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# Some Theses Concerning a Formal Ontology of Wholes

**Pedro Manuel dos Santos Alves**

psalves2@gmail.com

University of Lisbon

**Research Article**

**Keywords:** Formal Ontology, Mereology, Edmund Husserl, Foundation, Morphological Wholes, Special Composition Question, Structural Hylomorphism.

**Posted Date:** November 5th, 2026

**DOI:** https://doi.org/10.21203/rs.3.rs-11206557/v1

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**Additional Declarations:** No competing interests reported.

# SOME THESES CONCERNING A FORMAL ONTOLOGY OF WHOLES

"...πάντων γὰρ ὅσα πλείω μέρη ἔχει καὶ μὴ ἔστιν οἷον σωρὸς
τὸ πᾶν ἀλλ' ἔστι τι τὸ ὅλον παρὰ τὰ μόρια, ἔστι τι αἴτιον..."
"...ὁμοίως δὲ οὐδὲ τὸ μέρος τοῦ ἀνθρώπου πάντως,
οἷον ἡ χείρ· ἡ γὰρ νεκρὰ οὐ χείρ, ἀλλ' ὁμωνύμως λέγεται."[1]

**Abstract**

This paper argues that formal mereology requires a formal theory of wholes—termed "Holomereology"—to overcome the *structural blindness* of Classical Extensional Mereology (CEM). While CEM operates perfectly as the logic of unstructured aggregates (summative wholes), it fails to account for genuine structural composition. Addressing the Special Composition Question, I reject contemporary structural hylomorphism, which treats structure as a proper part. Instead, the paper introduces the concept of *Morphological Whole*, defined by an overarching architectural matrix (*Morphé*) and a material filling function. It also proposes a comprehensive formal taxonomy, distinguishing between exact and non-exact (porous) boundaries, and analyzable and non-analyzable internal "anatomies." Crucially, the paper moves beyond Husserl's horizontal web of dependent and interdependent parts by introducing the concept of "Architectural Foundation," showing that parts are fundamentally founded on the whole itself, the sole bearer of non-distributive top-level properties. Ultimately, this framework dissolves the rigid phenomenological dichotomy between exact and morphological and relocates CEM as a structural limit case—a degree zero of morphology—within a broader context.

**Keywords**

Formal Ontology; Mereology; Edmund Husserl; Foundation; Morphological Wholes; Special Composition Question; Structural Hylomorphism.

## 1. The Guiding Principle: Wholes First.

Formal mereology is like a body without a head.

This is particularly evident in Classical Extensional Mereology (hereafter "CEM," a term coined by Simons, 1987), which assumes the parthood relation is uniform, fundamental, and primitive.[2] It treats parthood as a partial ordering governed strictly by reflexivity, transitivity, and antisymmetry—a foundational thesis that traces back to Leibniz (Cotnoir and Varzi, 2021: 5).[3]

[1] Aristotle, Metaphysics, VIII, 1045a 10–11 and 1035b 30-31: "...but as for things that consist of many parts and are not merely a heap of parts, but rather have a whole that is distinct from the parts, there is a cause...", "...similarly, a part of a human being is not a human being in any state, such as the hand; for a dead hand is no longer a hand, but is called such only by homonymy."

[2] This does not preclude other possibilities for simple primitives, such as proper parthood (Leśniewski, 1916), disjointness (Leonard & Goodman, 1940), overlap (Goodman, 1951), or sum (Tarski, 1929). For my strict purposes, however, I focus on the primitiveness of parthood.

[3] While generic parthood ($P$) can serve as the fundamental logical primitive in CEM, its reflexivity ($P(x, x)$) renders it insufficient for capturing the natural intuition that a part is different from the whole and runs against the common-sense view that an object is not a part of itself. To account for this, CEM introduces proper parthood ($PP$) as a secondary concept, defined as $PP(x, y) \equiv P(x, y) \wedge x \neq y$. Consequently, proper parthood operates as a strict partial ordering under irreflexivity, transitivity, and asymmetry. In fact, for Boolean algebra, on which all of this is based, the strict partial

Upon this logical baseline, CEM imposes the axioms of extensionality and unrestricted composition.

However, this account overlooks the ontological dependence of parts upon the whole—a crucial insight in Husserl's *Third Logical Investigation*, where a part is fundamentally conditioned by the formal category of the whole in which it is embedded.

