

## RESEARCH

# The Use of Sets (and Other Extensional Entities) in the Analysis of Hylomorphically Complex Objects

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Hylomorphically complex objects are things that change their parts or matter or that might have, or have had, different parts or matter. Often ontologists analyze such objects in terms of sets (or functions, understood set-theoretically) or other extensional entities such as mereological fusions or quantities of matter. I urge two reasons for being wary of any such analyses. First, being extensional, such things as sets are ill-suited to capture the characteristic modal and temporal flexibility of hylomorphically complex objects. Secondly, sets are often appealed to because they seem to contain their members. But the idea that sets do contain their members, in the ordinary sense of containment, is a substantive metaphysical position that makes analyses that rely on that idea for their plausibility much more metaphysically committing than is generally thought.

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It is extremely common, one might say almost a reflex, for philosophers thinking about the natures of various kinds of entities to frame their analyses using the apparatus of sets.<sup>1</sup> The following claims have all been made. (I will very soon address the issue of whether such claims should be taken at face value.) A proposition is a set of possible worlds; a possible world is a set of propositions or sentences; a genre is a set of works or a set of properties; a musical work is a set of performances; a language is a set of dialects, or a set of sentences; a number is a set of sets; a species is a set of organisms; a material object is a set of space-time points; a context is a set of indices; and so on! I shall argue, in this paper, that in many (though certainly not all) cases in which they are invoked, sets are entirely the wrong kind of thing for the job and their invocation serves to mask the need for substantive work in the ontological analyses in which they are used.

I shall explore two reasons to worry about the common reliance on sets in ontology. The first will focus, initially, on the difficulty of using sets in the ontological analysis of paradigms of what I call hylomorphically complex entities—such things as biological organisms and ordinary material artifacts like clocks and chairs. I shall then go on to extend the worries to what I also think of as hylomorphically complex entities, but that are not paradigms of that category. As we shall see, the worries here also apply to analyses of these entities in terms of things that are alternatives to, though in some sense modeled on, sets: mereological fusions and quantities of matter. The problem, in all these cases, is with the extensional natures of the entities used in such analyses. The second reason for worry that I will develop potentially applies to a much wider range of cases than the first reason – namely, to all those cases in which the appeal to sets is motivated by what I shall call “taming multiplicity.” Here the problem is more closely tied to sets in particular, though I will say something about whether such worries might apply to mereological fusions as well.

<sup>1</sup> The differences between sets and classes will be irrelevant to my discussion and in fact, ontological claims in the literature are sometimes made in terms of sets and sometimes in terms of classes. Another caveat: in the following I will frequently generalize about the existence of sets in ways that would have to be qualified to avoid the set-theoretic paradoxes. Since the issues I am concerned with have nothing to do with the paradoxes, I allow myself to be careless about this.

## I

Before I begin with the first reason to worry, a couple of preliminaries will be in order. First, sometimes the same kind of ontological investigations that lead to the invocation of sets may also, or instead, lead to the invocation of functions: a proposition is a function from possible worlds to truth values; an ordinary object is a function from times to quantities of matter; etc. But functions themselves are frequently (and probably for many in philosophy, by default) explained in terms of sets, namely, as sets of ordered pairs, each containing an element of the function's domain and its associated value. If and when functions are understood in this way, the same doubts I shall raise about the use of sets in ontology will arise for functions. Secondly, sometimes claims are made about how to understand something in terms of a collection, or bundle, or plurality, or group of items (and there are, no doubt, many more such terms, including the ordinary, non-mathematical uses of the words "set" and "class"). These claims might predate the development of set theory, or post-date it but be made in contexts in which it is not automatic to assume such a precise understanding of what the type of thing in question – collection, bundle, etc. – is.<sup>2</sup> Such claims will lack the precision that their set-theoretic counterparts have and hence it will be unclear to what extent my objections to this use of sets apply to them. But if I am right about the problems with appealing to sets, then all such claims should be subject to scrutiny with respect to what is meant by "group," "collection," "bundle," etc., since sets in the strict sense will not be available as fallback interpretations. (I shall return to this.)

A third preliminary point is this. We need to keep in mind a distinction between using sets to *model* some range of entities and using them to say what entities of those kinds actually *are* (what I will call, using the term colloquially, ontological analysis, or just analysis). The restrictions on modeling will obviously be much laxer than those on ontological analysis. Modeling is context-sensitive and pragmatic; only certain aspects of a model are required to capture salient features of the objects modeled. One can potentially use anything to model anything – the proof of the pudding will be found in nothing more than its eating. My remarks in the following are directed at the use of sets in ontological analysis. I listed, in my opening paragraph, a large number of claims to the effect that Xs are sets of Ys. But if the claims were put forward as ways of modeling Xs in terms of sets of Ys, they would be immune to the objections I raise here. As I explain these objections below, I will mention particular examples where I think it is fairly clear that the claims involved are not modeling in terms of sets but are intended as genuine analyses.

But notwithstanding the clarity of the distinction between modeling and analyzing, I suspect that in practice, it is often somewhat blurred.<sup>3</sup> On the one hand, this means that an author who claims that Xs are sets of Ys might, if challenged, explain that they meant only to say that Xs can be modeled by sets of Ys. I shall, however, treat clear cases of categorical claims of the form "Xs are sets of Ys" at face value, unless there is strong evidence (beyond the mere implausibility of the claim) to suggest otherwise. The converse – claims about modeling disguising implicit claims of analysis – is probably a more real danger. For I think models are often offered as *faute de mieux* analyses – if Xs turn out to be nothing else, at least, if we have a good model in terms of sets of Ys, we can continue to accept the existence of Xs because we can default to taking them as sets of Ys. In this spirit, good models might (illicitly) be functioning as informal existence proofs. To the extent that I am right about this, use of sets in modeling ought to be viewed with the same suspicion as their use in ontological analyses. At the very least, one ought to be aware that a good ontological model is *not* tantamount to an existence proof or analysis. Furthermore, even claims of modeling may be susceptible to my second objection (discussed in section IV), if the modeling depends on taking sets to *contain* their members in a metaphysical sense.

