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ORIGINAL RESEARCH

Irreducibly collective existence and bottomless nihilism

Jonas Werner[1]

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Abstract
This paper develops the metaphysical hypothesis that there are irreducibly collective pluralities, pluralities of objects that do not have a singular object among them. A way to formulate this hypothesis using plural quantification will be proposed and the coherence of irreducibly collective existence will be defended. Furthermore, irreducibly collective existence will be shown to allow for bottomless scenarios that do not involve things standing in relations of parthood. This will create logical space for an anti-atomistic form of mereological nihilism.

Keywords Plurality · Plural quantification · Nihilism · Collective existence · Mereology

1 A bottomless world

Are there some things that form the bottom of reality or is the world bottomless? This question is often framed in terms of mereology. Is every thing made of atoms, objects that have no proper parts? Or are there gunky objects, objects such that every part of them has a proper part?[1] From the perspective of the mereologist, a scenario is bottomless just in case there is nothing (for an empty scenario does not seem to have a bottom) or there is a thing that is not an atom or composed of atoms.

It should be noted that this paper exclusively deals with what one might call objectual bottomlessness. There might be a form of property-bottomlessness such that every property is realized by two or more further properties and so on ad infinitum. Property-bottomlessness is not the topic of this paper.[2]

Framing the question of whether the world has a bottom in terms of mereology has a downside for mereological nihilists, philosophers who hold that no object is a proper

[1] In this paper I will use 'things' and 'objects' interchangeably.
[2] Thanks to a reviewer for inviting me to clarify this point. A form of property-botomlessness has been discussed in e.g. Bihan (2013).

✉ Jonas Werner
jonas.werner@philo.unibe.ch

[1] Institute of Philosophy, University of Bern, Länggassstrasse 49a, 3012 Bern, Switzerland

part. This way to frame the question seems to commit nihilists to the assumption that the world has a bottom, as the following argument shows:

P1 If nihilism is true, then no object is a proper part of another object.
P2 If no object is a proper part of another object and there is some object, then the world has a bottom.

Conclusion If nihilism is true and there is some object, then the world has a bottom

The first premise of the argument follows from every reasonable definition of nihilism. I assume that there is no room for denying it. The second premise seems undeniable when one thinks of bottomlessness in terms of mereology. If there is an object and there are no objects that have proper parts, then there is a thing and there is no thing that is not an atom.[3]

What should nihilists do about the above argument? They could try to live with its conclusion. There are proposals in the literature for atomic scenarios that evoke the illusion of bottomlessness (see e.g. Williams & Robert, 2006) and there are attempts to allow for the possibility of bottomlessness by arguing that if nihilism is true, then it is only contingently true (see e.g. Dershowitz, forthcoming). However, these options have downsides. Some nihilists might wish to hold that the actual world is bottomless or they take the notion of a part to be defective (see Dorr, 2005 for discussion) and hence hold that it is necessary that nothing has a part. For these nihilists it is no option to take nihilism to only be a non-actual possibility. Williams proposal for an illusion of gunk involves an infinity of overlapping atoms. It is a scenario in which every collection of objects is a collection of atoms. Such a scenario is not bottomless in the mereological sense spelled out above and it also does not qualify as bottomless in the more liberal sense that will be given below. It also seems intuitive to say that in this scenario the atoms form a bottom and it is just the spatial arrangement of this bottom that makes the scenario appear to be bottomless. I take it that some nihilists wish to rule out the possibility of an infinity of overlapping atoms. Even if one of the ways for nihilists to live with the conclusion of the above argument is viable, it would be a mere appeasement-strategy. The question whether there can be a genuine form of nihilistic bottomlessness remains open.

Can the second premise be denied by separating the question of bottomlessness from questions concerning mereology? The main contribution of this paper is to show that there is logical space for a genuine form of bottomless nihilism. I will develop the idea of irreducibly collective existence and show that for some things to exist in an irreducibly collective way is for the world to be bottomless. The upshot is that even if every *singular* thing is an atom, there can still be pluralities of things that do not bottom out in singular things.

To elucidate what kind of scenario will be discussed in this paper, I will start with a picturesque description of a bottomless scenario.

[3] I assume that the predicate "is an atom" is true of an object x iff it is not the case that "x has a proper part" is a meaningful and true description of x. I further assume that if nothing instantiates a mereological property (see e.g. Cowling, 2014) or the concept of parthood is defective (see e.g. Dorr, 2005), then for no x, "x has a proper part" is a meaningful and true description of x. This allows the defective-concept-nihilist and the no-mereological-relations-nihilist to speak of atoms.

> THE STARDUST SCENARIO: Imagine you are seeing a multitude of glowing things from afar. These things look like a plurality of thousands of stars. Zooming in you see that what you took to be individual stars are not single objects, but again collections of glowing things. Upon zooming in on these glowing things you, again, detect that what first looks like singular individual glowing things are clusters of further glowing things. The same happens again once you try to zoom in on these things and so on *ad infinitum*.

