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MEREOLOGY AND TRUTH-MAKING*

Abstract. Many mereological propositions are true contingently, so we are entitled to ask why they are true. One frequently given type of answer to such questions evokes truth-makers, that is, entities in virtue of whose existence the propositions in question are true. However, even without endorsing the extreme view that all contingent propositions have truth-makers, it turns out to be puzzlingly hard to provide intuitively convincing candidate truth-makers for even a core class of basic mereological propositions. Part of the problem is that the relation of part to whole is ontologically intimate in a way reminiscent of identity. Such intimacy bespeaks a formal or internal relation, which typically requires no truth-makers beyond its terms. But truth-makers are held to necessitate their truths, so whence the contingency when A is part of B but need not be, or B need not have A as part? This paper addresses and attempts to disentangle the conundrum.

Keywords: mereology; mereological propositions; truth-makers; continuants

1. Contingent Parts

A modern aircraft, such as the Aer Lingus Airbus A320-214 EI-DVM *St. Colmán*, is serviced often during its lifetime and in that time a fair number of parts are replaced. When *Colmán* was being assembled at the Airbus factory in Toulouse, many of the hundreds of thousands of objects from which it was assembled became parts of *Colmán* contingently. This may be contrasted with the situation of *Colmán* itself, which according to a certain metaphysical view, that of the necessity, or, as I prefer to

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say, essentiality of origin, could not have come into existence from other things than those which initially composed it. Let P be one of those initial parts and C the aircraft. Let T be the time of completion of C . Then the asymmetry between P and C regarding the status of P 's parthood of C can be expressed thus:

It is accidental to P that it be part of C at T
It is essential to C that P be part of it at T

Essentiality of initial parts is an attractive doctrine but nothing of moment turns on it in what follows.

During subsequent maintenance, some of the original parts have been replaced, so that of such a replacement part R now part of C we may not only say that:

It is accidental to R that it be now part of C

but also, since replacement parts are not essential to the whole in the way original ones may be:

It is accidental to C that it now have R as a part.

Such matters being so, we may raise the Aristotelian question:

In virtue of what is R part of C ?

Another way to put it is that we are looking for a p satisfying:

R is part of C because p

and to bring the matter to a head, we may wonder whether there are objects m ¹ such that:

R is part of C because m exist

If there are such objects m , they are *truth-makers* for the proposition that R is part of C . I shall be enquiring whether mereological propositions need, have, or can have, truth-makers of any sort.

¹ Upper case schematic letters are singular, lower-case singular-or-plural, treated syntactically as plural.

2. Truth-Making in General

Discussions about what entities, if any, serve to make certain propositions true continue old and long-running disputes about the denizens of reality. One such dispute took place in Oxford in the 1320s, when the nominalist William of Ockham denied, while his contemporary realist Franciscan confrère Walter Chatton affirmed, the need to posit real relations to account for certain kinds of change. Their opposition is eloquently described in Rondo Keele's *Stanford Encyclopedia* article on Chatton,² where it incidentally emerges that Chatton also delved into mereology, being one of the minority who posited the existence of indivisibles as parts of a continuum. Chatton's so-called anti-razor is formulated as:

Whenever an affirmative proposition is apt to be verified for actually existing things, if two things, howsoever they are present according to arrangement and duration, cannot suffice for the verification of the proposition while another thing is lacking, then one must posit that other thing. (*Lectura* I d. 3, q. 1, a. 1.)

Ockham's opposition to this is expressed as:

It is impossible for contradictories to be successively verified for one and the same thing, except (i) on account of local motion of something, or (ii) on account of the passage of time, or (iii) on account of the production or destruction of some thing.

