ORIGINAL PAPER

Composition as Identity and the Logical Roots of Leibniz's Nominalism

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Abstract

The paper deals with Leibniz's ontology and the metaphysics of the aggregate. Concerning the ontology of aggregates, the main aim is to provide *a new argument* in favor of the claim that an aggregate and its constituents have the same ontological import. This argument takes the form of a weakening of a principle known in the contemporary literature of mereology as 'composition as identity' (CAI). The paper shows that Leibniz's nominalism toward aggregates is a direct consequence of two elements: the way in which he considers the relationship between aggregates and their constituents in his logical calculus; and his theory of identity (and more generally, equivalence relations) as providing us with the ground for substitution *salva veritate*. It is concluded that Leibniz is committed to a principle that the author dubs Ontological-CAI: the aggregate/whole is *ontologically identical* (i.e. it has the same ontological import) as its constituents/parts. Concerning the metaphysics of aggregates, the paper outlines in what sense aggregates are grounded on their constituents: arguing that Leibniz is committed to a further principle that the author calls Metaphysical-CAI: the aggregate/whole is *metaphysically grounded* on its constituents/parts. From this it can be understood in which sense Leibniz could be considered a mereological nihilist, and in which sense not. The paper also sets out two different and competing readings of Metaphysical-CAI, and argues that Leibniz accepted both of them by interpreting them as different levels of explanation of the nature of aggregates.

Keywords Leibniz · Composition as identity · Real addition · Aggregates · Mereology · Grounding

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1 Introduction

In recent years there has been a lively debate concerning Leibniz's conception of aggregates. The debate has focused on the metaphysical and ontological status of aggregates: what are aggregates? Is Leibniz committed to the existence of aggregates as further objects with regard to their constituents? Or are aggregates nothing over and above their constituents? A wide variety of positions have been defended; here I shall classify them into three main categories: phenomenalist interpretations; the hybrid interpretation; and the nominalist interpretation. The *phenomenalist interpretations* are those defended by Adams (1994) and Rutherford (1994) both of whom have claimed that aggregates are mind-dependent objects, whose existence is dependent on a mind (finite or infinite, in the case of Rutherford) that apprehends the relations between the constituents of the aggregates. As Adams says, "aggregates have their unity, and therefore their being, only in the mind" (Adam 1994, 246). Aggregates are phenomena and "Leibniz does not believe that phenomena have any being except *in* the existence and occurrence of qualities and modifications of perceiving substances" (Adams 1994, 223). According to these views, aggregates are different objects from their constituents with a different ontological status: if there were no mind apprehending the relations, the constituents could still exist but their corresponding aggregates could not.[1] The *hybrid interpretation* is the one defended by Lodge (2001), according to which aggregates are mind-dependent entities which in order to exist require something more than the mere apprehension of relations between their constitutes. This 'something more' is a sort of act of invention of the mind that treats those relations as a *basis* to conceive a multiplicity of entities as one single entity. However, quoting a passage from the *New Essays* (A VI 6, 146/Leibniz 1981) where Leibniz says that aggregates' being is "in a way mental," Lodge argues that aggregates have their being only partially in the mind, and that their being also depends on the being of their constituents.[2] Aggregates are therefore hybrid entities whose being depends both on the being of their constituents and on a (finite) mind treating many things as one single thing. Finally, the *nominalist interpretation* argues that aggregates are nothing over and above their constituents. Merlo (2012) argues that aggregates are just the plurality of their constituents; here the word 'plurality' must be taken as in plural logic, i.e. as a loose talk to be substituted by plural

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[1] "The apparent conflict between the thesis that bodies are phenomena and the thesis that they are aggregates of substances springs from the assumption that an aggregate of *Fs* must have the same ontological status as the *Fs*. [...] We should not expect it to be assumed without argument that an army [...] has the same ontological status as the soldiers that are its elements. In fact, Leibniz makes clear repeatedly that he believes that all aggregates, as such, are at most phenomena, and hence that an aggregate of substances does not have the same ontological status as the substances" (Adams 1994, 244–45).

[2] "As we have seen, Leibniz thinks that an aggregate, such as a flock of sheep, exists only if a mind exists and apprehends the relation that constitutes the essence of that aggregate. However, this is not all that is required. For there to be such an essence, there must be things standing in those relations. [...] The fact that aggregates depend for their being both on the perception of relations and on the things related has important ramifications for the conditions under which aggregates may exist" (Lodge 2001, 473). Notice that Lodge wrote this passage within a paragraph called "the Ontological status of Aggregates": it is therefore clear that he interprets the being of an aggregate as its ontological import.

terms. According to this view, a flock of sheep just is many sheep. A similar view was defended by Hartz (1992) who proposed to interpret Leibnizian aggregates as mereological aggregates which simply are 'just the parts taken together'. According to Hartz, the perceiver should be totally left out of any explanation of aggregates.[3] By contrast, Arthur (2018) argues that the perceiver has a role to play insofar as he/she considers many things as one: "the only unity possessed by an aggregate is added by its being considered as one, a clearly nominalist thesis" (Arthur 2018, 54). Arthur calls such a principle the Aggregate Unity Principle. However, unity is not reality: "the reality of an aggregate derives only from the reality of its constituents, which I shall dub the Aggregate Reality Principle" (Arthur 2018, 51).[4] According to Arthur's nominalist interpretation, the mind just provides a way of considering many things as one; however, this does not constitute an ontological incrementation, in the sense that the acceptance of aggregates does not lead us toward any further ontological commitment with regard to their constituents.

The present paper aligns with the nominalist interpretation of aggregates, even though I shall raise some doubts about some versions of the nominalist interpretation (in particular the positions advocated by Merlo and Hartz, respectively). My first aim is to provide *a new argument* in favor of such an interpretation. I believe that a general weakness of all the interpretations mentioned above (from the phenomenalist to the hybrid, but also the nominalist one) is that they mainly focus on the passages where Leibniz speaks of the metaphysics of aggregates, while at the same time forgetting the logic of aggregates. In the second half of the 1680s Leibniz wrote a number of papers where he developed a calculus of aggregates that it is now sometimes called 'Real Addition calculus'. This calculus is interesting not only because it provides us with an anticipation of contemporary classical mereology (Mugnai 2019), but also because it gives us a number of clues as to how Leibniz thought of aggregates (and wholes). I will show that Leibniz's nominalism toward aggregates is a direct consequence of two elements: the way in which he considers the relationship between aggregates and their constituents in such logical calculus; and his theory of identity (and more generally, equivalence relations) as providing us with the ground for substitution *salva veritate*.[5] As such, my road to Leibniz's nominalism will start from Real Addition and pass through his logical theory of substitution. The second aim of this paper is thus to clarify the relationship between the logic and the ontology of aggregates, which is a point of significant interest and one that is not always dealt with attentively in the literature.

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[3] Lodge (2001) convincingly criticizes Hartz's interpretation. I will say something about this interpretation below when introducing the thesis known as "composition as identity."

[4] On the distinction between the phenomenalist and the nominalist interpretation, Arthur writes: "It is only the unity of the plurality—the plurality's being perceived as one thing—that lies in perception, not the plurality (the existence of many things) itself. As I have already argued above, Leibniz's position is a nominalist one, not a phenomenalist one" (Arthur 2018, 70).