A scenario that can be described in this way seems conceivable. There seems to be no hidden inconsistency in the description. Furthermore, a scenario of the sort described can plausibly be visually imagined. One can imagine the process of zooming in on some things and thereby detecting that what first seemed to be a single thing is in fact a plurality of multiple things. In fact, astronomers tell us that what appears to us as a single star when we look up into the sky at night is in some cases not a single star, but a distant galaxy. If we approached this galaxy, at some point we would realize that what appeared as a single star turns out to be a plurality of myriads of stars. The scenario described in the last paragraph consists in nothing more than the endless repetition of this process.

The stardust scenario has a structural similarity to mereological gunk. The similarity between gunk and stardust is that in both cases we envisage a sort of bottomlessness. In the case of stardust, we do not reach a bottom of singular things. In the case of a gunky object, we do not reach a level of atomic simples, a level of singular things that do not themselves have proper parts. Their commonality is that they falsify the claim that everything is made of atoms, singular objects that do not have proper parts. I take the falsity of this claim to be definitional of bottomlessness. In the context of this paper, I take a scenario to be bottomless iff according to the scenario there are some things that do not have any atoms or things composed of atoms among them. This conception of bottomlessness is conservative in so far as it yields the verdict that gunky scenarios are classified as bottomless and non-empty scenarios in which every plurality is a plurality of singular things made of atoms are not classified as bottomless. However, it leaves the possibility of a third kind of scenario open.

Is there a genuine third kind of scenario, or is the stardust scenario just a disguised gunk-scenario? In the following section I will argue that there is a way to formally describe a bottomless scenario without invoking mereological vocabulary. This formal description will be used to argue that bottomless scenarios that are not identical to gunky scenarios can be coherently described and made intelligible.

The main target group of this paper are mereological nihilists who are worried that they seemingly cannot accommodate bottomless scenarios. I will argue that there is a form of bottomless nihilism available to them. This result might also be interesting to philosophers who believe that nihilists are committed to the world having a bottom and who think that this deals a decisive blow to nihilism. Arguments for nihilism fall out of the scope of this paper. For sympathetic discussions of nihilism see e.g. Brenner, forthcoming, Cowling (2014), Dorr (2005), Sider (2013). Furthermore, some features of irreducibly collective existence seem to suggest that it might be helpful for dealing with collections of non-singular things as they are postulated by quantum theory. More comments on this can be found at the end of §4, when the proposal made in this paper is spelled out in more detail.

2 Formalizing irreducibly collective existence

In this section I formally introduce the idea of irreducibly collective existence (henceforth called 'ICE'). It can be captured with the following slogan:

ICE Some things are such that there is no single thing among them.

I take a single, or singular, thing to be an entity that is apt to be the value of a singular first-order variable. The singular things are those things our singular first-order quantifiers range over. If 'S' is used as a predicate that applies to all and only singular things, then my definition of what it is for something to be a singular thing yields $\forall x\ Sx$. Everything is singular, given that 'everything' is formalised with the means of a singular first-order quantifier.

As a consequence of this, ICE can only be expressed by making use of the resources of plural quantification. These resources will allow to express the claim that some things are not mere collections of singular things, but that they are irreducibly plural, or, differently put, that they exist in an irreducibly collective way.

The core idea standing in the background of plural quantification is that one can plurally quantify over some things. Recently, a number of authors (e.g. Oliver & Smiley, 2013; Rayo, 2002) have defended the acceptance of plural quantification as primitive. I will assume in what follows that plural quantification is intelligible, even if it is not reduceable to first-order quantification over sets of objects or to second-order quantification (as suggested by e.g. Boolos, 1984).

Irreducibly collective existence should be distinguished from the thesis that there are some fundamental truths about collections of things, a thesis that has been argued to be relevant for metaphysical debates by Einar Duenger Bohn (see Bohn, 2012, 2019). The fundamentality of collective truths does not require the truth of ICE. However, one might think that if ICE is true, then for there to be truths about what irreducible pluralities are like, there have to be fundamental collective truths.

Following the terminology of Rayo (2002), I will use 'xx', 'yy', 'zz' as plural variables and 'x', 'y', 'z' as singular variables. Following the convention introduced in Boolos (1984), I allow that a singular entity can be the value of a plural variable as a limiting case. Accordingly, every value of a singular variable is also apt to be the value of a plural variable (but not *vice versa*). Furthermore, I will assume a primitive is/are among-relation, expressed by the relational predicate '$\preceq$'. This relational predicate takes a singular or a plural variable on the left and a plural variable on the right. '$xx \preceq yy$' means that the xx are among the yy. For example, one might say that the undergraduate students are among the students, that the frogs are among the animals, or that the bananas on the table are among the snacks on the table. It is tempting to say that the xx are among the yy just in case every single x that is among the xx is also among the yy. However, ICE says that some things have no single thing among them. For the framework of plural quantification to be apt to deal with such cases, the plural case of some things being among others cannot be defined in terms of the singular case.

