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The Heart is Not an Animated Body: Machines of Nature, Functional Organs, and Monadic Domination in Leibniz

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For the mature Leibniz, the organic bodies of living beings or substances are 'machines of nature' containing both infinitely many (a) functional bodily organs and (b) further substances. These latter substances are said to be dominated by or subordinate to the original substance. I show that commentators have tended to conflate subordinate substances with organs, thus committing Leibniz to the position that organs are individual subordinate substances, i.e., living beings. Against this view, I argue for a 'Dual Component' account of Leibnizian organic body, according to which Leibniz distinguished organs and subordinate substances as distinct types of organic bodily parts. On this account, organs are not equivalent to individual subordinate substances, and are, in fact, aggregates of such substances. I thereby shed light on the metaphysical relationships of domination between substances as well as the mechanical structure of Leibnizian organic body.

Keywords: Leibniz; machine of nature; substantial domination; organ; organic body.

'*But it is not the case that any given part of an organic body is an organic body: thus, although a heart retains its motion for a certain amount of time after it has been torn out of the body, it is not proved from this that the heart is an animated*

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> *body, for a mere mechanism suffices for some continuation of this motion, even if perception and appetite are wanting*.' Leibniz to Georg Ernst Stahl (LSC 331)

> '*Each portion of matter can be conceived as a garden full of plants, and as a pond full of fish. But each branch of a plant, each limb [membre] of an animal, each drop of its humors, is still another such garden or pond*.' Leibniz, *Monadology* ¶67 (AG, 222/GP VI 618)

I. Introduction

In this paper, I analyze Leibniz's account of substantial or 'monadic' domination in connection with his concepts of organs and organic bodies. My aim is to shed new light on his views regarding substance and the structure of organic bodies. In his mature period, Leibniz characterizes the organic bodies of substances or monads as 'machines of nature' (AG, 207/GP VI, 599; LSC 21; AG, 221/GP VI, 618; Smith 2011, 106–10).[1] For Leibniz, the 'organic' is not opposed to the 'mechanical;' in fact, 'organism' does not refer to an individual living being, but rather to the mechanical organization of an organic body (Smith 2011, 106–10).[2] Leibniz claims that machines of nature have an infinite number of organs (AG 142/GP IV, 482).[3] They are also aggregates of innumerable further subordinate substances: thus, in a well-known five-part schema of substance from his June 20, 1703 letter to Burchard De Volder, Leibniz defines the 'mass' or 'secondary' matter proper to a substance as 'the organic machine, for which innumerable subordinate monads come together' [*machinam organam, ad quam innumerae concurrunt Monades subordinatae*] (LDV, 265/GP II, 252). According to Leibniz, this infinitely complex structure distinguishes natural machines from artificial

1. While Ohad Nachtomy has recently proposed that a machine of nature is not the organic body of a substance, but rather the 'whole living being' (2019, 186), I treat 'organic body' and 'machine of nature' as synonymous. This usage conforms to the primary texts cited (AG, 207/GP VI, 599; LSC, 21; AG, 221/GP VI, 618), and, as a collection of organs and other matter, a machine of nature itself is an aggregate, not a substance. I address Nachtomy's claim in Section VI below.

2. For more on 'organism' during the time-period, see Cheung 2006. Leibniz does appear to use 'organism' as a count noun in the June 30, 1704 letter to Lady Masham: 'I define an organism, or natural machine, as a machine of which each part is a machine [*je definis l'organisme, ou la Machine naturelle, que c'est une machine don't chaque partie est machine*]' (WF 214/GP III, 356/A II.iv, 259). However, Leibniz here identifies 'an organism' with a 'natural machine,' not with an individual substance.

3. For Leibniz, the literal concept of an infinite number is self-contradictory. Hence, his claim that machines of nature have an infinite number of organs is said 'syncategorematically' and means they have more than any finite number of parts (Arthur 2019). In other words, no matter how many organs one has counted, one continues to find more. Nachtomy (2019, 35–62) gives a helpful account of the development of Leibniz's understanding of the infinite and infinite number in his Paris period (1672–6).

machines (AG, 142/GP IV, 482; AG, 221/GP VI, 618), and its teleological organization results from God's design, or what Leibniz refers to as 'divine preformation' (Smith 2011, 165–96). As Leibniz explains to Georg Ernst Stahl, 'organism is in fact mechanism, but more exquisite and, so to speak, more divine' (LSC, 31). As the body of a living being, this organization additionally corresponds to the internal telic desires and volitions of a soul, which Leibniz conceives as a self-moving formal principle whose activities unfold in a mechanism-like way analogous to the movements of the body (Noble 2019a).

In treating Leibniz's machine of nature, commentators have often appeared to suggest that *each part* of a natural machine is a further natural machine. For instance, Pauline Phemister writes:

> an organic body is divisible into smaller and smaller organic bodies, each one of which is itself divisible into smaller organic-body-parts. Where the whole is an organic body belonging to a corporeal substance, the parts are the organic bodies of smaller corporeal substances. (2005, 99)

For Justin E. H. Smith, the difference between an organic and an inorganic body is that '[the organic body] and all of its parts and the parts of the parts, ad infinitum, are machines of nature' (2011, 108). François Duchesneau has claimed that 'machines of nature are indeed endowed with an integrative unity that unfolds in the internal organization of their parts, each of which forms in turn a machine of nature at its own level of integration, and so on indefinitely' (2018, 471; cf., 2010, 85). I have myself claimed that 'each organ of a living body is a further machine of nature nested in the first' (Noble 2019b, 329).

Relatedly, commentaries on 'monadic' or substantial domination, the process by means of which subordinate substances come to populate a larger organic body, tend to identify subordinate substances with organs. In this way, they argue that subordinate substances are functionally individuated to be subservient to dominant substances, a view that I will refer to as 'FIS.' Scholars including Robert Adams, Donald Rutherford, Brandon Look, Shane Duarte, and Ohad Nachtomy, have respectively identified subordinate substances and their organic bodies with sundry functional parts of living bodies, including white blood cells (Adams 1994, 287); organs, cells, and subcellular components (Rutherford 1995, 224); livers, hearts, and lungs (Look 2002, 391); muscle fibers (Duarte 2013, 230); leaves (Nachtomy 2007, 723); and livers (Nachtomy 2019, 132).[4]

In this paper, I argue that Leibniz's account of the structure of organic bodies resists both the claim that each part of an organic body is a further organic body

4. The examples of cells provided by both Adams and Rutherford are anachronistic, as Leibniz had no notion of modern cell theory.

