will identify the plank-hoarder's ship as the Ship of Theseus. In contrast, then, it seems that what leads us to think that the plank-hoarder's ship is a viable contender for the name 'Ship of Theseus' is the intuition that where we have a ship, we have something that *cannot* undergo complete part replacement—something that is necessarily such that if the *ps* compose it at a certain time, then, at *all* times, some proportion of the *ps* are among the objects that compose it. Thus, it seems that the Essentialist Assumption here is that if the *ps* compose a ship at time *t*, then there is a *z* such that the *ps* compose *z* at *t* and, necessarily, for all *qs* and *t*, the *qs* compose *z* at *t* only if *z* bears R_2 to the *qs*, where R_2 is defined as follows:

z bears R_2 to the *qs* =_{DF} for some $n \geq 1$, at every time *t'*, at least $1/n$ of the *qs* compose *z*.

And if we deny this assumption, then it seems that (short of replacing R_2 with some different relation) the correct response is to identify the continuously repaired ship with the Ship of Theseus. For suppose that the *ps* compose the Ship of Theseus and that they compose nothing that cannot survive complete part replacement. Then, by the PACP, it is possible for the Ship of Theseus to survive complete part replacement; thus there is no reason not to identify the continuously repaired ship with the Ship of Theseus (both at the end of the story and at every step throughout).²¹

the Ship of Theseus puzzle will *not* be determined by her decision to reject one of the above assumptions, since (as I mentioned earlier, and as I will discuss more fully at the end of section 4) the Ship of Theseus puzzle does not raise the problem of material constitution for a four-dimensionalist.

²¹One might object here as follows: Since the plank-hoarder's ship *would*

That the Identity Assumption underlies this puzzle is clear from the fact that we (initially, anyway) assume that there is just *one* ship composed of the original planks at the beginning of the puzzle. To reject the Identity Assumption is to admit that there might have been two (or more) co-located ships, one of which came to be dismantled and rebuilt, the other (or *another*) of which survived a replacement of all of its parts. But, of course, if this were the case, then neither ship at the end of the story would be the Ship of Theseus, for there would be no such thing as *the* ship that was composed of the original planks. Hence, the question is simply defective.

Finally, the Necessity Assumption is needed in the context of the puzzle to rule out the possibility that the Ship of Theseus *was* identical with something that could not survive complete part replacement, but is no longer identical with it. To reject the Necessity Assumption (and no other) is, in the present context, to embrace temporary identity (the thesis that possibly, there is an object *a* and an object *b* such that *a* is identical with *b* at one time and distinct from *b* at another). Of course, denying the Necessity Assumption is not *equivalent* to accepting the temporary identity thesis; but given how we have defined R in the Essentialist Assumption (i.e., as R_2), one who denies the Necessity Assumption *and* endorses all four other assumptions is committed to temporary identity.²² For suppose one holds that at the beginning of the story, the Ship of Theseus is identical (but not necessarily so) with something (call it Z_1) that cannot survive complete part replacement. Then at the end of the story either the Ship of Theseus is distinct from Z_1 , or

have been the Ship of Theseus had the ship merely been disassembled and then reassembled (that is, had none of its parts been replaced), in the actual case the plank-hoarder's ship should be identified with the Ship of Theseus as well. My reply is that this presupposes that part replacement never really occurs. The Ship of Theseus is gradually disassembled as planks are removed from it, and the continuously repaired ship is an object one portion of which is the partially disassembled Ship of Theseus and another portion of which is a partially constructed new ship. Thus, to raise this objection is in fact to endorse the Essentialist Assumption and deny the PACP. I am grateful to a referee for this journal for bringing this objection to my attention.

²²Note that those (like Allan Gibbard) who endorse contingent identity *and* four-dimensionalism are not committed to temporary identity because four-dimensionalism entails that the PACP as it is here defined is false (see page 542 and note 38).