Indeed, if there is no singular, uniform kind of whole, there cannot be a singular, uniform kind of parthood. Instead, a plurality of distinct wholes entails a corresponding plurality of parthood relations, each obeying different structural laws that may intersect. Consequently, the property of "being-a-part" is, under this assumption, neither uniformly determined nor primitive. It is dependent upon, and conditioned by, the overarching type of whole. Therefore, because parthood is neither uniform nor fundamental, it can never be treated as mereologically simple; it possesses its own internal structure, specific determination, and modal constraints.

Thus, formal mereology requires a formal theory of wholes to serve as its governing head. I propose to call this unified framework "Holomereology." Derived from the Greek *ὅλον* (whole), this term mirrors the exact etymological formation of "Mereology"—a term coined from the Greek *μέρος*, "part" (Leśniewski 1992: 227).[4]

In my paper, I will characterize the concept of "whole" (section 3); analyze the types of wholes (section 4), and their internal structure (section 5). Next, I will consider parts from the perspective of wholes (section 6), and finally revisit Husserl's theses on *foundation* to propose a new concept going beyond Husserl's unilateral and multilateral foundations (section 7).

My thesis requires preliminary justification. I shall briefly defend it by addressing two fundamental points in the following section. First, I contend the Special Composition Question (SCQ) is a conundrum only within the strict confines of extensionalist mereology; it dissolves once one recognizes that composition criteria vary according to the type of whole, as not every whole is merely the sum or fusion of its parts. Second, if this initial contention is sound, classical formal mereology must be understood not as an ontologically incomplete theory in need of *ad hoc* structural patches, but as a limit case within a broader framework. Standard extensional mereology, in addition to its great formal elegance, is arguably the most basic and universally applicable system precisely because it emerges when the structural variable is eliminated as a composition criterion—it is, therefore, the logic of the unstructured. However, to operate

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ordering is only a secondary principle: $A \subset B \equiv A \subseteq B \wedge A \neq B$. Throughout this paper, I use the symbols $P$ and $PP$ interchangeably with $<$ and $\ll$ to denote generic and proper parthood, respectively.

[4] While Leśniewski coined this name to designate his foundational systems of parts and wholes, the development of modern formal mereology shifted significantly towards a purely extensional calculus of individuals. This pivotal transition was led by Henry S. Leonard and Nelson Goodman (Leonard & Goodman, 1940) in their paper "The Calculus of Individuals and its Uses," which laid the groundwork for what would later be systematized by Nelson Goodman (Goodman, 1951).

beyond the limit case of CEM, a *formal ontology* of wholes and *their* parts is required. My contention is that it requires something like the Husserlian concept of *Fundierung* (foundation). Only by incorporating Husserl's concept can one shift from a "mereological equilibrium state" to a theory of internal morphological structure, capable of distinguishing between mere aggregates (*Inbegriffe, Summen*) and genuinely structured wholes (*Ganzheiten*). I pave the way for this final result in section 2 by discussing Kathrin Koslicki's proposal to consider structure as a *formal proper part*.

In a nutshell, my general guideline is summed up in the motto: *Wholes First!*[5]

## 2. **Composition and Structure**

The contemporary debate on mereology is largely shaped by what Peter van Inwagen termed the "Special Composition Question" (SCQ): "… in what circumstances do things add up to or compose something? When does unity arise out of plurality?" (van Inwagen 1990: 31[6]). This central ontological problem requires us to identify the boundary conditions distinguishing a mere plurality of objects from a *real* whole. Van Inwagen proposes a restrictive solution, "Organicism," arguing that objects compose a real whole if and only if their activity constitutes a life. While preserving sound insights about what qualifies as a "genuine" whole, it poses a significant challenge for formal mereology.

Within the framework of CEM, such restrictions are difficult to justify. As David Lewis argued, a commitment to unrestricted composition is a natural consequence of the axioms; mereological sums (fusions) obtain for every collection of objects, regardless of their nature (Lewis 1986: 212). Thus, the consistent extensionalist is led toward Mereological Universalism (or its opposite, Mereological Nihilism[7]), where any arbitrary collection—regardless of its lack of structural unity, as in Lewis's "trout-turkey"—is a "whole."[8]

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[5] In making this statement, I should add that I really appreciate the groundbreaking works of Kit Fine, particularly his affirmation of the ontological priority of the whole (Fine 1999) and his sharp distinction between mere aggregates and genuine compounds, namely rigid or variable embodiments (Fine 1994). From a more phenomenologically oriented perspective, Marina Banchetti-Robino has shown that, in the specific case of chemistry, parts lose their identity when incorporated into the molecular whole. This is also a strong way of affirming the ontological primacy of wholes. She has argued that Husserlian theory, like CEM, fails to account for this transmutation or loss of identity of the parts within the whole (Banchetti-Robino 2020). Concurring with her critique to a certain extent, I intend to return to this pressing issue in due course.