[5] In recent Leibnizian literature it has emerged that there are different concepts of substitution *salva* (*salva veritate*, *salva qualitate*, *salva quantitate*, etc.). I shall argue that the one that interests us here is substitution *salva veritate*.

The structure of the paper is as follows: in Sect. 2 I shall introduce Leibniz's notion of Real Addition, and argue that he accepted a principle that we now call Unrestricted Composition; moreover, I will introduce the idea of 'composition as identity' (CAI) and show that there are reasons to think that Leibniz defended a similar, but weaker thesis; Sect. 3 explains Leibniz's theory of substitution of equivalent terms; Sect. 4 develops an argument based on the latter theory that delivers us a weaker version of CAI, according to which an aggregate and its constituents have the same ontological import (even though they are, strictly speaking, different entities): I shall dub this principle Ontological-CAI; Sect. 5 deals with the idea that, in the real world, aggregates are grounded on their constituents: I present here a principle that I call Metaphysical-CAI, and argue that Leibniz accepts both Ontological and Metaphysical-CAI. I conclude by clarifying in which sense Leibniz can be interpreted as a mereological nihilist, and in which sense not. Section 6 concludes.

2 Real Addition, Unrestricted Composition, and Composition as Identity

The notion of Real Addition is similar to that of mereological sum or fusion of contemporary mereology: the idea is that we can add or fuse different things and obtain aggregates of those objects.[6] We shall use the symbol '$\oplus$' employed by Leibniz in *Specimen calculi coincidentium et inexistentium* (A VI 4A 830-845) to formalize the notion. There are two axioms that regulate how Real Addition works:

1. $\forall x(x \oplus x = x)$
2. $\forall x \forall y(x \oplus y = y \oplus x)$

Axiom 1 states the Idempotence of Real Addition (which is of course a property not shared by arithmetical addition); axiom 2 expresses Commutativity. Moreover, Leibniz does not state but presupposes a third axiom (associativity):

3. $\forall x \forall y \forall z(x \oplus (y \oplus z)) = ((x \oplus y) \oplus z)$

Thanks to the notion of Real Addition (and identity), Leibniz defines the containment relation (in what follows $C(x, y)$ must be read as x contains y, or y is contained in x). Leibniz's definition uses indefinite letters such as A, B, etc., i.e. letters that stand for variables and so allow us to express general statements. Leibniz writes that "$B \oplus N = L$ means that B is (contained) in L or L contains B" ("$B \oplus N = L$ *significat B esse in L seu L continere B*" (A VI, 4A, 832)). We shall avail ourselves of quantification theory instead of indefinite letters. So Leibniz's definition becomes:

$$C(x, y) \equiv_{def} \exists z(y \oplus z = x)$$

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[6] On Real Addition see, for instance, Swoyer (1994), Lenzen (2000), and Mugnai (2019).

which can be read as "*y* is contained in *x* if there is a *z* such that *y* plus *z* is equal to *x*."

A natural question that one can pose at this point relates to when a plurality of things can be summed together to obtain a unique aggregate of them. Leibniz answers "always." His acceptance of what we would nowadays call Unrestricted Composition, i.e. the principle that any plurality forms a single aggregate can be appreciated by Postulate 1 of *Non Inelegans specimen demonstrandi in abstractis* (A VI 4A 845-855) and Postulate 2 of *Specimen calculi coincidentium et inexistentium* (A VI 4A 830-845):

Postulate 1　　Any plurality of terms whatever can be added to constitute a single term; as for example, if we have A and B, we can write A ⊕ B, and call it L.

Postulate 2　　Any plurality of terms, such as A and B, can be added to compose a single term, A ⊕ B or L.

This is even more strongly stressed in the following passage:

I reply that our general construction depends upon the second postulate, in which is contained the assumption that any term and any other term can be put together as components. Thus God, soul, body, point, and heat compose an aggregate of these five things. And in this fashion also quadrilateral and trilateral can be put together as components. […] But if anyone wishes to apply this general calculus of compositions of whatever sort to a special mode of composition; for example if one wishes to unite "trilateral" and "circle" and "quadrilateral" not only to compose an aggregate but so that each of these concepts shall belong to the same subject, then it is necessary to observe whether they are compatible. Thus immovable straight lines at a distance from one another can be added to compose an aggregate but not to compose a continuum. (A VI 4a 842)

Real Addition and the containment relation must not be confused with compositions of parts into a whole and the part-whole relation: according to Leibniz, the part-whole relation is a restriction of the containment relation to *homogeneous entities*.[7] However, since homogeneity is an equivalence relation,[8] the formal features of the

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[7] Homogeneity is a complex technical notion is Leibniz's mereology. Similar things (i.e. those things that share all their qualitative properties) are homogeneous. However, also non-similar things can be homogeneous if they can be transformed into other things, which are similar. On this notion one can see De Risi (2007, ch. 2) or Arthur (2021, §2.3).

[8] That is, homogeneity is reflexive (everything is homogeneous to itself), symmetric (if A is homogeneous with regard to B, so is B with regard to A), and transitive (if A is homogeneous with regard to B, and B with regard to C, so is A homogeneous with regard to C).

containment relation are shared by the part-whole relation[9]: as such we have a correspondent version of Unrestricted Composition also for the part-whole relation: when do some homogeneous things compose a whole? Leibniz's answer is the same as before: always.[10] For this reason, in what follows we shall speak indifferently of Unrestricted Composition with regard to both the containment and the part-whole relations.

Exploiting the resources of Plural First-Order Logic, we can express Unrestricted Composition (UCP) in the following way:

$$(\text{UCP}) \quad \forall xx \exists y (\Sigma(xx) = y)$$

where 'Σ' is a multigrade operator that represents Real Addition. This principle says that, given any plurality xx of objects, there is something which is their sum (or their fusion). This is the aggregate of xx.

UCP is a very strong principle which delivers us many things; in particular, one should notice that when we consider infinite pluralities (i.e. pluralities made up of infinitely many objects), UCP delivers us with objects which are constituted of infinitely many things. As such Leibniz's Real Addition calculus can accommodate any kind of aggregates, both finite and infinite ones.[11]

However, the fact that we can have a logic of infinite aggregates/wholes does not imply that such wholes *really exist*. According to Leibniz, there is a sharp difference between the logic and the metaphysics of aggregates: while we can consider any kind of aggregates, even infinite ones, this does not imply that they ontologically exist, or—as Leibniz often says—that they have a metaphysical unity. What Unrestricted Composition allows us to do is to introduce a singular term denoting an aggregate (finite or infinite), and to use this term within sentences of our logical theories. However, this is not sufficient to prove that the referent of that term actually exists. In other words, the definition of aggregates that UCP delivers is only nominal, not real.[12]

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[9] The proof of this fact is straightforward, and just depends on the properties of the containment and the homogeneous relations: see, for example, Mugnai (2019, 61).