it is identical with Z_1 (though it might not have been) and therefore has not undergone complete part replacement. In the former case, the temporary identity thesis is true; thus one who wants to embrace contingent identity but avoid temporary identity must say that the latter case obtains. But why should we think that this case obtains? That is, why should we think that the ship has not undergone complete part replacement? Is it because it *cannot*? Then the PACP is false.²³ On the other hand, if the PACP is true, then presumably we could construct a puzzle just like the Ship of Theseus (call it “the Ship of Odysseus puzzle”) in which the relevant ship *does* undergo part replacement; then the proponent of contingent identity will be forced to embrace temporary identity or else deny that the ship and the object that cannot survive complete part replacement were ever identical in the first place (thus rejecting the Identity Assumption). So, in the present context, to reject the Necessity Assumption (and to endorse the other four) commits one to temporary identity; and once one is committed to temporary identity, there seems to be no reason to identify the plank-hoarder’s ship as the Ship of Theseus. For if the temporary identity thesis is true, then why think that just because Z_1 is identical with the Ship of Theseus at the beginning of the story, it is identical with the Ship of Theseus at the end of the story as well? Indeed, because we have not rejected the Identity Assumption or the PACP, there is good reason not to think this: it is possible for the Ship of Theseus to undergo complete part replacement. But, of course, Z_1 cannot undergo complete replacement of its parts; hence, though Z_1 was identical with the Ship of Theseus at the beginning of the story, it is no longer, since presumably the ship has survived its many repairs and is in fact the continuously repaired ship.²⁴

²³Or else co-located with the original Ship of Theseus was another ship that could undergo complete part replacement, in which case the Identity Assumption is false.

²⁴It is unacceptable to say here that perhaps Z_1 was identical to the Ship of Theseus at the beginning of the story, was distinct from the Ship of Theseus so long as the original planks lay unassembled, but then *became* identical with the Ship of Theseus again once the planks were reassembled. For we would then have the bizarre consequence that at the precise moment the planks were reassembled, the Ship of Theseus somehow *instantaneously moved* from wherever the continuously repaired ship was to wherever the plank-hoarder’s ship was; but this view seems too bizarre and ad hoc to be considered as a serious option for solving the puzzle.

I have now shown that rejecting any of the above five conflicting assumptions will suffice to tell us which (if either) of the final two ships is the Ship of Theseus. In concluding this section, I would like to emphasize the fact that the fundamental problem here will arise *whether or not* we suppose the original planks are reassembled in their original form. Indeed, if the argument of this section is correct, the problem arises just as soon as we suppose the Ship of Theseus can undergo complete replacement of its parts. Thus, it turns out that the function of Hobbes's twist on the puzzle is purely rhetorical: it highlights the fact that we have intuitions that *conflict* with the PACP, intuitions that we might otherwise suppress if the puzzle merely asked us to decide whether the continuously repaired ship was the Ship of Theseus or whether Theseus's ship lay disassembled in the plank-hoarder's yard.

4. The Body-minus Argument

The Body-minus Argument is another puzzle with a long history. Its origin is in Chrysippus, where it appears as the paradox of Dion and Theon.²⁵ More recently, the puzzle has been reintroduced by Wiggins, who casts it in terms of the now familiar story about Tibbles the cat.²⁶ The story runs roughly as follows.²⁷

Consider Tibbles—a cat who, at a certain time t , is endowed with a tail, but who unfortunately finds herself separated from that tail at some later time t' . (Let us suppose that Tibbles's tail is *annihilated* sometime after t and shortly before t' .) The body that Tibbles has when her tail is intact we shall call 'Body'; we will use the name 'Body-minus' to refer to Body minus the tail. Thus Body and Body-minus coexist, and indeed overlap, prior to the annihilation of Tibbles's tail; but clearly Body is not identical with Body-minus—Body-minus is just a proper part of Body. Now, the problem arises as follows.

²⁵David Sedley speculates that Chrysippus raised the paradox as a rejoinder to the Growing Argument. For details, see Sedley 1982, 270.

²⁶A story that Wiggins (1968) borrowed from Geach (see 1980, sec. 110) who, in turn, developed it from a (unfortunately unnamed) passage in William of Sherwood. Other recent versions and/or discussions of the puzzle are to be found in Heller 1990, Noonan 1976, Simons 1987, Thomson 1983, and van Inwagen 1981.

²⁷The version I present here is loosely based on versions by van Inwagen and Simons.

At t , it seems that Tibbles is identical with Body. Thus

(1) At t : Tibbles = Body.

At t' , however, after Tibbles has suffered the annihilation of her tail, it seems that Tibbles is identical with Body-minus. Hence

(2) At t' : Tibbles = Body-minus.