(Ockham, *Scriptum* (= *OTH IV*), I, d. 30, q. 1, 396, lines 8–9)

The idea of things *verifying* propositions, undisputed by either Ockham or Chatton, is simply truth-making in medieval terminology. Acknowledging the general legitimacy of looking for truth-makers underdetermines one's ontology: Chatton defends Scotist realism about universals, Ockham denies it, but both accept the truth-making question as valid. Those truth-makers which *must* be posited to account for the truth of propositions are that to which the propositions ontologically commit us. The terminology of verifying and falsifying is markedly more mellifluous than talk of truth-making or falsity-making and I shall occasionally avail of it for stylistic relief.

Modern truth-maker theory positing facts or states of affairs as truth-makers goes back to Stumpf and Husserl on the European continent

² [4]. Both passages cited below are from this.

and to Russell and Wittgenstein in Britain. Its most prominent contemporary advocate was David Armstrong, who also upheld the principle of truth-maker maximalism, according to which every truth has a truth-maker ([1]). Maximalism encounters grave difficulties with general propositions and negative existentials which will not be pursued here, but which are sufficient to warrant abandoning it in favour of the more moderate principle of John Bigelow that truth supervenes on being: that what is true or false depends on what does and does not exist ([2, 133]). I consider that the only propositions unequivocally in need of truth-makers are true atomic propositions,³ including true singular existentials, and those propositions which require such atomics to be true in order to be true themselves. As to the nature of the truth-makers themselves, that is a more delicate matter. Sometimes, as in the case of a true singular existential, it is simply the object itself. In a wide class of other cases, the truth-makers can be taken as *tropes* ([5]). Whether these have to include real relations, the Ockham-Chatton issue, is relevant here. A trope is a particular that depends for its existence on something with which it shares no part. A *relational* trope is one dependent on two disjoint particulars. A putative example of a relational trope is the collision between the *Titanic* and a certain iceberg which took place in the north Atlantic late on 14 April 1912. That trope makes it true that the *Titanic* and an iceberg collided.

3. Truth-Making in Mereology: the Problem

With these general remarks in mind, let us turn to the issue of mereological truths, such as the truth that R is part of C now. Those who posit facts or states of affairs have no difficulty here: there are mereological facts just as there are other facts. I shall be essaying a more parsimonious nominalist theory dispensing with facts and also dispensing with the universals held to be non-particular components of such facts.

³ The question as to which propositions are atomic is a delicate one. Essentially logically complex ones clearly are not, nor are ones which conceal logical complexity, like ‘John kissed Mary’. A positive characterization is harder to come by. My own tentative suggestion for what it’s worth is that the only atomic propositions are particular existential propositions, stating the existence of an individual, multitude or mass.

When one object is part of another, this is a particularly intimate relation, touching the very being of the two terms, by comparison with which most relations appear very incidental. Two mereologically overlapping objects are in part identical, while a part helps to make up or compose the whole, to make it what it is. As we have seen, in many straightforward cases, it is accidental to an object that it be a part of another or have another as part, and the question arises as to why this is part of that. So when mereological truths are considered, we can and should raise the truth-maker question.

Suppose we say, with the collision example in mind, that when A is part of B this is because of the existence of a parthood trope connecting A and B . There are two worries about this, one minor, the other terminal. The minor worry is that we would need a way to distinguish the case of A 's being part of B from that of B 's being part of A . The parthood trope will need to have two different kinds of end-attachment, so to speak. In this it may simply reflect a worry about relational tropes in general, which is how they differentiate the two directions of a relation if it is not symmetric. Maybe there is a way to do this. Here is one thought. Parthood can be defined in terms of mereological overlapping: A is part of B if and only if everything that overlaps A overlaps B . Overlapping is symmetric, so the order problem does not arise for it. That we understand overlapping as having a common part could be excused by saying that what is metaphysically prior is not the same as what is epistemically or semantically prior. I will come back to this. But here is the terminal objection. If the parthood trope exists, being a dependent particular, it will surely in some sense exist in the part and thereby of course in the whole. But if we are to make sense of existing in, it seems we should think of the parthood trope as being a part of the part. This starts an infinite regress. Further, for each object D of which A is part there is another part of A in virtue of which A is part of D , so then A will contain distinct parthood tropes for each superordinate object D , which appears absurd, especially in a mereology with liberal existence conditions. A will turn out to be a sort of microcosm of all its superordinates, and have infinitely many parts.⁴

⁴ An alternative is that the part-tropes be somehow strung out between A and its wholes. The problem with this is the same as with every relational trope, namely where it might be located. And if a whole B has many parts, it also contains the part-tropes linking it to each part, and these kick off an infinite regress within B .