[10] This is not entirely correct. Leibniz's rejection of infinite numbers and infinite quantities amounts to a rejeticon of infinite wholes. So Composition for parts/wholes should be restricted to the case where we only have finitely many parts to compose. However, this won't play any role in what follows, so to keep things easy I shall indiscriminately refer to Unrestricted Compositon both in the case of aggregates and constituents, and in the case of wholes and parts

[11] The use of Plural logic makes Real addition an infinitary operation, i.e. given any finite or *infinite* plurality of objects, UCP delivers us the aggregate of them. In virtue of Leibniz's argument against the infinite number, which is supposed to show that an infinite aggregate is not a whole, one might find it strange that Leibniz's Real Addition calculus can accommodate infinite aggregates. As far as I know, in these papers, Leibniz does not mention infinite aggregates, but he does not exclude them; however, infinite aggregates enter into his philosophy, for instance when he claims that bodies are aggregates of infinitely many substances or that bodies are actually divided into infinitely many parts. As such, his logic of aggregates should also account for them. I defend at length this interpretation in Costantini (Manuscript).

[12] Another way of expressing this idea is to say that an application of UCP is not enough to give us an entity with a true unity, i.e. a substance. Levey (2012, 100–01) writes: "Under what conditions do some things compose a further thing? […] Leibniz's answers, while amounting to metaphysical claims, are hardly esoteric. Not just any bunch of things form something further that is a single thing in its own right. Single objects do not consist of parts that are scattered around in disparate places, for instance. Merely regarding many things together in a single thought or calling them by a single name isn't enough to make them constitute some one thing." This is a metaphysical analysis of what it means to be a real unity, which is fully compatible with the use of UCP as a logical (and not a metaphysical) principle.

2.1 Composition as Identity

Unrestricted Composition tells us that any plurality can be summed together to form an aggregate/whole, or that an aggregate/whole is the sum of its constituents/parts. But it does not tell us what the relationship is between the things that are summed and the aggregate/whole, i.e. between the summed and the sum. Is the aggregate/whole just identical to its constituents/parts? Or is it something more, an ontological addition with regard to its constituents/parts, just as a set is a different and new object with regard to its elements? It is clear that Leibniz propends toward the first option. For instance, in a comment on Postulate 2 above, Leibniz writes:

> In this calculus nothing else will be used than a certain thing in place of the things that are contained, so that many things similarly placed are equivalent to one. So as $A \oplus B = L$, where A and B are related in the same way each other, and in place of them one single thing can be posited.[13]

The passage contains two extremely interesting points: the first is the explicit claim that the relation between the summed and the sum is one of equivalence; the second, more implicit, is the idea that "we can posit one thing instead of a plurality of things," i.e. we can substitute the summed with the sum (or vice versa). Clearly, the two points are related: it is in virtue of their equivalence that we can proceed with the substitution. I shall here briefly discuss the first point, while dealing with the notion of substitution in Sect. 3.

Leibniz's endorsement of this claim strongly suggests that he took aggregates/wholes to be nothing over and above their constituents/parts. In a letter to De Volder, he even expresses this thought with almost the same words: "an aggregate is not anything other than all those things from which it results" (*Aggregatum enim nihil aliud est quam ea omnia simul sunt ex quibus resultat*, GP II 256).[14] Nowadays, the slogan "the whole is nothing over and above its parts" is usually considered to express the philosophical thesis known as 'Composition as identity' (CAI): the relation between the whole and its parts is an instance of the identity relation, namely the whole just is all its parts. CAI has proven to be attractive to mereologists with nominalist inclinations, because to identify the whole with its parts allows us to declare mereology as "ontologically innocent" (Lewis 1991).[15] However, one must

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[13] "*In isto calculo nihil aliud adhibetur, quam pro inexistentibus quidem, ut plura similiter posita simul aequivaleant uni. Ut $A \oplus B = L$ ubi A et B eodem modo se habent, et pro ambobus sic scriptis poni potest unum*" (A VI 4A 859, my translation/Leibniz 2000, 112).

[14] "[A]n aggregate is nothing other than all those things from which it results taken at the same time, which really have their unity only from a mind, on account of those things which they have in common, like a flock of sheep" (GP II 256, quoted from Lodge 2001, 470).

[15] One may find questionable our use of CAI to deal with Leibniz, the risk being that of anachronistically imposing later views on Leibniz. However, while the expression "composition as identity" goes back to David Lewis, the idea behind it is as old as philosophy. As Normore and Brown (2014) document, this idea has been discussed from the ancient era (for instance by Plato) to the modern one, passing through the medieval period. In particular, a proponent of this thesis with whose work Leibniz was well-acquainted was Thomas Hobbes, who in *De Corpore* wrote: "The whole and all the parts taken together are the same thing. And as [...] in division it is not necessary to pull the parts asunder; so in composition, it is to be understood, that for the making up of a whole there is no need of putting the parts together" (*De corpore*, ii, vii, 8; Hobbes 1839, 97, quoted from Cotnoir and Varzi 2021, 194).

stress that CAI does not follow from the axioms of classical extensional mereology (or from the axioms of the Real Addition calculus). As such, one can accept classical mereology with UCP and reject CAI. In the contemporary literature on mereology, there are different characterizations of CAI, from the weak version defended by David Lewis (composition is *analogous* to identity), to the strong version for which composition is identity.[16] I shall focus here on the strong version, so I will take CAI to be the following principle:

Strong-CAI   The aggregate/whole is *numerically identical* to its constituents/parts.

If we compare Strong-CAI with Leibniz's claims above that "a plurality of things similarly considered is equivalent to one thing", we may suspect that Strong-CAI is indeed too strong as an interpretation. While Leibniz speaks of "equivalence", Strong-CAI interprets the relation as numerical identity. This is in fact true, as we will see below. I will argue that by imposing some restriction on Strong-CAI we can easily determine Leibniz's ontology of aggregates. To introduce these restrictions, we shall exploit the idea of substitution of equivalent terms. It is therefore necessary to introduce Leibniz's conception of identity and equivalence, since they play a crucial role in our argument.

3 Identity and equivalence in Leibniz

The relation of identity plays a pivotal role in Leibniz's logical calculi. Definitions 1 of both *Non inelegans specimen demonstrandi in abstractis* (A VI 4a 846) and *Calculus coincidentium et inexistentium* (A VI 4a 831) characterize the identity relation by means of a substitution rule: "Identical or coincident are those things of which one can be substituted everywhere for the other preserving truth (*salva veritate*)". However, the idea of substituting coincident terms *salva veritate* is not confined to the identity relation *strictu* sensu.[17] It has been noted that sometimes Leibniz refers to equivalence relations more generally as (a kind of) identities. When Leibniz speaks of proofs as "reduction to identities" (via appropriate substitutions), he not only has in mind propositions of the form "$A = A$," but also refers to a plurality of equivalence relations.[18] For instance, Leibniz defines *similar things* as those objects that have the same qualities (Leibniz 1969, 667; GM VII, 19). Similarity is clearly

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[16] On Composition as Identity see Cotnoir and Baxter (2014).

[17] This fact has been stressed by Mugnai (1990); see also Rabouin (forthcoming) for a deep analysis of this matter.