But, of course, since identity is not merely temporary, it follows from (1) and (2) that

(3) (Tibbles = Body) & (Tibbles = Body-minus).

And since identity is transitive, (3) entails

(4) Body = Body-minus.

But (4) is false. Hence something must have gone wrong.

Typically, the problem is said to reside in one of eight assumptions made by the argument:²⁸

- (a) Material objects such as Tibbles exist.
- (b) Material objects such as Tibbles and her parts are three-dimensional enduring objects.²⁹
- (c) Material objects such as Tibbles can survive gain and loss of material parts.
- (d) Proper parts of material objects, such as Body-minus, exist even while undetached from the objects of which they are proper parts.
- (e) Identity is transitive.
- (f) Identity is not relative to a sortal concept.

²⁸The following list comes (with some alterations) from Simons 1987, 119.

²⁹As opposed to four-dimensional perduring objects. (Following established convention, I say that an object "endures" if it persists through time by being wholly present at every time at which it exists and I say that an object "perdures" if it persists by being partially present (i.e., by having spatiotemporal parts) at every time at which it exists. Hence perduring objects are four-dimensional since they are extended in time just as they are extended in space.) The assumption is made in setting up the problem. 'Tibbles = Body' and 'Tibbles = Body-minus' can be true only if the names refer to three-dimensional objects (or three-dimensional stages of objects). For, in the above scenario, if the names refer to four-dimensional objects, then Tibbles, Body, and Body-minus turn out to be different objects by virtue of the fact that each has parts that the others don't have.

- (g) Identity is not temporary, or relative to a time.
- (h) Distinct material objects cannot fully occupy the same place at the same time or share all their proper parts at the same time.

By rejecting any one of these assumptions, it is possible to avoid the unwelcome conclusion that Body = Body-minus.

It will be useful to digress here briefly and note that insofar as rejecting any one of these assumptions solves the problem of material constitution, it will also solve the other puzzles under consideration in this paper; hence, this list, when prefaced by the words 'Reject one of the following:', constitutes what is perhaps the most comprehensive list of possible solutions to the problem of material constitution currently available. But the list is not exhaustive. There are solutions to the problem (indeed, to the Body-minus argument itself) available that do not reject *any* of the assumptions listed above.³⁰ Moreover, as a list of solutions to the problem of material constitution, the list is not accurate: there are solutions listed above that solve only some of the puzzles that express the problem.³¹ And, finally, it is not at all clear *why* rejecting any one of these assumptions will provide a solution to the other puzzles under consideration in this paper—or at least it is not immediately clear. What we need is a general statement of the problem underlying each of these different puzzles, together with a taxonomy of possible solutions that shows how the different available solutions are related to one another and provides a relatively easy means of classifying newly discovered solutions.³²

³⁰See, for example, Burke 1994a and 1994b.

³¹Rejecting (b), (d), or (e) will solve the Body-Minus puzzle as it is usually presented, but rejecting these will not solve the problem of material constitution. More on this below.

³²I say it would be good to have a *taxonomy* of possible solutions rather than a *list* because it would be much harder (perhaps impossible) to provide the latter. The reason for this is that there is no end to the variety of possible solutions to a problem: one can solve the Ship of Theseus puzzle, for example, by denying that there are boats, by denying that there are artifacts, by denying that there are any material objects other than wooden planks and Leprechauns, and so on. Each of these alternatives might be seen as a different solution, but they can all be categorized as solutions that deny the Existence Assumption by denying that there are ships. For this reason, it seems that the prospects for providing an exhaustive taxonomy of solutions—a list of such categories—are much better than the prospects for providing an exhaustive list of solutions.

And so we return to the Body-minus argument, with the goal of recasting it in such a way as to show that it expresses essentially the same problem expressed by the Growing Argument and the Ship of Theseus puzzle. This is a relatively easy matter, for once we realize that the upshot of the story is that there is something paradoxical about a cat's losing its tail, it becomes clear that the assumptions underlying the Growing Argument will be necessary and sufficient to show this. The Existence Assumption is that there are cats and *ps* that compose them (Tibbles is our instance here); the Essentialist Assumption is that for any cat, the *ps* that compose it compose an object that cannot survive the loss of a part (in the story, Body satisfies this assumption, and we can again take R_1 as our substitution instance for R); the PACP is that for any cat, the *ps* that compose it compose an object that *can* survive the loss of a part (hence our intuition that Tibbles, unlike Body, can survive the annihilation of Tibbles's tail); the Identity Assumption entails that Tibbles is identical with Body; and the Necessity Assumption entails that Tibbles is necessarily identical with Body. Making the relevant substitutions, we can recast the Body-minus argument as an argument of the sort outlined in section 1 (I leave this to the reader), and we of course find that the scenario is paradoxical.