as well as FIS. It is, hence, a mistake to argue that substantial domination results in the direct functional individuation of subordinate substances as organs within the body of the dominant substance. One good reason to be skeptical of both claims is that Leibniz argues, vis-à-vis the heart, that 'it is not the case that any given part of an organic body is an organic body' in his debates with Georg Ernst Stahl (LSC 331).[5] Not only does this passage provide an example of a distinct organic bodily part that is not identical to a subordinate substance, but this part—the heart—would seem to be a paradigmatic organ. Instead, I argue that, for Leibniz, bodily organs are in fact aggregates of subordinate substances, and that these substances supply the matter comprising the organs. While organs are individuated in terms of the functional roles that they play within a body's physiological structure, subordinate substances are independent living individuals individuated by ends and purposes distinct from those of the dominant substance. The result is a 'dual component' [henceforth, 'DC'] model of a Leibnizian machine of nature according to which such a machine consists of two distinct infinite collections of parts: infinitely many subordinate substances, on the one hand, and infinitely many functional bodily organs, on the other. While examples of organs include functional parts such as the heart or an eye, subordinate substances are literal animals—Leibniz speaks of worms and fish (LDB 257/GP II, 451; AG 222/GP VI, 618)—that both populate the organic body and supply the matter of which its organs are made.

Raphaële Andrault has argued powerfully against the view that each part of an organic body is a further organic body in the 2014 study *La Vie Selon la Raison.* In addition to drawing attention to textual evidence such as Leibniz's aforementioned denial that the heart is an organic body (LSC 331; Andrault 2014, 145), Andrault shows that the thesis that organs are living beings is not supported by the contemporary anatomical and physiological research that informed Leibniz's views—particularly that of Nicolas Steno. For Andrault, this conception conflates two distinct relations of containment present in Leibniz: on the one hand the physiological relation between an organic body and its organs and, on the other, the relation of material constitution between bodies whereby each portion of matter consists of organic bodies. As Andrault writes, 'there is … no reason to identify the functional comprehension of machines of nature with the

5. Smith and Duchesneau note this passage in the introduction of their 2016 edition of the Leibniz-Stahl correspondence: 'Any given part of an organic body is not itself an organic body—the excised heart is a mere mechanism that continues to move for a while' (LSC, lxxxi). However, here they do not qualify their earlier comments to the effect that each part of an organic body is an organic body (Smith 2011, 108; Duchesneau 2010, 85); further, Duchesneau has repeated such a claim as recently as 2018 (471). It thus remains unclear from their published writings how Smith and Duchesneau understand the organic machine's parts.

thesis according to which all bodies contain organic bodies within themselves' (2014, 148, translation mine).[6]

While I fully concur with Andrault, her account does not address the metaphysics of substantial domination that has led commentators to adopt FIS. Indeed, Ohad Nachtomy has recently drawn on Andrault's physiological approach to support a version of FIS according to which the 'nested' structure of machines of nature results in the functional individuation of subordinate substances as organs. Nachtomy argues that the infinite structure of a machine of nature is incommensurate with empirical physiological investigation, so that 'if we try to understand the notion of a natural machine … as a physiological characterization of *emboitement* (of machines within machines) to infinity, we don't get very far' (2019, 184). Instead, Nachtomy claims that a natural machine is a unitary and hierarchically organized metaphysical structure in which subordinate substances are functionally nested, and that 'the notion of domination among the monads may well express this degree of functional organization' (2019, 184).[7]

For this reason, I take a fresh look at the relation between Leibniz's account of organic body and his metaphysics of substantial domination. I argue that domination does not generate a functional relationship between an organic body and its subordinate living beings. In other words, while domination entails that the organic body of a subordinate substance forms a part of the organic body of the dominant substance, it does not entail that this subordinate substance plays a specific functional role within the organic structure of the dominant substance's body. Rather, dominant substances subordinate others in such a way that these subordinate substances supply the matter out of which the dominant substance's organs are formed. These organs are physical sub-machines individuated and defined in terms of their functional roles in the organic body of a dominant substance whereas subordinate substances are independent beings only indirectly related to the functioning of the organic body. Thus, while organs are functionally individuated and nested within the physiological structure of a natural machine, the organic bodies of subordinate substances are not. Richard T. W. Arthur has recently observed that 'organic bodies… are machines of nature, machines whose parts are also either themselves organic bodies of other living beings, or aggregates thereof, to infinity' (2018, 176). While Arthur does not explicitly identify organs as such aggregates, the view provided here aligns with his description and additionally explains why organs are aggregates of organic

6. '*il n'y a donc aucune raison d'identifier la comprehension fonctionnelle des machines de la nature avec la thése selon laquelle tout corps continent en lui des corps organiques*.'

7. In this connection, Nachtomy proposes that the term 'machine of nature' does not refer to a substance's organic body, but rather to the 'whole living being' (Nachtomy 2019, 186). I address Nachtomy's position in Section VI below. Cf. fn.1.

bodies. In other words, DC allows us to see why—on metaphysical grounds and in principle—FIS misses the mark, and, consequently, why Leibniz denies that the heart is an organic body.

I have not attempted to resolve all of the questions concerning how relations between monads result in organic bodies, nor the thorny question of whether these bodies are, for Leibniz, 'real' or merely 'phenomenal' in the sense of being reduced to the contents of monadic perceptions.[8] My goal is rather to explain Leibniz's distinction between organs and subordinate substances, and hence to shed light on the metaphysical relation of substantial domination, as well as on the structure of organic body. Whether Leibniz's position is ultimately coherent, as well as how DC may contribute to discussions of the status of Leibnizian corporeal substances, are questions for another occasion.

I first outline Leibniz's account of organic bodies as natural machines. I defend a reading of the distinction between natural and artificial machines according to which natural machines have infinitely many functional parts or organs, whereas artificial machines have finitely many such parts. I then consider the parts of organic bodies, arguing: (a) that an organic body is a part of another if its dominant substance is subordinate to the dominant substance of the larger body; and (b) that not all parts of an organic body are individual subordinate substances. I next detail how scholars have developed FIS as a means of explaining Leibniz's account of substantial domination. I then argue that FIS is incompatible with Leibniz's views on organs. Consequently, I propose that substantial domination does not mean that subordinate substances are individuated to play direct functional roles within the structure of an organic body, but rather that subordinate substances supply the matter out of which organs are constructed. I conclude that no organ is equivalent to an individual subordinate substance.