[6] In van Inwagen's formalized version: "When is it true that ∃*y* the *x*s compose *y*?" (van Inwagen 1990, 30).

[7] Indeed, Sider's argument expanding Lewis's thesis—based on the "vagueness" of any restriction on composition—leaves us with only two extreme cases: either composition occurs whenever there is a plurality of objects (his thesis, following Lewis), or it never occurs, leaving only "mereological simples" (Sider 2001, ch. 4: 120–34).

[8] A mermaid and a centaur also align with Lewis's example. A survey of the SCQ debate is beyond the scope of this paper. I restrict myself to outlining its general contours: (i) Mereological Universalism (or Permissivism), referred to

This leaves us with an ontological tension: on the one hand, van Inwagen's restrictivism seeks to preserve our intuitions about composite objects but introduces constraints that may seem empirically contingent and *ad hoc*: it is a contingent fact that there is life, lacking the value of a universally valid criterion. On the other hand, the universalism mandated by extensionalist rigor risks diluting the concept of a "whole" to include any random collection of parts, generating gerrymandered wholes like my nose, your eyes, and the Moon.

I suggest both positions are constrained by a framework treating composition as a uniform relation. Therefore, we are not forced to choose between these extremes if we acknowledge that composition criteria vary according to the type of whole, from a strict *conceptual* point of view (I will later say: *"eidetic*"). By moving beyond the monistic view of parthood, we see that composition is not a single, uniform event, but ontologically dependent on the structural, i.e., *morphological* unity of the whole.

Van Inwagen's key point boils down to a single dilemma: either we take structure seriously, or we are insensitive to structure and cannot distinguish a fictitious whole from a real one. Take a live cat and then make a "soup" out of all the ingredients of its body: cells, minerals, and water. The difference is huge. The former exhibits system-level properties (or "founded properties") belonging to the whole *qua tale*—such as life and its associated functions; the latter completely lacks them. This structural difference is ontologically massive.

Yet, in 2008, Achille Varzi continued to maintain that mereology should be, *by definition*, insensitive to form and structure. He reaffirmed the principles of the *extensionality of parthood* ("If *x* and *y* are composite objects with the same proper parts, then *x* = *y*"), of the *uniqueness of composition* ("If *x* and *y* are sums of the same things, then *x* = *y*"), and of the *extensionality of composition* ("If *x* and *y* are composed of the same things, then *x* = *y*") (Varzi, 2008: 108-9). However, none of these principles captures the difference between a living cat and a cat soup.[9]

Apparently, we are left with an alternative: either Varzi's authoritative stipulation that mereology does not deal with structure delimits the scope of the discipline, or mereology must be reformulated *from within* to capture such a striking difference between a cat and cat soup, or a functioning car and a heap of its disassembled pieces.

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above, sustaining that composition is unrestricted; (ii) Mereological Nihilism, maintaining that composite objects do not exist, leaving only fundamental particles (Unger 1979; Merricks 2001); and (iii) Restricted Composition, seeking to identify specific conditions under which a whole is formed. This latter category is highly heterogeneous, encompassing approaches such as Organicism, Brutalism, in which composition is simply an empirical "brute fact" (Markosian 1998), Structural Hylomorphism (Koslicki 2008), which I will briefly discuss, and conventionalist views (Hirsch 2011). For a comprehensive overview, see Cotnoir and Varzi (2021).

[9] If an extensionalist objects that standard mereology is not supposed to account for such structural differences, they prove my point: CEM is a baseline theory that strictly requires supplementation by a more fine-grained formal ontology of wholes and *their* parts. It is, thus, a limit case where the structural variable vanishes to zero. Hence, its universal applicability and its lack of explanatory depth.

It was Kathrin Koslicki who famously took this second path in the very same year as Varzi's article (Koslicki, 2008). In an inspiring book, she defended a "hylomorphic," "neo-Aristotelian" approach emphasizing the crucial importance of *structure*. Consequently, for her, structure is not merely a contingent restriction—as in van Inwagen's suggestion—but a *universal* condition that must be taken into account in any kind of whole, *if it is to be considered real rather than arbitrarily composed*. In stark contrast to the "ontologically innocent" fusions of CEM—which, as Varzi frequently points out, weigh nothing extra, pay no taxes, and do not contribute to global warming—both for Koslicki (and for me), *real* wholes are ontologically efficacious and relevant.