I conclude therefore that there are no parthood tropes and that we should enquire elsewhere as to why mereological truths are true. Here is a more promising line. In other cases of ontologically important and fundamental concepts such as existence, identity, difference, and similarity, there are truth-makers to hand which do not require any spooky ethereal tropes. For the truth of a singular or plural existential proposition we have no need of a trope of existence, and indeed the very form of the truth-making template tells us what these should be: the proposition that m exist is true *because* m exist, so the object or objects m are themselves the truth-maker for this proposition. For the truth of the basic proposition that objects A and B are different, $A \neq B$, the objects A and B themselves suffice.

With this in mind, and recalling the consideration about symmetry, in a paper of 1998 ([7]) I proposed that overlapping be considered the metaphysically primitive notion, with *part* defined as before. The suggestion was that the form of a mereological atomic proposition is ‘ A overlaps B ’ and that the folk understanding of *part* is not metaphysically primitive. The truth-makers for such a mereological proposition, I suggested then, are just the objects c which are the common parts of A and B , where the parts c do not serve as *joint* truth-makers, but act *severally*: each on its own serves as a truth-maker, since even one common part is enough for overlap. True propositions of the form ‘ A is part of B ’ would be verificational hybrids:

$$\begin{aligned} A \text{ is part of } B &=_{\text{Df}} A \text{ exists and } B \text{ exists and for no } X: \\ &X \text{ overlaps } A \text{ and } X \text{ does not overlap } B. \end{aligned}$$

Being a conjunction of singular existentials and a negative general existential this will be true because A exists and B exists and because there is no X overlapping A that does not overlap B . True negative general existentials do not require their own truth-makers: they are true by default for want of a falsifying instance ([9]).

The problem with this theory is that where it is contingent that one thing overlaps another, the objects invoked to make the overlapping propositions true do not have to do so. Aircraft C and replacement part R are like this. R overlaps both R and C , but did not have to, so the mere existence of R is insufficient to entail that R overlaps C : R could easily have existed and been incorporated into a different aircraft, or never have been incorporated into any aircraft but have lived out its existence as an

unused spare. R and C might never have had any common part. It is however generally held that for objects m to make a proposition p true, they have to *necessitate* it, in the sense that p has to follow necessarily from the objects' m existing.

NEC If m is a truth-maker for p , then necessarily, if m exists, then p

As the example shows, objects may overlap yet none of their common parts necessitate this.

4. Some Rejected Solutions

There are several ways one might get out of this difficulty. One of course is to give up truth-making altogether, or to move to a position like that of David Lewis where not what there is alone but what there is and how things are together determine truth. To me this just gives up truth-making except for an uninteresting class of cases, and it also pushes us back on the question as to how things are the way they are if not in virtue of what there is. In other words, I would prefer if possible to adhere to Bigelow's Tractarian conception that what is true supervenes on what there is.

A second move might be to give up on necessitation as essential to truth-making. Then the objects that are contingently part of both A and B can still figure in the story as to why A and B overlap. The problem with this is that it throws the baby out with the bathwater, because then it is not the mere existence of the objects in question which forces the proposition to be true, but something about them and maybe other things. This returns us to the previous position, since we are again asking what — other than their being common parts of A and B — about the objects c makes them relevant to the truth that A and B overlap.

The necessity inherent in the truth-making relation is not logical or analytical necessity: it does not turn solely on the meanings of terms, logical or otherwise. Rather, it is metaphysical necessity. There is nothing in the meaning of the term 'cold' (in the folk medical sense) that requires the truth-makers for 'John has a cold' to be rhinoviruses causing the usual symptoms in John's upper respiratory tract. But for all that, their presence with the resulting effects are what indeed make it true that John has a cold.

