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Author(s): Judith Jarvis Thomson
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The Statue and the Clay

JUDITH JARVIS THOMSON
Massachusetts Institute of Technology

1. The problem, familiarly enough, emerges as follows. Suppose I bought a ten pound portion of clay at 9AM. What is a portion of clay? We will return to that question. For the time being, a portion of clay is some clay. It is a quantity of clay. Let us give the name CLAY to it:

CLAY = the ten pound portion of clay I bought at 9AM.

Suppose that at noon, I made a statue of King Alfred the Great out of it, and that I put it on the table at 2PM. Let us give the name ALFRED to the statue:

ALFRED = the statue on the table at 2PM.

How are ALFRED and CLAY related to each other? That is the problem.
 Is this supposed to be a hard problem? Why isn't the solution simply that ALFRED is CLAY? If we can say that

Identity Thesis: ALFRED = CLAY

is true, then the problem is solved, easily.
 Some people say it is obvious that the Identity Thesis will not do, for the following reason. By hypothesis, they say, I bought CLAY at 9AM, so

(1) CLAY existed at 9AM

is true. But, they say, it is obvious that ALFRED did not come into existence until noon, so

(2) ALFRED did not exist at 9AM

is also true. And they go on to say it is therefore obvious that the Identity Thesis is false. (A similar argument turns on my smashing ALFRED at midnight.)

   If we accept this argument, then we do have a hard problem before us. AL-
FRED and CLAY plainly stand in some intimate relation to each other—they
currently occupy the same place, they currently have the same shape, size, color,
texture, smell, and so on and on. In what relation do they stand to each other if not
identity? Opponents of the Identity Thesis say we should say that CLAY consti-
tutes ALFRED. But what can "constitutes" mean for these purposes? Opponents
of the Identity Thesis have not found it at all easy to say.
   Moreover, the Identity Thesis does not merely supply us with a simple solution
to our problem: the solution it supplies is attractive in another way too. For let us
take a closer look at the fact that ALFRED and CLAY currently have the same
shape. ALFRED is blob-shaped on top, then is wider in the middle; the same is
true of CLAY. The following is on any view true:

   (3) ALFRED is a statue at 2PM

Isn't

   (4) CLAY is a statue at 2PM

also true? But if (3) and (4) are both true, and ALFRED is not identical with
CLAY, then there are two statues on the table at 2PM, one of which is ALFRED
and the other of which is CLAY—both of them, I add, occupying the same place.
That certainly sounds false.
   Let us stop over (4) for a moment. Wouldn't it be odd to deny it? No doubt
CLAY was not a statue at 9AM, but isn't it one at 2PM? What, after all, *is* a statue?
Isn't it merely a portion of clay, or stone, or wood, or metal, shaped in a certain
way, with a certain intention, by some person? Isn't what I did at noon precisely
to make CLAY *become* a statue? Opponents of the Identity Thesis would say "No
no, you can't make a portion of clay become a statue, you can only make it come
to constitute a statue." Is there really any good reason to agree?[1]
   If we disagree—if we instead believe that a statue is merely a portion of clay,
or stone, or wood, or metal, shaped in a certain way, with a certain intention, by
some person—then we can have the Identity Thesis, and we can therefore have
that there is only one statue on the table now, viz., ALFRED, viz., CLAY, and that
ALFRED has been in existence as long as CLAY has been, though of course
ALFRED, viz., CLAY, did not become a statue until noon.
   It might pay to set this idea into a wider context. A great many properties can
be called temporary properties, that is, properties that a thing can have at one time
and not at another. Here are some examples:

   some temporary properties: being a wife, a teenager, a student, ... , being
   hungry, round, red, ...

(I divide these into two groups because while those in the first group are com-
monly called phase- or stage-properties, those in the second are not; all, however,

are temporary.) Suppose that Mary got married at noon. Her marrying did not make a wife come into existence: it merely made her become a wife. Your reaching the age of 20 did not make a teenager go out of existence; it merely made you cease to be a teenager. And so on.

There is a sub-class of temporary properties that are particularly interesting for present purposes, of which the following are examples:

> some shape-constrained temporary properties: being a puddle of M, a piece of M, a lump of M, ... , being a heap of M, a mound of M, a stack of M, ...

"M" here is short for an appropriate mass-noun, such as "clay," "soup," "pudding," "coal," "wood" and so on. (I divide these too into two groups, for a reason that will emerge later. And I say "appropriate" because while a thing can be a puddle of soup, nothing can be a puddle of clay; and while a thing can be a piece of clay, nothing can be a piece of soup.)

These shape-constrained temporary properties are of interest to us in two ways.

First, the things that acquire and lose these properties are portions of stuff, that is, portions of clay, soup, pudding, coal, wood, and so on. A portion of clay might be scattered in many little pieces around the room; if we collect those pieces and mash them together, we do not make a piece of clay come into existence—rather, we make the portion of clay become a piece of clay, and if the piece is mound-shaped, we also make the portion of clay become a mound of clay. The portion can also lose those properties: it will lose them if we cut it up into little pieces and scatter them around the room again. Second, what fixes whether a portion of an appropriate stuff has one of those properties is its shape. If a portion of clay is, so to speak, gappy, as when it is scattered around the room, it is neither a piece of clay nor a mound of clay. When it is no longer gappy, as when it is mashed together, it is a piece of clay, and if it is mound-shaped, it is also a mound of clay.

Now let us go back to statues. Why shouldn't we include being a statue among the temporary properties possessed from time to time by portions of stuff? Why shouldn't we suppose that it is, like being a piece of clay, a property that can be had by a portion of clay at one time and not at another? No doubt shape does not wholly fix whether a portion of clay is a statue: if a portion of clay falls out of a window and in consequence now looks like Queen Victoria, that does not mean it is a statue of Queen Victoria or of anything else. But if a portion of clay is moulded by some person in order to make a statue of Queen Victoria—and does manage to resemble her in some degree—then isn't *it* (the portion of clay) now a statue of Queen Victoria, and a fortiori a statue?

Why not say the same of all artifact-properties, thus not merely being a statue, but also being a chair, being a car, being a ship, and so on?

> ??? some further temporary properties: (artifact-properties) being a statue, a chair, a car, a ship, ...

Doesn't a scattered portion of wood become a chair when you arrange it into a chair? And cease to be a chair when you disarrange it again? In all these cases, shape is relevant, though so too is intention.

If we say that being a statue is a temporary property possessed from time to time by portions of stuff, then we can have that attractive Identity Thesis for ALFRED and CLAY, and analogous theses for all artifacts. And there is no hard problem raised by the statue and the clay.

It is a nice idea, I think. At all events, if we are to be forced to reject it, we must be provided with something stronger than the argument I gave at the outset. And we really should try to be clear about exactly why we have to reject the Identity Thesis (if we do) since what forces us to reject it (if anything does) is what makes CLAY merely constitute ALFRED, and should therefore help us to see what constituting *is*.

2. Alas, there is another, equally familiar, but considerably stronger argument against the Identity Thesis. Suppose that just before 3PM I break off ALFRED's left hand, replace it with a new one, and throw the old one on the floor. CLAY is not wholly on the table at 3PM, for part of it is on the floor then:

(5) CLAY is not wholly on the table at 3PM.

But isn't ALFRED wholly on the table at 3PM? If

(6) ALFRED is wholly on the table at 3PM

is also true, then the Identity Thesis is false.

I will call this a replacement argument. (We will meet more replacement arguments later.) Should we accept it?

Sentence (5), I think, we really do have to accept. In breaking off ALFRED's left hand I was breaking a part of CLAY off from the rest of CLAY, a part, we should note, that is itself a portion of clay. I divided CLAY into two sub-portions of clay, a big one, which I left on the table, and a little one, which I threw on the floor. So the portion of clay we began with—and that I am calling CLAY—is now scattered; it is not wholly on the table now, and (5) is therefore true.