## II

The first reason for being wary of ontological analyses of what I call hylomorphically complex entities (paradigms of which include organisms and ordinary artifacts) in terms of sets is this: sets are extensional, the objects they are used to analyze are not. Both parts of this claim will be examined. By saying that sets are extensional, I don't just mean that they are governed by the axiom of extensionality (that sets S and S' are identical if and only if they have exactly the same members), but that they have their actual members necessarily and at all times at which they exist.<sup>4</sup> This means that the temporal and modal aspects of sets are fully determined by their actual members. In fact, the problems generated for the analysis of hylomorphically

<sup>2</sup> See, for a random example, Limor Shifman's claim (2014: 41) that a meme is a "group of digital items" (meeting various further conditions).

<sup>3</sup> McDaniel (2006: 41), however, is crystal clear on the distinction.

<sup>4</sup> See van Cleve (1985) for the argument for necessity of membership.

complex objects by the fact that sets are extensional are shared by other extensional approaches to these objects. Accordingly, we may enlarge the range of actual examples by considering these other extensional forms of analysis. One such is analysis in terms of mereological fusions. Classical mereology, as is well known, was developed as an alternative to set theory so the idea that fusions are analogues of sets – and hence may, if they are used in ontological analysis, encounter some of the same issues as sets – is hardly surprising. Like sets, classical fusions are extensional.  $O$  and  $O'$  are identical if and only if they have the same parts; and a given fusion always and necessarily has the parts it has.<sup>5</sup> Setting aside issues stemming from the empty set, singletons, fusions of something with itself, and so on, the operations of both set- and fusion-formation are ways of deriving a singular entity from a plurality of entities and in both cases, the method by which this is done ties the singularity to the plurality in the particular way we denote by saying that sets and fusions are extensional. Another extensional approach focuses on deriving a singular entity not from a plurality but from something (at least *prima facie*) unquantified, namely matter or stuff. Singular quantities of matter are also extensional.  $Q$  and  $Q'$  are identical if and only if they comprise the same matter, and a given quantity has the matter it comprises necessarily. Like mereological fusions, quantities of matter were explicitly introduced into the philosopher's toolkit by analogy with sets.<sup>6</sup> Where sets make one out of many, quantities make one out of *sm*.<sup>7</sup> So although superficially sets, fusions, and quantities may appear disparate kinds of things, from our point of view, they very naturally go together. Besides their common extensionality, another feature that sets, fusions, and quantities share is that each exists automatically given that their members, parts, or constituting matter exist.

Interestingly, although (as noted above) there is some tendency on the part of philosophers to want to treat claims of the form “ $X$ s are sets of  $Y$ s” as attempts at modeling rather than analysis, I am not aware of anyone who treats claims of the form “ $X$ s are fusions of  $Y$ s” or “ $X$ s are quantities of  $M$ ” in this spirit. All such claims are, I believe, meant entirely at face value. I suspect that the reason for this asymmetry is that sets are abstract while quantities of matter and fusions (of concrete things) are concrete. The similarities between sets, fusions, and quantities deriving from their extensionality, and the problems I raise for analyses in terms of all three of them consequent on this extensionality, render irrelevant the distinction between abstract and concrete. The issues I discuss, therefore, are of some interest for that fact alone.

What do I mean by saying that the objects which are sometimes analyzed in terms of sets, fusions, or quantities of matter are *not* extensional? The kinds of objects in question, organisms and artifacts, are what I called above paradigms of hylomorphically complex objects. By this I mean principally that it is in the nature of these objects to be flexible, both temporally and modally, with respect to their parts or matter. Things like clocks or cats typically change the parts or matter that constitute them over time (temporal flexibility) and, even when they do not, they are capable of so doing (modal flexibility).<sup>8</sup> Another feature of these kinds of objects which makes it problematic to analyze them in terms of sets, fusions, or quantities is that such objects essentially have distinctive ways of coming into being. Organisms essentially come into being through evolution and species-specific kinds of reproduction (sexual or otherwise). Human, as Aristotle puts it, comes from human. (This formulation, of course, misses out on the evolutionary aspect.) If this is taken as a variety of origin essentialism, it is an extremely weak variety since all I hold here is that things of the relevant kinds essentially have certain *types* of origins. To put the point epigrammatically, Swampman is not an organism, indeed, not even a living thing. Artifacts also essentially have certain kinds of origins – being intentionally made.<sup>9</sup>

I begin with the problems caused for ontological analysis in terms of sets (or fusions, or quantities) posed by this second feature of hylomorphically complex objects. This is an important (though somewhat neglected) issue but I shall not say a lot about it here. Artifacts and organisms have certain distinctive

<sup>5</sup> Mereological essentialism (the view that a mereological fusion has its parts necessarily) is a highly controversial doctrine which I cannot properly address here. Suffice it to say that a) some attempts to resist it, such as the appeal to four-dimensionalism, are ways of allowing for change, not ways of denying the necessity of parts and b) classical mereology, strictly taken, simply does not have the resources to express things like parthood at a time or a world. So attempts to deny mereological essentialism are in fact ways of developing non-classical mereologies. I address some of these issues below when I come to discuss Judith Thomson's views.

<sup>6</sup> See Helen Cartwright (1970).

<sup>7</sup> *sm* expresses the unstressed “some” in “I'd like some tea.” For extensive critical treatment of this theme, see Laycock (2006).

<sup>8</sup> If the initial parts or matter that constitute something are held fixed, then modal flexibility is just the possibility of temporal flexibility (i.e. change). In fact, contrary to the prevailing orthodoxy, I hold (2016a) that many hylomorphically complex objects might have had different original matter and hence that modal flexibility is more substantive than the mere possibility of change. This accentuates, but does not fundamentally alter, the nature of the problems I consider here.