She states,

> My project in this book is to help reverse this trend in contemporary metaphysics and to put the notion of *structure* or *form* squarely back at the center of any adequate account of the notions of part, whole, and object. To this end, I propose in what follows a conception of ordinary material objects as *structured wholes*: it is integral to the existence and identity of an object, according to this approach, that its parts exhibit a certain configuration or manner of arrangement (Koslicki, 2008: 5).

So far, I agree. I also endorse her introduction of the concept of "form" to account for the structuring of an organized whole, which is not merely a sum of disparate elements. However, as the argument progresses, our differences become increasingly pronounced. I disagree with Koslicki on three key points. They are as follows: (i) characterizing form as a *part*; (ii) classifying it as a *proper part*; and (iii) the *ancillary nature* of mereology in relation to a Quinean-style ontology of "what there is," with the consequent dependence of the theory on an ontology of "natural kinds."

*Ad* (i). I contend that treating structure as a "formal part" conflates two distinct ontological categories: the *constituents* and the *constitutive principle* of a whole. If structure is relegated to the status of a part, it loses its role as the unifying principle of the elements. Consequently, the "formal part" remains an entity in search of an ontological home—it explains nothing because it requires a principle of unification to be integrated into the whole. Indeed, structure is not a constituent or a special kind of part, but the structural closure that defines the whole as such. My critique of Koslicki's "formal parts" rests on this fundamental ontological distinction. While Koslicki introduces these parts to account for structural unity and to avoid the shortcomings of classical mereology, what she identifies as a "formal part" is not a constituent. It is rather the *constituted* Whole itself—the principle of unity (*Ganzheit*) governing the ontological status and functions of the material parts.

The motivation behind characterizing structure as a mere part seems driven by a reluctance to abandon the extensionalist framework. Ultimately, Koslicki merely replaces the standard mereological definition of a whole—say, $W = (a + b + c)$—with a new formula that does not truly constitute a step forward. Under her account, the formula becomes: $W = (a + b + c + S)$. The whole remains an empty placeholder: it is simply the sum of its elements, now with the structure added as just another piece. Yet, how this structure relates to the other parts remains a mystery, as they belong to different ontological categories (one being "formal" and the others "material"). The metaphor Koslicki uses—structure as a "recipe"—does not strike me as accurate either. Structure is not a recipe for "making" a whole; it is the intrinsic architecture of an existing whole itself.[10] Therefore, the notion of structure as a part must be rejected in favor of the formulation: $W = S(a + b + c)$, which entails (assuming linearity) $W = Sa + Sb + Sc$. In other words, there is no such thing as bare parts plus structure as an additional element; there are only parts, already embedded within the encompassing structure itself.

*Ad* (ii). If Koslicki simply meant structure—taken together with its structured elements—constitutes the whole, one could trivially accept that structure is a part, since under CEM, parthood is reflexive (i.e., a whole is an improper part of itself). However, this is not her claim. For her, the structure is a *proper part* of the whole. She states this in the following crucial passage:

> Since there is overwhelming evidence in favor of the thesis that the lump of clay, i.e., its single material component, is a proper part of the statue, we must now look for additional proper parts within the statue besides its single material component: the most likely candidates for these additional proper parts are of course those elements of the whole to which we have been referring as its "formal components". Thus, assuming WSP[11] and the cogency of Leibniz's Law-style arguments […], we arrive at the conclusion that the formal components of a whole as well must be counted among its proper parts. […] [G]iven that we have taken the relation between a whole and

[10] If one simply lines up sugar, flour, eggs, chocolate, almonds, and a recipe (the formal part) side by side, the resulting mereological whole is obviously not yet the cake.