A third move would be simply to give up looking and admit defeat: mereological propositions get to be true or false somehow, but there is no enlightening or otherwise helpful story about how this comes to be: it just does. This is basically a counsel of despair. It may not be wrong for all that, but if we can make some progress towards a less doleful solution it might be avoided.

5. Parts of Processes: Occurrent Mereology

It will be noted that the examples of accidental part-whole and other mereological relations are all drawn from the realm of enduring continuants, such as aircraft and their material parts, and there are countless similar examples. In the case of continuants and their parts we must recall that the crucial mereological relations are time-relative: A is part of B now, C was part of D yesterday, A overlaps B at time T , or from time T_1 to T_2 , and so on. But for processes, events and other occurrents, part-whole and cognate concepts are not significantly tensed. Mario Götze's winning goal-scoring event is part of the 2014 World Cup Final, *simpliciter*. The time of the goal-scoring is of course among the times of the whole match, the events are not themselves atemporal, but the mereological relations among them are not significantly tensed. This tells us that the mereology for occurrents is importantly different from that for continuants. And this is one of the differences: that occurrents obey mereological essentialism, in the following sense: that for all O and P : if O has P as a part then it is essential to O that it have P as a part. This means that the existence of O already suffices for P to be part of O , and therefore also of course that P exists. O and P can be taken as the truth-maker for the proposition. Note that while it is essential for O that it have P as a part, it is not in general essential to P that it be part of O . For P might easily occur without O occurring, if for example the football match were abandoned after rioting broke out following the goal. For the part-whole relation to obtain between P and O , *both* have to exist — that is the first axiom of free mereology. Given O 's existence, that P exists and is part of O follow by metaphysical necessity. So the part-relation between P and O obtains internally. In old-fashioned terminology, it is an internal relation. In truth-making terms, nothing further is required for P to be part of O than that both exist, so there is no need for a relational trope or other item as special truth-maker.

There is an obvious worry about this, which is that it makes events and processes modally incredibly rigid. No event could have had any other parts than those it in fact has. Had one stumble of a warhorse or one breath of a soldier not happened, the Battle of Waterloo would not have happened. This seems absurd. However we should not overlook the fact that an expression like ‘the Battle of Waterloo’ is a description, not a proper name, so *any* event uniquely satisfying the description would be its referent. By contrast, the *actual* Battle of Waterloo, as it in fact and in every detail took place, is a determinate event. *It*, that very battle, would not have taken place had any part been different, no matter how otherwise like it its counterpart was. So I consider that indeed there is just such mereological rigidity, irrespective of the size or complexity of the event. What is however not true is that the events that do take place have to take place. The abandoned football match could have happened though it did not. The goal-scoring did not need to happen. The metaphysically strict position then is that if any parts P had not happened and P is in fact part of O , then O would not have happened, but quite possibly some other event very like O would have happened. An insignificant part of the Battle of Waterloo may have made very little or no difference to the outcome, and there still would have been an event which would merit the description ‘the Battle of Waterloo’, but it would have been a numerically different event from our Battle of Waterloo, an historical counterpart, not the very same event. In this strict mereological rigidity, occurrents are unlike continuants.

The upshot then is that for some objects in time, we have a decent and deflationary solution to the question why the mereological relations that obtain amongst them do so obtain. The next question is then how this affects our initial problem about contingent parts.

6. Mereology for Continuants

Parthood and other mereological predicates are not the only ones which are relativised to times when considering continuants. The same applies to existence: Napoleon existed in 1815 but not in 1715 or 1915. But while Napoleon may be considered to necessitate that he exist at *some* time, he by no means necessitates that he existed in 1815: he might have died earlier. So to provide truth-makers for such contingent temporal existence propositions I have suggested we look to what I call

vital constitutive processes: the processes, whatever they in fact are, in virtue of which a continuant continues to exist from one moment to the next ([8]). That there are such processes is very evident in the case of organisms, less obviously so in the case of inorganic objects. However, even in the case of inorganic objects such as stones there are continuous processes going on in regard to the forces which hold parts together, such as electromagnetic interactions mediated by photon exchange or the strong force mediated by gluon exchange.