II. Natural Machines in Leibniz

Leibniz introduces the term 'machine of nature' in the *New System of the Nature and Communication of Substances,* published in 1695 (Fichant 2003). However, Leibniz had conceived living bodies as machines and developed mechanical models to understand their physiological and chemical processes prior to the *New System* (Duchesneau 2010, 47–84; Smith 2011, 59–93). For instance, in a text

8. For instance, Pauline Phemister (2005), and Richard T. W. Arthur (2018) make the case that Leibniz held a consistently realist position while Daniel Garber (2009) argues Leibniz moves from a realist position to an immaterialist one where only immaterial monads are real. While I do not argue for a position concerning the *reality* of organic bodies in this paper, Leibniz does associate substances with organic bodies (whether real or phenomenal) throughout the period in question (1695–1716). Wherever there are monads, there are organic bodies (Smith 2011, 5–8).

of the early 1680s entitled 'The Human Body, like that of any Animal, is a sort of Machine,' Leibniz characterizes an animal as 'a Hydraulico-Pneumatic machine, but also in a certain respect a Pyrotechnic one' (HBM, 296). Here, animals represent nature's attempt to 'conserve, as much as possible, and with respect to its particular species, a machine of Perpetual Motion in the universe' (HBM, 292). Animals approximate perpetual motion in virtue of the durability of their parts, their capacity to repair them to some degree, and their ability to tap into external sources of motive force via processes such as nutrition. Moreover, reproduction provides for the conservation of species-specific forms of motion beyond the lifespan of an any given individual member (HBM, 293–4). Thus, in the early 1680s, Leibniz argues that animals are machines aimed at producing perpetual motion via organized bodily parts that use hydraulic, pneumatic, and pyrotechnic processes to prolong the vital motions of both individuals and species.

Leibniz specifies that animal machines are governed by final causes that render the arrangement of their material parts intelligible: 'any machine, moreover, is best defined in terms of its final cause, so that in the description of the parts it is therefore apparent in what way each of them is coordinated with the others for the intended use' (HBM, 292). A machine's parts contribute to its final-causal aim and allow for an explanation, in efficient causal terms, of how the machine harnesses motive force. Consider a windmill; to grind grain, it must have parts that bring about the grinding through efficient causal processes: sails moved by the wind, as well as gears, shafts, and millstones that translate that motion into grinding. Likewise, the organs of an animal machine are material parts disposed to carry out functions intelligible in terms of the larger order of the animal by means of efficient causal interactions.

Leibniz first introduces the 'machine of nature' in the *New System* in 1695 (Fichant 2003), a published text marked by the development of his dynamics—a science of forces underlying physical bodies (Duchesneau 2010, 85–98)—and his engagement with emerging microscopical research (Smith 2011, 165–96; Becchi 2017) Here, Leibniz attributes microscopical findings as helping him to the view that the apparent generation and corruption of animals are actually transformations of a preexisting structure. Thus, Leibniz claims:

> there is only one reasonable view to take—namely, the conservation not only of the soul, but also of the animal itself and its organic machine, even though the destruction of its larger parts reduces it to a smallness which escapes our senses, just as it was before its birth. (AG, 141/GP IV, 480)

This point is echoed in a letter to Johann Bernoulli of January 1699: 'I confess that certain organs of animals, namely the gross ones, are destroyed and broken up. But I believe that something else always survives, so that the animal (shrunken,

I allow) remains still endowed with the prior entelechy' (AG, 171/A III.viii, 39). Thus, in the 1690s, Leibniz maintains the thesis that individual animals have no natural beginning or end, and that despite the destruction of certain organs, they always survive in some form.[9]

In order to explain this natural indestructibility, Leibniz argues that the structures of organic bodies are infinitely more complex than those of artificial machines. Indeed, natural machines have an infinity of organs, such that in investigating their structure, one finds new organs, *ad infinitum*. For Leibniz, this infinite structure entails that they cannot be naturally destroyed; no physical violence can fully decompose or break it. Rather, damage simply results in a new transformation of the same machine:

> machines of nature have a truly infinite number of organs, and are so well supplied and so resistant to all accidents that it is not possible to destroy them. A natural machine still remains a machine in its least parts [*demuere encore machine dans ses moindres parties*], and moreover, it always remains the same machine that it has been, being merely transformed through the different enfolding it undergoes, sometimes extended, sometimes compressed and concentrated, as it were, when it is thought to have perished. (AG, 142/GP IV, 482)[10]

In this passage, Leibniz claims that a machine of nature 'remains a machine in its least parts.' What parts does Leibniz have in mind, and, further, what does it mean to remain a machine in the least of its parts? Consider *Monadology* ¶64:

> each organized body of a living being is a kind of divine machine or natural automaton, which infinitely surpasses all artificial automata. For a machine constructed by man's art is not a machine in each of its parts. For example, the tooth of a brass wheel has parts or fragments which, for us, are no longer artificial things, and no longer have any marks to indicate the machine for whose use the wheel was intended. But natural machines, that is, living bodies, are still machines in their least parts, to infinity [*sont encore des machines dans leur moindres parties jusqu'à l'infini*]. (AG, 221/GP VI, 618)

9. Leibniz had already proposed the natural indestructibility of corporeal substances in the mid 1680s (A VI iv 1491; Smith 2011, 188). I thank an anonymous reviewer for this point.

10. Cf. Leibniz's June 20, 1703 letter to De Volder: 'there never arises a new natural organic machine, since it always has an infinity of organs (*semper infinitorum organorum est*)' (LDV, 261/GP II, 251).

It seems that what Leibniz means in claiming that a natural machine 'remains a machine in the least of its parts' is that one can find functional parts referring back to the larger mechanical structure at all its material levels. By contrast, in examining an artificial machine, one eventually arrives at parts—e.g., fragments of brass—not designed to fit the original machine. While these parts belong to the material mass of the artificial machine, they do not perform functions within its structure. Further, since the structure of artificial machines comes to an end, it follows that they have *finitely* many distinct functional parts. Indeed, insofar as Leibniz characterizes functional parts as engineered for the machine to which they belong, an artificial machine possesses exactly as many functional parts as are intentionally installed by the builder. In a Leibnizian natural machine, however, there is no level where we cannot identify parts engineered to fit the larger machine: the further down one goes, the more functional parts one encounters, *ad infinitum* (Andrault 2014, 138–9, 147).

Ohad Nachtomy has recently expressed concern that the distinction between living and non-living machines in Leibniz cannot correspond to the relevant quantity of parts:

> Leibniz's claim that a natural machine "is made up of an infinity of entangled organs" cannot account for the difference between artificial and natural machines. The reason is that […] an artificial machine would involve infinitely many organs as well. If an artificial machine consists of infinitely many natural machines, it would also have infinitely many organs and in this sense would be indistinguishable from a natural one. (2019, 122; cf. 2011, 71–2).