What about (6)? Can't a statue undergo replacement of a part? We certainly think of artifacts generally as capable of undergoing replacements of parts. If a thief snaps the windshield wiper off your car and steals it, or steals a tire or a whole wheel, or a bumper, or a fender, then you might replace the stolen part; and after the replacement, we think that you still have the car you originally had, and that it is still in front of your house, though the part the thief took is long gone across town.

If you get a new windshield wiper for your car, then in one way, of course, your car is not the same: it has a windshield wiper it formerly did not have. Just as if you drive your car through a puddle of mud, then in one way your car is not the

same: it is dirtier than it was. But these changes are changes in it, that is, in the very car you have owned all along. We might say that the car isn't *the same*, for it has changed—but it is *it*, the same car, that has changed.

I think we had better agree, and thus that we had better reject the Identity Thesis. Philosophy should not depart more than it absolutely has to from what we ordinarily think and say, and it seems as plain as day that we do ordinarily think and say that artifacts can and often do undergo replacement of parts.[2]

There are difficulties in the offing. First, while it is all well and good to say that artifacts can undergo replacement of parts, they cannot undergo replacement of too large a part all at once. If a thief snaps the windshield wiper off your car and you replace the windshield wiper, we do think you have the same car after the replacement. If the thief instead snaps everything else off the windshield wiper, and you replace everything he removed, we do not think you have the same car after the replacement. But how large is too large?

A second difficulty is generated by series of replacements of small parts. Some people think that an artifact can undergo replacement of all its small parts, if they are replaced one by one, slowly enough. Can that be right?

(i) Suppose I bought a car in 1977. The car didn't work very well, but I loved it. So I replaced its parts, slowly, small part by small part. In the end, the car I now have has no small parts that were parts of it when I bought it. Can it really be that the car I now have is the car I bought in 1977? That seems intuitively wrong. It seems intuitively worse when we discover that my neighbor has been collecting the small parts I discarded, and has now fitted them all together just as they were fitted together in 1977. For many of us now undergo a gestalt shift: surely, we feel, it is my neighbor, not me, who has the car I bought in 1977. (I here up-date the problem of the Ship of Theseus.)

Moreover, (ii) suppose the car I bought in 1977 was a 1977 Chevrolet. Suppose the parts I replaced its parts with were those of a 1947 Buick I happened to have owned as well. And suppose that I slowly replaced all of the parts of the Chevrolet with all of the parts of the Buick. Has my 1977 Chevrolet become a 1947 Buick? (Why didn't I instead just move the Buick, part by part, into the space formerly occupied by the Chevrolet? Can it have been my intentions that made the difference?)

These difficulties are serious. Ordinary thought about artifacts supplies no answer to the question how large a part is too large, or to the question whether there is a point in a series of replacements of small parts at which the result is not the artifact we began with, and if so, what marks it. On the other hand, we cannot simply declare that there is vagueness here, since identity is not vague, or so I throughout assume.

Some philosophers therefore conclude that artifacts cannot undergo replacement of any part, and others that there are no artifacts at all. These responses strike me as *weird*. But I am not even going to try to produce a better one. I will simply suppose—with ordinary thought—that artifacts can undergo replacement of a small part, leaving open how small is small, and what happens when (or

would happen if) a replacement of a small part is (or if it were) part of a series of such replacements.

In particular, I will suppose that ALFRED remained wholly on the table after replacement of his left hand. CLAY, however, did not. Then how *are* ALFRED and CLAY related to each other? We can call the relation "constituting" if we like; we now have to say what constituting is.

3. We are committed to supposing that one thing can constitute another at one time and not at another. CLAY, we are supposing, constitutes ALFRED at 2PM. But CLAY does not constitute ALFRED at 3PM, for part of CLAY is on the floor at 3PM. I drew attention to temporary properties in section 1; so it looks as if the two-place relation 'x constitutes y' is, analogously, a temporary relation. For a variety of reasons, it will be simpler for us to aim at analyzing, not the two-place relation 'x constitutes y', but instead the three-place relation 'x constitutes y at t'. We lose nothing in doing so, for we can go back and forth at will: CLAY, for example, has the two-place relation 'x constitutes y' to ALFRED at 2PM if and only if CLAY has the three-place relation 'x constitutes y at t' to ALFRED and 2PM. (This three-place relation is plainly not a temporary relation: *it* is had at all times if at any time, and so cannot be acquired and lost.)

Very well: what is the three-place constituting-relation? It can, I suggest, be analyzed wholly in terms of parthood with the help of a few modal operators.

We need to fix three ideas about parthood before proceeding. First, we are supposing that one material object can be part of a another at one time and not at another—ALFRED's left hand, for example, is part of ALFRED at 2PM but not at 3PM. So we are supposing that the two-place relation 'x is part of y' is a temporary relation. But as in the case of constituting, it will be simpler for us to focus, not on the two-place relation 'x is part of y', but instead on the three-place relation 'x is part of y at t'. As before, we lose nothing in doing so: ALFRED's left hand, for example, has the two-place relation 'x is part of y' to ALFRED at 2PM if and only if ALFRED's left hand has the three-place relation 'x is part of y at t' to ALFRED and 2PM. (And this three-place relation too is plainly not a temporary relation: it too is had at all times if at any time.)

Second, I will follow two conventions governing the word "part" that are common in the literature on parts and wholes. I will call them housekeeping conventions. The first is that the word "parts" is throughout not restricted to what are often called "proper parts". For example, we are to suppose that ALFRED has among his parts at 2PM: his head, his hands, his feet, *and* himself. More generally, we are to suppose that

(i) x exists at t → x is part of x at t.

The second housekeeping convention is that parthood entails existence. For example, ALFRED's left hand is part of ALFRED at 1PM only if both exist at 1PM. More generally,

(ii) x is part of y at t → x and y both exist at t.[3]

Third, since what I am concerned with throughout is material objects, the parthood relation I make use of is parthood *on material objects*. Many people have said of other kinds of entities that they too have parts. Some people say that a subset of a set is part of it. Some people say that propositions have parts. Many people say that events have parts. Anyone who uses the word "parts" in respect of things of a kind K must tell us what for his or her purposes is to count as one K's being part of another. Since what I am concerned with is material objects, my variables x, y, and z will throughout range only over material objects. And I will suppose that the parthood relation I make use of is governed by the following biconditional:

x is part of y at t $\longleftrightarrow$ the space occupied by x at t is part of the space occupied by y at t.

What is it for one space to be part of another? On some views, spaces are sets of space points. If they are, then one space is part of another just in case it is a subset of the other. No doubt there are other possibilities too. I leave this open. It is essential to a material object y that it be spatially located at all times at which it exists; and intuitively, y's parts at a time t are just those material objects that are where y is at t. Perhaps those material objects are not parts of y throughout y's life. Perhaps they are not even parts of y for very long. But they are parts of y *at t*. It is this intuition that the biconditional is intended to express.

It is of course arguable that we do not know what space a thing y occupies at a time unless we already know what things x are parts of it at that time. It is for that reason that I do not define parthood on material objects in terms of parthood on spaces. It is enough for our purposes that the two go together—hence the biconditional.

And it should be be added that exactness of spatial location is not to be expected. Material objects have atomic, indeed subatomic, parts; what is their exact location, and thus the exact location of a material object made of them? We needn't care, for exactness is not required for our purposes: it is enough for us that a material object's parts are wherever it is, and vice versa.

We can now take our first step in defining constitution: surely x constitutes y at t only if x and y occupy the same space at t—thus only if x is part of y at t and y is part of x at t.[4]

But mutual parthood, while necessary for constituting, is not sufficient for it. For example, CLAY and ALFRED occupy the same space at 2PM, and we do want to have that CLAY constitutes ALFRED then; but we surely do not want to have that ALFRED constitutes CLAY then, so there has to be a further condition or conditions in the definition, in order to fix that constituting goes one way but not the other. Finding the needed further condition or conditions is the hard job.