[11] Koslicki is referring to the Weak Supplementation Principle. It states that if a whole has a proper part, it must have at least one other disjoint proper part (a remainder). This contrasts with set theory, which allows singletons (sets with only one element) that, as sets on their own (e.g., {*a*}), can be elements of other sets (e.g., {{*a*}, *b*, *c*}). Another striking difference is that, unlike set theory—which allows the empty set—extensional mereology rejects it, since it is nonsensical to speak of a whole that is empty, that is, without parts. Consequently, the total number of parts generated by a whole composed of *n* atomic parts is $2^n - 1$. It is precisely against this "multiplication of entities" — namely, sets as entities allowing for singletons and a nested hierarchy of sets of sets, as well as the null set— that classical mereology was directed, beginning with Leśniewski and later consolidated by Goodman's nominalist stance. I do not wish to debate here whether this "Occam's razor" against the proliferation of entities or the nominalist bias is essential to mereology. As a phenomenologist engaged in formal ontology, I am interested only in the pure determination of the Whole-Part eidetic laws.

> its formal components to be that of proper parthood in the special case just considered, in which a whole consists of just a single material component, it is of course natural to extend this hybrid conception to the more general case as well." (Koslicki 2008: 180-81)

To secure the existence of formal proper parts, Koslicki relies on the Weak Supplementation Principle (WSP). Applying Leibniz's Law to the classic statue-and-clay paradox, she affirms the clay is just a proper part of the statue. Since WSP dictates that every proper part requires a non-overlapping remainder, and there is no material remainder here, Koslicki posits the "formal part" to satisfy this mereological requirement. Thus, the "formal part" becomes a *proper* part of the whole.

This argument, however, encounters significant difficulties. The relation of overlap (∘) underpinning WSP is standardly understood as spatial and extensional. Thus, it is difficult to conceptualize how an abstract formal component could overlap with a concrete material component. Furthermore, generalizing this solution, as she does, reveals a structural weakness. Even if one were to concede that a formal part is logically required to satisfy WSP in single-part objects (such as the clay statue), this formal necessity vanishes when applied to objects with multiple proper parts. In complex objects, any material proper part naturally leaves other material parts as its non-overlapping remainders, satisfying WSP by default. Consequently, the formal pressure to posit structure as an additional proper part ceases to exist for most ordinary objects. This calls into question the methodological legitimacy of the move: one should not derive the universal architecture of wholes by generalizing an *ad hoc* maneuver designed solely to solve a mereological limit case (coincident entities).

*Ad* (iii). In direct opposition to Koslicki's perspective, I assert that the mereologist is not dependent on the empirical ontologist; rather, mereology is by itself a formal ontology that establishes its propositions in its own right, without being subordinate to any other discipline. In contrast, Koslicki states:

> [B]y presupposing that the question, "What mereologically complex objects (if any) are there?" is *descriptively* settled in the course of arriving at a scientifically and commonsensically acceptable ontology of kinds, the present approach assigns to the mereologist proper a more limited set of responsibilities directed at the characterization of those mereologically complex entities whose existence is already confirmed by independent evidence to which the mereologist must hold himself accountable. (Koslicki 2008: 171)

The "scientific" and "commonsense" ontology Koslicki has in mind is fundamentally a Quinean-style inquiry into "What is there?". However, this is not the most radical question.

Instead of asking, “What objects are there to think about?”, the question should be: “What are the formal conditions for something to be constituted and thought of as an object?” This question operates on an entirely different level. The aim of formal ontology is not to compile an inventory of what exists; rather, it is to determine the eidetic modes and forms through which something is thinkable (and knowable) as an object. Asking this places the mereologist firmly in the position of a formal ontologist, free from any reliance on “independent evidence.” In short, it involves shifting from the Quinean inventory question to the regressive transcendental question regarding the conditions under which we can constitute and grasp things as structured objects.

To summarize my disagreements regarding Koslicki’s highly stimulating work in two sentences, I will state:

First, *structure is not a proper part of the whole*. If anything—*improprie dicto*—the structure is what governs the elements of the whole as its proper parts. Properly speaking, this entails replacing the extensional concept of “proper part” with a reworked Husserlian concept of *Fundierung*: the parts of a whole are *founded* (in a sense I will clarify later) upon its “structure” or “form” (*Morphé*).

Second, *the mereologist is inherently a theorist of formal ontology*, searching for what kinds of wholes are formally conceivable, rather than relying on an ontology of “natural kinds” to provide the pre-packaged material that they subsequently formalize. This reliance, however, does not prevent Koslicki from launching into a lengthy discussion of biological taxa as natural kinds—a move which clearly shows that, *malgré elle*, she is already doing ontology. Indeed, to remain strictly dependent on data provided—and disputed—by other disciplines would be tantamount to succumbing to naive empiricism, accepting given *facta* prior to any mereological conceptualization. A theory of wholes and parts does not come after the facts. It comes before, as a purely eidetic inquiry into the possible types and properties of wholes.