<sup>9</sup> I argue for these claims in (2016a) and shall not repeat what I say there. With respect to organisms, I am echoing the views of Karen Neander (1991), Ruth Millikan (1996), and Michael Thompson (2008).

histories. The sets or fusions of their parts or the quantities of their matter do not. Those things exist just in case the parts or the matter exist. This engenders two problems. First, suppose my clock has 18 parts. The set of those parts will exist regardless of how those parts are arranged, regardless of whether anything like a process of clock-making has occurred. To counter this, a defender of the view that the clock should be identified with the set of its parts might say that we should just abandon the view that clocks must be made by intentional activity and also the view that they must be clock-like. As long as the parts exist, the set of them exists, and that is what the clock is – though it may not be a clock at all points of existence. What a ‘maker’ has to do is the arrange the members of the set so that the set comes to enter a clock-phase. This will be an accidental property of the set, so it will follow that when clocks are clocks (i.e. clock-like, in clock phases), they are only accidentally so. I don’t like this view but I shall not argue against it;<sup>10</sup> I merely point out that the view of the clock as the set of its parts leads us quickly to some deep metaphysical waters. But secondly, even setting that aside, and supposing that we have somehow isolated entities (perhaps temporal parts of the clocks parts) that exist only when the clock, ordinarily, would be thought to exist, and perhaps even supposing that we throw in there some further element, a structure or relation or something like that, still, the set is something that just exists automatically when its parts do; it cannot be an artifact (or a biological organism).<sup>11</sup> Sets, fusions, and quantities are, we might say, ahistorical kinds of things. This does not mean that they exist outside of time. A set might exist at one time and not another – at those times at which all its members exist, or at which some of them exist. And likewise for fusions and quantities.<sup>12</sup> But they are entities such that historical considerations play no role in thinking about their conditions of existence. This is part of what is meant by saying that they exist *automatically*, given the existence of their members, parts, or constituting matter.

I come now to the problems raised by the first feature of hylomorphically complex objects, their temporal and modal flexibility. At least in the case of temporal flexibility, extensional views accommodate this fact by enlarging the conception of extension to include the temporal dimension. This can happen in various ways. Quine (1985) takes a material object to be a certain quantity of matter, namely, the material content of any region of space-time and Lewis (1976), thinking in much the same terms, but making explicit the mereological component of the view, takes a material object to be a fusion of momentary objects (temporal parts) at different times. Thomson (1983), basically on board with Lewis’s classical mereology but not liking temporal parts, deals with the problem of change by amending the underlying mereology to her Cross-Temporal Calculus of Individuals and taking objects like organisms and artifacts to be cross-temporal fusions of different parts at different times. On the set theoretic front (and also incorporating the apparatus of quantities of matter), Grandy (1975) takes an ordinary material object to be a function from times to quantities of matter, and explicitly takes a function to be a set of ordered pairs. I note that in all these cases, there is no question that the various authors are trying to say what ordinary material objects *are*. They are not offering models of such objects. (Grandy’s is the view where the ontological claim may strike one as most peculiar. But I think it is plain that he does mean the view that ordinary objects *are* functions in an ontological sense. He introduces the view by saying “let us try treating a ring as a function” (221) and later says that “rings and other physical objects are best construed as sets or functions” (222), both of which fail, in my opinion, to settle the matter between an ontological reading and a modeling reading. But he concludes by considering an objection that his view is implausible because it takes physical objects to be abstracta. If he were in the business of modeling, this would be the place to say so and dispense with the objection summarily. Instead, he says that “if in the best semantics for English ‘table’ is true of sets, then tables are sets” (224). Here, incidentally, we see how an argument that proceeds via semantics, and hence may appear to be in the vicinity of the modeling approach, easily leads to an ontological conclusion when coupled with a certain philosophical methodology.)

<sup>10</sup> See my (2013) for further discussion of it.

<sup>11</sup> In some sense, this objection is similar to the one Graham Oddie (2001) responds to, that we cannot reduce properties (such as the taste of pineapple) to functions because those properties are scrumptious and functions cannot be. Oddie’s response is that “the beauty of philosophy is precisely that it never leaves things quite the same. Some functions really are quite scrumptious” (155). A similar response could be offered to the objection in my text. Perhaps, but I note that this is not the only objection I offer – and also that philosophy must leave *some* things the same, on pain of changing the subject, and which things can and which cannot be ditched in an analysis has to be debated on a case by case basis. For the importance of origins for organisms and artifacts, I have made the case, as best I can, in (2016a).

<sup>12</sup> Fine (1994) develops a theory of fusions that distinguishes between those that exist when all their parts exist and those that exist when any of their parts exist. There is no principled reason, as far as I can see, why such a distinction should not be pursued with regard to sets as well, or quantities.

Vastly different as all these approaches are from some points of view, from the point of view I am interested in, they are much the same. They all deal with the problem of the temporal flexibility of hylomorphically complex objects by building into the very substance of these objects their pasts and futures. This, I contend, misrepresents the temporal flexibility of these objects. The correct way of understanding such objects' temporal flexibility is to conceive of them as in themselves open to certain changes; the identity of the objects is fixed independently of what happens to happen to them. Changes to their matter or parts (as to other many other of their features) are *adventitious* to them, to their identity. The extensional views, by contrast, tie the identity of the objects to the changes they happen to undergo. Although the view makes it true to say of objects that they did or will have different matter or parts, it does this in a shallow way by simply incorporating into the objects those past and future matters and parts.