Let us go back. I invited you to agree in section 2 that when (shortly before 3PM) I broke ALFRED's left hand off and threw it on the floor, CLAY got scattered. It was crucial to the story I told that in breaking ALFRED's hand off, I was breaking a part of CLAY off from the rest of CLAY, and not merely a part of

CLAY but more important, a part of CLAY that was, itself, a portion of clay—it was a sub-portion of the portion of clay that I am calling CLAY. For two ideas about portions of clay seem to me very plausible. The first is that if a portion of clay is on a table, and you break off a part of it *that is itself a portion of clay* and throw that part on the floor, then what remains on the table is not the original portion, but is merely a proper part of it.

More generally, if x is a portion of clay and y is a portion of clay and x is part of y at a time, then if y still exists at a later time, then x is still part of y at that later time. More strongly, if x is a portion of clay and y is a portion of clay and x is part of y at a time, then *necessarily* if y exists at any time, then x is part of y at that time. If we abbreviate "x is part of y at t" as "x<y@t," and "x exists at t" as "xE@t," then we can reput the idea here as follows:

Portion of Clay Principle: {x is a portion of clay & y is a portion of clay & ($\exists$t)(x<y@t)]} → $\square$($\forall$t)(yE@t → x<y@t)

I should think that analogues of this principle are also true of a great many other stuffs M, such as coal, soup, pudding, wood, and so on. (We will have another look at such principles in section 5.)

Let us give the name CLAYHAND to the portion of clay that was part of CLAY at 2PM, but which I broke off from the rest of CLAY shortly before 3PM. Given the Portion of Clay Principle, CLAY cannot exist at a time unless CLAY-HAND is part of CLAY at that time.

CLAYHAND was not merely a part of CLAY at 2PM, it was also part of ALFRED then. But ALFRED's left hand having been replaced shortly before 3PM, CLAYHAND is not part of ALFRED at 3PM. Indeed, ALFRED's left hand having been *wholly replaced*, no part of CLAYHAND is part of ALFRED at 3PM. So ALFRED can exist at a time at which no part of CLAYHAND is part of ALFRED.

To return now to constituting. We would like to have it turn out that CLAY constitutes ALFRED at 2PM. It is plain that the following is true:

(i) CLAY<ALFRED@2PM & ALFRED<CLAY@2PM.[5]

The considerations we have just surveyed make clear that the following is also true:

(ii) There is a z such that z<CLAY@2PM, and such that z is essential to CLAY, and nothing that is part of z at 2PM is essential to ALFRED.

(CLAYHAND is a z that meets that condition.)
I suggest that we can also say:

(iii) NOT-(There is a z such that z<ALFRED@2PM, and such that z is essential to ALFRED, and nothing that is part of z at 2PM is essential to CLAY).

Why so? There is at least one z such that z was part of ALFRED at 2PM, and such that z is essential to ALFRED, namely ALFRED himself. (ALFRED is always part of ALFRED, and ALFRED cannot exist at a time without having ALFRED among his parts at that time.) But ALFRED had many parts at 2PM which were portions of clay, and given the Portion of Clay Principle, they are all essential to CLAY. Is there another z such that z was part of ALFRED at 2PM, and such that z is essential to ALFRED? Perhaps you think that ALFRED had, at 2PM, a big proper part—much bigger than his left hand—which is essential to ALFRED? Even if so, anything that was a big proper part of ALFRED at 2PM, had (as did ALFRED himself) many portions of clay among its parts then, and they are all essential to CLAY. So (iii) is true.

I suggest now that we should say that (i), (ii), and (iii) are necessary and jointly sufficient for the truth of "CLAY constitutes ALFRED at 2PM". And generalizing, that we should define constituting as follows:

x constitutes y at t $=_{df}$
   (1) $x < y@t$ & $y < x@t$ &
   (2) $(\exists z)\{z < x@t$ & $\Box(\forall T)(xE@T \rightarrow z < x@T)$ &
      $(\forall z')[z' < z@t \rightarrow \Diamond(\exists T)(yE@T$ & $\neg(z' < y@T)]\}$ &
   (3) NOT-$[(\exists z)\{z < y@t$ & $\Box(\forall T)(yE@T \rightarrow z < y@T)$ &
      $(\forall z')[z' < z@t \rightarrow \Diamond(\exists T)(xE@T$ & $\neg(z' < x@T)]\}]$

It is easy to see that if x constitutes y at t, then y does not constitute x at t. So given (i), (ii), and (iii), and therefore that CLAY constitutes ALFRED at 2PM, it follows that ALFRED does not constitute CLAY at 2PM. It can also be seen—though not quite so easily (I leave the proof as an exercise for the reader)—that if x constitutes y at t, and y constitutes z at t, then x constitutes z at t.[6]

I suggest, then, that that does it.[7] And the definition we have reached does not merely *happen* to yield the results it should: there is a good reason why it does. What condition (2) does is to generalize on the very fact that led us to say that CLAY is not identical with ALFRED but merely constitutes it. We concluded that CLAY is not identical with ALFRED on ground of my having done the following: I replaced a part of ALFRED, leaving ALFRED on the table but scattering CLAY. (It should be stressed that in replacing that part of ALFRED, I was removing it and all of its parts from ALFRED.) For me to have succeeded in doing that, there had to be a part of CLAY that CLAY could not lose but that ALFRED could lose every part of. That CLAY had such a part is exactly what condition (2) requires. By contrast, I could not have replaced a part of CLAY, leaving CLAY on the table but scattering ALFRED. For me to have succeeded in doing that, there would have to have been a part of ALFRED that ALFRED could not lose but that CLAY could lose every part of. That ALFRED had no such part is exactly what condition (3) requires.

In short, CLAY is more tightly tied to its parts than ALFRED is, and that is the ontological difference between them marked by saying that CLAY is not identical with but merely constituted ALFRED.

The same holds for any other pair of an artifact and the stuff of which it is made at a time t. Let WOOD be the portion of wood of which CHAIR is made at t. You can replace a part of CHAIR, leaving CHAIR but scattering WOOD; you cannot replace a part of WOOD, leaving WOOD but scattering CHAIR. The definition therefore yields that WOOD is not identical with CHAIR, but merely constitutes it at t. And so on.

This outcome is as it should be. Continuity of shape matters to an artifact's continued existence more than continuity of material parts: a fortiori, the artifact's material parts can change while the artifact remains. By contrast, continuity of material parts matters to a stuff's continued existence more than continuity of shape does; a fortiori, the stuff's shape can change while the stuff remains.

What we have been looking at so far are only pairs of an artifact and a stuff. We move down an ontological level when we move down from ALFRED to CLAY. We should see that similar things are to be said when we move down yet another ontological level, from CLAY to something else. The something else I have in mind is what—borrowing a term from Locke—I will call a mass of atoms. However we need a piece of technical machinery in order to be able to say what those entities are.

4. Consider a non-empty set of material objects S. ("S" here is short for a name.) I will say that x all-fuses S just in case x meets two conditions.

Condition (1) is that necessarily, x exists at a time if and only if all of the members of S exist at that time. (Hence the name "*all*-fusion".)

x all-fuses $S =_{df}$
　(1) $\Box(\forall t)\{xE@t \longleftrightarrow [(\exists y)(yeS) \,\&\, (\forall y)(yeS \rightarrow yE@t)]\} \,\&...$

The first conjunct following the double-arrow, namely "$(\exists y)(yeS)$," is intended to insure that x does not exist at a time in a world W unless S itself exists in W, and therefore (since sets cannot change their members) unless all of S's members exist in W. The second conjunct, is intended to insure that all of S's members exist when x does.