Note that this formulation of the argument does not assume that Body-minus exists—hence it assumes nothing with respect to the “doctrine of arbitrary undetached parts” (hereafter, “DAUP”)³³—nor does it assume that identity is transitive. The reason for this is that neither of those assumptions are essential to the puzzle.³⁴ On

³³The doctrine of arbitrary undetached parts is (roughly) the doctrine that in every occupiable subregion of the region of space occupied by an object *O* at a certain time *t*, there is an object that exists at *t* and is a part of *O* (see van Inwagen 1981, 123). It is generally assumed that assumption (d) is true only if DAUP is true.

³⁴It may be helpful to point out here that DAUP is not essential to the puzzle because it is stronger than necessary. That is, it entails but is not entailed by the puzzle's Essentialist Assumption. In “The Doctrine of Arbitrary Undetached Parts,” Peter van Inwagen argues that DAUP entails what he calls “mereological near-essentialism.” Mereological near-essentialism is

the thesis that it is impossible for an object to lose any of its parts; that is . . . if a part is removed from an object, and no new part is added to the “remainder,” then that object must therewith cease to exist. (1981, 124)

But clearly if mereological near-essentialism is true, then the above Essen-

an intuitive level, all one really needs in order to show that there is something paradoxical about Tibbles losing her tail are the premises that Tibbles and Body exist, that Tibbles = Body, and that Tibbles can but Body cannot survive the loss of Tibbles's tail. On a more rigorous level, all one needs are the five assumptions outlined in section 1. Consequently, one cannot solve the problem of material constitution simply by taking a particular stand on DAUP or the transitivity of identity.

Moreover, one cannot solve the problem of material constitution by rejecting (b) either. One *can* solve the Body-minus puzzle by rejecting (b); but the reason for this is that once we have rejected (b), we can admit that Tibbles exists and Body exists without admitting that one constitutes the other. Thus the Body-minus puzzle does not even *raise* the problem of material constitution for the four-dimensionalist, because once we have accepted four-dimensionalism we no longer have an instance of material constitution. To see why this is so, we must first clear up an ambiguity that arises when our assumptions are read from a four-dimensionalist perspective.

The locus of ambiguity is in expressions of the form 'the *ps* compose *O* at *t*'.³⁵ Such an expression might mean that, at *t*, the *ps* compose the object *O*, or it might mean that the *ps* compose the object *O*-at-*t*. From a three-dimensionalist perspective, these amount to the same thing: if the *ps* compose *O* then they *also* compose *O*-at-*t*, since '*O*-at-*t*' is just another name for *O*.³⁶ But from a four-dimensionalist perspective, '*O*-at-*t*' names a temporal stage of *O*; hence if the *ps* compose *O*, then they *do not* compose *O*-at-*t* and vice versa. This ambiguity infects all of the assumptions except the Necessity Assumption and it also makes a difference as to what object we take to be the referent of the name 'Body'. I will not

tialist Assumption must be true. Hence, insofar as DAUP entails mereological near-essentialism, it entails the above Essentialist Assumption. (And in fact van Inwagen would reject this assumption, for he thinks that, for any *ps*, the *ps* compose something only if their activity constitutes a life; but a living being is just a being that is capable of changing its parts over time (see van Inwagen 1990, chap. 9).).

³⁵Of course, other expressions are ambiguous from a four-dimensionalist perspective: for example, '*O* exists at *t*' might mean 'it is true at *t* that *O* exists' or '*O* has a temporal stage at *t*'. But in these cases, the ambiguity does not make much difference in how one reads the argument.

³⁶On this issue, see Merricks 1994.

belabor this issue by explicitly considering all of the possible ways of disambiguating these premises; it will suffice simply to say that every expression of the form ‘the ps compose O at t ’ should be understood to mean that, at t , the ps compose the object O .³⁷ Indeed, the four-dimensionalist will do best simply to drop the ‘at t ’ qualifiers altogether since, on her view, if it is true at one time that the ps compose O , then it is true at all times.