One of the ways of building in the past and future vicissitudes of an object directly into the object is the four-dimensionalist view exemplified, among those I have mentioned, by Quine and Lewis. (This approach is very widespread in philosophy now.) Such views are regularly critiqued as conflating objects with their histories. But an interesting lesson that arises from treating together the variety of views I have targeted here is that the problems besetting extensionalist views transcend the ordinary opposition between three- and four-dimensionalism. Thomson (1983), for example, paints herself as a staunch opponent of the metaphysics of temporal parts ("a crazy metaphysic," she calls it). And there may indeed be features of the metaphysics of temporal parts that her own view avoids. (Her main objection seems to be that it entails a kind of continuous creation *ex nihilo*.)<sup>13</sup> But her own view, taking ordinary objects as cross-temporal fusions, does not avoid the problem that I have indicated here for extensionalist views in general – the way in which they make changes that are in fact adventitious to objects internal to them. For her no less than for someone like Lewis, an object's very identity is determined by what happens to it at different times. Material contents of regions of space-time, functions from times to sets or quantities of matter, cross-temporal fusions, all of them act like four-dimensional objects in that respect and hence, I claim, misrepresent the temporal flexibility of ordinary organisms and artifacts.

To bring out how it is the extensional nature of the entities in question, sets, functions, fusions, quantities of matter, that renders them inappropriate to analyze hylomorphically complex entities, it will be instructive to compare Grandy's theory, that such objects are functions from times to quantities of matter, and that these functions are themselves to be understood extensionally, as sets of ordered pairs of times and quantities of matter, with a theory that it superficially resembles, Kit Fine's (1999) theory of variable embodiments. Fine takes variable embodiments to be *sui generis* entities each of which is associated with a single principle and a series of manifestations. The principle is a function from times to manifestations. Structurally, this is very similar to Grandy's idea that such objects are functions from times to quantities of matter. The differences between the two views are these. One, which is irrelevant to present purposes, is that manifestations are not quantities of matter but (at least generally) structured entities called by Fine "rigid embodiments." I shall not discuss these rigid embodiments here since, as I indicated, this difference between the two theories is not central to my point here.<sup>14</sup> A second difference is that, unlike Grandy, Fine does not identify an object under analysis with its function/principle but with an entity that is associated with both that function/principle and its values for the times in its domain. The nature of this association is slightly murky. Fine has wavered over whether the principle is a part of the variable embodiment or not. But finally, and most importantly for my present purposes, Fine has been explicit (in personal communication) that the functions that are associated with variable embodiments should not be understood extensionally, as they are by Grandy. How they are to be understood is a further question, but in rejecting an extensional understanding of them, Fine is avoiding one way in which his theory might misrepresent the objects – organisms and artifacts among them – that he takes to be variable embodiments. It remains possible, depending on how the functions that are the principles of variable embodiments are to be understood, that variable embodiments do exhibit the kind of deep temporal flexibility that I have claimed characterizes paradigm cases of hylomorphically complex entities, that the theory does not individuate the objects it deals with in terms of which manifestations they adventitiously happen to have at different times. If the function, for example, were thought of as a rule or recipe for determining what an object's manifestations were at a given time, it would not itself be tied in its identity to which things were its manifestations, as it would be if it were understood as a set of ordered pairs

<sup>13</sup> This objection of hers likely derives from thinking of the metaphysics of temporal parts against the background of an uncongenial metaphysics of time. The variations available in combining theories of times with theories of the nature of objects are complex and I am not able to get into them here without derailing the paper.

<sup>14</sup> But see my (2016a) for an extensive discussion of rigid and variable embodiments and their relations.

of times and manifestations. The lesson here is clear. If a theory wants to avoid going extensional and building into an object's identity its entire history, it has to enlist other metaphysical resources in an attempt to characterize the nature of that object. In Fine's case, those metaphysical resources would include a positive account of the functions in question, and the invocation of the *sui generis* nature of variable embodiments. Since sets (and fusions and quantities of matter) are extensional, their appearance in ontological accounts of things that are not, deep down, extensional always risks obscuring the real role for metaphysics in accounts of those objects. (Of course, the defenders of extensional accounts are, in effect, denying that the objects in question are not, deep down, extensional. My point is just to make clear the difficulty of having one's cake and eating it too in this context.)

Similar considerations apply to the modal nature of hylomorphically complex objects. Accounts of their modal nature that are extensional, while they allow us to give truth-conditions to sentences of the form "O might have had F as part (but doesn't)," still build into the object's identity its modal vicissitudes. This is most clear in the kind of "five-dimensionalism" supported by Andrew Graham (2015) and previously discussed, but not supported, by David Lewis (1986) and Kit Fine (1994). On this view, an object has parts in possible worlds. The object might have had something as part if and only if one of its parts in another possible world does have it as part. Since there is nothing else to determine the identity of an object, and distinguish it from other similar objects, than which parts it has, the view makes the identity of the object dependent on what might have happened to it, just as with the comparable four-dimensionalist view, its identity is tied to what will happen to it. So, we might put it, what is possible for the object is not adventitious to it. Judith Thomson (1983) briefly sketches an extension of her Cross-Temporal Calculus of Individuals to encompass modality. She uses modal operators attached to the theorems of the Cross-Temporal Calculus but leaves undiscussed the metaphysical basis in the nature of the objects in question for the modal claims about them. One possibility is that she might extend the theory of cross-temporal fusions to a theory of cross-world fusions. A given object fuses one set of objects at one world and a different set of objects at another world, just as it fuses one set of objects at one time and a different set a different time. In that case, the features of her original theory that seemed problematic will carry over, leaving the modal flexibility of the objects it theorizes as poorly treated as their temporal flexibility (from the hylomorphist's point of view).<sup>15</sup>

### III

I now look at some issues that arise when we consider that the features I have indicated as important to paradigms of hylomorphically complex entities characterize a wider class of entities, many of which are also analyzed in extensional terms. In these cases, because the nature of the analyzed entities is somewhat different from things like ordinary artifacts and organisms, analyses in terms of quantities of matter have played no role (at least none of which I am aware). Analyses in terms of mereological sums are less prevalent, but not altogether absent. I shall simply present and comment on a few examples. My goal is not to settle any questions about the entities in question, or even to look at the conceptual terrain in detail. It is rather to illustrate that extensional analyses of entities in terms of sets or fusions is quite common in a variety of philosophical environments and that in such cases, it often appears that the entities in question exhibit the kind of temporal and modal flexibility that characterizes paradigms of hylomorphically complex entities. As such, the analyses in question are problematic from the start.