A second clause is needed, for clause (1) tells us only x's existence conditions, and we need to know also what its parts are. I mean for y to be part of x at t if and only if necessarily, x and y meet two conditions. First, x and y must exist at t:

　(2) $\Box(\forall t)(\forall y)\{y{<}x@t \longleftrightarrow [xE@t \,\&\, yE@t \,\&...$

(Housekeeping convention (ii) requires this.) Let us say that z is discrete from z' at t just in case z and z' have no parts in common at t. Then we are to add, second, that y must have no parts at t which are, at t, discrete from all of the members of S. Thus, abbreviating "is discrete from" as "D," we are to add, second:

　$...\neg(\exists z)[z{<}y@t \,\&\, (\forall z')(z'eS \rightarrow zDz'@t)]]\}$

(This should remind us of the notion 'fusion' in familiar mereological systems— for a survey of such systems see Simons (1987)—and hence the name "*all-fusion*".)

In sum:

x all-fuses S $=_{df}$
  (1) $\Box(\forall t)\{xE@t \longleftrightarrow [(\exists y)(yeS)\ \&\ (\forall y)(yeS \to yE@t)]\}$ &
  (2) $\Box(\forall t)(\forall y)\{y{<}x@t \longleftrightarrow [xE@t\ \&\ yE@t\ \&$
    $\neg(\exists z)[z{<}y@t\ \&\ (\forall z')(z'eS \to zDz'@t)]]\}$[8]

It can easily be seen that the definition yields that if x all-fuses S, then if x exists at a time, then every member of S does not merely exist at that time, but is also part of x at that time. Let us suppose that x all-fuses the set whose members are the chairs in my house. The chair I am now sitting on is now part of x, since it has no parts now which are now discrete from all of the chairs in my house.

It can easily be seen that the definition also yields that if x all-fuses S, then if x exists at a time, x also has a great many other parts at that time. If x all-fuses the set whose members are the chairs in my house, then everything that is now part of the chair I am now sitting on is now part of x—the left front leg of the chair, for example, is now part of x since it has no parts now which are now discrete from all of the chairs in my house. Indeed, every atom that is now part of the chair I am now sitting on is now part of x.

What we have so far, however, is merely a definition. Does anything answer to it?

Well, everything is the all-fusion of at least one set, namely the set whose sole member is itself.

Again, I have been supposing that

Portion of Clay Principle: $\{x$ is a portion of clay $\&$ y is a portion of clay $\&$ $(\exists t)(x{<}y@t)]\} \to \Box(\forall t)(yE@t \to x{<}y@t)$

is true. Then surely every portion of clay is the all-fusion of the set whose members are all of the portions of clay that are ever parts of it. And I should think we could say also that for every set of portions of clay, there is a portion of clay which all-fuses it, thus:

x is a portion of clay $\longleftrightarrow$ for some set of portions of clay S,
    x is the all-fusion of S

Similarly for other stuffs, such as soup, pudding, coal, wood, and so on.

Again, let us have another look at a list I gave earlier:

some shape-constrained temporary properties: being a puddle of M, a piece of M, a lump of M, ... , being a heap of M, a mound of M, a stack of M, ...

where "M" is short for an appropriate 'mass-noun', such as "clay," "soup," "pudding," "coal," "wood" and so on. I said that the things that acquire and lose these properties are portions of stuff, that is, portions of clay, soup, pudding, coal,

wood, and so on. We can now say that the things that acquire and lose these properties are all-fusions of sets of portions of stuff.

The possibility of an attractive generalization now emerges. I divided that list in two for an interesting reason. Consider the following list:

  being a heap of Cs, a mound of Cs, a stack of Cs, ...

where "Cs" is the plural of a count-noun, as for example, "flowers," "bananas," "cards," "chairs," "beans," and so on. Nothing can be a puddle, piece, or lump of flowers, bananas, cards, and so on. But a thing can be heap, mound, or stack of flowers, bananas, cards, and so on. (Hence my division of the list.) What entities are they that are from time to time a heap, mound, or stack of flowers?

Consider yet another list:

  being a bunch of Cs, a cluster of Cs, a bouquet of Cs, ...

Nothing can be a bunch, cluster, or bouquet of clay, soup, pudding or coal; something can be a bunch, cluster, or bouquet of flowers, or a bunch or cluster of bananas, cards, and so on. What entities are they that are from time to time a bunch, cluster, or bouquet of flowers?

All-fusions, I suggest. A heap or bunch of flowers is the all-fusion of the set whose members are those flowers, and the all-fusion is (currently) a heap or bunch because of the all-fusion's (current) shape. If someone removes one flower from your heap or bunch, you no longer have the same heap or bunch: you only have a proper part of the one you had. If someone removes only one petal of one flower, you do still have the same heap or bunch: that is because flowers (like statues) can survive the loss of some of their parts, and a petal (like ALFRED's left hand) is a part that can be lost.

In sum, the entities that from time to time possess the following shape-constrained temporary properties—

  being a puddle, piece, lump of M, ... , being a heap, mound, stack of M, ... ,

and

  being a heap, mound, stack of Cs, ... , being a bunch, cluster, bouquet of Cs, ...—

are all all-fusions, of sets of portions of M on the one hand, of sets of Cs on the other.

Can we say that for any non-empty set of material objects S, there is an x that all-fuses S? No. Suppose S has three members (and thus is non-empty). Suppose also that there is never a time at which all three exist at once. Then clause (1) of the definition of all-fusing tells us that if x is the all-fusion of S, there is no time at which x exists. Thus there is no x that all-fuses S.

I am inclined to think, however, that we should agree that for any set of material objects S for which there is a time at which all of its members exist, there is an x that all-fuses S. This idea is not needed for our purposes here, but I see no good reason to reject it.[9] Accepting it commits us to the existence of some very queer looking entities, such as, for example, the all-fusion of the chair I am now sitting on and your car. But why not? The relation of all-fusion is well-defined in a certain strong sense. (i) The definition tells us when a set's all-fusion in fact exists and what its parts in fact then are. Moreover, (ii) the definition tells us when the set's all-fusion would exist and what its parts would then be in any possible world you like. (iii) Although we know from the definition that a set may in fact have no all-fusion, it is clear that any (non-empty) set could have had an all-fusion: there is no metaphysical impossibility in the supposition that it does. Alternatively put: there is a possible world in which it does.

Suppose, then, that there is a time at which all the members of a set S exist. Then there is a possible world in which S has an all-fusion. Why not this world? How could empirical investigation disclose that S doesn't in fact have an all-fusion? Is there supposed to be some contingent matter of fact—discoverable, perhaps, by meticulous scientific investigation—that fixes that it doesn't? I hardly think so. So I see no good reason to reject the idea that S has an all-fusion.

5. To return to where we were. What we had been looking at in section 3 were pairs of an artifact and a stuff of which it is made at a time t. And I had suggested that the definition of constituting I supplied yields the result that the stuff constitutes the artifact at t, from which it follows that the artifact does not constitute the stuff at t.

I said that if we think of ourselves as moving down an ontological level from ALFRED to CLAY, it pays to see that similar things are to be said when we move down yet another ontological level, from CLAY to something else. What something else do I have in mind? I will call it a mass of atoms, to be defined as follows:

x is a mass of atoms $=_{df}$ for some set of atoms S, x all-fuses S.[10]

Are there such things? I can see no good reason to think there are not.

Now I assume that CLAY is made of atoms, and indeed, that every atom it is made of at a time is part of it at that time. Let $S_{atoms,CLAY,2PM}$ be the set whose members are all of the atoms that are parts of CLAY at 2PM. Let ALL-$S_{atoms,CLAY,2PM}$ be the mass of atoms that all-fuses $S_{atoms,CLAY,2PM}$. Consider, now,

ALL-$S_{atoms,CLAY,2PM}$ = CLAY.

Can we accept that thesis? I think we had better not, because of a replacement argument like the one that led us to reject

CLAY = ALFRED.