But if this is right, then according to the four-dimensionalist it is false that, at t , the ps that compose Tibbles also compose Body.³⁸ For, in the context of the story, the name ‘Tibbles’ clearly refers to the *whole* cat (that is, the object that, according to the four-dimensionalist, fills the region of spacetime that constitutes the entire life of the cat). But Body occupies only *part* of that region, since its career is terminated whenever Tibbles’s tail is annihilated. Thus, according to the four-dimensionalist, Body is at best a proper spatiotemporal part of Tibbles. But then Body does not constitute Tibbles and so there is reason to think that Body might be identical with Tibbles; thus there is no paradox.

So the Body-minus Argument does not raise the problem of material constitution for the four-dimensionalist. And neither do the other two puzzles we have considered so far. The problem of material constitution arises whenever it appears that there is an object a and an object b that constitute one another and are essentially related to their parts in different ways. But in each of the puzzles

³⁷The reason we must disambiguate these premises in this way is that if we disambiguate them the other way, it turns out that (for the four-dimensionalist) the Identity Assumption claims that if x and y share a temporal stage, then $x = y$. But this is as ludicrous as saying that if x and y overlap spatially then $x = y$. But it doesn’t have to be read this way, and so we may just stipulate that it is to be read by the four-dimensionalist with the ‘at t ’ qualifiers dropped. And if we disambiguate the Identity Assumption this way, then, to preserve the validity of our inferences, the other premises must be disambiguated this way as well.

³⁸It is also false that objects undergo mereological change; hence, according to the four-dimensionalist, the PACP as it is defined above is false. But I take it that, though the four-dimensionalist in fact denies the PACP here, she does not *solve the puzzle* by denying it. For the point of the PACP is to bring out the fact that Tibbles and Body are essentially related to their parts in different ways; but the four-dimensionalist does not need to deny *this* in order to solve the puzzle. For if Body does not constitute Tibbles, then the puzzle is already solved: there is no reason to think Tibbles and Body are identical, and hence no reason to think that they shouldn’t be related to their parts in different ways.

we have considered so far (and, generally, in any puzzle that purports to show that actual mereological change is paradoxical), our putative *a* and *b* do not appear to the four-dimensionalist to constitute one another; in each case she will simply say that one is a proper spatiotemporal part of the other.

But this does not mean that the problem of material constitution does not arise at all for the four-dimensionalist; it just means that we have not yet found the right story to raise it. What we need is a story in which even the four-dimensionalist will grant that there appear to be objects *a* and *b* that constitute one another and are essentially related to their parts in different ways. Allan Gibbard's puzzle about Lump1 and Goliath is just such a story.

5. Lump1 and Goliath

The Lump1/Goliath story is original to Gibbard (1975), and it is designed to show that there are some *contingent* identities. It runs as follows.

A sculptor sets out to create a statue of the infant Goliath, but he does so in the following way: he sculpts Goliath's upper body from one piece of clay, his lower body from another, and then finishes the statue by sticking the two pieces of clay together. Thus, in joining the two pieces of clay he simultaneously brings into existence a *new* piece of clay and a completed statue of the infant Goliath. He allows the clay to harden, but then a day later (perhaps dissatisfied with his work) he smashes the statue, thereby terminating the careers of both the statue and the piece of clay.

The question is whether the statue in this story (Goliath) is identical with the piece of clay (Lump1). Gibbard answers affirmatively since Lump1 and Goliath come into existence at the same time and pass out of existence at the same time and share all of the same spatiotemporal parts at all times during which they both exist. But, he says, Lump1 is not *necessarily* identical with Goliath since it is possible that Lump1 exist and Goliath not and vice versa. (For example, such a possibility might have been realized if, while the sculpture was still wet, the sculptor had squeezed Lump1 into a ball and reshaped it into a statue of David, or if, after the statue had hardened, Goliath's finger had been annihilated.) Thus, Gibbard concludes, there are some contingent identities.