That in virtue of which a continuant exists at a certain time is the phase of its total vital processes which, if they are taking place at that time, necessitate the truth that they do, since their temporal location is essential to them, and also necessitate the existence of their constituted continuant at that time.

Let us follow then the thought that a continuant exists at a time not on its own account but by dint of being constituted by vital processes. How does this play into the mereology of continuants? The career or continued existence of a continuant is dependent on the continuation of vital processes constituting it. Further, these processes have to be suitable continuations of earlier processes for it to be the same continuant which existed earlier. The processes have to stand in a suitable equivalence relation, called *genidentity*, to earlier processes. When that happens, the constituted continuant carries on existing; when not, it ceases to be.

Here then is how continuants differ modally and mereotopologically from processes. Continuants are modally floppy, even unpredictable, in that at a given time it is not necessary, nor is it in general wholly determinate, how it will carry on, that is, which vital processes will succeed the current ones and keep it existing. I come to the crossroads and decide to go one way rather than the other. I could have gone the other way. My constitutive processes up to the decisive moment could have been continued otherwise than they did in fact continue, and then I would have continued to exist but would have taken the other path. The processes which actually take place make it true (necessitate) that I exist then and am where I am, even though I could have been elsewhere, or no longer existent.

Now let us look at the parts of continuants. If R is part of C at T , this is because the processes $\text{Pr}(R)$ constituting R are among the processes $\text{Pr}(C)$ constituting C , and indeed given that $\text{Pr}(C)$ exist, $\text{Pr}(R)$ could not have failed to occur and be part of $\text{Pr}(C)$. But R could have existed

and have been constituted by other the same or other processes not part of processes $\text{Pr}(C)$. As a result, while R is part of C at those times, neither does R have to be part of C , nor does C have to have R as a part. So what makes it true that R is part of C at T ? Answer: some processes P occur at T (a time essential to P) and constitute at T that same R which existed earlier, by contingently succeeding earlier processes which then constituted R , so that they are genidentical with earlier processes. These processes P are part and/or some of other processes Q taking place at T which equally contingently continue earlier processes and non-contingently constitute C . So R is contingently part of C at T and the truth-maker for this is P and Q together. Processes can then be truth-makers for propositions about continuants.

This solution is compatible with but does not entail the thesis that the initial parts of a continuant, those it has when it comes into existence, are essential to it. Consider again our Irish aircraft *St. Colmán* and imagine some small part such as a bolt or washer had been used instead of the one that was actually used. Would it have been a different aircraft, albeit one sharing most of its parts with the actual one? In practical and everyday terms, no, but maybe we should be metaphysically strict, because a slope of a thousand miles begins with a single slip. This ambivalence between loose and strict interpretations of initial mereological essentialism is well brought out in a passage of David Mannings's delightful fable "Hume and a Broom", reproduced in Desmond Henry's *Medieval Logic and Metaphysics*, where Hume, having received an unusually lively impression of being tumbled down the steps of his club by a man sweeping them, enters into conversation with the man about the fact that the broom appears remarkably well preserved despite having been in continuous use for many years. It transpires that the broom head and handle are regularly replaced in turn, and Hume sets out to disabuse the poor fellow as to his confusions regarding the notion of continued identity through time. The workman proves adept in debate and Hume begins to wonder whether he might perhaps be a distant relative of Locke from among the lower classes. Hume explains patiently that a succession of distinct parts destroys the continued identity, but the man objects that if it loses just a bristle it is still the same broom.

'If some small or inconsiderable part be added to the mass,' explained Hume kindly, 'or be subtracted from it: though this absolutely destroys the identity of the whole, strictly speaking, yet as we seldom think so

accurately, we scruple not to pronounce a mass of matter the same, where we find so trivial an alteration.'