Nachtomy is correct that artificial machines—like all bodies—consist of matter involving infinitely many substances. However, if the analysis given in the preceding paragraph is correct, it does not follow that artificial machines have infinitely many *organs* in the sense of functionally individuated parts. In this way, we need not share Nachtomy's concern: while both artificial and natural machines contain infinitely many material parts in the sense of portions of mass that may be individually specified, only natural machines have an infinite number of functional parts or organs.[11]

Leibniz also distinguishes artificial from natural machines in a 1704 letter to Lady Damaris Masham. Here he asserts that a natural machine is

11. Nachtomy's interpretation of the distinction may be linked to an identification of the organs of a natural machine with individual subordinate substances, see Section VI below.

> a machine of which each part is a machine […] the complexity of its construction continues to infinity, no part being so small that this does not apply, whereas by contrast, the parts of our artificial machines are not themselves machines. (WF, 214/ GP III, 356/A II.iv, 259)

While in the *New System* and *Monadology*, Leibniz's account concerns the overall structure of a machine of nature, here he claims that the parts of a natural machine are themselves machines. Leibniz's claim that artificial machines do not have machines as parts may mean that he does not consider their functional parts to be machines in turn. Although Leibniz was certainly aware of artificial machines comprised of systems of simpler functional mechanisms—consider his own machine for arithmetical calculation (Jones 2018)—the idea may be that that none of those component mechanisms are sufficiently complex as to constitute machines in their own right. In any event, what of the sub-machines of a natural machine: in identifying them as 'machines,' does Leibniz mean that they are natural machines in the technical sense of being the organic bodies of living creatures? One reason to suspect that the answer is yes may be Leibniz's claim in a July 6, 1699 letter to De Volder that an animated body 'consists, in turn, of parts, each of which is separately animated or actuated [*rursus constet ex partibus privatim animatis vel actuatis*]' (LDV, 101/ GP II, 187/A II.iii, 577). In the next section, I address this question by developing a closer analysis of the parts of natural machines.

III. The Parts of a Natural Machine

As I have argued, a Leibnizian natural machine has an infinite structure extending to all levels of its parts. Moreover, according to Leibniz, each part of a natural machines is a further machine. In this section, I clarify the relationship between a machine of nature and its components. I show that, for Leibniz, when one monad subordinates another, the latter's organic body becomes a part of the former's organic body. However, while organic bodies count as parts of larger organic bodies in this way, Leibniz denies that each part of an organic body is a further organic body. I therefore conclude that the parts of natural machines involve two distinct types of machines: further living bodies or natural machines, on the one hand; and complex functional mechanisms which are machines but not infinitely complex *machines of nature*, on the other.

For the mature Leibniz, all bodies are constituted by simple substances called monads, and, metaphysically speaking, bodies are aggregates of these substances. However, Leibniz does not consider monads *parts* of bodies because he maintains that parts must be homogenous with their wholes. Leibniz illus-

trates this point with the relationship between a point and a two-dimensional line-segment. He argues that a point on a line is not a part of the line because lines are figures with length, and points lack length by definition. Points are not homogenous with lines, and thus they are not parts of lines. In contrast, a line-segment half the length of the larger line would be a part. Thus, Leibniz writes to Michelangelo Fardella: 'although the aggregate of these [immaterial] substances constitutes body, they do not constitute it as parts, just as points are not parts of lines, since a part is always of the same sort as the whole' (AG, 105/A VI.iv, 1671). Similarly, Leibniz indicates to De Volder on June 20, 1703 that 'subordinate monads [...] do not make up a part of the organic body although they are immediately required for it' (LDV, 265/GP II, 252). For Leibniz, just as points are constituents but not parts of lines, monads are constituents of the physical world, but they are not parts of it (Arthur 2018, 76–84).

For Leibniz, there is a key difference between the parts of an ideal geometrical entity like the line-segment and the parts of real things in the world. In a line, the whole comes before the parts in the sense that the whole is given all at once, and parts are then made by arbitrary divisions. For instance, I can arbitrarily divide a line into two, three, or four different parts. In contrast, in real things, the whole is composed of real parts whose existence precede the whole. In other words, the parts of the whole are characterized by a non-arbitrary set of actual divisions. As he writes to De Volder, 'in real things, namely bodies, the parts are not indefinite [...] but are actually assigned in a certain way, in accordance with the divisions and subdivisions that nature actually institutes, according to different motions' (GP II, 268/LDV, 303). These divisions, and hence these real parts, 'all result from certain primary constituents, i.e. from real unities' (GP II, 268/LDV, 303) and correspond to bodies individuated by distinct motions. These bodies may either be organic bodies—as Leibniz tells Fardella: 'the organic bodies of substances included in any mass of matter are parts of that mass' (AG, 105/A VI.iv, 1671)—or inanimate bodies that are, metaphysically speaking, aggregates of organic bodies, such as the individual sails and gears of a windmill.[12]

While all bodies are thus aggregates of monads, a natural machine or organic body is a special type of body resulting when one monad dominates others, thereby producing a physical mass. Thus, in the aforementioned letter to De Volder of June 20, 1703, Leibniz proposes a five-part schema of a corporeal substance that distinguishes: (1) the primary entelechy or soul, (2) the primary matter, (3) the monad composed of both primary entelechy and primary matter, (4) the mass or secondary matter, and (5) the animal or corporeal substance itself. Here the dominant monad corresponds to the third term, and Leibniz defines

12. I thank an anonymous referee for emphasizing this distinction between ideal and real parts.

the fourth term as follows: 'the mass, i.e., the secondary matter, i.e., the organic machine, for which innumerable subordinate monads come together [*machinam organam, ad quam innumerae concurrunt Monades subordinatae*]' (LDV, 265/GP II, 252). Here 'mass' or 'secondary matter' corresponds to the organic body, and this mass involves infinitely many subordinate monads. Thus, relationships of domination between monads result in the organic body of the substance, and this organic body is a mass or collection of subordinate monads.

Given Leibniz's view that monads are not parts of the bodies they constitute, it follows that subordinate monads are not parts of the dominant monad's organic body. However, as Leibniz tells De Volder in this same letter, monads 'have a certain kind of situation [*situs*] in extension, i.e., they have a certain ordered relation of coexistence to other things' (LDV, 267/GP II, 253). Crucially, monads' situation is expressed 'through the machine over which they preside' (LDV, 267/GP II, 253). In other words, although monads are not parts of extension, they are situated relative to each other in spatial extension, and these relations are exhibited in and through their organic bodies, as well as in the way that these bodies grant a perceptual point of view on the world (Rey 2011, 164–7). What this means for our purposes is that relationships of *situs* between monads are in turn reflected by the way that subordinate animals and their organic bodies count as parts of the organic body of the dominant monad. Although a subordinate monad is not part of the dominant monad or its organic body, the animal corresponding to this subordinate monad is. Further, this material relation of containment reflects the relations of *situs* between the two monads. For instance, in a letter to Bartholemew Des Bosses on June 16, 1712, Leibniz suggests that when there is a dominant monad present in a given mass of matter, the animals contained within count as parts of the dominant monad's organic body: 'some worm can be a part of my body [*vermis aliquis potest esse pars corporis mei*] and subject to my soul as its dominant monad, and the same worm can have other little animals in its body subject to its dominant monad' (LDB, 257/GP II, 451).[13] Thus, when one substance dominates another, the subordinate animal becomes a part of the dominant substance's organic body. With respect to the dominant monad or soul of this subordinate animal, however, it is not a part of this larger organic body.