As I have said, Gibbard constructed this story with a particular aim in mind—to show that identity is sometimes contingent. However it should be obvious by now that granting Gibbard's conclusion is but one of many possible solutions to the problem raised by the Lumpl/Goliath story. This is because it is just another expression of the problem of material constitution. It turns out, though, that when we try to identify the assumptions of the Lumpl/Goliath story, we find that, unlike the other stories we have considered, this one presents us with *two* distinct puzzles. One shows that there is something paradoxical about the fact that an object could have had material parts other than those it in fact has; the other shows that there is something paradoxical about the fact that an object could have had a different shape (or, more generally, a different *arrangement* of parts) than it in fact has. Still, we can identify in each puzzle five assumptions of the sort presented in section 1.

In the first puzzle, paradox seems to arise from the fact that Goliath can but Lumpl cannot survive the loss of small parts; and initially it looks as if this might be just another puzzle about mereological change. However, we must recall that this is a four-dimensionalist's puzzle; hence, saying (for example) that Goliath loses a finger is just a loose way of saying that one "temporal stage" of Goliath has a finger whereas a later one does not. Thus it is not mereological *change* that poses the problem; rather, the puzzle arises from the fact that Lumpl and Goliath actually share all of the same spatiotemporal parts (and hence seem to be identical), but Goliath could have been composed of different parts whereas Lumpl could not. Thus the Existence Assumption is that there are statues and *ps* that compose them (and Goliath is the instance); the Essentialist Assumption is that if the *ps* compose a statue, then the *ps* compose something (Lumpl is our instance) such that it cannot exist and fail to be composed of the *ps*; the Identity Assumption, as always, remains the same and justifies our intuition that Lumpl = Goliath; the Necessity Assumption, which Gibbard rejects, is reflected in our intuition that if Lumpl = Goliath then Lumpl could not have been distinct from Goliath; and the PACP is that if the *ps* compose a statue, they compose something that could have existed and failed to be composed of them (Goliath satisfies this assumption). To generate these assumptions, we sub-

stitute ‘statue’ for F and R_3 for R, where R_3 is defined as follows: Suppose the ϕ s actually compose z . Then

z bears R_3 to the ϕ s =_{DF} the ϕ s = the ϕ s.

In the second puzzle, paradox arises from the fact that Lumpl can whereas Goliath cannot survive certain changes in the arrangement of its parts. In particular, Lumpl can but Goliath cannot become a non-statue.³⁹ We can accommodate this simply by modifying the Essentialist Assumption and the PACP by replacing R_3 with R_4 , where R_4 is defined as follows:

z bears R_4 to the ϕ s =_{DF} the ϕ s compose a statue.

Gibbard’s story is the only one of the puzzles we have seen that explicitly acknowledges a possibility of this sort; but clearly it is possible for, say, the aggregate of particles that constitutes a human being to exist when the human being does not, and likewise for cats and other composite objects. Thus Gibbard’s puzzle is superior to the other three as an instance of the problem of material constitution in that (i) it is puzzling for three-dimensionalists and four-dimensionalists alike, and (ii) it highlights the fact that “formal” change is just as paradoxical as material change.

6. Solutions

We have now seen that one problem underlies four familiar philosophical puzzles. The problem, again, is that for any composite object a , we can (generally) identify an object b that constitutes it and is essentially related to its parts in a way that a is not. The Identity Assumption tells us that a is identical with b (constitution is identity); the Necessity Assumption tells us that a and b could not have been distinct; hence a and b are not essentially related to their parts in different ways. To solve the problem, we must (i) reject the Identity Assumption, (ii) reject the Necessity Assumption, or (iii) reject some feature of the story that introduces the problem (that is, claim that a does not exist or that b does not

³⁹Indeed, Goliath cannot even become a non-Goliath-shaped statue; but for convenience let us ignore this. To take account of this fact, we would simply have to replace ‘statue’ in the relevant places with ‘Goliath-shaped statue’.

exist or that one or the other is not related to its parts in the way we think it is).⁴⁰ To do (iii) we must reject the Existence Assumption, the Essentialist Assumption, or the PACP for whatever F and R are presupposed in the case at hand. (In other words, to give a *complete* solution to the problem without rejecting the Identity Assumption or the Necessity Assumption, we must reject the conjunction of the other three assumptions for *all* substitution instances of F and R.) The puzzles we have considered in this paper differ only insofar as they supply different substitution instances for F and R and different stories to engage our intuitions about the five conflicting assumptions.