For suppose that just before 3PM we replace an atom in CLAY, throwing the replaced atom on the floor. (You have to use a very tiny spoon to do that.) Then

(7) ALL-S$_{atoms,CLAY,2PM}$ is not wholly on the table at 3PM

is true, for something that is still part of ALL-S$_{atoms,CLAY,2PM}$ is on the floor at 3PM. But I think we should agree that

(8) CLAY is wholly on the table at 3PM

is also true, for I think we should agree that CLAY has undergone a replacement of a part as ALFRED underwent a replacement of a part when I replaced his left hand. It follows that CLAY is not identical with ALL-S$_{atoms,CLAY,2PM}$.

Why should we agree that (8) is true? I said in section 3 that there were two ideas about CLAY that seemed to me very plausible. The first idea was that any part of CLAY *that is itself a portion of clay* cannot be removed from, and hence cannot be replaced in, CLAY: any such part of CLAY remains a part of CLAY. The generalization of that first idea is expressed in the Portion of Clay Principle. The second idea is that any *atom* that is part of CLAY can be replaced in CLAY. We can have this second idea along with the first only if we agree that no atom that is part of CLAY is itself a portion of clay; but that is surely obvious.

Of course if too many atoms are replaced too quickly, then we do not have the original portion any longer, just as if too much of ALFRED is replaced too quickly, then we do not have ALFRED any longer. One atom, however, is replaceable, just as ALFRED's left hand is.

So I take it that ALL-S$_{atoms,CLAY,2PM}$ is not identical with CLAY. What seems right is, rather, that All-S$_{atoms,CLAY,2PM}$ constitutes CLAY at 2PM. Not at 3PM, but at 2PM. And I think you will see that, given the definitions of all-fusing and constituting, that is exactly the result we do get.

In sum, we now have three ontological levels represented:

ALFRED
CLAY
ALL-S$_{atoms,CLAY,2PM}$

At the top, continuity of shape matters to the thing's continued existence more than continuity of material parts: a fortiori, its material parts can change while the thing remains. In the middle, continuity of macro-material constitution matters to the thing's continued existence more than continuity of micro-material parts: a fortiori, its micro-material parts can change while the thing remains. At the bottom, only continuity of micro-material parts matters to the thing's continued existence: a fortiori, its micro-material parts cannot change while the thing remains.

A difficulty arises when we turn from clay to certain other stuffs, however. Clay, after all, is a mixture. What about gold? Suppose we have a chunk of gold;

call it GOLD. The generalization of the first idea about CLAY, namely the Portion of Clay Principle, has an analogue for gold:

Portion of Gold Principle: {x is a portion of gold & y is a portion of gold & $(\exists t)(x < y@t)]$} $\rightarrow \square(\forall t)(yE@t \rightarrow x < y@t)$

The second idea about CLAY also has an analogue for GOLD, namely that any *atom* that is part of GOLD can be replaced in GOLD. Can we accept both of these ideas? Only if we accept that no gold atom is itself a portion of gold. Should we?

I initially introduced the term "portion" in the following way: I said that for the time being, a portion of clay is some clay. It is a quantity of clay. Does it seem intuitively right to think that a gold atom is some gold, and is a quantity of gold? Perhaps so. No doubt you don't have much gold if you have only one gold atom, but perhaps we are inclined to think you do have some. If so, then if we continue to use the term "portion" as I initially introduced it, we must agree that a gold atom *is* a portion of gold. And if we do, something has to go—either the Portion of Gold Principle, or the idea that any atom that is part of GOLD can be replaced in GOLD.

The ordinary use of the term "portion" is heavily context-dependent. If an atom drifts away from your portion of gold, do you still have the same portion of gold? You will say no if you are a scientist engaged in an experiment for which every atom matters. You will say yes if you are a jeweler about to make a ring. Similarly, in fact, for clay. If you have just bought a load of clay, and a handful falls off while you are on your way home, is the portion you have when you get home the same as the portion you bought? You will say no if you had carefully measured and bought exactly as much as you need. You will say yes if loss of a handful makes no difference to you.

So if we are to use "portion" in a way that is context-independent—as I have all along meant to do and will continue to do—we have to impose a constraint. We have to stipulate a use.

I begin with a distinction. Some things are big enough to be, from time to time, a piece, puddle, lump, ... , heap, mound, or stack of M. The clay of which ALFRED's left hand is made is big enough to be a piece of clay. A cupful of water is big enough to be a puddle of water. Other things are too small. A gold atom is too small ever to be a piece of gold. A water molecule is too small ever to be a puddle of water.[11]

The stipulation, then, is this: "portion" is to be so used that a thing is not a portion of M unless it can from time to time be a piece, puddle, lump, ... , heap, mound, or stack of M. In short: unless it can from time to time possess one of the shape-constrained temporary properties I pointed to in section 1, and discussed in the preceding section. This stipulation gives those properties a central role in fixing what counts for our purposes as a portion of M. But I think it is not merely arbitrary to assign them this role. Among other things, it is only what is large enough to possess one of those shape-constrained temporary properties that can

constitute an artifact. (What is large enough to possess one of those properties may be very small indeed, however; some artifacts, after all, are themselves very small.)

The stipulation allows us to retain the Portion of Clay Principle and the Portion of Gold Principle compatibly with retaining the idea that any atom that is part of CLAY or GOLD can be replaced in it. And it allows us to have that a portion of gold, like a portion of clay, is (not identical with but instead) constituted at a time by the all-fusion of the atoms that are parts of it at that time.

Similarly for other stuffs, such as water, coal, soup, pudding, and so on.

6. We now have in hand a definition of the three-place relation 'x constitutes y at t'.

We saw in section 3 that it yields that a portion of stuff might constitute an artifact. (For example, CLAY constitutes ALFRED at 2PM.) Let us now take note of the fact that a portion of stuff might constitute something other than an artifact. Suppose that in 1991, a shortsighted Moscow shopkeeper made a portion of tin into a large bunch of little tin statues of Lenin. Call them lenins; call the tin TIN. What is the bunch of lenins? I suggested in section 4 that it is the all-fusion of the set of lenins; call it ALL-S_{lenins}. Then we have:

TIN constitutes ALL-S_{lenins} in 1991.

(That is true because we can replace one of the lenin's left hand, and after doing so, that lenin, and hence ALL-$S_{lenins'}$ remains but TIN does not.) So here we have a portion of stuff that constitutes not *an* artifact but the all-fusion of a set of many artifacts.

There are also cases in which the all-fusion of a set of many artifacts constitutes *an* artifact. Being unable to sell his lenins, the shopkeeper might in 1992, and purely for his own pleasure, make a big tin statue of Lenin out of them—not by melting them down, but by twisting their little arms and legs together with a pair of pliers. Call the big statue LENIN. Then we have

ALL-S_{lenins} constitutes LENIN in 1992.

(That is true because we can replace one of the lenins, and after doing so, LENIN remains, but ALL-S_{lenins} does not.) Intuitively, these results are as they should be.

But can the all-fusion of a set of only one artifact constitute an artifact? Since the all-fusion of a set with only one member *is* that one member, we can reput our question as follows: can an artifact constitute an artifact?

We can certainly make an artifact out of an artifact. I suspect that in all such cases, an additional or different use—or anyway intended use—is required. In some cases, that by itself suffices, as where we make a desk out of a table. In others, we also deform one to make another, as where we make a tierack out of a statue by stretching its fingers out appropriately. In still others, we add a part.

Suppose we make a throne out of a chair by adding a gilt crown and coming to use it as our throne. Call the chair CHAIR and the throne THRONE. Does CHAIR now constitute THRONE?

Since CHAIR and THRONE now occupy the same place,

(i) CHAIR<THRONE@NOW & THRONE<CHAIR@NOW

is true. Consider now

(ii) There is a z such that z<CHAIR@NOW, and such that z is essential to CHAIR, and nothing that is part of z at NOW is essential to THRONE.