[18] Rabouin forthcoming, 7, writes: "[…] a reinterpretation of 'the reduction to identities' of which, on one side, I shall show that this corresponds to a certain mathematical practice, on the other side that they do not reduce only to the logical tautology A is A, but on a plurality of identical relations" (my translation).

an equivalence relation, meaning that two similar things are identical with regard to all their qualitative aspects. As a consequence, we can substitute (a term referring to) a thing by (a term referring to) a similar thing *salva qualitate.* Or, again, *equal things* are those objects that share all the same quantitative properties (Leibniz 1969, 667; GM VII, 18-19). Equality is clearly an equivalence relation, meaning that two equal things are identical with regard to all their quantitative aspects. As a consequence, we can substitute (a term referring to) a thing by (a term referring to) an equal thing *salva quantitate.*[19] And this idea can be generalized to any equivalence relation.[20]

The general idea behind the *substitution salva* is that to say that two things are equivalent with regard to some aspect φ is the same as to say that they are φ-identical. This is the same idea as that behind the Fregean abstraction principles. As Rabouin (forthcoming, 153, my translation) stresses:

> We see that Leibniz has diagnosed perfectly well the mechanism of what will be later called "definitions by abstraction," namely a mechanism in which an abstract term, like "place," "quality" or "quantity" is introduced indirectly by a characterization of what it means to "have the same place/quality/quantity." This equivalence is then characterized by an identity of certain features […].

If two things are φ-identical, we can proceed with the substitution *salva φ* of one another. Since Leibniz characterizes the relation between an aggregate/whole and its constituents/parts as a relation between equivalent terms, the idea of substituting one for the other follows immediately from his conception of equivalence relations. Leibniz himself claims that "every substitution arises from some equivalence" (*Omnis autem substitutio nascitur ex aequipollentia quadam*: A VI 4, 922). And it is from this substitution that his nominalism toward aggregate follows, as we shall now show.

4 Restricting CAI via Substitution

I will now argue that Leibniz's conception of identity via substitution *salva veritate* requires a restriction of Strong-CAI, and this directly leads to Leibniz's nominalism.

The need to impose some restrictions stems from the fact that Strong-CAI contradicts the Indiscernibility of Identity.[21] If two things are identical, then they must share all properties; however, *prima facie*, this is not the case with aggregates/wholes and their constituents/parts. The main problem here is given by the fact that a whole is one thing, its parts are many. Leibniz would have agreed with this point;

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[19] "Equals are those things that […] can be mutually substituted *salva quantitate*. Similar are those things that can be mutually substituted *salva qualitate*" (A VI 4. 406).

[20] The equipollence principle in physics claims that the full cause has the same quantity of force of the entire effect. See Adomaitis (2020) for a deep analysis of the equipollence principle in physics, and how the logic of *substitutio salva* played a crucial role in Leibniz's dynamics.

[21] This is the same reason why Lewis (1991) defends a weak version of CAI, according to which the composition relation is *analogous to* identity.

he stresses many times that the unity of an aggregate is mental: "So the only perfect unity that these 'entities by aggregation' have is a mental one, and consequently their very being is also in a way mental, or phenomenal, like that of the rainbow" (*New Essay* 146). The mental unity of an aggregate is a property of the aggregate and not of its constituents (even when we take the constituents together, they are many constituents, not one). If we consider an aggregate of substances, while the unity of the aggregate is mental, the unity of the substances is a metaphysical unity. Leibnizian aggregates are not numerically identical with their constituents.[22]

A further problem with Strong-CAI concerns the fact that it is not always possible to substitute a term designating an aggregate/whole by a term designating its constituents parts without violating grammar: the problem is that the term referring to a whole is a singular term, while that referring to its parts is a plural term, with the consequence that from a true sentence we would get an ungrammatical one.[23]

Leibniz is aware of these difficulties. In particular, he is aware that some attributes can be equally said of the parts and the whole, while others can only be said of the part or of the whole (but not of both). However, in this latter case, he thinks that it is in principle possible to provide a paraphrase such that what can be said only of the whole can also be said of the parts:

> It is worth investigating in what way an entity through aggregation, such as an army or even a disorganized multitude of men, is one; and in what way its unity and reality differ from the unity and reality of a man. It seems that the chief difference is to be observed in their attributes and operations. Some attributes are said equally of the whole as of its parts, as, for example, that the army is located in the fields of Marathon, which is true of each individual soldier. *Other attributes can be said only of the whole*, as, for example, that the army is 30,000 strong, and that it is disposed in a lunar-shaped battle line. *Nevertheless, all these things can be stated and expressed even if the multitude is not viewed as a single entity.* Thus, I can say that 30,000 soldiers are present and that one soldier is situated with respect to another just as the battle line mentioned requires, so that certain ones are distanced from a fixed point by so much, others by so much. (A VI 4, 555-556; trans. Sleigh [1990], 123, emphasis added, quoted from Harmer 2013)

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[22] This shows that Hartz's interpretation of aggregates as mereological aggregates is untenable. According to Hartz, aggregates just are their parts taken together, where the perceiver must not be taken into account. It seems to me that Hartz conflates the notion of mereological aggregate or fusion as described by classical extensional mereology with the notion of aggregate described by Strong-CAI. The claim that aggregates just are (i.e. are numerically identical to) their parts taken together is Strong-CAI; however, Strong-CAI is a metaphysical claim about the nature of aggregate, which cannot be derived from Classical Mereology. UCP just says that for any plurality of things there is their aggregate/sum, but it is silent about the nature of this aggregate. One may even argue that a defender of classical mereology should not accept Strong-CAI: UCP is a function that takes as input many things and gives as output one single thing. If the input and the output were numerically identical, then UCP would collapse to the identity function, which is clearly wrong. For a defense of classical extensional mereology and a critique of Strong-CAI, see Lando (2017).

[23] Both Inwagen (1994) and Sider (2007) have raised this point in the modern discussion.

That there are attributes that can be said only of the whole is a clear clue that the relation between the whole and its parts is not numerical identity. The whole and its parts are, strictly speaking, different objects. However, that we can provide a paraphrase such that everything that can be said only of the whole can be stated also for the parts clearly shows that, in some robust sense, the whole and its parts are equivalent: "a plurality of things similarly considered is equivalent to one thing," as Leibniz said commenting on Postulate 2, quoted above. This is revealing of how Leibniz considers unrestricted composition and the relationship between the aggregate/whole and their constituents/parts. The parts are equivalent to the whole or the constituents are equivalent to the aggregates. But we know that equivalence means *identity with regard to some specific aspect*: so Leibniz is claiming that the aggregate/whole is identical to its constituents/parts with regard to some specific aspect. But what aspect? The clue to answering this comes from the fact that equivalence relations between terms permit the substitution of one term with another. However, we have seen that different equivalences relations allow the substitution of equivalent terms preserving *different properties*: coincidence terms can be substituted *salva veritate*; similar terms can be substituted *salva qualitate*; equals terms can be substituted *salva quantitate*, etc. Which of these properties must be preserved in the current case? There are at least three reasons why it is plausible to assume that in this case the right substitution is the one *salva veritate*. First, this seems the basic kind of substitution, which Leibniz uses as a model for the others; thus if he had a different kind of substitution in mind, he would have mentioned it in this context; second, the claim that the whole and its parts are equivalent is a comment on Postulate 2, and the only substitution mentioned and used in the Real Addition calculus (of which Postulate 2 is a key axiom) is substitution *salva veritate*. Third, the reference to a paraphrase in the text quoted above clearly makes sense only if the paraphrase is *salva veritate.* So it is fair to assume that the right property that substitution must preserve is truth.