We are now in a position to categorize the solutions to the problem of material constitution. One natural way to do it would be to identify three categories corresponding to (i), (ii), and (iii) above, and, for any given puzzle, three different ways for a solution to fall into the third category. However, since one may reject a proposition either by claiming that it is false or by claiming that it is *neither* true nor false, and since there are few philosophers who do the latter for any of the assumptions we are considering, I will group the “indeterminacy solutions” in a separate category of their own, leaving in the remaining three categories only solutions that *deny* the relevant assumption. Let us now look at these four categories in a bit more detail.

6.1 Solutions that deny the Identity Assumption

As I have already noted, the Identity Assumption corresponds (roughly) to the view that is sometimes expressed by the phrase “constitution is identity.”⁴¹ To deny it, one must hold that, sometimes, distinct objects have all of the same parts at the same time. Among the philosophers who explicitly defend this sort of view are Fred Doepke (1982), Mark Johnston (1992), Peter Simons (1987),

⁴⁰I take it that if, in a particular story, it turns out that *a* and *b* exist but do not constitute one another, then we simply do not have a story that raises the problem. Thus “deny that *a* and *b* constitute one another” will not count as a general strategy for solving the problem.

⁴¹We would have a more precise correspondence if the assumption contained a biconditional.

199–204), and David Wiggins (1968 and 1980). Furthermore, it seems that those who adopt “relative-identity” solutions should also be seen as falling into this camp. A relative-identity solution is any solution that maintains that all expressions of the form ‘ $x = y$ ’ in the assumptions and the argument of section 1 should be replaced by claims of the form ‘ x is the same F as y ’, where F is a schematic letter taking sortal terms as substitution instances. (One might hold such a view if, for example, one followed Geach (1980) in holding that *all* true identity statements are relativized to a sortal; but one need not go this far in order to endorse a relative-identity solution.) Presumably, the relative-identity theorist could endorse appropriately modified versions of the Identity Assumption and the Necessity Assumption, but she would reject them as they stand since they contain unqualified expressions of the form ‘ $x = y$ ’. But this alone will not suffice to solve the problem of material constitution. To see this, consider the Lump1/Goliath puzzle from the point of view of a relative-identity theorist. Either Lump1 is the same statue as Goliath, or it is not. If it is, then the problem of material constitution (or a relative-identity version of it) arises with a vengeance; for, according to the story, it is possible that Lump1 *not* be the same statue as Goliath. If, however, Lump1 is not the same statue as Goliath, then the Identity Assumption is false; for according to the story Lump1 and Goliath in fact share all of the same spatiotemporal parts throughout both of their careers—and this despite the fact that, on the present view, one is a statue and the other is either a different statue or not a statue at all. Thus, it seems, either an appeal to relative identity does not solve the problem of material constitution at all, or else it entails a rejection even of a “relativized” version of the Identity Assumption. Hence, it seems reasonable to categorize relative-identity solutions as solutions that deny the Identity Assumption.⁴² Among those who defend relative identity solutions are Hugh Chandler (1971), Peter Geach (1980, 215–18), and Nicholas Griffin (1977, 177–85).

⁴²I must emphasize, though, that it is possible to hold that identity is sortal relative, endorse (a relativized version of) the Identity Assumption, and solve the problem of material constitution by denying one of the other assumptions that generate the problem. However, one who does this will not be solving the problem simply by appeal to relative identity.

6.2 Solutions that deny the Necessity Assumption

These solutions will hold that there are cases where ' $a = b$ ' is true and it is possible that a exists or b exists and ' $a = b$ ' is false. As we have seen, this is the solution that Gibbard adopts. Moreover, the views of Gallois (1990) and Myro (1986)⁴³ also fall under this category since they maintain that some identity statements are just *temporarily* true.

6.3 Solutions that deny the conjunction of the remaining assumptions for all substitution instances of F and R

In this category I group the views of philosophers who *accept* the other two assumptions and thus solve *every* puzzle that raises the problem of material constitution by rejecting some feature or other of the story that raises it. Also, it is worth pointing out that most philosophers whose views fall into this category do not solve every puzzle the same way: they deny the conjunction of the three schematic assumptions for all substitution instances for F and R , but they deny different conjuncts for different instances. Following are some examples.