I will assume that there are no empty pluralities. This allows to hold that the are-among-relation comes with existential import and is reflexive. All xx are such that the xx are among them (formally:$\forall xx\ xx \preceq xx$). Consequently, all plurali-

ties have some things among them (formally: $\forall xx \exists yy\ yy \preceq xx$). Furthermore, I will make the standard assumption that the are-among-relation is transitive (formally: $\forall xx \forall yy \forall zz(xx \preceq yy \wedge yy \preceq zz) \rightarrow xx \preceq zz$; see e.g. Oliver & Smiley, 2013, p. 109).

Identity between two pluralities is standardly defined as follows (see e.g. Oliver & Smiley, 2013, p. 109):

Identity: $xx = yy \equiv_{def} xx \preceq yy \wedge yy \preceq xx$

To make notation easier, it will prove useful to define a relation of being properly among:

Properly among: $xx \prec yy \equiv_{def} xx \preceq yy \wedge \neg xx = yy$

Cast in terms of plural quantification, ICE can be spelled out as follows:

ICE $\exists xx \neg \exists y(y \preceq xx)$

This formalisation of ICE invokes both plural and singular quantification. I do not take plural quantification to be definable in terms of singular quantification. I rather propose to treat plural quantification as primitive and to define singular quantification in terms of it. Remember that a singular entity can be the value of a plural variable as a limiting case. This gives rise to the question under which conditions some things are such that they are just one singular thing. I take some things to be a singular thing just in case no things are properly among them.[4] This yields:

$$Sing(xx) \equiv_{def} \forall yy(yy \preceq xx \rightarrow xx \preceq yy)$$

Now one can define singular predication in terms of plural predication by stipulating that '$\phi(x)$' is true just in case '$\phi(xx) \wedge Sing(xx)$' is true. This allows to define singular quantification as follows:

$$\exists x \phi(x) \equiv_{def} \exists xx(Sing(xx) \wedge \phi(xx))$$

If singular quantification is defined in this way, we can return to ICE and provide an unpacked version of it that does not invoke singular quantification:

ICE $\exists xx \forall yy(yy \preceq xx \rightarrow \exists zz(zz \prec yy))$[5]

[4] I borrow this thought from Rayo (2002, p. 452) where '$1(xx)$' is defined as being true just in case all yy that are among the xx are such that the xx are among the yy.

[5] The equivalence between this statement of ICE and the one invoking singular quantification can be established as follows. We start by plugging the definition of singularity into the statement of ICE invoking singular quantification:

$$\exists xx \neg \exists yy(yy \prec xx \wedge \forall zz(zz \preceq yy \rightarrow yy \preceq zz))$$

By the duality of $\forall$ and $\exists$, this is equivalent to

$$\exists xx \forall yy \neg (yy \preceq xx \wedge \forall zz(zz \preceq yy \rightarrow yy \preceq zz))$$

This formulation is relevant for the purpose of this paper insofar as it wears the bottomlessness of the resulting scenario on its sleeve. One can use it to see that irreducibly collective existence (in the sense defined) leads to bottomlessness. ICE says that there are some things such that all the things among them have some things properly among them. The resulting structure is the one given by the stardust scenario. In what follows I will call some things irreducibly collective iff $\lambda xx.\forall yy(yy \preceq xx \rightarrow \exists zz(zz \prec yy))$ is true of them.

After this formal introduction to irreducibly collective existence, the following three sections answer central questions for proponents of irreducibly collective existence and rebut objections against their view. The next section concerns how irreducibly collective existence differs from mereology. In the fourth section I will discuss how we can describe irreducibly collective pluralities. The fifth section defends the conceptual coherence of irreducibly collective existence against the backdrop of the results established in the first four sections.

3 Primitively plural quantification and mereology

Friends of mereology will try to argue that by stating ICE, I made use of mereology in disguise. The primitive relation of being among has structural similarities to the relation of parthood. It allows to define a notion of being properly among, which is analogous to the relation of proper parthood, and the definition of single object is structurally similar to the usual definition of an atom as an object that does not have proper parts. Further mereology-analogous definitions suggest itself:

Overlap: $O(xx, yy) \equiv_{def} \exists zz(zz \preceq xx \wedge zz \preceq yy)$
Binary fusion: $zz = (xx \cup yy) \equiv_{def} \forall vv O(vv, zz) \leftrightarrow O(vv, xx) \vee O(vv, yy)$[6]

With these definitions in place, one can state principles governing the primitive relation of being among that are exactly analogous to mereological principles. An example is the following supplementation principle:

STRONG PLURAL SUPPLEMENTATION $\forall xx \forall yy(\neg xx \preceq yy \rightarrow \exists zz(zz \preceq xx \wedge \neg O(zz, yy)))$

In fact, primitively plural quantification can be axiomatised exactly analogous to extensional mereology. I take this to be what allows to faithfully recapture scenarios

Footnote 5 continued
By the definition of the material conditional, this yields

$$\exists xx \forall yy(yy \preceq xx \rightarrow \neg \forall zz(zz \preceq yy \rightarrow yy \preceq zz))$$

This is equivalent to

$$\exists xx \forall yy(yy \preceq xx \rightarrow \exists zz \neg(zz \preceq yy \rightarrow yy \preceq zz))$$

This is equivalent to the given formulation of ICE.