Many people have taken species to be sets of organisms. At a certain point, an insurgent view developed that sees them as concrete individuals, and the organisms that belong to them as parts – i.e. that sees species as mereological fusions. (See Brogaard 2004: 225 for references to both views.) I see no signs that either of these views is meant as anything other than a straightforward ontological claim about what species *are*.<sup>16</sup>

<sup>15</sup> David Lewis's (1986) modal counterpart theory is harder to assess with respect to my concerns here. (And *mutatis mutandis* for its adoption in the temporal dimension by people like Ted Sider (2001).) Lewis thinks the counterpart relation is context-relative. On the one hand, this does avoid individuating the object in terms of its modal vicissitudes, which is a plus from the point of view of the hylomorphist. On the other hand, it makes the modal adventitiousness I have tried to identify a linguistic or conceptual matter rather than a characteristic of the object itself which, for Lewis, is just an extensional four-dimensional worm. If one took the counterpart relation to be objective and not context-relative, then the view seems to be little different from the view of cross-world fusions described in the main text. Either way, then, at the metaphysical level, I don't think Lewis's view does any better than the views assessed in the text at capturing the characteristic flexibility of hylomorphically complex objects.

<sup>16</sup> This is emphasized, in the case of the mereological fusion view, by the fact that from the point of view of modeling, the view of species as sets is clearly superior since it preserves the integrity of individual organisms in their relation to the species. No-one, therefore, could propose the mereological view as a more plausible model of species and their members. Its only *raison d'être*, therefore, must lie in its claim to ontological superiority to the alternatives.

The two views, of course, are quite different – hence the way they are positioned as rivals in the literature.<sup>17</sup> But again, from my point of view, those differences don't matter. Each of them faces an initial problem that a species comes to have different members over time and could have had different members from its actual members. Hence if a species were a set, it would have to be the set of all its past, present, and future members, and all its possible members. Or it might be a function from times, or worlds and times, to sets of organisms. And if a fusion, it would have to be a fusion of all its past, present, and future members (as advocates of the fusion idea think), or a fusion of the Cross-Temporal Calculus of Individuals, that fuses different organisms at different times, or even across different worlds.<sup>18</sup> In whichever variety of extensional approach one takes, the identity of the species depends on its actual or possible members (assuming, implausibly, that it has determinate possible members), rather than seeing a species as a hylomorphically complex entity that itself, in some sense, picks its members at different times and worlds rather than depending on them.

As another example, think of linguistic entities like words and languages. According to some, “a word or sentence is a set of tokens or utterances, each understood as ink marks, acoustic waves, or bodily movements. A language is then a set of such sets” (Stainton 2014: section 2).<sup>19</sup> Stainton is clearly addressing the ontology of language at that point, hence the view is a view about what languages are, not how to model them. (Curiously, though, he calls the view “physicalism” about languages and says that on it, “objects of study in linguistics belong in the same family as rocks and their happenings.” This is because the members of the relevant sets are like rocks.) John Hawthorne and Ernie Lepore (2011) attribute to David Kaplan (1990) the view that words are mereological fusions of individual inscriptions and utterances.<sup>20</sup> Hawthorne and Lepore characterize Kaplan's view as one on which a word is an “archipelago of utterances” and this nice phrase would do well as a description of the set-theoretic construction Stainton describes as well. But a word seems like something that has different tokens at different times and that could have had different tokens from those it has (or will have). Hence it seems to exhibit the customary flexibility of hylomorphically complex entities, despite the fact that it might be thought to be something abstract. Likewise, a given language might have comprised different words and different sentences.<sup>21</sup> Hawthorne and Lepore raise this as an objection to Kaplan's view and the same point would tell against any view that identified a word or language with any kind of set or function. Again, one could envisage extending the apparatus to functions from pairs of worlds and times to sets, or in the mereological case, to cross-world fusions, and again, this seems to misrepresent the nature of the flexibility of the entities in question. Like species, languages and words seem almost like living things, open to what life may throw at them, not depending for their very identities on what it actually does throw at them or at what it throws at them in possible but non-actual worlds.

As a final example, consider the case of genres. Many theorists take genres to be sets of works, identifying the genre of tragedy, say, with the set of all tragedies. Todorov says it is just obvious that “genres are classes of texts” (1990: 16). And Fowler comments that “the notion that genres are classes has dominated literary theory for a very long time” (1982: 38). Greg Currie (2005) also takes genres to be sets, but sets of properties not of works. (I don't know of any view that treats genres as mereological fusions of works. See my 2015 for a more thorough treatment of these issues.) Again, such claims seem to be put forward as ontological claims about what a genre is. And of course, this suggests the now familiar problem: the members of a genre change over time (as new works are written) and might have been other than they, or the properties a genre comprises might change or have been different. Again, we can imagine various ways of adapting the idea of genres as sets of works to try and account for future and possible members and again, this attempt makes

<sup>17</sup> For example, as Brogaard (2004) brings out, the view that species are sets is often associated with the view that they are natural kinds, contrary to the view of them as individuals. In fact, this association between the view of them as sets and as natural kinds seems at least partially contingent. A species might be a set the members of which share some other property than a natural-kind-like essence; and if one sees them as mereological fusions, they might fuse any organisms, for instance those sharing an essence, and not just those related by descent.

<sup>18</sup> Brogaard (229) makes the point about the parallelism between both the mereological and set-theoretic approaches in how to deal with changing membership but imagines a new theory of historical sets for which the membership relation is temporally relativized, like Thomson's fusions, rather than thinking of species as functions from times to ordinary sets. I'm not sure whether there is a substantive difference between these two approaches. In any case, for Brogaard a crucial difference remains that historical sets are in some sense abstract whereas mereological fusions are concrete. From my perspective, this difference is irrelevant.

<sup>19</sup> Stainton says Michael Devitt (2006) “fits approximately here.”