13. The context concerns whether forms contained as elements of a larger animal exist potentially or actually. For Des Bosses,

> according to many Peripatetics, with respect to their essence or metaphysical actuality, but not with respect to their existence or physical actuality, forms, and therefore monads themselves […] always exist more or less in the way that parts are said to be in a whole only potentially. (LDB, 245–7/GP.ii, 446)

In contrast, Leibniz holds that these formal elements correspond to actual substances.

While Leibniz thinks that animals and their organic bodies are parts of larger organic bodies, there is evidence from Leibniz's debate with Georg Ernst Stahl that Leibniz rejected the view that each part of an organic body is a new organic body. For Stahl, no part of a living body can function purely mechanically and without the direct intervention of the soul. Thus, in addressing the phenomenon of bodily parts continuing to move when severed or separated from the body, Stahl proposes that the original soul is divided and that some of it remains with the severed part:

> no animal body, but even less any human body, if perfectly severed from a soul, is ever found that shows its mechanism by truly organic actions […] Here it is easy to respond in a few words to the objection concerning the motion of parts that are torn off and still move quasi-normally […] namely, that those souls, being nearer to corporeality […] may also be divisible. (LSC, 169–71)

Stahl therefore suggests that a severed part does not continue to move by a physical mechanism alone, but does so in virtue of the continued presence of part of the soul.

In contrast to Stahl, Leibniz maintains that the mechanical functioning of a given part of an organic body does not require the direct activity of a soul. In this way, the continued motions of a severed heart take place by mechanical means alone. Thus, the continued motion of the heart does not imply the presence of a soul and the heart is a mechanism that is not itself an animated or organic body:

> But it is not the case that any given part of an organic body is an organic body: thus, although a heart retains its motion for a certain amount of time after it has been torn out of the body, it is not proved from this that the heart is an animated body, for a mere mechanism suffices for some continuation of this motion, even if perception and appetite are wanting. (LSC, 331)

Leibniz's explanation resists both Stahl's suggestion that the original soul is divided and the hypothesis that the heart has its own dominant monad. In this way, for Leibniz, the heart is a machine, but not a natural machine in the technical sense of being the organic body of an animal (Andrault 2014, 145). Thus, while 'it is true that in a heart and in any part of an animated body, indeed in any given mass, complete organic bodies are inherent… and that these bodies are animated or actuated by themselves [*eademque esse animata seu per se actuata*]' (LSC, 331), the heart is a part of an organic body that is not itself an organic body.

We can now return to Leibniz's claim to Lady Masham that each part of a natural machine is a machine. In light of the Stahl passage, it seems that we should not read this letter as suggesting that each part of a natural machine is itself a natural machine. While the heart is a machine, it is evidently not a 'machine of nature' in the technical sense of being the infinitely complex organic body. In this way, a natural machine consists of two distinct types of machines: complex functional mechanisms like hearts on the one hand, and the organic bodies of subordinate substances, on the other.

In this section, I have proposed DC as a reading of Leibnizian machines of nature, according to which they feature two distinct types of machines as parts: animals with organic bodies and complex mechanisms like the heart. While these latter parts contain further animals, they are not animals themselves. If DC is correct, there are thus distinct mechanical parts of the Leibnizian organic body which are not themselves organic bodies.

IV. Substantial Domination as Functional Individuation

As we have seen, Leibniz holds that the heart is a mechanical part of an organic body that is not itself an organic body. However, in the Stahl passage, Leibniz does not elaborate on *why* the heart is not an organic body, nor does the passage rule out the possibility that *some* organs may be equivalent to organic bodies. In this section, I turn to metaphysical considerations related to substantial or monadic domination that have led commentators to argue for FIS, the view that domination entails the functional individuation of individual subordinate substances as organs. I detail how commentators have proposed FIS as a way of explaining the nature of substantial domination; in the following section, I argue that there is textual evidence to prefer DC over FIS.

Leibniz makes few explicit statements about substantial domination. Clearly it does not involve direct inter-monadic influence—indeed, for the mature Leibniz, substances act *spontaneously* according to their internal natures (Jorati 2017, 37–58). Domination does not alter monads' natures; rather, he tells Des Bosses, it results from differing grades of perfection in monads: 'considered in terms of the monads themselves, domination and subordination consist only in degrees of perfection' (LDB, 257/GP II, 451). Consequently, commentators have interpreted monadic domination in terms of 'ideal' influence where one monad appears to act on another, something Leibniz associates with relative distinctness of perceptions. Thus, in the *Monadology*, Leibniz claims that more perfect monads can be said to act upon less perfect ones: 'the creature is said to *act* externally insofar as it is perfect, and to *be acted upon* by another, insofar as it is imperfect. Thus,

we attribute *action* to a monad insofar as it has distinct perceptions, and *passion* insofar as it has confused perceptions' (AG, 219/GP VI, 615).

In this way, scholars have suggested that domination specifically concerns how monads perceive the functions of an organic body. Robert Adams argues that 'what the dominant monad as such perceives more distinctly than any other monad in its body is an appetite or tendency for perceptions of the normal organic functioning of the body' (1994, 289). While all the monads of the body perceive this appetite, the dominant monad perceives it most distinctly. According to Donald Rutherford, 'the [subordinate] monads that ground the reality of a soul's organic body will be just those whose bodies are expressed (by themselves and by the soul) as the functional components of the soul's body' (1995, 224). Brandon Look argues that in ideal causation, 'one finds in [the dominant monad] that which provides an a priori reason for what happens in the [subordinate monad]' (AG, 219/GP VI, 615), and a dominant monad can 'perceive the functioning of its body precisely because it has within it the *reasons* for what happens in its subordinate monads' (2002, 390). For Shane Duarte, a dominant monad contains reasons for what happens in subordinate monads, and hence the latter carry out its functions. Although 'Leibniz himself does not say much about which parts of an animal's body count as corporeal substances in their own right,' we might 'imagine that the monads in a muscle fibre in one of the biceps of a human being are so related' (2013, 229–30). Thus, subordinate substances play functional roles in the body, such as facilitating muscle contraction.