[6] The limitation to binary fusion is due to the expressive limitation of the given language. A general definition of fusion would require superplural quantification (superplural quantification can, if one carelessly allows oneself to speak about pluralities in a reifying way, be described as qantification over pluralities of pluralities). See Rayo (2006) for a discussion of superplural quantification.

that are often mereologically formulated in non-mereological terms. However, this feature also raises the suspicion that I just redressed good old mereology in new clothes.

There is, however, an important difference that sets mereology apart from primitively plural quantification. The mereological description of a bottomless scenario differs in ontological commitment from the description in terms of primitively plural quantification. The mereological description posits a singular thing that has singular things as proper parts that, in turn, have further singular things as proper parts, and so on. ICE only postulates that there are some things that have some things properly among them that, in turn, have some things properly among them, and so on. Plausibly, this difference in ontological commitment between two claims is sufficient for them to stating metaphysically different hypotheses.

Certain mereologists might try to respond by pointing out that fusions (as they understand them) are no ontological commitment over and above the commitment to the objects they fuse. These mereologists will treat composition as analogous to identity [as in Lewis (1990)] or even as a form of identity (see Baxter, 1988 and the ensuing debate about composition as identity). Still, a description of the bottomless scenario in terms of composition as identity will differ with respect to ICE about which things are posited. They are different with respect to *ontology*. This might be the case, even if they do not differ with respect to *ontological costs*. The nihilist and the proponent of composition as identity agree that no composite object incurs ontological costs. However, they do so for very different reasons: The nihilist believes that there are no composite objects and the proponent of composition as identity claims that they come for free.

Furthermore, the two descriptions of bottomlessness differ with respect to *ideology*: Proponents of composition as identity have to make sense of one-many identity. To do so, they have to make use of a notion of identity that allows to express that multiple things are identical to a singular thing. There are various ways to make sense of such a form of identity (see Cotnoir, 2014 for an overview) and I cannot review all of them here. But even without a detailed review, it seems plausible that making sense of one-many identity requires conceptual commitments that are different to those used in stating ICE.

I take the ontological difference alone to be sufficient for warranting the conclusion that the metaphysical hypotheses given by ICE on the one hand and the combination of gunk and composition of identity on the other hand differ. This is strengthened by the further observation that these two hypotheses plausibly differ in the ideological commitments needed to formulate them. Therefore, bottomless scenarios described by means of ICE and those described in terms of mereology are metaphysically different.

It should be noted that the aim of this section was only to argue that composition as identity and primitively plural quantification are distinct metaphysical ideologies. I did not aim to provide any reasons to favour one over the other. Still, some readers who find the combination of gunk and composition as identity more intuitive than irreducibly collective existence might conclude from my discussion that composition as identity is an ideologically less problematic and more intuitive way of allowing for

bottomlessness.[7] For this reason, it might be worth pointing out that there are potential problems for composition as identity that do not seem to carry over to nihilism. For example, it has been argued that the most straightforward way to spell out composition as identity leads to the result that composition as identity collapses to nihilism (see Calosi, 2016; Loss, 2018) and that other ways to spell out composition as identity lead to the result that there are no atoms (see Lechthaler, 2019).

4 How to speak of irreducibly collective pluralities?

Plural predicates are often divided into collective and distributive predicates. A collective predicate applies to some things collectively, it says of them that they collectively are a certain way. A distributive predicate applies to some things just in case the things are a plurality of singular things and the predicate applies to every thing among them.[8] For example, if squares are arranged in a circle, then the collective predicate 'being arranged in a circle' applies to them and so does the distributive predicate 'being rectangular'. Note that formulations like e.g. 'being rectangular' or 'weighing more than 40 kg' are ambiguous and can be interpreted as collective predicates or as distributive predicates. 'Having proper parts', in contrast, is clearly a distributive predicate. It applies to a plurality just in case it is a plurality of singular things that have proper parts. There is no non-distributive way to understand what it is for things to have proper parts available. This is why ICE allows for a form of non-mereological bottomlessness. Irreducibly collective pluralities neither have gunky things nor atoms among them, for they do not have singular things among them and only singular things can be atomic or gunky.