The substitution of a term for the aggregate/whole with a term for the constituents/parts must thus preserve the truth-value of the statement in which the substitution occurs. A necessary condition for the preservation of the same truth-value is that the sentence's subject matter remains the same after the substitution: if the substitution changes the sentence's subject matter, we would have no guarantee that its truth-value would remain the same. At this point we should recall that according to Leibniz's theory of truth, a sentence is true when the predicate is contained in the subject; it is false otherwise. We thus have two cases: (1) the subject is a substance; and (2) the subject is not a substance. Case 1 can be immediately dismissed, since we are dealing with aggregates and wholes and Leibniz is clear that no entity by aggregation is a substance. Case 2 is the case where the subject is not a substance. Here I would like to suggest that in order to preserve the same subject matter, the two terms must refer to the *same portion of reality*,[24] namely they must have the same *ontological commitment*. In fact, if this were not the case, i.e. if the aggregate/

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[24] This is the same notion that comes out from Lewis's *Parts of Classes*, and indeed one that often comes out in the literature on mereology. I shall defend the use of such a notion later.

whole were an addition of being with regard to its constituents/parts (as a set is normally viewed as a further object with respect to its elements), the substitution would not preserve the same subject matter. In fact, in this case, the term referring to an aggregate/whole would be referring not only to the parts collectively but also to something more, i.e. the proper ontological contribution of the aggregate/whole, and this would make it impossible to maintain the same subject matter.

Our argument can be schematized as follows:

1	Aggregate/wholes are EQUIVALENT to their constituents/parts	Assumption
2	Terms for aggregate/wholes can be SUBSTITUTED for terms for constituents/parts *salva veritate*	From 1, by Leibniz's notion of equivalence
3	The substitution must preserve the SUBJECT MATTER of the sentence	From 2, necessary condition to be truth-preserving
4	The terms for aggregate/wholes and for their constituents/parts must refer to the SAME PORTION OF REALITY, i.e. they must have the same ontological commitment	From 3, necessary condition to preserve the same subject matter

To better appreciate the argument, I would like to suggest that it can be used as a test to assess the other positions presented in the literature. Let us consider Adams' phenomenalist position according to which aggregates have a mental being, no matter the being of their components. As we saw above, Adams claims that not only are aggregates different objects from their constituents, but they also have a different ontological status. So in the case of a flock of sheep, while the sheep are material objects in space–time, the flock would merely be a mental entity. If we now substitute a term referring to the sheep plurally, with a singular term referring to the flock, the substitution would change the subject matter: from some material beings to a mental being. Since the subject matter is different, nothing can assure us that the substitution is *salva veritate.* In this scenario, Leibniz's claims that the aggregate/whole is equivalent to its constituents/parts would simply be false.

Another account that would find itself in trouble with regard to substitution is the one proposed by Lodge (2001). According to Lodge, aggregates are hybrid entities: their unity is mental but they are grounded on the reality of their constituents. In this case, a term referring plurally to these constituents just refers to them, while a term referring to the aggregate would probably refer both to the constituents and to the aggregate as mental entity. In this case, too, the subject matter would not be the same, and nothing can assure us that the substitution preserves truth.

By contrast, the nominalist positions of Merlo and Arthur (and the mereological position of Hartz, too), according to which an aggregate simply is the plurality of its constituents, would pass the test. A singular term referring to an aggregate and a plural term referring to its constituents just refer to the same reality from different perspectives. My only concern with respect to Merlo's position regards his use of the term "plurality." Merlo stresses that the term is used as in plural logic, i.e. as a loose talk to be substituted by plural expressions. The key feature of pluralities as conceived in plural logic is that they are uniquely decomposable: there is only one

way of decomposing them. Consider a flock of sheep in a certain field: this is just a plurality of different sheep. This is the plurality of everything that is in the field and that satisfies the property of "being a sheep." Each sheep is one of the sheep of this plurality; and, in turn, each sheep can be seen as a plurality of atoms or molecules; however, no sheep's atoms or molecules is one of the sheep, i.e. no sheep's atoms or molecules is an element of the plurality of sheep. Transitivity does not apply here, because the plurality of sheep and that of a sheep's atoms/molecules are determined by different properties. The "is one of" relation between an object and the plurality to which it belongs is not in general a transitive relation. However, Leibniz's containment relation (i.e. the relation between an object and the aggregate in which the object is) is transitive.[25] This is a clue that we should dismiss talk of pluralities. My suggested alternative is to talk of *portion of reality*: the term "reality" stresses the fact that the equivalence between an aggregate and its constituents regards ontology, i.e. what there really is, while the term "portion" introduces transitivity: if x is a portion of y, and y of z, then x is a portion of z.

We have argued that the equivalence between an aggregate/whole and its constituents/parts is therefore an equivalence with regard to ontology: they are identical in their ontological commitment. The term referring plurally to the constituents and the term referring singularly to the aggregate just refer to exactly the same portion of reality. Strong-CAI should therefore be restricted in the following way:

Ontological-CAI　　the aggregate/whole is *ontologically identical* to its constituents/parts.

This is the sense in which the whole is just the sum of its parts: they represent the same portion of reality, namely the whole is no ontological addition to its parts. The whole is thus identical to its parts with regard to the ontological commitment. This captures well Leibniz's nominalism toward wholes and aggregates more generally, as expressed in the following passage:

> What has no greater unity than the logs in a bundle of firewood or woodpile, or bricks placed one on top of the other, is not properly one being, but rather beings, although one name can be supposed for them all (A VI 3, 1464/LLC 257).

This passage expresses a quite radical form of nominalism which is particularly interesting for our aims, since it goes well with what Leibniz actually does in his logical calculus on Real Addition. We know that Unrestricted Composition allows us to treat more things as one single thing without expanding our ontological commitments. But this ultimately means that it allows us to introduce a singular term (a name, as Leibniz says in the quotation) to singularly refer to several entities at once. The Real Addition calculus just gives us a logic for these kinds of terms.

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[25] For instance, Theorem IV of *Non Inelegans specimen demonstrandi in abstracti* exactly proves that "if A is in B and B is in C, then A is in C" (*si A est in B et B est in C, etiam A erit in C*).

This shows that wholes and aggregates are just the things of which they are composed/constituted. Leibniz's nominalism is thus the claim that aggregates/wholes are just the same portion of reality as their constituents/parts. The logical roots of Leibniz's nominalism toward aggregates consist thus in the fact that nominalism is a consequence of Leibniz's conception of equivalence, which requires a substitution *salva veritate*. Once he admits the whole is equivalent to its parts, the restriction of Strong-CAI to Ontological-CAI is required to guarantee that substitution *salva veritate* of the equivalent terms.

When Leibniz claims that aggregates have a mental unity, or that they are merely phenomena,[26] he is not claiming that, in our catalog of the world, we should accept, next to their constituents, some weird mental entities called aggregates; he means to say that the difference between the parts and the wholes just depends on us considering (or perceiving) more things as one thing. Since wholes and their parts just are the same portion of reality, their differences (that, as we saw above, it seems to contradict the Indiscernibility of Identity) can only concern our way of referring to them: unrestricted composition just allows us to refer to the same portion of reality either in plurals or in singular terms. The fact that the aggregate is one and its constituents are many does not convey anything about reality, but just depends on us treating the same portion of reality as one entity or more entities.