Ohad Nachtomy has made the most detailed argument for FIS. In a 2007 paper, Nachtomy argues that subordinate substances are 'nested' within dominant ones, and this relation is determined functionally by the dominant substance: 'a substance (S') is nested in another (S) if it is activated (or dominated) by it; that is, if it is functionally organized by it' (2007, 722). A subordinate substance plays a role within the dominant substance's infinite 'programme of action:' 'since a substance is defined by having its own source of activity, S' is also active in the sense that it will activate another substance, call it S'', nested within it. In its turn, S'' will activate S''' which will activate S'''' and so on to infinity.' (2007, 722). Nachtomy's example is an oak tree:

> All the substructures that make up an oak tree—branches, leaves, cells, subcellular constituents, etc.—are organized by a single program and directed towards a single end, which gives the tree its unity. At the same time, each constituent is fully organized (and in turn organizes its substructures) towards the fulfillment of its function. (2007, 723)

For Nachtomy, a leaf and its substructures are individuals inseparably individuated by functional roles in the tree and not in virtue of merely physical

or material containment: 'In this description of the oak tree, the primary sense of nestedness is functional and it cannot be fully captured in material/physical terms' (2007, 724). Nested individuals are 'complete' individuals (2007, 724) that are nevertheless 'activated and organized by another dominating individual' (2007, 717).

More recently, Nachtomy argues in the book *Living Mirrors* that the infinite structure of a natural machine is complemented by the fact that 'each of its parts contributes to the end of the whole machine by performing a certain function' (2019, 131). Here Nachtomy maintains that 'constituents are seen as inseparable and as inseparably individuated from the whole structure and *telos* of the animal,' and he cites the example of 'my liver' (2019, 132). Further, Nachtomy argues that this functional network results from metaphysical domination:

> a living being […] does not merely contain other living beings (as a pond contains a fish) but, rather, involves other living beings as part of a well-ordered and organized functional network, which is captured, I suggest, by Leibniz's notion of domination. The notion of domination among the monads may well express this degree of functional organization. (2019, 184)

Nachtomy thus appeals to substantial domination to explain his claim that machines of nature are functionally—as opposed to merely physically or materially—nested, thereby supporting FIS by making subordinate substances inseparable functional parts of a natural machine.

In linking substantial domination to organic functions, these scholars identify functional parts of organic bodies with organic bodies involving dominant monads subordinate to the original dominant monad. Adams supposes that a subordinate monad in the body of a kitten is simultaneously a dominant monad whose organic body is a white blood cell whose activities vis-à-vis a bacterium express 'a perception of the bacterium and an appetite for its obliteration' (Adams 1994, 287).[14] Look suggests that a dominant monad may correspond to the brain while its subordinate monads are dominant monads directing the heart and liver (2002, 391). Duarte suggests that a muscle fiber is a substance with a dominant monad (2013, 229–30). Nachtomy illustrates functional nesting with the examples of leaves (2007, 723), and livers (2019, 132).

These commentators are thus united in using FIS, the view that subordinate substances are individuated as functional organs, to account for domination as

14. Despite the anachronism of Adams's example of a white blood cell (cf. fn. 4 above), it seems reasonable to equate hypothetical Leibnizian "white-blood cells" with organs given their functional roles within the body.

the functional subordination of substances as organs in a network at whose apex is the dominant substance.

V. Organs as Aggregates of Subordinate Substances

As we have seen, several commentators have argued that substantial domination renders subordinate substances functional organs of an organic body. However, they acknowledge that Leibniz himself does not specify that substantial domination results in FIS. Should we really conclude that domination defines a specific function for a subordinate substance?

Consider the following passage where Leibniz associates the production of organs with the subordination of substances. In a 1701 letter to the Electress Sophie, Leibniz suggests that the organs result from the cooperation of subordinate substances contained within an animal's body:

> And just as the body of an animal can be composed of other animals and plants, bodies have their souls and their own unities. It is clear that these animals, these unities, or these primitive forces, are dominant in their little sphere, although they are subjugated in the larger body in which they work together to form the organs [*quoique ells soyent assujjetties dans le corps plus grand dont actu concourent à former les organes*], and from which they can be detached because bodies are in a continual motion and flux. (LTS, 209/A I.xx, 75)

According to this passage, organs result from the cooperation of animals that are subordinate to the dominant substance. Thus, it suggests that subordinate substances serve *some role* in forming the dominant substance's organs. However, there is an ambiguity: to say that subordinate substances 'work together' to form organs could mean either: (a) an organ is equivalent to one substance, and consequently it has a dominant monad of its own; or (b) each organ is an aggregate of substances, and hence does not have a dominant monad. For this passage to support FIS, we must opt for (a); however, there are reasons to incline towards (b).

One piece of textual evidence in favor of (b) is Leibniz's claim in the *Monadology* that 'each portion of matter can be conceived as a garden full of plants, and as a pond full of fish. But each branch of a plant, each limb [*membre*] of an animal, each drop of its humors, is still another such garden or pond' (AG, 222/GP VI, 618).[15] In this passage, Leibniz claims that *all* portions of matter—organic or

15. Ariew and Garber render Leibniz's '*membres*' as 'limbs.' Present-day usage tends to restrict the 'limb' to large bodily appendages such as the arms and legs. However, according to the 1st edition of the *Dictionaire de l'Academie Française* contemporaneous with Leibniz, '*membre*' is

inorganic— may be thought of as gardens or ponds; i.e., settings that are populated by living beings. Further, Leibniz does not propose that 'each branch of a plant, each limb [membre] of an animal' is a living being. On the contrary, Leibniz classifies fishponds as aggregates: in a letter to Queen Sophie Charlotte of May 1704, Leibniz cites 'a pond full of fish' as an example of an 'assemblage of substances' (LTS, 313/A I.xxiii, 345), and in a chart included with his letter of Aug. 19, 1715 to Des Bosses, Leibniz identifies a fish pond as a 'semi-substance collected from substances' (LDB, 356/GP II, 506). Thus, Leibniz's association of functional parts of plant and animal bodies like branches and limbs with gardens and ponds suggests that he thinks of them as aggregates of substances, not as substances themselves.

Further textual evidence that Leibniz distinguishes between organs and subordinate substances is found in some versions of a text Leibniz wrote in 1702 in response to Pierre Bayle's criticisms of the pre-established harmony in note L to his entry *Rorarius* in the second edition of Bayle's *Historical and Critical Dictionary*. Here Leibniz writes that 'there is no soul or entelechy which is not dominant with respect to an infinity of others which enter into its organs [*qui entrent dans ses organs*], and the soul is never without an organic body which fits its present state' (L, 580/GP IV, 564/WF, 117 n. 98).[16] In this passage, Leibniz does not identify subordinate substances with organs; instead, as in the fish-pond analogy, he appears to treat organs as a larger entity within which we find subordinate substances.