Suppose that z is a small part of CHAIR now. I said in section 2 that I would suppose—with ordinary thought—that artifacts can undergo replacement of a small part. *Any* artifact, I should think, and *any* small part. A certain small bit of its case is now part of my watch; and my watch can undergo replacement of that part, and hence can exist at a time without having that part at that time. My computer can undergo replacement of its current delete key, and hence can exist at a time without having its current delete key at that time. Similarly for my car, my lawnmower, my telephone, and so on.

It might be worth stress that this is true even of those of an artifact's small parts that are more important to it than a small bit of its case is to my watch. Artifacts are made for a purpose: they have characteristic functions. (Hence the importance to them of their shapes.) Thus a watch has the function of indicating the time. A computer has the function of computing. Now my watch has a small part, a certain cog, such that if that cog were removed and not replaced, then my watch would no longer be able to indicate the time. Still, my watch could undergo replacement of that cog, and hence can exist at a time without having that very cog itself among its parts at that time. Similarly for my computer, my car, and so on.

So I think it plain that if z is any small part of any artifact at t, then, however important z may be to the functioning of the artifact, the artifact can exist at a time at which z is not among its parts.[12]

To return, then, to (ii). We were supposing that z is a small part of CHAIR now. It follows that z is not essential to CHAIR. So (ii) is false for that z.

Suppose, instead, that z is a large part of CHAIR now. We might suppose CHAIR largely made of a single slab of wood, appropriately bent, that serves as both seat and back; call it SLAB. Perhaps SLAB is essential to CHAIR? (Its being so, if it is, is compatible with *its* undergoing replacement of a small part.) Then how could SLAB fail to be essential to THRONE?

Suppose that z is not merely a large part of CHAIR now but *is* CHAIR. CHAIR cannot exist at a time without having CHAIR among its parts at that time, so this z is on any view essential to CHAIR. But this z now has a part, namely THRONE, which is essential to THRONE.

In sum, (ii) is false, and it follows that CHAIR does not now constitute THRONE. (Similar reasoning yields that THRONE does not now constitute CHAIR.)

So what happened when we made a throne out of CHAIR? CHAIR did not come to constitute a throne (as CLAY came to constitute a statue); I should think that CHAIR instead became a throne. And when we make a desk out of a table, the table becomes a desk. Similarly for making a tierack out of a statue.

If that is acceptable, then at least some of what I called artifact-properties (being a statue, being a chair, being a car, being a ship, and so on) really are temporary properties. In section 1, I drew attention to the idea that they are temporary properties of portions of stuff, and in section 2, rejected it. But that left open that they are temporary properties of other things. What has emerged here is that some anyway (being a throne, being a desk, being a tierack) are temporary properties of artifacts. It might be worth looking into the question whether all are, and if not, why not.[13]

7. In the preceding section I argued that CHAIR does not now constitute THRONE: the argument relied on CHAIR's failing to meet one of the three conditions it has to meet if it is to constitute THRONE now. Let us now look at a different argument for the conclusion that CHAIR does not now constitute THRONE.

Some people say that no two material objects can occupy the same place at the same time. I have made clear enough that I think that is a mistake.[14] Many more people say that while two material objects can occupy the same place at the same time, no two artifacts can—thus:

Artifact Thesis: No two artifacts can occupy the same place at the same time.

If they are right, then since CHAIR and THRONE now occupy the same place, CHAIR *is* THRONE. A fortiori, CHAIR does not now (or at any other time) constitute THRONE.

If they are right, then, quite generally, *no* artifact constitutes an artifact at any time. For in order for an artifact x to constitute an artifact y at a time t, it has to be the case that x and y occupy the same place at t. But if x and y occupy the same place at t—and if, also, the Artifact Thesis is true—then x is identical with y and a fortiori does not constitute y at any time.

Are they right? Let us look at an argument to the effect that they are not. Consider, again, the definition of all-fusion:

x all-fuses S $=_{df}$
   (1) $\Box(\forall t)\{xE@t \longleftrightarrow [(\exists y)(yeS) \ \& \ (\forall y)(yeS \rightarrow yE@t)]\} \ \&$
   (2) $\Box(\forall t)(\forall y)\{y<x@t \longleftrightarrow [xE@t \ \& \ yE@t \ \&$
     $\neg(\exists z)[z<y@t \ \& \ (\forall z')(z'eS \rightarrow zDz'@t)]]\}$

We can obtain another notion 'fusion' by replacing clause (1). For example, consider what I will call some-fusion, and define as follows:

x some-fuses S $=_{df}$
    (1) $\square(\forall t)\{xE@t \longleftrightarrow [(\exists y)(yeS \ \& \ yE@t)]\} \ \&$
    (2) ....(as above)....

Do any sets have some-fusions? Well, just as every set with one member has an all-fusion which is identical with the set's one member, so also does every set with one member have a some-fusion, which is identical with the set's one member. What of sets with more than one member? I suggested in section 4 that many familiar objects—mounds of clay, bunches of flowers—are all-fusions of sets with more than one member; are there any familiar objects that are some-fusions of sets with more than one member? I doubt it. In any case, I cannot think of any. Still, why should familiarity matter? I said that all-fusion is well-defined in a certain strong sense; so also is some-fusion. And how could empirical investigation disclose that a (non-empty) set lacks a some-fusion?

A warning is in order, however, since all-fusion and some-fusion are only the beginning. Why not also three-fusion? We obtain its definition by making yet another replacement for clause (1). Thus x three-fuses a set only if x exists at a time if and only if three members of the set exist at that time. Analogously for three-or-more-fusion. Analogously for some-red-fusion: x has this relation to a set only if x exists at a time if and only if some member of the set exists and is red at that time. And then there is two-three-bears-fusion: x has this relation to a set only if x exists at a time if and only if two members of the set exist at the time and three members had, before that time, been eaten by bears. These relations too are well-defined, and why should we accept some of the resulting entities and not others?[15]

Accepting all of them commits us to less clutter than at first appears. First, there are identities among some of them. If a set has three members, and there is a time at which all of them exist, then it has both an all-fusion and a three-fusion, and its all-fusion *is* its three-fusion. Second, there are parthood relations among them. If a set has an all-fusion, then it also has a some-fusion, and there are times at which its all-fusion and some-fusion are parts of each other. Third, there are times at which some constitute others. Thus suppose there is a time t at which all the members of a set S exist. Then S has an all-fusion and a some-fusion, and its all-fusion constitutes its some-fusion at t. (I hope this outcome will seem unobjectionable. After all, all-fusions really are more tightly tied to their parts than some-fusions are.) My own view is that we should accept all of those entities. (We can think of Reality as like an over-crowded attic, some of its contents interesting, and most merely junk. There is no need to deny the junk; we can simply leave it to gather dust.) But I won't argue for this view. Let us just have a look at what happens if we accept some-fusions.

Suppose we grant that for any non-empty set, there is something that some-fuses it. Consider the set whose sole members are Caesar's sword and my chair. (Which chair do I refer to by "my chair"? It is a chair that came into existence only recently.) Let us give the name SWORD-CHAIR to the thing that some-

fuses that set. SWORD-CHAIR exists now, since my chair does. Is it a chair? Of course it wasn't always a chair, but isn't it a chair now? If so, then—since SWORD-CHAIR came into existence far earlier than, and hence is not identical with, my chair—there are two things, both of them now chairs, both now occupying the same place. It looks, then, as if the Artifact Thesis has to go.[16]

There are several ways in which that conclusion can be blocked. A familiar way is to allow that my chair and SWORD-CHAIR are both now chairs, but to deny that counting chairs is as straightforward as might have been thought. We might say: to count the number of chairs in a room at a time t, you have to count, not the number of things in the room at t that are chairs at t, but rather the number of sets, each of which has as its members all the things in the room at t that are chairs at t and that are parts of each other at t. (There is only one set that has as its members all the things in my room now that are chairs now and are parts of each other now—that set has my chair and SWORD-CHAIR among its members— hence there is only one chair in my room now.) And we might add that it should be no surprise that accepting some-fusions requires accepting more sophisticated counting-methods.