Some might object to my claim that 'having proper parts' has to be interpreted as expressing a distributive predicate by observing that e.g. 'The felines have the house-cats as a part.' has a true reading, whereas 'A feline has the house-cats as a part.' is clearly wrong. However, the only way to read the former sentence as true whilst upholding that it literally states that there is a part-whole relation between the felines and the house-cats seems to consist in taking 'the felines' to not be a plural expression, but rather a way to denote the mereological sum of all felines. Of course, someone might try to develop a system of mereology where things can have parts in a collective way. It should be noted, however, that extant accounts of mereology take the parthood-relation to hold between singular objects. If there were a notion of collective parthood, it would be highly non-standard.

One might worry that accepting ICE comes at the price of accepting very limited expressive resources. If only collective predicates can be applied to irreducibly collective pluralities, then we cannot say much about them, or so the worry goes.

[7] Thanks to an anonymous referee for pressing this point.

[8] One might be tempted to hold that distributive predicates can apply to pluralities without applying to the singular things among the pluralities. This seems to be motivated by cases like the following: The predicate 'are galaxies' can apply to a plurality of galaxies although the galaxies are not singular things. I reserve 'distributive predicate' for predicates that apply to a plurality only if they apply to the singular things among the plurality and I maintain that in the example 'are galaxies' is not a distributive predicate (unless the galaxies are reified as singular things). I will provide a way to express cases like the galaxy-examples using collective predicates, below.

One way to respond to this worry is to draw attention to the fact that many predicates that are mostly used as distributive predicates do have a collective reading. For example, we mostly say of singular things that they are white. But it is also possible to say that the sugar crystals in my cup are white, even if none of the single crystals is white; every single sugar crystal is transparent. Generally, nihilists will find it necessary to reconfigure allegedly distributive predicates to collective plural predicates; as the presence of constructions like 'simples arranged tablewise' in the debate about nihilism indicates (see e.g. Dorr, 2005 §1).

Another strategy is to show that we can construct complex collective predicates that apply to irreducibly collective pluralities. For example, we can say that a collective predicate applies to all things that are among some other things. More formally, we can take a collective predicate F and define its universal and existential siblings as follows:

- $F^{\forall}(xx) \equiv_{def} \forall yy(yy \preceq xx \rightarrow F(xx))$
- $F^{\exists}(xx) \equiv_{def} \exists yy(yy \preceq xx \wedge F(xx))$

One might furthermore wish to say that although the irreducibly collective xx are not F, they decompose into subpluralities that are F. To be able to say something like this, one needs a non-mereological notion of decomposition. The parallels between mereology and primitively plural quantification warrant optimism that such a notion can be constructed. The main challenge is to provide a surrogate for reifying talk about pluralities, a way to uphold the view that pluralities are not single things and to nevertheless allow oneself to speak as if they were.

In what follows I spell out a method to do so. This method will later also prove to be useful for saying of some irreducibly collective things how many they are. Its underlying idea is to use the *terms* to which an *assignment function* assigns pluralities as proxies for these pluralities.[9]

At this point it should be noted that assignment-functions that can assign irreducibly collective pluralities to terms might be multi-valued functions that are not reducible to set-valued functions and that do not have a codomain. Multi-valued functions are functions that assign some members of its domain more than one value. Every member of the domain gets assigned a plurality of values. One way to understand multi-valued functions is to reduce them to single-valued functions that assign each member of their domain a set of values. In our context we cannot rely on the claim that there is a set of values, because there are reasons to doubt that the members of irreducibly collective pluralities form sets. Sets are standardly understood as collections of singular objects, their elements.[10] It might be a worthwhile project for the friend of irreducibly collective pluralities to try to develop a plural set theory allowing that irreducibly collective pluralities form sets. For now, however, the friend of ICE should be prepared

[9] An alternative to the proposal to be developed consists in making use of superplural quantification (see also fn. 4). The following proposal is also available to those who find superplural quantification unintelligible. Furthermore, superplural quantification does not straightforwardly allow to say of an irreducibly collective plurality how many things are among them.

[10] At least sets as they are described by Zermelo-Fraenkel set theory with the axiom of choice (ZFC) seem to be sets of singular things by nature. The well-ordering axiom, which is part of ZFC, allows to impose a well-order on every non-empty set that has a unique minimal element and this unique minimal element arguably has to be understood as a singular thing.

to accept that some values assigned to plural terms do not form sets. If the values of some members of the domain do not form a set, then we also get the result that there is no set of all the values assigned to members of the domain. Hence the multi-valued functions we are interested in have no codomain (unless we accept that 'codomain' is itself a plural term, rather than a singular term that denotes a set). Accepting functions without a codomain is independently motivated, given a standard assumption about the semantics of denoting expressions. The standard assumption I make is that a semantic account of how denoting expressions are linked to the enities they denote crucially involves a function that takes the denoting expression as its argument and gives the entities it denotes as its values. If there is a function that assigns its cardinality to every set, this function has more than set-many arguments and more than set-many values (for there is no set of all cardinal numbers). Friends of plural terms that have proper-class-many values also need multi-valued functions without a codomain to provide assignment functions. Take, for example, the following stipulation made by Øystein Linnebo: 'Let *oo* be the plurality of all ordinals' (Linnebo, 2010, p. 152). Assuming that '*oo*' has semantic values and that every ordinal is among the values of '*oo*', a function that assigns its values to '*oo*' has to be a multi-valued function without a codomain.