Therefore, before advancing to the structures of what I call a “*Morphological Whole*,” a strict methodological demarcation is required. The present framework of Holomereology operates exclusively within the domain of Formal Ontology—understood in the Husserlian tradition as a pure, a priori eidetic science of the “object as such” (*Gegenstand überhaupt*). Consequently, my framework systematically brackets all questions regarding empirical genesis, physical causation, or the forces that assemble a whole. The formal theory does not inquire into the etiology of the wholes one can find in the several material regions. Putting aside any kind of physical, psychological, biological, or social explanations, the entire endeavor is strictly descriptive and taxonomical. Within this purely formal domain, the morphological structure exerts no causality; rather, it establishes an a priori eidetic constraint. The ontology of the whole

restricts itself to describing the object's logical dependencies and formal conditions of possibility. It merely expresses the structural rules and conditions of admissibility that any given material must satisfy to function as a proper part within a whole, remaining completely independent of the empirical specificities of its realization. After the formal treatment, however, examples from various material regions are desirable for verification. Specific cases are not, thus, the starting point of the theory, but the point at which it is illustrated.

## 3. Wholes.

Regarding Koslicki's valuable work, I will say that the real problem is not restricting compositional universalism. It is always valid and as natural as counting the elements of a multiplicity—even if they are disparate—and gathering them into a whole resulting from this additive operation. The principles of CEM regarding composition are unassailable, and I fully endorse them, particularly the following two foundational axioms:

1. *Unrestricted Composition (Universalism):* For any non-empty plurality of entities, there exists a whole that fuses them. If we define overlap as $O(x, y)$ (meaning $x$ and $y$ share at least one part), the fusion $z$ of any entities $x$ and $y$ is formally expressed as:

$$\forall x \forall y \exists z \forall w \left( O(w, z) \leftrightarrow \left( O(w, x) \vee O(w, y) \right) \right)$$

2. *Uniqueness of Composition (Extensionality):* This resulting whole is entirely determined by its parts. No two distinct wholes can have exactly the same proper parts. Indeed, if two entities share all their parts, they are numerically identical:

$$\forall x \forall y \left( \left( \forall z \left( P(z, x) \leftrightarrow P(z, y) \right) \right) \rightarrow x = y \right)$$

Closely related to the previous is *Composition as Identity* (CAI), i.e., the thesis that a whole is strictly identical to its parts taken collectively. Formally, this is often expressed as a plural identity ($x = Y$, where a singular whole $x$ is strictly identical to a plurality of parts $Y$). However, unlike the first two principles, CAI is not a strict formal requirement of CEM and remains highly controversial. I do not agree with it for the reasons I explain below (a recent, thorough overview of this debate can be found in Lando 2017).

Consequently, in CEM, composition is flat, unique, and ontologically cost-free. The theoretical challenge does not lie in restricting this permissiveness, but in recognizing its limits. The *real* problem is, thus, finding a *formal place* for entities that *can only be conceived as internally self-contained wholes*—unities that are not merely gerrymandered *ad libitum* by an external conceptual act, but possess an *intrinsic, mind-independent self-cohesion.* Are there such

entities that can only be grasped as wholes? Before this question regarding "what is there?" I intend to show that such entities are *conceivable* and propose a *formal characterization* of them. In this theoretical framework, the actual cases are instances of unities of thought that can be conceived and determined in regard to their essential (eidetic) laws.

Therefore, what is at issue is not a refutation of CEM by means of any restriction to universal fusion. Rather, what is at issue is identifying conceptually determinable *types of objects* that can only be conceived *as wholes*, thereby shifting composition from a mere option to a *necessity*. I will not say that these wholes are "natural." Rather, they are *real* wholes that, by their very nature, constrain the arbitrariness and optionality of fusion inherent to CEM. For these entities, being grasped as a whole is not an external cognitive operation, but an intrinsic, strict necessity.

In the standard theory of mereological fusion, the formal-ontological determinations of the parts are left out of consideration. The operation of fusion is ontologically blind to the nature of its elements. Consequently, under unrestricted composition, one can freely fuse the white of a wall and the Moon into a single whole. However, from a formal-ontological perspective, these entities have radically different modes of being: the Moon is an independent concretum, whereas the white of the wall is a dependent part (a moment) that requires a surface to exist.