Another possibility is to deny that SWORD-CHAIR is a chair now. If SWORD-CHAIR is a chair now, it became a chair, for it wasn't always a chair. Moreover, it became a chair simply because some other chair (namely my chair) came into existence. Now it does seem plausible to suppose that nothing can become a chair simply because some other chair comes into existence—at least as plausible as that every non-empty set has a some-fusion. And if that *is* right, then SWORD-CHAIR did not become a chair: while it now has a chair among its parts, it is not itself a chair now.[17]

There is obviously more to be said about these matters. But I doubt that any of the more that has to be said would yield compelling reason—reason it would be unreasonable to resist—for rejecting the Artifact Thesis. (Or at least for rejecting what its friends intend by it.) My concern has been merely to point to a kind of consideration that friends of that thesis have not addressed themselves to but should.

8. In any case, we now have in hand an analysis of constituting. Three things call for brief mention.

First, the highest ontological level I described is that of artifacts, and it might well be asked whether there is a level above them—above them as artifacts are above portions of stuff and portions of stuff above masses of atoms. What would they be like? We have to suppose them to be even less tightly tied to their parts than artifacts are. Are they to be thought to float entirely free of their parts? What, then, could be thought to fix their paths through time, or even to mark one off from another? The cluster of issues that arise here might be worth looking into: they might have an interesting bearing on the difficulties (described in section 2) having to do with limits on replacements of parts in artifacts.

Second, I have been concerned throughout with artifacts and the things that constitute them, and have therefore said nothing at all about living creatures. I take cats and people to *be* their bodies, and hence not to be constituted by their bodies; but their bodies are surely constituted from time to time by this or that portion of flesh, just as a statue may be constituted from time to time by this or that portion of clay. I think that the definition of constituting that I supplied will be found to work for feline and human bodies too—as also for many non-artifactual but non-living things—but I lack space to discuss the matter.

Third, it may have been noticed that I have said nothing at all about temporal parts of material objects. According to the metaphysic of temporal parts (MTP), every material object is the fusion of its temporal slices. I had two reasons for bypassing that idea.

(i) it is unclear what MTP *means*. Unclear in two ways. (ia) Suppose CHAIR is a chair that existed at a given time-point, say 2PM. What is its 2PM temporal slice? We know that it is supposed to be the x such that x and its parts exist only at 2PM, and x and CHAIR are parts of each other at 2PM. Could x have lasted longer than it did in fact last? Could it have been red instead of brown? Proponents of MTP have to go on to stipulate answers, for "temporal slice" is not here well-defined in the sense I drew attention to—what I just wrote gives no modal information at all about temporal slices—and we have no modal intuitions to pick up the slack. (Standardly, I think, proponents of MTP stipulate that temporal slices of a thing couldn't have lasted for more than a time-point, but could have been red instead of brown.)

(ib) What is the relevant fusion-relation? All-fusion is obviously not on the cards; what about some-fusion? This question can't be answered until a prior question is answered. It is plain enough that any chair, and thus CHAIR in particular, could have lasted for a longer or shorter time than it does in fact last. How are proponents of MTP to accommodate that modal fact? One possibility is for them to say that CHAIR has some temporal slices in some possible worlds that it lacks in others. If they say this, then they cannot have that CHAIR is the some-fusion of its temporal slices: they have to opt for a modalized version (which?) of one or other of the temporary fusion-relations I mentioned in note 15 (which?). (And given temporary fusion-relations, it is hard to see what is gained by helping oneself to temporal slices as well.) A second possibility is for them to say that CHAIR has the same temporal slices in all possible worlds in which it exists, but—despite the slices' being temporally point-thick in all possible worlds—they spread over longer or shorter periods of time in different worlds.[18] (Thus perhaps that every pair of CHAIR's temporal slices are temporally further apart in nonactual world alpha, and temporally closer together in nonactual world beta, than they are in this world.) If proponents of MTP say this, then they can have that CHAIR is the some-fusion of its temporal slices. Perhaps there are other possibilities too. Which should they choose? (Is that really an interesting question?)

My second reason for bypassing MTP, (ii) is that it helps not a bit in solving the problem of the statue and the clay. That is because what makes the problem a hard one, and constrains what can count as a solution to it, is our modal intuitions about ordinary, familiar, three-dimensional portions of stuff and artifacts. That is where we have to begin, and what has to be respected throughout. I am sure that the story we arrive at (whether mine or anyone else's) can—given enough ingenuity—be translated into a modalized language of temporal parts. But I see no good reason to think the enterprise would pay.[19]

Notes

[1]Ali Akhtar Kazmi (among others) asks an analogue of this question in (1996, section V).

[2]The statue of David in Florence is not merely a statue: it is also a genuine Michaelangelo. The statue would survive the loss of a hand, and would still be, after the loss, a genuine Michaelangelo. The statue would go on to survive insertion of a new hand (by Bloggs, as it might be), but after the insertion, the statue would no longer be a genuine Michaelangelo. In sum, being a genuine Michae-langelo is a temporary property. (For discussion of subtleties that I must bypass, see Elgin (1994).) The point here is not restricted to works of high art: any artifact will do. If I knit you a sweater, the result is a sweater made by JJT. It is so still after the collar unravels. It is still a sweater after you replace the collar, but not a sweater (wholly) made by JJT.

[3]Among the consequences of (ii) is

(iii) x is part of x at t → x exists at t,

which has counterintuitive consequences: for example, it yields that since Caesar does not now exist, he is not now part of himself. Unfortunately, the alternatives to convention (ii) are intuitively no better and are markedly messier.

(i) and (iii) jointly yield

(iv) x exists at t ↔ x is part of x at t,

which permits elimination of the predicate "exists at t". See note 7.

[4]Accepting the ideas I am arguing for obviously requires rejecting the Calculus of Individuals as standardly interpreted, since according to its standard interpretation, parthood is an atemporal two-place relation and mutual parthood suffices for identity. See Leonard & Goodman (1940). A tempo-ralized, modalized identity-thesis is suggested in Thomson (1983), and appears in note 8.

[5]Some people argue in the following way against the possibility that two material objects can oc-cupy the same space at a time. Suppose ALFRED is on a scale at 2PM, and weighs ten pounds then. CLAY, by hypothesis, weighed ten pounds at 9AM, and we may suppose it still does at 2PM. Since AL-FRED is on the scale at 2PM, and CLAY occupies the same space at that time, CLAY too is on the scale at that time. But if ALFRED is not identical with CLAY, then the scale should read twenty pounds, not ten—and it doesn't. (See, for example, Lewis (1986, p. 252) and Zimmerman (1995, p. 89).) But why should the scale read twenty pounds when ALFRED and CLAY are both on it? The two are not iden-tical, but they are not discrete from each other: each is part of the other. ALFRED's left hand is still part of ALFRED at 2PM; suppose that it weighs six ounces at 2PM. Expecting the scale to read twenty pounds at 2PM when ALFRED and CLAY are both on it is about as sensible as expecting the scale to read ten pounds six ounces at 2PM when ALFRED and his left hand are both on it.

Another kind of argument against the possibility that two material objects can occupy the same space at a time relies on the premise that if x and y are material objects, then if x and y do not differ in their intrinsic (or physical or qualitative) properties at a time t, then they do not differ in their modal properties either. (More briefly put: the modal supervenes on the intrinsic.) Here, then, is the argu-ment. By hypothesis, ALFRED and CLAY occupy the same space at 2PM, and hence have the same

parts at 2PM. It follows that they do not differ in their intrinsic properties at 2PM. Therefore—given the premise—they do not differ in their modal properties. It follows that they are identical. (See, for example, Burke (1992), Zimmerman (1995, pp. 87–90), and Levey (1997).)