In what follows I will argue that functions that work akin to assignment-functions allow to define a plural notion of decomposition. I will call these functions labellings:

Definition of a labelling $\mathbb{L}$: A labelling $\mathbb{L}$ is a multi-valued function that assigns each member of a set of items I (the labels) some things.[11]

Let I be the domain of labelling $\mathbb{L}$. An $i \in I$ is a label for the xx iff the xx are the values the function $\mathbb{L}$ assigns to i. A label is a singular individual entity, whereas its values might be more than one thing. By letting the labels go proxy for their values, we can now simulate reifying talk about pluralities without treating pluralities as individual singular entities.

Now we can define the notion of a label-partition of a plurality in the following way:

Definition of a cover-labelling of the xx: A labelling $\mathbb{L}$ with the domain I covers some things xx iff (i) the xx overlap all values $\mathbb{L}$ assigns to some $i \in I$ and (ii) every yy that overlaps some of the values $\mathbb{L}$ assigns to some $i \in I$ is overlapped by the xx.

Definition of a label-partition of the xx: A cover-labelling $\mathbb{L}$ of xx is a label-partition of xx iff it is such that the values of this function are pairwise non-overlapping. (To say that the values of a labelling with domain I are pairwise non-overlapping just is to say that for any two $i, i' \in I$, the values of i does not overlap the values of i'.)

Label-partitions provide us with plural decompositions. Informally speaking, they give us pluralities that together make up the xx and do not overlap. We can now express the thought that the xx decompose into subpluralities that are F as follows:

- $F^{Dec}(xx)$ iff$_{def}$ there is a label-partition $\mathbb{L}$ of the xx with the domain I such that for every plurality yy and every $i \in I$, if yy are the values of i according to $\mathbb{L}$, then $F(yy)$.

[11] The main difference between a labelling and an assignment-function is that the labels of a labelling need not be terms of a language. They can be any entities of any sort and hence there will never be a shortage of them, even if we enter the realm of infinite cardinalities.

As already advertised above, labellings also help us to say of irreducibly collective xx how many things the xx are. It might be tempting to say that there is no answer to the question how many things are among an irreducibly collective plurality. Cardinality is defined in terms of bijections between sets and, as already mentioned above, irreducibly collective pluralities arguably do not form sets. However, label-partitions allow for a straightforward and motivated way to assign cardinal numbers to pluralities, be they collective or not.

Cardinality of a plurality xx: The smallest cardinal κ such that no set I that is the domain of a label-partition of the xx has a cardinality larger than κ.

Carelessly put, the idea underlying this definition is as follows: The cardinality of a plurality is the supremum of non-overlapping pluralities into which it can be decomposed. It allows to say of irreducibly collective pluralities how many things there are among them without having to assume that the things among the pluralities form sets. Of course, nothing in this definition guarantees that every plurality has a cardinality. This is intended, for there might be class-sized pluralities, like e.g. the plurality of all sets. The definition is conservative with respect to the results of counting singular objects: If the xx are a set-sized plurality of singular objects, then the smallest cardinal κ such that no set I that is the domain of a label-partition of the xx has a cardinality larger than κ is the cardinality of the set of all and only the xx.[12]

One reason to welcome cardinalities for irreducibly collective pluralities is that this allows to mirror distinctions between gunky objects. There are distinctions between countable gunk (a gunky object that has not more than countably many non-overlapping parts), gunk of higher cardinalities, and hypergunk [a gunky object that has more than κ-many non-overlapping parts for every cardinality κ; see Nolan (2004)]. Given the above notion of the cardinality of a plurality, these distinctions can now be emulated in terms of irreducibly collective existence.

At this point enough of the technical machinery is in place to revisit the question whether ICE can be relevant to quantum theory. The potentially fruitful connection between irreducibly collective existence and quantum theory is due to the dominant metaphysical account of quantum particles doing away with individual particles. In this respect, Steven French and Décio Krause call the claim that "quantum particles should no longer be regarded as individual" the "Received View" (French & Krause, 2006, p. xiii). They develop a theory of quasi-sets to deal with things that are not individuals. One potential advantage of my account over theirs is that I do not have to make use of a primitive notion of quasi-cardinality (see French & Krause, 2006, p. 276) to say of collections of non-individuals how many they are, but can use the procedure using label-partitions described above.[13] However, more work has to be done to develop the doctrine of irreducibly collective existence in a way that allows to deal with the kind

[12] Let κ be the cardinality of S_{xx}, the set of all and only the xx. This cardinality κ is also the cardinality of the domain I of the label-partition that assigns each member of I a distinct member of S_{xx}. No label-partition of the xx can have a larger domain, for otherwise the covering-condition or the non-overlap condition would be violated.