5 Conditions of Identity, Conditions of Existence, and the Metaphysics of Grounding

The Real Addition calculus gives us conditions of identity and existence for aggregates. The condition of identity corresponds to what in classical extensional mereology is called the Extensionality Principle: A and B are the same aggregate/whole if, and only if, they share the same constituents/parts. This directly follows from the axioms of Leibniz's calculus.[27] The condition of existence for aggregates provided by the calculus is the principle of Unrestricted Composition. This principle gives us only a condition of *logical existence*, i.e. it says when we are allowed to treat more things as one and to introduce in the calculus a singular term referring to an aggregate. And we know that we are always allowed to do that. However, UCP does not give us a *real* condition of existence, in the sense that it does not tell us whether

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[26] For instance, "no being that is truly one is composed of a plurality of parts; and every substance is indivisible, and those things that have parts are not beings, but merely phenomena" (A VI 4 627/ LLC 271), or "So the only perfect unity that these 'beings by aggregation' have is a mental one, and consequently their being also is in some way mental or phenomenal, like that of the rainbow" (*New Essays* XII, §6; A VI 6, 146).

[27] As I have shown in Costantini, (Manuscript). Moreover, Leibniz appeals to a version of extensionality when arguing that the Cartesian notion of body as pure extension does not allow bodies to persist in time, since the continuous movements present in bodies imply that bodies will have different parts at different instants. Since they have different parts in different times, bodies conceived as extensional entities cannot persist in time. Here Leibniz is assuming that, when dealing with extensional entities, something like the extensionality principle gives us the condition of identity for aggregates.

aggregates really have an ontological import or not. We argued above that that their ontological import is the same as that of their constituents.

In this way a gap emerges between logic and ontology: from a logical point of view, aggregates are different objects than their constituents; and this is a consequence of the Indiscernibility of Identity, since they have properties that their constituents lack. But from an ontological point of view, aggregates just are their constituents, in the sense that they do not require any additional ontological commitment. Aggregates and their constituents refer to the same portion of reality. This gap can be appreciated if one thinks of one of Leibniz's favorite examples of aggregates, namely the aggregate of all Roman Emperors. The Roman Emperors form an aggregate; however, for Leibniz's own standard, there is no time in which this aggregate has ever existed. In fact, in a reply to a criticism of his dynamics raised by Papin, Leibniz writes that

> But motion consists in a certain respect, so that, strictly speaking, it does not exist, any more than does time, or *any other whole whose parts cannot be together at the same time*, so it should be that much less of a wonder that the same quantity of it is not conserved (GM VI 202/Leibniz (forthcoming), emphasis added).

Then in *Specimen Dynamicum*, Part I:

> For motion, just like time, never exists, if you take things in a precise sense, since *a whole never exists when it does not have coexisting parts* (GM VI 235/ Leibniz (forthcoming), emphasis added).

The aggregate of the Roman Emperors has never existed since there has never been a time where all Roman Emperors have simultaneously existed. But this did not prevent Leibniz from presenting it as a prominent case of an aggregate.

What we have argued so far is that aggregates are different objects from their constituents; however, these objects do not imply any further ontological commitment. Once we are committed to the constituents, the commitment to the aggregate comes for free. If one adopts a Quinean meta-ontology, where existence is a univocal notion (captured by quantification), the last sentence does not make any sense. Since existence is univocal, everything exists in the same way (the differences between things only depend on the nature of things), and once we recognize that aggregates are distinct objects from their constituents, then their existence should be on a par with the existence of their constituents. In a list of what there is we should list the constituents and the aggregate. In other words, within a Quinean meta-ontology, a principle like UCP commits us to the existence of aggregates (as further objects) once we are committed to their constituents. An aggregate would require a further ontological commitment beyond its constituents.[28] However, Leibniz does not adopt a univocal notion of existence. For him there are things which are *more fundamental* than others. Aggregates are derivative entities; derivative with respect to their

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[28] Classical mereology quantifies (with first-order quantifiers) over sum/fusions of entities: but to quantify over an entity means to be committed to its existence, according to Quinean meta-ontology.

constituents, which are more fundamental. Clearly this is an Aristotelian element (*being* is said in many ways, and the substance is a way of being more fundamental than its accidents), which allows Leibniz to recognize the legitimacy of aggregates (from a logical point of view) and to remain a nominalist. That the constituents of an aggregate are more fundamental than the aggregate is something that Leibniz stresses in many places, where he claims that the reality of an aggregate/whole is grounded on the reality of its constituents/parts: the aggregate/whole is real insofar as its constituents/parts are real. This clearly excludes the possibility that the aggregate/whole can bring an ontological surplus with regard to its constituents/parts:

> I believe that where there are only beings by aggregation, there will not in fact be any real beings; for any being by aggregation presupposes beings endowed with a true unity, because it derives its reality only from that of its constituents. It will therefore have no reality at all if each constituent being is still a being by aggregation, for whose reality we have to find some further basis, which in the same way, if we have to go on searching for it, we will never find. (to Arnauld, 30 April 1687; A II 2B 185/WFT 123).
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> There are no divisions in [a continuum] except those that the mind makes, and the part is posterior to the whole. In real things, on the contrary, unities are prior to the multitude, and multitudes do not exist except through unities (to De Volder, 11 October 1705; GP II 278/LDV 327).
>
> In actual realities the whole is a result of the parts (GP VII, 562) (quoted from Adams 1994, 217).
>
> In realities, where only divisions actually made enter, the whole is only a result or assemblage, like a flock of sheep. It is true that the number of simple substances in any mass, however small, is infinite; for besides the soul, which makes the real unity of the animal, the body of the sheep, for example, is actually divided, i.e. is an assemblage of invisible animals or plants, similarly composite except for what makes their real unity; and though this goes on to infinity, it is plain that all in the end depends on these unities, the rest, or the results, being only well-grounded phenomena. (GP IV 492/WFT 185)

The picture that emerges from these passages is as follows: in the real world, the constituents/parts of an aggregate/whole are *prior to* the aggregate/whole. Here "prior" means more fundamental: aggregates are well-founded phenomena, in the sense that they exist in virtue of the existence of their constituents. They are distinct objects whose existence entirely depends on their constituents. Aggregates/wholes are therefore *ontologically dependent* or *grounded on* their constituents/parts. Since aggregates are grounded on their constituents, when we commit ourselves to the existence of these constituents, the commitment to their aggregate comes for free, i.e. it is not a further ontological commitment.[29]

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[29] See Cameron (2014, 99–100) where this idea is defended at length. The idea that we can apply the relation of grounding to interpret the Leibnizian conception according to which aggregates inherit their reality from their constituents has also been suggested by Levey (2012, 105). Phemister (2005) and Arthur (2018) have also defended this thesis with regard to bodies and monads.