(David Mannings, 'Hume and a Broom' in: [3, 118–9])

The episode ends with a flustered Hume, to his great annoyance, tipping the man a *whole* penny by mistake.

It is of course the discrepancy between the practical, ends-oriented conception of continued identity and the mereologically constant conception, adumbrated here by the semi-fictitious Hume, that gives rise to puzzles such as that of the Ship of Theseus, the message of which appears to be that matters of continuant identity and fate may turn on different conditions of continuation or succession among the processes constituting a continuant. The merchant's ship and the museum director's ship fulfil different mereological persistence conditions, and therein lies the origin of the puzzle ([6, 199 ff.]). In a word, what counts as genidentity may be in some cases and to some small degree up to us, especially among artefacts. In China, restoration of old buildings and monuments, which in Europe would constitute rebuilding and replacement by a replica, there often counts as restoring the original. Tiananmen in Beijing is variously said to date to 1420, the date of the first gate on the site, or to 1651, the date of the Qing reconstruction after the previous gate was destroyed during the rebellion against the Ming, but it in fact dates to 1970, when the 300-year old gate was rebuilt under scaffolding, with a lift, heating and earthquake-resistant features, but a largely unchanged external appearance, while people were told that it was being "restored".

7. Other Cases

We consider first occurrents. The account given for the truth-makers of a proposition 'A is part of B' works for both proper and improper part, and does so whether one defines improper part using identity or using reciprocal parthood. To verify that A exists and B exists and A is different from B we need both A and B. For the truth of 'A exists and B exists and A is identical to B' we need just A (also known as B): that $A = B$ is true by default. Occurrents A and B overlap if and only if for some X, X is part of A and of B. So any occurrent C that is a common part of A and B is such that the three objects A B C verify the proposition that C is part of A and part of B and by the entailment principle they verify the general existential proposition that

A overlaps B . The same applies to any other trio of objects $A B D$ such that D is a common part of A and B . A truth to the effect that two occurrents A and B are disjoint has no truth-makers but is true by default when there is no trio $A B C$ falsifying it. If an occurrent O is a sum or fusion of several occurrents m this rests on the truth of two propositions: that each one of m is a part of O , and that no part of O fails to overlap at least one of m . The first proposition has as its joint truth-makers every pair X, O where X is one of m . There are two ways this can be summarised: one is simply to take O and adjoin it to the multitude m , the other is to take the pairs $X O, Y O, Z O$ and so on for each of $X Y Z \dots$ that is one of m . This will be a multitude of multitudes. Nothing in previous truth-maker theory decides which of these alternatives is preferable, though the first does not, while the second does, commit us to higher-order multitudes.⁵ Call the first the flat view and the second the storeyed view. The second proposition is true by default for want of an object X that is part of O but not part of any one of m . Incidentally, the proposition that X is one of m is verified by m if we adopt the flat view of a multiple truth-maker, since m includes X already; on the storeyed view the truth-maker is the pair X, m .

Now let's look at continuants. The accounts for overlapping, disjointness and fusion at a time will depend in the same way on the more basic part-whole propositions as for the case of occurrents, but the underlying truth-makers where needed will be inherited from the constitutive processes as in the simple case. A continuant is, becomes, remains, or ceases to be a part of another continuant according as the constitutive processes of the part enter into, remain within or cease to be part of the constituent processes of the whole.

8. Conclusion

There is after all a truth-making story to be told about how mereological propositions concerning objects in space and time get to be true and false. It is moderately straightforward, it turns on an account of the metaphysics of the relationships between continuants and occurrents

⁵ Multitudes are not sets: they are concrete pluralities. There is no null multitude and a singleton multitude is just its own member. There may also be higher-order multitudes; I think there are.

which I consider independently attractive, it raises interesting questions about the potential utility of higher-order multitudes, and finally it reflects by its economy the intimate nature of the part-relation.

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