There are additional conceptual reasons to be skeptical of (a). First, as we saw in section III, Leibniz denies that the heart is an organic body (LSC, 331). To adopt (a) in light of this denial thus commits Leibniz to the view that a heart is not actually an organ. For this reason, it appears more natural to opt for interpretation (b), concluding that the heart is formed by many subordinate substances, none of which play the role of a dominant substance (the relevant dominant substance being the soul of the entire body). Second, there is Leibniz's 1699 claim to Bernouilli that at least some organs are destructible: 'I confess that certain organs of animals, namely the gross ones, are destroyed and broken up [*destrui ac dissolvi*]' (AG, 171/A III.viii, 39). As we saw in section II, Leibniz here contrasts the destruction of organs with the persistence of whole animals. If Leibniz considered organs complete individuals, it is unclear why he would describe them in passive terms as being destructible. Instead, he would claim

any 'external part of the body of an animal distinguished from all other parts by some particular function' (1694 II, 37, translation mine). Assuming that Leibniz's usage conforms to this definition, it would be able to refer to any functional external bodily part—e.g., a finger.

16. This sentence does not appear in the version of the text originally published in 1716 (Leibniz 1716, 99). However, in his edition, Gerhardt includes it in his presentation of the text 'with many later additions from Leibniz [*mit vielen nachträglichen Zusätzen Leibnizens*]' (GP IV, 421).

that any damage they receive leads to a transformation of a continuously existing structure. The fact that organs are in principle destructible is thus evidence supporting (b).

The indestructibility of subordinate substances, as opposed to at least certain organs, is a consequence of the fact that they are ontologically independent individuals with their own perceptions and appetitions. Indeed, as Leibniz stresses to Stahl, the animated bodies found within the heart are 'actuated by themselves [*per se actuata*]' (LSC, 331). This independent existence and the spontaneous, *per se* activity of subordinate substances poses a final challenge to interpretation (a) by cutting against the view that subordinate substances are inseparably individuated constituents of a natural machine.

To start, Leibniz appears to deny that a given subordinate substance need be dominated by the same substance for its entire lifespan. For instance, subordinate animals 'can be detached' from the larger bodies that they compose since 'bodies are in a continual motion and flux' (LTS, 209/A I.xx, 75). Further, as Leibniz tells Des Bosses in 1709, only the formal structure of a body remains stable over time, not its matter: 'this organic body itself remains the same in the way that the ship of Theseus or a river does; that is, it is in perpetual flux, and perhaps no portion of matter can be designated that always remains proper to the same animal or soul' (LDB, 123/GP II, 370). In the *Monadology*, he reiterates that 'bodies are in a perpetual flux, like rivers, and parts enter into them and depart from them continually' (AG, 222/GP VI, 618). In other words, the body continuously exchanges matter with its environment. Since living creatures are in each portion of matter, it follows that the collection of subordinate substances in the body is in flux. Simultaneously, that there are flows of matter entering and leaving the body may not entail any corresponding changes in the collection of organs belonging to the body. While certain organs may be destroyed, the loss of a given portion of matter need not result in the loss of any given organ's functional integrity. Thus, it appears that a machine of nature may have different collections of animal constituents even as it retains the same collection of functional organs.

Further, as we have seen, when a heart is removed from the chest, Leibniz takes its imminent material dissolution as evidence that it is not an organic body, and that the unity it once possessed derived from its erstwhile functional role. The situation is markedly different in the case of a subordinate animal that leaves the body, as its life continues unabated after it frees itself from domination. These considerations also pose a challenge to Nachtomy's claim that we should view subordinate substances as 'inseparable and as inseparably individuated from the whole structure and *telos* of the animal' (Nachtomy 2019, 132); while organs may be thus described, subordinate animals are separable and independently individuated from the structure of the organic body.

For all of these reasons, it seems most reasonable to read the 1701 letter to Sophie in terms of (b): each organ is an aggregate of substances. These substances are subordinate to the organic body's dominant monad, and none of them plays the role of a new dominant substance over the other members of the dominant monad's organic body. In this way, substantial domination would result in DC, not FIS—no organ is identical to an individual subordinate substance, and an organic body contains both subordinate substances and organs as distinct parts.

We may now propose a new account of the physical structure of an organic body. I argued in Section II that Leibniz's claim that a machine of nature remains a machine in the least of its parts means that at any level of organization, one finds organs that perform functions. In this section, I have argued each organ is an aggregate of substances. If these points are correct, at progressively smaller levels of organization, one will find *both* organs and animals, *ad infinitum*. However, while each organ refers back to the original machine insofar as it plays a distinct role in the machine's functional or physiological structure, the animals do not likewise refer back to this functional structure. In other words, if one entered into a given organ as one might a mill or factory, one would both find new sub-organs referring back to the larger machine as well as new animals and plants that help provide the matter from which the organ is made. On entering into these sub-organs, one would find new sub-sub-organs referring back to the original machine, and so on, *ad infinitum*, a finding that satisfies Leibniz's claim that a machine of nature always remains the *same* machine in the least of its parts (AG, 142/GP IV, 482). In contrast to organs, however, upon entering into an animal, one would find *their* organs and *their* subordinate animals, but no new organs that refer back to the original natural machine in the sense of playing roles within its physiological structure.

VI. Substantial Domination and Leibniz's Fishpond

If substantial domination does not result in FIS, how should we understand it? Recall that commentators proposed FIS as a means of addressing a lack of clarity in Leibniz's own presentation of substantial domination. In this section, I advance an alternative interpretation of monadic domination and the composition of the organic body compatible with DC. Given that Leibniz did not explain himself in depth on this point, my positive reconstruction of Leibnizian substantial domination must remain provisional. Nevertheless, as compared with the FIS, I think that it accords more adequately with the status of both the organs as well as the fact that subordinate substances are full-fledged individuals whose perceptions and purposes are defined independently of those of its dominant substance.

We have seen that Leibniz identifies organic bodies with secondary matter or mass (LDV, 265/GP II, 252), and, in the previous section, I have argued that subordinate substances are aggregated together to form individual organs. If organs are aggregates of subordinate substances, then these substances provide the matter comprising the organs. They therefore make up the material constituting the flesh, blood, bones, humors, and nerves of the body. This material mass is further organized in terms of the ends of the dominant substance into a structure involving innumerable functional parts or organs. However, even when, e.g., 'flesh,' is further specified as matter proper to an organ like the heart, the living creatures contained within the relevant mass are still considered in aggregate form as 'heart-flesh.' If this is correct, the dominant substance never distinctly perceives these subordinate substances as independent living creatures. On the contrary, it perceives them confusedly *as matter*, to which it provides form.