[13] It should be noted that French and Krause seem to think that one can use singular quantifiers to quantify over non-individuals, as e.g. talk abut 'non-individual y' (French & Krause, 2006, p. 319) suggests. If the present proposal were applied, this would result in non-individuals only being quantifiable over by means of plural variables.

of non-individuality that quantum objects arguably exhibit. The major problem is that according to ICE, a plurality xx exists in an irreducibly collective way only if it has an infinite chain of subpluralities yy_1, yy_2, yy_3, ... such that yy_1 is a proper subplurality of yy_2, yy_2 is a proper subplurality of yy_3, etc. ad infinitum. Together with the axiom of strong plural supplementation mentioned above, this yields the result that every plurality that exists in an irreducibly collective way can be decomposed into infinitely many sub-pluralities and gets hence assigned an infinite cardinality. This would clash with the demands given by many plausible cases of collections of non-individual fundamental particles in physics. E.g. the two electrons of a helium atom or the quarks of a hadron are plausible candidates for finitely many elementary particles existing in an irreducibly collective way. However, it is an open question whether there is a fundamental level of elementary particles (see Crowther, 2019 for a discussion of how this question might be tackled). Consequently, whether and how the resources of this paper can be used in the context of giving a metaphysical account of quantum objects is a question that only further research both in physics and metaphysics can settle.

This section has shown that there are various ways to describe irreducibly collective pluralities, including a way to say how many things there are among such a plurality. Some philosophers will still doubt the viability of this hypothesis, they will claim that it is conceptually incoherent. The next section defends the conceptual coherence of ICE.

5 The conceptual coherence of ICE

This section discusses and rebuts the objection that ICE is conceptually impossible because it is analytic of the concepts of objects or things that every plurality of things has singular things among them.

The claim that ICE is conceptually incoherent has recently been endorsed by Simon Thunder, who reasons as follows:

> 'To say that the only answer to the question of "what is *oo* a plurality *of*" is "more pluralities" simply looks like a conceptual mistake. What it is to be a plurality is ultimately to be many genuine individuals. If there are no genuine individuals, then there can't be a plurality.' (Thunder, forthcoming)

Of course, the proponent of ICE can give a flat-footed answer to the question what a plurality of irreducibly collectively existing things is a plurality of. It is a plurality of things (although not a plurality of singular things). This answer will probably not satisfy Thunder (or a like-minded objector), for it presupposes that there can be pluralities that are not pluralities of singular things (or, to use Thunder's terminology, pluralities of genuine individuals).

One way to understand Thunder is that (his talk about a conceptual mistake notwithstanding) he is concerned with the essence or real definition of pluralities. Thunder might be reconstructed as arguing that if it wasn't part of the real definition of a plurality that it is a plurality of singular things, then there could not be any informative answer to the question what the plurality is a plurality of. This worry can be answered

with the help of the material of §4. There I developed ways for the proponent of irreducibly collective existence to describe pluralities in various ways. Among other things, I have shown how a an irreducibly collective plurality can be described as a plurality of stars, pieces of dust, or apples, without committing to the claim that it has a singular star, a piece of dust, or an apple among it.

An interpretation that is more faithful to the letter of Thunder's claim is that he is indeed worried that talk about irreducibly collective pluralities involves a conceptual error. The claim that it is a conceptual truth that every plurality is a plurality of singular things can be made plausible by means of the following line of reasoning. We understand the concept of things by virtue of understanding the concept of a singular thing. 'Things' is just the grammatical plural of 'thing' and once we understand what a (singular) thing is, the concept expressed by the grammatically plural 'things' comes for free: Things are just some singular things taken together. If it is a conceptual truth that things are just singular things taken together, then it is a conceptual truth that every plurality of things has a singular thing among them.

According to this line of reasoning, the falsity of ICE turns out to be a conceptual truth. If the falsity of ICE was a conceptual truth, then ICE would be conceptually incoherent.

In a nutshell, my response consists in arguing that when doing non-descriptive metaphysics, we should be prepared to make use of revisionary conceptual tools. I grant the objector that the concept expressed by 'things' in ordinary contexts is such that it is a conceptual truth that every plurality of things (with 'things' being used in this sense) has a singular thing among them. However, I maintain that this should not stop the practitioner of non-descriptive metaphysics to propose and use a concept of things that allows to formulate ICE.