<sup>20</sup> Kaplan himself rejects this interpretation but it is not clear on what grounds. Hawthorne and Lepore are certainly right in seeing this view in what Kaplan says.

<sup>21</sup> I argue in (2016a) that languages are hylomorphically complex and are, in fact, abstract artifacts. These two things are intimately connected for me, but one might recognize a language's flexibility without being committed to thinking of it as an artifact.

the very identities of genres rigidly dependent on their actual and possible members in a way that is at odds with the appearance of deep flexibility they have with respect to which works belong to them.<sup>22</sup>

The kinds of objections I have been mooting here to identifying certain kinds of entities with sets or fusions will not apply in all cases in which such analyses are appealed to. If one thinks, for example, that a possible world is a certain kind of set of propositions (maximal and consistent, perhaps), it is not plausible to object on the grounds that a given possible world might have been characterized by other propositions than those that do characterize it. Here the inflexibility of sets seems to represent accurately the nature of the analyzed object. Likewise for the view that a proposition is a set of possible worlds. The point I have been hoping to make is that the range of entities that are seen as hylomorphically complex, as exhibiting the characteristic temporal and/or modal flexibility, extends beyond the paradigm cases and that the set-theoretic (and occasionally mereological) analyses of this wider class of entities is problematic for the same reasons it is problematic in the more central cases.

In all these cases, as in the cases of paradigmatic hylomorphically complex entities examined in the previous section, the effect of giving extensional analyses of the entities, either with respect both to time and possibility, or just with respect to time and leaving it to counterpart theory or primitive modal concepts to elucidate claims of possibility, is to obscure the role that real ontological analysis ought to be performing. A species cannot be a set or a fusion of actual and possible organisms – so we have to draw on other resources, or other ways of thinking, to say what it is. (Or perhaps admit that it is *sui generis*.) This is a place where philosophy might be done, but its invitation is ignored by the readiness-at-hand of sets and fusions. Likewise for artifacts, organisms, genres, languages, and all the rest. My goal here is not to say anything positive about these issues (I have done my best in 2015 and 2016a) but merely to point out why one common philosophical approach has had a deleterious effect on our thinking about these things.

#### IV

I turn now to a second reason for being concerned about ontological analyses in terms of sets that extends beyond their use to capture entities that exhibit the temporal or modal flexibility characteristic of hylomorphically complex entities. To approach this cause for concern, we may ask, why is it so common to conduct ontological analysis in terms of sets? Why is it practically second nature for philosophers, thinking about such a wide variety of topics, to go almost unthinkingly to sets? There are two reasons that work in concert. First, the existence of sets is (relatively) uncontroversial. So many other kinds of entities have come under a variety of skeptical clouds that to analyze anything in terms of them seems to come with a significant ontological burden. Sets, by contrast, have for the most part remained above this ontological fray, underwritten by all the authority of mathematics, their existence and identity conditions fully specified by a formal theory. As David Lewis famously says:

Renouncing classes means rejecting mathematics... How would you like the job of telling the mathematicians that they must change their ways, and abjure countless errors, now that philosophy has discovered that there are no classes? (1990: 58–9)

(Of course, we know that some have tried it. This was how classical mereology was born.) The second reason why philosophers like to analyze things in terms of sets, I believe, is the way in which sets serve to tame multiplicity, replacing it with singularity. Many entities are suggestively associated with multiplicities: a material object with its parts, a club with its members, a deck of card with the 52 individual cards that it comprises, a species with the organisms that belong to it, etc. We are often tempted to analyze such singularities in terms of these multiplicities. But owing to the one-one nature of the identity relation, we cannot say such things as “an F is some Gs,” if we mean by that that for any F, there are some Gs such that the F is identical to the Gs. Sets tame the multiplicities in question, giving us a single thing to stand in for the multiplicity and do duty for it.<sup>23</sup> Not only that, but owing to the first point in their favor, they tame multiplicities in one of the mildest ways possible. Their availability to stand in for multiplicities, owing to their existence and identity

<sup>22</sup> Currie explicitly confronts this problem and addresses it by locating the flexibility I attribute to genres themselves in the semantics for genre terms. All sets of properties a work can have are genres. A given genre term might have named, or might come to name, a different (though largely overlapping) set of properties from the one it actually, currently names. As with Lewis’s version of counterpart theory, on which the counterpart relation is context-relative, the view thus identifies the flexibility I am interested in, but resists seeing it as a feature of the relevant objects themselves.

<sup>23</sup> We saw above that a similar point applies to mereological fusions and, *mutatis mutandis*, to quantities of matter.



conditions, is underwritten by mathematics. Instead of some Gs, we can always advert to the set of those Gs; if the Gs exist, mathematics assures us that their set does too (setting aside worries connected with the paradoxes). The apparent ontological cost of appealing to such stand-ins is minimal.

This brings me to my second reason for being skeptical of ontological analyses in terms of sets. Taming multiplicity might just mean that, for any multiplicity, we can substitute a singular entity that will be shared with no distinct multiplicity. In this sense, the singular entity *represents* the multiplicity. And set theory does assure us of the existence of entities that will fulfil this condition. To doubt the existence of such easily available representations of multiplicities would be to doubt set theory. But when the *ontological* analyst wants to tame a given multiplicity, I think it is pretty clear that they want the singularity to have a more specific relation to the multiplicity than what is guaranteed by its representing it. They want the singular entity to contain, or include, or gather the various members of the multiplicity. But, as Kit Fine points out, “the view of sets as having members as *constituents* is no part of the mathematics of the theory” (2005: 188). The idea of sets as somehow containing, or collecting, their members rests on thinking of sets as having their members as constituents. Once we see that mathematics gives no reason to think of sets as containing their members as constituents, we see that it also gives no reason to think of them as ontologically complex at all.<sup>24</sup> For all that set theory has to say, sets might be without parts or internal ontological structure at all. The membership and subset relations impose a structure on how the universe of sets is arranged but they do not require us to see that structure as reflected in the intrinsic nature of the sets so arranged.