This meta-ontological view allows Leibniz to adhere to a principle like UCP within his logical system, and at the same time to develop a nominalist position concerning aggregates. Within the calculus, UCP gives us a wide variety of entities, which are different objects from their constituents. But these entities are all grounded on their constituents, and as such they are not some further ontological commitments: from an ontological point of view, they are the same portion of reality as their constituents. At this point, we may reformulate CAI within a metaphysics of grounding:

Metaphysical-CAI   The aggregate/whole is *metaphysically grounded* on its constituents/parts.

Metaphysical-CAI and Ontological-CAI (the aggregate/whole is *ontologically identical* to its constituents/parts) are two different but compatible principles: Ontological-CAI regards the ontological status of aggregates, and takes care of Leibniz's claim according to which the aggregate is equivalent to its constituents. Metaphysical-CAI takes care of Leibniz's claim that, in reality, composite entities are well-founded on their constituents, and as such their constituents are prior to them. While the latter is clearly an asymmetrical relation (the constituents ground the aggregates, not vice versa[30]), the former is a symmetrical relation (equivalence relations are symmetrical). The fact that Leibniz can uphold both claims depends on the fact that they are made with regard to two different aspects: one is the ontological aspect for which they just are the same portion of reality; the other one is the metaphysical aspect for which they are different entities, one dependent on the other.

Metaphysical-CAI, i.e. the fact that the aggregate/whole ontologically depends on its constituents/parts, implies that if the constituents/parts do not exist, then the aggregate/whole does not exist either. And this is exactly what Leibniz argued with regard to the aggregate of Roman Emperors: since there has never been a time in which all Roman Emperors exist, then there has never been a time in which the aggregate of all Roman Emperors exists. However, the quotations above suggest that this is only part of the story. An aggregate/whole depends on its constituents/parts not only for its being, but also for its identity. The constituents/parts determine the identity of the aggregate/whole, and this is clearly confirmed by Leibniz's acceptance of Extensionality for aggregates (see above). It is enough to change a constituent/part to obtain a different aggregate/whole. The identity of an aggregate

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[30] Usually, the grounding relation is considered to be asymmetric, and consequently irreflexive, the idea being that nothing can ground itself. This is a natural reading if one interprets the clam "x grounds y" as "x provides an explanation for y." However, in the present context we linked the notion of grounding with that of ontological dependence: we took "x grounds y" as equivalent to "the existence of y depends on x," and the notion of ontological dependence may be reflexive (plausibly a necessary being like God would ontologically depend only on itself). If reflexivity is admitted, then the relation would be antisymmetric, not asymmetric. I will not take a stand either on this point or on the relationship between grounding and ontological dependence, since this will immediately take us very far away from Leibniz. The key point here is the fact that Metaphysical-CAI is not a symmetric relation, contrary to what happens with Ontological-CAI.

is grounded on its constituents in the precise sense that had some constituents been different, then the aggregate itself would have been a different aggregate.[31] Metaphysical-CAI can thus be read as a conjunction of two statements: (1) the aggregate/whole ontologically depends on its constituents/parts; and (2) the aggregate/whole depends for its identity on its constituents/parts.

6 Two Different Interpretations of Metaphysical-CAI

Metaphysical-CAI can be interpreted in two ways,[32] both of which can be found in Leibniz: according to the first interpretation, aggregates as dependent entities are just singular names that we use to refer to many things. The difference between aggregates and their constituents would just be explained in virtue of us representing many things as one single entity. In this sense, it is not the case that aggregates inherit their being from their constituents, but rather they do not have any proper being. This view fits well with Leibniz's quotation above in which he claims that aggregates are just singular names for a plurality of different things, and it seems to be presupposed on the nominalist account we developed above according to which the difference between an aggregate and its constituents depends simply on the fact that we treat (or perceive) more things as a single thing. By contrast, the second interpretation considers aggregates and composite entities in general as *real entities* with their own beings, and claims that aggregates completely inherit their being from their constituents. This sits well with Leibniz's claim that aggregates are well-founded phenomena, that derive their reality from their constituents. In fact, the latter view suggests that aggregates are more than mere names, but *real* objects whose reality (entirely) depends on the reality of their constituents.

   The first interpretation amounts to a position known as mereological nihilism. Sometimes mereological nihilism is defined as the thesis that there are no composite objects (i.e. there are no objects with proper parts[33]): since every composite object would just be a name for a plurality of simple objects, it follows that for Leibniz aggregates are not real entities.[34] Since aggregates are not truly one being, and only what is *one* being is truly one *being*, then aggregates are not true beings. Not so for the second interpretation: aggregates would be real entities different from and yet grounded on their constituents. In this sense, it would also make sense to claim that some aggregate can persist through time: this would be true in virtue of the

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[31] For a general introduction to the notion of identity-dependence in the contemporary debate see Tahko and Lowe (2020).

[32] I took this distinction from Cameron (2014, 100n22).

[33] See for example Harmer (2013) or Wasserman (2018, §4).

[34] This has been argued by Adam Harmer in his doctoral dissertation (2013), and more recently in Harmer (2022) since only what is truly one thing is a real entity, and aggregates are many things, no aggregate is a true entity. Only monads, insofar as they are simple and so possess a metaphysical unity, are true beings. Moreover, Harmer (2022, §3) stresses that while substances persist through time, aggregates do not. For these reasons Harmer claims that Leibniz is a mereological nihilist.

persistence of simple substances in them.[35] The two interpretations contradict each other, and so—one might think—they cannot be upheld together. However, it seems to me that Leibniz subscribes to both interpretations without incurring any contradiction. And this is possible because he interprets them as two different *kinds of explanation*. Since this is a key aspect of Leibniz's thought, before proceeding, I shall explain what I mean by "kinds of explanation" and their role within Leibniz's philosophy.

As Arthur (2021, chapter 3) argues, the idea that Leibniz gives different kinds of explanation of the same phenomenon vividly emerges in his dynamics, in particular with regard to the notion of motion.[36] Already in *Principia Mechanica* (c. 1676) Leibniz realized that motion is relative if analyzed in a purely geometrical way, i.e. as a mere change of situation (*situs*): "For it could be judged that motion is something respective, so that when things are changing situation among themselves, it makes no difference which of them it is attributed to" (Leibniz 2013, 102). The idea is that if all there is to motion is change of situation, then given two things A and B which are changing their respective situation, there is nothing that can make us decide whether it is A, B or both that are moving: "However, change of situation *is not yet sufficient* for us to judge which of two things that have changed situation with each other we should ascribe the motion to" (Leibniz 2013, 100, my emphasis), and so he concludes that "from this it is therefore clear that from the phenomena of the changed situation *alone* no certain knowledge can ever be had concerning absolute motion and rest" (Leibniz 2013, 106, my emphasis). But relativity of motion can be overcome by resorting to different hypotheses in virtue of which we ascribe the cause of motion to a specific object: "From these things it is clear that in the case of two bodies, motion is attributed to that one which contains the cause of their mutual situation having changed, because we have seen it receive a blow, or because it is dislocated and deformed, or shows other signs of having received blows and of the change made in it as a result. If such signs are absent, we judge from what could happen more easily, or from what has usually happened up till now" (Leibniz 2013, 101). The geometrical interpretation of motion as mere change of situation is not enough to determine which object is moving and which is still, because it does not take into account the *cause* of motion. Therefore, the geometrical interpretation only gives us a partial explanation of motion; in order to overcome the relativity of motion conceived as mere change of situation, we need to develop further a hypothesis that allows us to ascribe the cause of motion. When we proceed to identify the

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[35] There is no doubt that Leibniz holds that bodies, conceived as corporeal substances, persist through time. This is even a key premise in his argument (developed against the Cartesians) for the claim that there must be more than mere extension in bodies—this is what Levey (2012) calls the Principles of Unity Argument.