Taking the formal-ontological determinations of the entities undergoing composition into account is an indispensable theoretical step. By taking this step beyond the flat domain of CEM, we immediately confront *necessities of composition* belonging to the very internal structure of the objects themselves. The inherent morphology of the elements dictates strict compositional demands, standing in sharp contrast to the arbitrary freedom of extensional fusion.

This leads to a specific domain of entities whose composition is not optional or gerrymandered but necessarily determined in one specific way. To capture this fundamental difference, I distinguish between two conceptually distinct types of wholes: purely *Summative Wholes* ($^{s}W$), which are the result of the free, arbitrary fusions allowed by CEM, and *Morphological Wholes* ($^{m}W$), whose composition is governed by intrinsic, formal-ontological constraints.

At the purely formal level, the structural backbone of any morphological whole is defined by a system of connections $(e_1, \dots e_n)$ linking elements or positions, abstractly conceived $(p_1, \dots p_n)$, in which:

1. Each position is connected to at least one other position,
2. Each position has an immediate or mediate connection to all other positions,
3. Each position, thus, has a connection to the entirety of the network itself.

Such a network guarantees *internal cohesion*, *topological closure*, and *identity*—that is, the structural capacity to function as a self-sustaining unit. I designate this purely formal unity of connections and abstract positions with the classical Aristotelian term *Morphé* ($\mathfrak{M}$).[12]

To determine the ontological status of that *Morphé* without collapsing into empirical naturalism or naive Platonism, it must be situated within Husserl's architectural framework articulated in *Ideen* I, § 10. The *Morphé* is not an *abstractum* requiring material foundation or an "*idea"* floating in a *topos ouranios*; it is a structure belonging to formal ontology, i.e., to the "region" dealing with the pure category of *object as such*. As Husserl established, the formal region is not one material region among others; "*it is not properly a region, but the empty form of region as such* [*überhaupt*], it has all regions, with all their material [*sachhaltig*] characteristics, not merely beside itself, but rather (albeit only *formaliter*) *under* itself" (Husserl 1976: 26, my translation). Accordingly, he proceeds, "Examples of logical categories therefore include concepts such as property, relative quality, state of affairs, relation, identity, equality, set (collection), number, whole and part, genus and species, etc." (Husserl 1976: 27, my translation).

As a category belonging to the "region" *object as such*, the *Morphé* is formally empty; it requires a principle of material instantiation to be fulfilled by concrete content belonging to the various material regions. I designate this function of material filling as $\Phi$. Therefore, A Morphological Whole is defined by the ordered pair of its *Morphé* and its Filling:

$$^{m}W \equiv \langle \mathfrak{M}, \Phi \rangle$$

*Morphé*, for its part, is defined by a generative structure in which the connections determine the Positions:

$$\mathfrak{M} \equiv (E \rightarrow P)$$

*Filling* is the function mapping Positions to specific parts, embedded within the network of connections that determine them.

$$\Phi: P \rightarrow \{x_1, x_2, \dots, x_n\}$$

This representation of morphological wholes is strictly trans-regional: it applies across material ontologies—capturing entities in the physical, biological, or social realms—and extends even into the domain of meaning and its logical articulation.

[12] While CEM is grounded in Boolean algebra, I must stress that this description of a morphological whole is structurally akin to mathematical graph theory. It shares the same level of formal abstraction and a strictly topological focus on connections (*edges*) and structural slots, which I term "positions" (*vertices*). Furthermore, the three conditions outlined above correspond precisely to the definition of a connected graph. This structural proximity is not merely accidental; rather, it shows how graph theory can be naturally incorporated as a formal apparatus within an ontology directed toward the whole-part correlation.

To exhibit this universal scope, consider a foundational structure of logical inference, such as the classical syllogism in *Barbara* in the traditional concrete example that, however, Aristotle never gave:[13]

If mortal is said of all men,

And man is said of all Greeks,

Then mortal is said of all Greeks.