The notion of non-descriptive metaphysics is set in opposition to the notion of descriptive metaphysics due to Strawson (1959). The descriptive metaphysician, according to Strawson, seeks to 'describe the actual structure of our thought about the world' and to 'lay bare the most general features of our conceptual structure' (Strawson, 1959, p. 9). Non-descriptive metaphysics is not primarily concerned with our conceptual structure, it seeks to describe the world as it is in itself (and to formulate hypotheses about what it might be like).[14] Of course, our conceptual structure is relevant insofar as we use it to describe ways for the world to be. However, the practitioner of non-descriptive metaphysics should not presuppose that our conceptual structure is apt to formulate all relevant metaphysical hypotheses. They should not shy away from developing and using concepts that differ from our ordinary concepts. When realising that the use of our ordinary concepts turns a metaphysical hypothesis into a conceptual falsehood, they should feel free to develop novel concepts that allow to formulate the given hypothesis. In particular, they should feel free to make use of primitively plural quantification to formulate ICE.

The opponent might retort that if I do not take 'things' to express the concept ordinarily expressed by it, then it becomes obscure what I mean to say with 'Some

[14] A related distinction has been proposed by Kit (Fine, 2017) who distinguishes between naive and foundational metaphysics. However, Fine's way to draw the distinction crucially involves a primitive notion of reality (see also Fine, 2001) and I do not think that this notion of reality is needed to draw the distinction relevant in the context of this paper.

things are such that there is no single thing among them'. This would be a fair charge if all I did was claiming that 'things' does not mean 'some singular things taken together'. However, I did offer a way to understand pluralities without taking recourse to singular things and to define singularity in terms of plurality and the being among-relation. This way to understand 'things' has been regimented in terms of plural quantification. The upshot is that I take the concept expressed by 'things' to be primitive and suggest to define the concept expressed by the grammatically singular 'thing' as things that do not have things properly among them. An opponent who challenges this move has to explain why she takes this manoeuvre, which has been spelled out in more detail in the foregoing sections, to be unintelligible.

What is the metaphysical picture underlying this plea for the adoption of novel conceptual resources? Some might read my proposal as a proposal to introduce the basic category of a proper plurality in addition to the familiar basic category of a singular thing. My aim is not to propose the introduction of an additional basic ontological category. The proponent of irreducibly collective existence acknowledges the category of things and they take some of the things to be singular. Being singular (or being a singular thing) is a particular way of being some things. It is a sub-category of being some things, rather than an additional category. The important bit of unorthodoxy that opens the logical space for irreducibly collective existence is not the introduction of an additional basic category, but the primacy of plurality over singularity.

Some might now argue that by proposing to adopt novel conceptual resources, I propose to change the topic in a problematic way. One might adopt a language in which 'things' means animals. In the resulting language the sentence 'All things are alive' might express a truth, but this does not yield the result that all things are alive (as it is witnessed by 'Four' being the correct answer to the famous riddle 'How many legs would a horse have if "leg" meant "tail"?'). Do I propose to change the meaning of 'things' in a similarly problematic way?

I do not claim to possess a criterion for when adopting a proposal to depart from the ordinary meaning of a word for the purpose of formulating metaphysical hypotheses changes the topic in a problematic way.[15] Still, I can provide two considerations to show that in this particular case the topic is not changed. *First*, the ordinary concept of (singular) thing and my concept of (singular) thing have the same extension. Everyone can agree that some things that do not have some things properly among them just are one singular thing. The main difference is that the proponent of primitively plural quantification takes this to be definitional of 'singular thing', whereas the ordinary concept of singular thing is arguably primitive. Furthermore, the proponent of primitively plural quantification will acknowledge the existence of every plurality the proponent of the ordinary concept acknowledges. The only possible difference in extension is due to the conceptual possibility of pluralities that are not pluralities of singular things that is created by the adoption of primitively plural quantification. *Second*, both proposals are intimately bound up with our first-order quantifiers. They agree that things are just those entities these quantifiers range over. Both proposals are about what there is for first-order quantifiers to quantify over. These two considerations show that it is

[15] Some debate about this question can be found in the literature about conceptual engineering. Herman Cappelen proposes an account of topic-continuity (see Cappelen, 2018, p. 112ff). For criticism of Cappelen's account see e.g. Knoll (2020).

fair to say that the proponent of plural quantification did not change the topic in any problematic way.

I conclude that making use of primitively plural quantification as it has been developed in the previous sections allows to formulate the hypothesis ICE in a conceptually coherent way.

6 Conclusion

This paper has presented a theoretical option that has been overlooked in the debate, so far. The option accords with the Quinean view that to settle what there is, we have to investigate which values there are for first-order quantifiers to range over. However, there might be more than there is for singular quantifiers to range over, some things might exist in an irreducibly collective way and they can only be quantified over with a plural quantifier.

To show how irreducibly collective existence can be metaphysically relevant, I have shown that it affords a form of bottomless nihilism. For the nihilist, all singular things are atoms. Irreducibly collective pluralities allow for nihilism without atomism. This result should be of interest to nihilists who do not wish to commit to the claim that the world has a bottom.

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