[36] There are further examples. One regards the notion of space. Arthur (2021, 182) writes: "Similarly, Leibniz had claimed in *De tempore locoque* […] that if space is conceived independently of appetition, then 'it is indifferent to different ways of being dissected. But if appetite is added to space, it makes existing substances, and thus matter, or the aggregate of infinite unities" (A VI 4, 1641/LLC 335)." Again, there are (at least) two different ways of treating space: one purely mathematical; the other more metaphysical. The purely mathematical one is totally legitimate, but partial.

cause of motion, we are going beyond the pure mathematical explanation, since this requires a number of non-mathematical hypotheses.

As Arthur (2021, chapter 3) stresses, the difference between motion as change of situation and motion with regard to a cause is not a difference between ontological levels; rather it is a difference in kinds of explanation. The same phenomenon (the motion of some specific objects A and B) can be explained at the mathematical-geometrical level, according to which it is just change of situation (and as such it is relative), or at a deeper level, where we ascribe the cause of motion, and in this way break the relativity of the former level. The key aspect is that the mathematical explanation is only a partial explanation that must be integrated in order to provide a full explanation of the phenomenon.

A similar story happens with regard to the two interpretations of Metaphysical-CAI. To see that this is the case, let's consider the example of bodies, and Leibniz's argument for the existence of monads from the persistence of bodies in time.[37] Leibniz supposes that bodies are just Cartesian bodies, i.e. they are only extended things. As such, they can be identified with infinite aggregates of extended parts. No body is at rest, but it is always moved by internal motions; each part of a body is individuated by means of some internal motion. The consequence is that, given two different instants t_1 and t_2 no body maintains the same parts. But if we look at a body merely from the point of view of mereology, i.e. as an aggregate of parts, then no body persists through time, because at different times a body will always have different parts. Since Leibniz endorsed a sort of Extensionality principle for composite things, the consequence is that at different times we will have different bodies. In this sense, bodies are just names for aggregates of parts. Leibniz considers this conclusion as a refutation of the Cartesian view of bodies: since bodies persist through time, they cannot be mere aggregate of parts, but there must be substances in them. If we suppose that bodies are (also) infinite aggregates of substances, i.e. if we consider bodies not only as extended things, but as corporeal substances (namely as embodied monads), then we can explain why they persist through time: a corporeal substance is an aggregate of monads together with a material body that persists through time thanks to the persistence of the dominant monad in it, which functions as a diachronic unity for the body.[38]

What clearly emerges from this argument is that we can treat bodies from a purely mereological perspective as aggregates (or wholes) of extended parts. This leads us to the conclusion that no body persists in time. Recall Leibniz's famous claim according to which an entity by aggregation is not *one entity* but many entities. However, Leibniz believes that bodies, conceived as corporeal substances, do persist in time. A corporeal substance is an aggregate of a dominant monad and an organic body. In turn, its body is an aggregate or further monads endowed with their

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[37] Again, I am referring to the Principle of Unity Argument. This argument has been analyzed in detail by Arthur (2018, ch. 1). I limit myself to a brief and not exhaustive reconstruction, which, though deficient in many ways, will suffice to stress the point I want to make.

[38] That the unity is diachronic means that even the organic body of a corporeal substance does not remain precisely the same, but we can refer to it as "the same" body because it is the body of the same entelechy.

own organic bodies, and so on without end. Since a corporeal substance is an aggregate that persists through time, Leibniz infers that the mereological explanation of bodies is only partial and necessitates an integration. This integration consists in recognizing the role of the dominant monad in providing a foundation for the persistence of the corporeal substance. The recognition that corporeal substances have a unity does not require us to reject the idea that they are entities by aggregation; rather, it requires us to recognize that there is more to bodies/corporeal substances than being merely an aggregate. This mirrors exactly the case of motion discussed above: to recognize that we need to ascribe the cause of motion is not to reject that motion is a change of situation, but to recognize that there is more to motion than the mere change of situation. Since it is of the same body of which we say that it is an aggregate of extended parts and an aggregate of simple substances, these two claims are made from two different perspectives: one is the mereological point of view; the other is the metaphysical point of view. Therefore, they are two different (but integrating) kinds of explanation of the nature of bodies.

The two interpretations of Metaphysical-CAI outlined above represent two different ways of looking at the same reality: when we look at the world from the perspective of mereology, then composite objects are merely phenomena, names for a plurality of things. There is nothing within pure mereological considerations that makes an aggregate a true being, a unity, and in this sense, Leibniz may be viewed as a mereological nihilist; however, when we take into account the role of substances (and in doing this we go far beyond mereological considerations), then an aggregate such as a corporeal substance is not a mere name for a plurality of things, but a well-founded phenomenon which inherits the reality from its dominant substance: such an aggregate is real, and persists through time. In this sense, Leibniz can no longer be identified as a mereological nihilist.

7 Conclusion

In this paper we argued that Leibniz's position toward aggregates can be seen as a conjunction of two theses: first, we have Ontological-CAI, which claims that aggregates/wholes have the same ontological import as their constituents/parts, in the sense that when we are committed to some things, the commitment to their aggregate/whole does not constitute a further ontological commitment; second, we have Metaphysical-CAI, which claims that aggregates/wholes are objects grounded on their constituents/parts, and in this sense they are well-founded phenomena.

The argument in favor of the first thesis has exploited what Leibniz explicitly says concerning the relationship between aggregates and their constituents in his logical calculus concerning Real Addition, and his theory of substitution of equivalent terms. In this sense, the argument we presented is very Leibnizian in spirit, since it exploited only elements and argumentative strategies present in his philosophy. Moreover, this allowed us to clarify the relationship between the logic and the ontology of aggregates, which has often been neglected. We argued that while the logic of aggregates can accommodate any kind of aggregates (finite or infinite), this does not imply the acceptance of the real existence of any such entities. It seems to me

that it is Leibniz's nominalism toward aggregates (as embodied in Ontological-CAI) that gives him freedom to treat any kind of aggregate in his logic: we can be liberal about aggregates in logic precisely because they do not constitute any incrementation of being (with respect to their constituents).

The second thesis, Metaphysical-CAI, can be interpreted in two different ways, and we argued that both are present in Leibniz's philosophy. According to the first way, aggregates are just names for pluralities of things: this is the reading present when Leibniz is considering only a mereological (i.e. mathematical) level of explanation. When we limit ourselves to this kind of explanation, no substantial reality can be ascribed to aggregates; however, the mathematical/mereological level of explanation is not the only one (nor is it the deepest one): when we take into consideration the metaphysical unities (i.e. the monads) present in aggregates, then we can recognize a more substantial nature to some aggregates: corporeal substances are aggregates that are real in virtue of the dominant monad contained in them. At this deeper level of explanation, such aggregates are not merely names for pluralities of things, but they inherit the same reality of the substances in them.

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