Should we accept that premise? Well, what do its friends have in mind by "intrinsic"? They standardly leave this to intuition, and that makes for trouble. After all, under a familiar understanding of intrinsicality, two things can perfectly well share their intrinsic properties at a time, and yet, since they are two, differ in their modal properties. Consider two Chevrolets A and B, A in my garage, B in yours. They may well share their intrinsic properties now; but while it may be the case that they therefore share some of their modal properties—indeed, I suspect it is the thought that they therefore must share some that is responsible for the initial plausibility of the premise—they certainly do not share all. (For a familiar kind of example, A can, and B cannot, undergo replacement of a part without B's doing so.)

"Ah, but I didn't mean by intrinsic what you mean by it. I meant to include parthood relations. That is what is crucial to my argument: ALFRED and CLAY have the same parts at 2PM!" But if that is what is crucial, then that is what is doing the work. So you might as well have argued, more simply, that since ALFRED and CLAY share all their parts at 2PM, it follows that they do not differ modally, and hence that they are identical. But this idea is not at all obvious. Why should it be thought that if x and y share all their parts at one time, it follows that they must at all times? This is what was itself to be *argued* for, not merely asserted.

⁶In an earlier draft, I defined constituting more simply as the conjunction of clauses (1) and (2). I did not at the time see that certain of the rather queer looking entities of the kind I described in section 4 would make trouble for that definition. (See note 9 for an example.) I am indebted to James Pryor for drawing my attention to the trouble, and to Ralph Wedgwood for suggesting that I add condition (3), which I think eliminates it.

⁷I proposed to analyze constituting wholly in terms of parthood with the help of a few modal operators. But what of that predicate "xE@t" that appears in the definiens? Given housekeeping conventions (i) and (ii), it is itself definable in terms of parthood—see note 3.

⁸If we help ourselves to what I take to be a very plausible identity-thesis, namely

$$x = y \leftrightarrow \Box(\forall t)\{(xE@t \text{ v } yE@t) \rightarrow [x{<}y@t \text{ & } y{<}x@t]\},$$

then we can conclude that if x all-fuses S, then x uniquely all-fuses S.

The idea for all-fusion is suggested by Locke's remarks about what he calls masses of atoms—for a familiar quotation, see note 10—and by some of Peter Simons' remarks about what he calls masses in Simons (1987).

Kit Fine has recently drawn attention to differences between what he calls compounds and what he calls aggregates; see Fine (1994). The compound of a set S, like the all-fusion of S, exists when and only when all members of S exist, so compounds and all-fusions share existence condition (1). But Fine believes that there is no one relation 'part' on material objects: he takes there to be two, namely 'compound-part' and 'aggregate-part', and neither is a temporary relation. I regret not having space to discuss these ideas. (I am not at all sure I have fully understood them.) In any case, compounds and all-fusions do not share parthood condition (2). There is a similar difference between aggregates and what I will later call some-fusions.

⁹Given this idea, the simpler definition of constituting I mentioned in note 6 will not do. Let F1 be the all-fusion of my chair and its left front leg and F2 be the all-fusion of my chair and its right front leg. F1 is now part of F2 and F2 is now part of F1, so F1 and F2 meet condition (1) on constituting. F1 now has a part essential to it, no part of which is essential to F2. (The chair's left front leg is essential to F1, but I presume that that leg could be replaced in the chair, and thus that neither that leg nor any of its parts is essential to F2.) So F1 and F2 meet condition (2) on constituting. If the conjunction of (1) and (2) sufficed, it would follow that F1 now constitutes F2. Unfortunately, similar reasoning would yield that F2 now constitutes F1. Adding condition (3) blocks both outcomes. And intuitively, they should both be blocked: intuitively, neither F1 nor F2 now constitutes the other—neither is ontologically below the other.

A problem that arises here is this. Suppose we grant that there are such things as F1 and F2. Are they both chairs? If they are, then there are not only three things, there are three chairs currently occupying the same place: my chair, F1, and F2. *Can* that be so? We return to this question in section 7.

[10]My definition does not capture exactly what Locke had in mind. Locke said: "...if two or more atoms be joined together into the same mass, ...whilst they exist united together, the mass, consisting of the same atoms, must be the same mass, ...let the parts be ever so differently jumbled. But if one of these atoms be taken away, or any new one added, it is no longer the same mass... ." I interpret Locke as meaning that a mass of atoms (in his sense) continues to exist only while the atoms are "united together"; that is not among the existence conditions of a mass of atoms in my sense.

[11]Compare the fact that the all-fusion of the set whose sole member is one flower is 'too small' (contains too few flowers) ever to be a bunch, cluster, or bouquet of flowers.

[12]Some of the terms we use to refer to artifacts may mislead us into thinking otherwise. Suppose I put a small painting into a large frame; can that framed painting exist at a time at which the painting (that very painting) is not part of it? Intuitively, no. But that is surely because a framed painting is the painting—the painting is now a framed painting because it happens, now, to be in a frame—and a painting cannot exist without having itself among its parts. Similarly for a mounted medal and a potted plastic geranium. (Similarly for a potted geranium, but that example is irrelevant here, since a geranium is not an artifact.) Similarly, I should think, for a deskclock, which I take to be a clock mounted on or embedded in a stand suitable for use on a desk. (I am indebted to Alex Byrne for "deskclock".)

[13]Are any artifact-properties temporary properties of other things besides artifacts? Peter van Inwagen had the delightful fantasy that we have a very long thin snake, which we weave into a hammock. (We are somehow able to persuade it to stay put.) See van Inwagen (1990). Here a living creature acquires an artifact-property.

[14]The well-known problem about Tibbles the cat does not turn on the fact that Tibbles is a cat, so let us suppose it is a clay statue of a cat. We are invited to suppose first that Tib is the material object that, at 2PM, occupies the space occupied, at 2PM, by all of Tibbles except its tail. Shortly before 3PM, someone breaks off Tibbles' tail. At 3PM, Tibbles—having lost its tail—occupies the same space as Tib does. We are then invited, second, to agree that no two material objects can occupy the same space at a time. It follows that Tibbles is identical with Tib. But of course it is not, for Tibbles's tail was once part of Tibbles but was never part of Tib. So something has to give. What should give?

Well, we should refuse the second invitation: we should refuse to agree that no two material objects can occupy the same space at a time, for a portion of stuff and an artifact and a all-fusion of atoms and an all-fusion of artifacts can all occupy the same space at the same time. But this means that we should refuse the first invitation too. There is no such thing as *the* material object that, at 2PM, occupies the space occupied, at 2PM, by all of Tibbles except its tail. There are at least two material objects that occupy that space at that time: a portion of clay and an all-fusion of atoms. So "Tib" was not even well-defined.

There is a larger lesson in the offing here. Many people are in the habit of inviting us to attend first to (as it might be) a statue or a car, and second to (as they put it) *the* left-hand half of the statue, or *the* rest-of-the-car-other-than-its-tires. What entities are those? What warrants those occurrences of "the"?

[15]And this is only one *kind* of fusion relation. The fusion-relations discussed in the text are not temporary relations: if x has one of them to a set, there is no time at which x does not have it to that set. But there are also temporary fusion-relations: a thing can have a temporary fusion-relation to a set at one time and not have it to that set at a different time. These ideas are discussed in Thomson (1983).

[16]And it also looks as if *all* artifact properties are temporary properties. For consider any currently existing artifact x, of any kind K you like. Consider the set whose members are Caesar and x; call its some-fusion CAESAR-X. If SWORD-CHAIR is now a chair, then surely CAESAR-X is now a K. It wasn't a K in 44BC, but it is one now.

[17]I think it even more plausible to suppose that no chair has one of its legs essentially. If that is right, then the all-fusions F1 and F2 of note 9 are also not chairs, and the fact that they and my chair currently occupy the same place does not count against the Artifact Thesis.

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