Recall Leibniz's claim in the *Monadology* that 'each portion of matter can be conceived as a garden full of plants, and as a pond full of fish. But each branch of a plant, each limb [*membre*] of an animal, each drop of its humors, is still another such garden or pond' (AG, 222/GP VI, 618). This analogy suggests that dominant and subordinate substances have very different perspectives on the nature of the body and its constituents. While plants and fish perceive their respective gardens or ponds, they lack a clear understanding of, and hence remain oblivious to, what these gardens or ponds are from the perspective of the dominant monad. Here the garden or pond is a limb; that is, a functional part of an organic body that helps realize the dominant monad's ends and goals. What is thus a limb—an organ[17]—for the dominant monad is rather a habitat for the subordinate substances. Second, from the perspective the dominant substance takes towards its body, a subordinate substance is not recognized for being an independent living creature with ends and purposes of its own, but rather is understood and acted upon as part of a mass comprised of other substances.

On this reading, the higher degree of perfection of the dominant substance compared to the subordinate substance, as well as the fact that the latter is part of the former's organic body, does not result in FIS. It does not, in other words, render the subordinate substance anything like a brain, liver, kidney, muscle fiber, or white blood cell. Further, neither dominant nor subordinate substances directly perceive the ways that a given subordinate substance contributes to the functioning of the dominant substance's organic body. Rather, domination entails that the dominant substance disregards the individual nature of a subordinate substance: it must perceive it as confused together with others as anonymous matter. Further, subordination does not entail that a subordinate substance directly perceives the organic functions or appetites of the larger organic

17. Cf. fn. 15.

body. Instead, the subordinate substance perceives the organ it helps comprise as a habitat or environment, and it is only confusedly aware of how this habitat relates to the larger world. In other words, the subordinate substance necessarily lacks a distinct understanding of the way that this habitat, *qua* organ, fulfills purposes located in the perceptions of the dominant substance.

As indicated in the Introduction, Andrault has distinguished between the physiological or functional relation of containment between an organic body and its organs, and the material relation of containment whereby all bodies—including organic bodies—are comprised of infinitely many organic bodies. According to DC, substantial domination names the process whereby the organic bodies of subordinate substances come to be material parts comprising the organic body of the dominant monad. Subordinate organic bodies are thus contained materially within the dominant organic body. The functional network of organs belonging to the dominant organic body is also built out of these subordinate organic bodies. However, according to DC, subordinate organic bodies are not formal nodes of this network in the sense of playing direct functional roles. Rather, they serve as the material constituents of the organs insofar as, when aggregated, they make up the anonymous fleshy material out of which the organs are made. In this way, the organic bodies materially contained within the dominant organic body are harnessed, indirectly, within the dominant substance's functional network of organs. Domination consists precisely in this mode of harnessing whereby a subordinate substance comes to passively serve as anonymous material part of the dominant substance's organic body.

This account of substantial domination involves a literal interpretation of Leibniz's fish-pond analogy according to which living beings are contained within the limbs of the body of a dominant substance.[18] However, Ohad Nachtomy has argued that we should qualify this analogy on the grounds that it does not accurately capture the relationships of domination and subordination between substances: 'a living being […] does not merely contain other living beings (as a pond contains a fish) but, rather, involves other living beings as part of a well-ordered and organized functional network' (2019, 184). Nachtomy's claim is part of a larger argument that the machine of nature is a metaphysical unity corresponding to the substance or 'whole living being' (2009, 186), as opposed to its organic body alone. Nachtomy argues that Leibniz fails to distinguish between living and non-living things in virtue of claiming that a natural machine has an infinite collection of organs:

18. Such a literal reading has been defended by Pauline Phemister (2005, 89–94), for whom it challenges the view that Leibniz was an idealist who denied the reality of bodies in his last years: 'The point of the simile, in my opinion, is not just to stress that the entities in each case are *substances*, but rather that they are *corporeal substances*' (2005, 91).

> Leibniz's claim that a natural machine 'is made up of an infinity of entangled organs' cannot account for the difference between artificial and natural machines. The reason is that […] an artificial machine would involve infinitely many organs as well. If an artificial machine consists of infinitely many natural machines, it would also have infinitely many organs and in this sense would be indistinguishable from a natural one. (2019, 122; cf. 2011, 71–2)

Instead, Nachtomy proposes that while an artificial machine is an aggregate or collection of substances, a natural machine is a unitary network of functionally dominated substances in which subordinate substances dominate others in turn:

> While there is a dominant entelechy (or principle of action) at the top of each animal, there is also a whole hierarchy of dominated entelechies (one governed by the other, so to speak) *ad infinitum*) […] it is this very complex system of functionally organized machines from the top down that accounts for the distinction between living and nonliving things. (2009, 184)

I argued in section II that we need not share Nachtomy's concern about Leibniz's distinction. In this section, I have argued that domination does result in the direct functional subordination of substances. In light of these considerations, Nachtomy's revision of the fishpond analogy would be too strong. While the organic body is an infinite network of functionally individuated physical organs, the living beings contained within a limb are not 'involved' within it in the sense of fulfilling a direct functional role. Rather, their involvement consists in the way that they provide, in aggregate, the raw material from which the dominant substance's organs are made. This interpretation of the fishpond analogy better accommodates the nature of subordinate substances and the way that their lives and perspectives remain independent of the purposes of a dominant substance. It also reaffirms that the machine of nature corresponds to the organic body of a substance, not to the substance as a whole.

VII. Conclusion

I have defended DC, a view according to which Leibnizian machines of nature feature two distinct types of mechanical part: organs—complex mechanisms like the heart—and further machines of nature corresponding to subordinate substances. While subordinate substances are independent living beings, organs are physical sub-machines that carry out functional roles. Although organs are

machines, they are not 'machines of nature' in Leibniz's technical sense of being the infinitely complex organic bodies of substances. Organs are fully individuated and defined by their functional roles. Substantial domination does not entail FIS, the view that subordinate substances are individuated as functional organs. Rather, aggregates of subordinate substances comprise the matter from which organs are formed. Finally, Leibniz's claim that each branch of a plant or each limb of an animal may be conceived of as a garden full of plants or as a pond full of fish is a literal illustration of the relations that exist between the organs of a machine of nature and the innumerable subordinate living beings of which they are made.

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The author has no competing interests to declare.

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