It might be objected that although the mathematics of set theory does not imply that sets contain their members in any robust sense, the idea that they do was part of the motivation for the development of set theory. I am happy to agree with this, but (I address this issue below and just anticipate briefly here) if the theory is supposed to be doing justice to an independent, metaphysically real relation, we have at least to contemplate the possibility that the theory gets it wrong and that which sets (things that contain their members in the robust sense) exist may not automatically serve the needs of metaphysicians invoking them in their analyses.

If we bracket the idea that sets contain their members as constituents, that they include their members, that they gather their members together in an embrace of some kind, it seems to me that the use of sets in the ontological analyses of various entities will be much less appealing. Suppose we say, for example, that a species is a set of organisms. If we can mean by that *only* that a species is some single, perhaps entirely simply, entity that represents those organisms, that exists if and only if they exist and is such that no other entity of the same types also exists if and only if they do, then our claim is unappealing on the face of it in a way in which the alternative claim, that a species is some kind of collectivity that includes or contains the organisms of that species, is not (though it may be problematic for the reasons I mooted in the previous section).

My point here is an instance of a broader problem I have written about elsewhere (2016b), that I call the Problem of Too Much Content, that afflicts so-called easy ontology, or deflationism, of the kind pursued by Amie Thomasson (2014) and Stephen Schiffer (1996, 2003) – unsurprisingly, since I think that the existence and identity conditions that feature in formal theories like set theory and classical mereology are the inspiration for this ontological trend.<sup>25</sup> The problem is this. Everyone will agree that there is a parallel between claims made at the first-order ontological level regarding the existence of entities of some kind *K* and claims made at the second-order level as to whether the concept *K* applies. There are *K*s if and only if the concept *K* applies. But the easy ontologist (as opposed to those who think ontology is a substantive and difficult enterprise) takes the second-order aspect to be primary since the concept is thought to contain, analytically, the conditions for its application. So easy ontologists hold that the concept *chair* analytically includes the provision that the concept applies just in case some material is arranged chair-wise (what being arranged chair-wise entails can be left unexplored here). Since that condition is manifestly satisfied, it is an ‘easy’ conclusion that chairs exist, contrary to philosophers like Peter van Inwagen who hold that chairs don’t exist

<sup>24</sup> It is sometimes suggested (e.g. in Raven 2018) that sets themselves should be seen as having some kind of hylomorphic structure. If they did, they would be unlike any of the examples of hylomorphically complex entities I have looked at here – not just the paradigm cases but also the non-paradigmatic – in not exhibiting temporal or modal flexibility (and in not having characteristic historical ways of coming into being). But setting aside their striking difference from these other cases, I am skeptical of the suggestion simply because I am uncertain how one would even approach the question of whether sets had any kind of ontological complexity to them. See my remarks below.

<sup>25</sup> Thomasson does not discuss the case of sets, though she does, briefly, apply her view to mereological fusions (2009, fn. 8) and I think it is clear that her view naturally extends to the deflationary treatment of sets I discuss in the text. Rayo (2013) does develop a deflationary view of sets, consonant with the one I associate with Thomasson, but I find it harder to characterize the metaphysical issues I am concerned with in connection with his views.

even though there does exist stuff arranged chair-wise. The Problem of Too Much Content is that if chairs are the sorts of things the existence of which is guaranteed merely by the satisfaction of an existence condition like this, we cannot assume that they have any other properties. To assume that the concept in question implied further facts about the things falling under it would be to pack more content into it than one is entitled to, if one wants to take questions of existence to be determined in this concept-first way. Hence the Problem of Too Much Content. In the case of chairs, for example, on what basis could we assert that chairs exist *in the same location* as the material arranged chair-wise on which their existence depends? On what basis could we assume that for each distinct quantity of material arranged chair-wise there exists a distinct chair?<sup>26</sup> Such questions as those cannot be answered merely on the basis of the satisfaction of the existence conditions contained in the concept *chair*.

Set theory provides, we hope, consistent existence and identity conditions for sets. It is easy to take the theory as a whole as providing a kind of implicit definition of the concept *set*. On that basis, one would be justified in taking sets to exist just in case the existence conditions implied by the axioms of the theory obtained. (Justified because it would be analytically true.) But if we are to take existence questions as being so easily settled, nothing else can be assumed about the entities in question than what follows from the axioms that implicitly define the concept. And while those axioms may contain other concepts, such as *subset* or *member*, those concepts too must be seen as being implicitly defined. To go on to take the relation between a set and its members as one of containment is to overstep what follows from the existence and identity conditions, i.e. the mathematics of the theory. Set theory will guarantee that if *a*, *b*, and *c* exist, then there is a set of which *a*, *b*, and *c* are members. But if we also want sets to contain their members, where “containment” is taken in something like its ordinary sense and not just as a term for the converse of membership, as defined by the theory, we now cannot assume that just because *a*, *b*, and *c* exist, something meeting this further condition also exists. We would need a real argument for that. All of this is obscured by the fact that the relation between sets and their members has been given the name “membership.”<sup>27</sup> More content has been smuggled into our informal understanding of sets and membership than we are entitled to by the mathematics of sets.