6.3.1 Denying the Existence Assumption

The Existence Assumption states that (for a given F) (i) there are F s and (ii) there are things that compose F s.⁴⁴ Hence falling within this category will be all of the various solutions (to particular puzzles) that deny either or both of these claims for the relevant substitution instances of F . For example, van Inwagen denies (i) for all substitution instances of F except those where F is a simple or a living organism, and he denies (ii) for all substitution instances of F except those where F is a living organism (since simples are not composite).⁴⁵ And Unger (1980) denies (i) for all substitution

⁴³Myro gives credit for the view to Paul Grice.

⁴⁴It also states that there are times; but denying that there are times does not seem to constitute a solution to the problem. This is because the problem could, with some work, be recast to do away with the assumption that there are times.

⁴⁵See van Inwagen 1990, chap. 9. However, van Inwagen notes that 'the

instances of *F* except those where *F* is a simple, and so he denies (ii) for all substitution instances of *F* whatsoever.

6.3.2 Denying the Essentialist Assumption

The Essentialist Assumption says that if the *ps* compose an object *O* (which is an *F*), then they compose an object such that (for some specified *R*), necessarily, that object exists only if it bears *R* to its parts. This is consistent with saying that *O* is the *only* object the *ps* compose; it is also consistent with saying that, in addition to composing *O*, the *ps* compose exactly one other object—perhaps an aggregate—or, indeed, many such objects that are distinct from *O* but co-located with it for some period of time. To deny the Essentialist Assumption for some *F* and *R* is to say that there is at least one case where there are *ps* that compose an *F* but do not compose something such that, necessarily, it exists only if it bears *R* to its parts. Van Inwagen, for example, denies the Essentialist Assumption in all cases where it implies that the *ps* that compose a living organism compose something that cannot undergo complete replacement of its parts (1990, chap. 9), though he might accept it in cases where it implies that an *F* (where *F* is a natural-kind term) cannot become a non-*F*. Likewise, Burke also accepts it in some cases where it implies that an *F* cannot become a non-*F*, and he seems to deny it in cases where it implies that the *ps* that compose an Aristotelian substance compose something that cannot undergo mereological change.⁴⁶

ps' might refer to just one object (ibid., 24), and that one might want to say that, in a sort of degenerate sense, simples are self-composing (ibid., 98). Viewing things this way, van Inwagen accepts the Existence Assumption for simples.

⁴⁶See Burke 1994a and 1994b. In discussing the Body-minus argument, for example, Burke claims that the right solution is to say that Body-minus passes away as soon as its parts come to compose a cat, since cats are cats essentially and non-cats are non-cats essentially. In saying this, I take it that he means that the *ps* that compose Body-minus compose an object of the sort described in its Essentialist Assumption (that is, such that, necessarily, it exists only if it bears *R*₁ to its parts) *only* until the *ps* come to compose a cat. Once the *ps* compose a cat, however, they no longer compose an object of the sort described in the Essentialist Assumption; but then the Essentialist Assumption is false.

6.3.3 Denying the PACP

The PACP maintains that if the *ps* compose an object *O* that is an *F* and an object *Z* that satisfies the Essentialist Assumption for some *R*, it is possible that *O* exist and fail to bear *R* to its parts. Mereological essentialists—Chisholm (1976), for example—deny this principle for substitution instances of *R* that imply that objects do not have their parts essentially. The Academics (apparently) denied this principle for substitution instances of *R* that imply that mereological change is possible.

6.4 Indeterminacy Solutions

These will be any solutions that attempt to solve the problem by saying that the Identity Assumption, the Necessity Assumption, or the conjunction of the other three is neither true nor false. The only indeterminacy solutions (that I am aware of) that have been discussed in any detail as such are solutions that maintain that the Identity Assumption is indeterminate because it is sometimes indeterminate whether '*x = y*' is true.⁴⁷

This completes our taxonomy of solutions to the problem of material constitution. All of the available solutions to the problem fall under one of the above categories, and it seems that any *possible* solutions to the problem must also fall under one of these categories.⁴⁸

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⁴⁷See, for example, Parsons 1987.

⁴⁸I am grateful to Michael Bergmann, Michael Loux, Trenton Merricks, Alvin Plantinga, Philip Quinn, Dean Zimmerman, and two anonymous referees for the *Philosophical Review* for helpful comments on earlier drafts of this paper.

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