What is someone to do who wishes to appeal to sets in ontological analysis in order to perform the function of taming multiplicity? There are two tacks one might take. One is to continue to treat the existence conditions for sets, as specified in set theory, in the way of the easy ontologist and to argue that we can also, somehow, intuit further facts about the entities whose existence is established in this way. But I don’t see how any intuitions we have about some form of groups and the containment of their elements could justifiably be taken as insights about the very entities whose existence is so unproblematically established by this approach. Consider: I associated by fiat a concept, *nextion*, with the existence condition that a nextion of *X* exists just in case *X* is next to something (never mind the issue of vagueness here). So it is analytically true that if *A* is next to something, a nextion of *A* exists. The easy ontologist will be fine with this. But now suppose I intuit, by some means or other, that certain things have a property *F* (where being *F* is a property not defined exclusively, or at all, by the theory of nextions, such as being purple, being in Verona, or being divisible by two). On what basis could I justifiably assert that it is *nextions* that I am intuiting to be *F*? Surely none. How could the fact that *A* is next to something by itself be enough to guarantee, trivially, that anything was purple or divisible by two or in Verona? So, if we take the axioms of set theory to guarantee, in this trivial way, that a set of *A* and *B* exists if *A* and *B* exist, that is fine. But by itself, that cannot guarantee that that set, or anything, *contains* *A* and *B*, if by “contains” we mean anything like our ordinary notion of containment.<sup>28</sup>

The second tack is to treat the existence conditions for sets as substantive and themselves based on insight into the nature of some entity. In this sense, the mathematical theory of sets is just a part of the theory of the nature of some kind of entity to which we have independent access. This seems to be Fine’s view. After his remarks about containment not following from the *mathematics* of sets, he immediately goes on to supplement that skeptical remark with a positive account of why we can nonetheless think of sets as containing their members. “We recognize a certain distinctive operation, the set-builder, that *constructs* or *builds up* a

<sup>26</sup> The easy ontologist is liable to want to answer this second question, at least, by adverting to what she calls “re-application” conditions. I argue in 2016b that this cannot work. See Thomasson (2014: 221–9) for a (pre-publication) response to my argument.

<sup>27</sup> And just imagine how we might think of sets and their members differently if our notation for the set whose only members are *a*, *b*, and *c* were something like “//<sub>a,b,c</sub>” rather than “{*a*,*b*,*c*},” the curly brackets embracing the members with outstretched arms like loving parents. (I’m not entirely joking!)

<sup>28</sup> Of course, “contains” could be treated as a purely technical term, co-defined with “set” and “member,” to apply to the relation between a set and its members. But that does not give us the containment that is at issue in taming plurality.

set from its members" (2005, 188). Assuming (as I think we are meant to, though I'm not entirely sure) that "recognize" here is like "recognizing a friend" rather than "recognizing the existence of a (new) country," the idea is that we grasp sets via some intellectual capacity we have and on that basis justify the mathematics of the theory of sets but also go on to develop further theoretical insights about them, such as that they are constructed or built up from their members in such a way that they contain them, here using "containment" in some sense continuous with its ordinary one.

It is not my intention to engage with this latter view. I wish only to point out two things. If that is the right picture, we must recognize that the conditions we lay out about which sets exist might be wrong. It is conceivable that the conditions for the existence of genuine collections that genuinely contain their members might be much more stringent than is envisaged by set theory. And secondly, the casual invocation of sets in all sorts of contexts is piggy-backing on some pretty serious metaphysical and epistemological claims regarding sets and our knowledge of what they are like. One does not risk the task that Lewis suggests is so unenviable, of telling mathematicians that they must "change their ways, and abjure countless errors" by oneself abjuring this substantive and striking theory. One can question whether there really is any single entity that genuinely contains, say, all zebras, and that could be identified with the species zebra and still allow the mathematicians their sets as entities that do not genuinely contain their members, but represent them in some thinner sense, by taking set theory in the manner of the easy ontologist.

Finally, one may question whether those who identify entities of some kind with sets – a genre with a set of works, a species with a set of organisms, etc. – are really interested in sets at all, or whether they might be after some more substantive notion of collection. After all, as I mentioned at the outset, philosophers have resorted to bundles, collections, and sets (in a non-technical sense) before the advent of set theory, or after that advent but in contexts where it is not salient. These philosophers might set at naught all the reflections of the previous paragraphs and say that they are really appealing to the existence of some other notion of collection. Their efforts have been hijacked, as it were, by the success of one particular branch of mathematics, with its benign-sounding technical terms ("set" and "member"). This is well and good, but then, once again, we must point out that one cannot just assume the existence of whatever such collections one happens to feel the need of in ontological analysis. Maybe such a collection of zebras exists, but why should one assume that without any further investigation?

A comparison with the case of classical mereology here is instructive. The axioms, including the existence axiom for fusions, of mereology can also be taken either in a deflationary or a substantive way. But if taken in the former way, one could not assume that the fusion of a and b has a and b as parts, where parthood is understood in a non-deflationary (i.e. ordinary) way on which something's parts are contained in it. The mere existence of a and b cannot analytically entail that anything has them as parts, in that ordinary sense, even if, on a deflationary reading, it can analytically entail the existence of their fusion. But parthood is much more deeply rooted in our ordinary thought than the ordinary notion of membership. Hence mereology typically encounters a much greater degree of skepticism than does set theory. With set theory, we can almost unknowingly waver between, on the one hand, assuming its existence claims in a deflationary spirit and letting membership be defined entirely by the theory (and hence as not implying ordinary containment) and, on the other, thinking of sets as really containing their members. But that wavering is much less easily accessible in the case of mereology because we are resistant to treating mention of parthood as being defined wholly by the theory in question. We think of mereology as really trying to give a theory of genuine parthood and hence (at least many of us) are highly doubtful that it gets the existence of composite objects right.

## V

To conclude, the upshot of all of this is that the impulse to invoke sets in the context of ontological analysis may be serving to mask serious ontological work that needs to be done in thinking about the various entities metaphysicians write about. What is a species? What is a genre? What is an artifact, or a material object in general? What is an action? What is a context? We will not, generally speaking, shed light on these questions by appeal to sets (though in some cases we might). If the existence of the sets follows from existence conditions analytically contained in the notion of set, then they cannot be things that contain their members. If they can genuinely contain their members, then we immediately take on board substantive metaphysical and epistemological commitments by what seems an innocent move – the invocation of the set of works, or organisms, or indices, or whatever. Perhaps the answers to our ontological questions will be couched in terms of sets, but those answers should not be assumed to be any less costly than substantive answers that wear their metaphysical strangeness more openly. Ontologists cannot hide behind sets.

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