This inferential structure constitutes a morphological whole ($^{m}W$). Let us assign the terms as formally conceived positions ($P$): $A$ (Mortal), $B$ (Men), and $C$ (Greeks). The generative connections ($E$) are the formal relations of universal affirmation ("is said of all"). The structural necessity of the syllogism dictates its internal topology: if connection $e_1$ links $A \rightarrow B$ ("Mortal is said of all men"), and $e_2$ links $B \rightarrow C$ ("Man is said of all Greeks"), a topological closure is mandatory. A third connection, $e_3$, must link $A \rightarrow C$ ("Mortal is said of all Greeks"). This closure establishes a self-sustaining inferential unity governed entirely by its internal structural morphology. It has *internal order*, but is not a temporal sequence. The temporal component belongs to the psychological process of grasping the morphological whole and possibly expressing it. Yet, the whole itself stands as a *timeless* inferential meaning unity:[14]

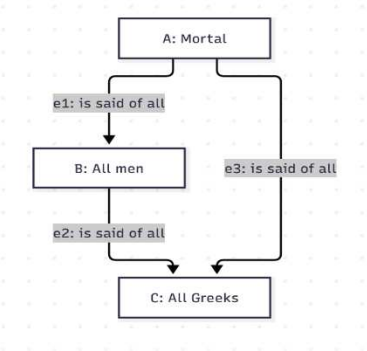



Figure 1. A morphological treatment of a logical inference.

I designate a fully determined unity of this kind as an *Exact*, *Analyzable* Morphological Whole. The description of the several kinds of morphological wholes will constitute the subject matter of the following section.

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[13] Out of a playful precisionism, immaterial for the issue at hand, rather than relying on the usual Euler/Venn presentation, I adopt the original formulation of the Aristotelian syllogism reconstructed by Łukasiewicz (where a universal affirmative is rendered as "A is predicated of all B"), modifying his phrasing to the equally admissible "…is said of…" (see Łukasiewicz 1972: 23).

[14] To avoid confusion with phenomenological realism, it must be stressed that these ideal units are constituted as such—that is, as transcendent units—through the achievements (*Leistungen*) of transcendental subjectivity. However, introducing the theory of constitution and the transcendental stance here would add an extra complication contributing nothing to the matter at hand.

## 4. Kinds of Wholes: Exact *versus* Non-Exact.

I define the *core* of a morphological whole as the set of elements without which the whole collapses—that is, the elements which are strictly necessary to it.

So, let $x$ stand for any of these necessary elements, whether they are formal connections $(E)$, topological positions $(P)$, or the material parts assigned by the filling function $(\Phi)$.

Formally, we have:

$$Core({}^{m}W) \equiv \{x \in {}^{m}W : \Box(\neg\exists x \rightarrow \neg\exists\, {}^{m}W)\}$$

This formula states that the *core* of a morphological whole is the set of elements $x$ belonging to that whole such that, necessarily, if any single one of them is suppressed or varied, the whole itself collapses.

Within this framework, I distinguish between morphological wholes with *tightness* and morphological wholes with *porosity*. A *tight* morphological whole does not admit a "periphery" of structural pairs $(E, P)$, and their corresponding material fillings $(\Phi)$. Conversely, it is an eidetic possibility that a whole admits intersection with pairs $(E, P)$ and fillings $(\Phi)$ belonging to other wholes. These elements can vary within certain limits—the absolute limit being that they do not destroy the core itself—and are diverse and changeable. They act as *transient coincident positions* (*vertices*). In formal terms, this is characterized as an *intersection* (or a multiplicity of intersections) that overdetermines the core of a given morphological whole.[15]

I call the first group *exact* morphological wholes (${}^{m}W^{E}$), and the second group *inexact* or *non-exact* morphological wholes (${}^{m}W^{NE}$). For the case of rigid or exact morphological wholes, the most obvious examples come from mathematics. If to the morphological whole corresponding to the equation of a circle, $(x-a)^2 + (y-b)^2 = r^2$, one adds one more pair *E, P* with *p* duly filled in, for instance, $(x-a)^2 + (y-b)^2 + (z-c)^2 = \mathrm{r}^2$**,** the result is tantamount to altering the initial whole. In fact, it is no longer a circle, but a cylinder. The same applies to the mathematical sciences of nature. To return to the oft-cited example of the water molecule, $H_2O$, the addition of, for example, one more oxygen atom drastically alters the whole. It is no longer water, but hydrogen peroxide, which is undrinkable and lethal.

[15] I prefer to call it "intersection" ($\cap$) rather than "overlap" ($x \circ y$), because the latter, in CEM, has a strong connotation with mere spatial superposition, which is not the only case at stake here.

Surprisingly, or maybe not, one finds exact morphological wholes outside mathematics and natural sciences. They occur even in the region of the social world. I will give two examples. The first is the alphabet. An alphabet is not a CEM "bag" of letters. Each letter, to recall Saussure, is defined by a system of negations and distinctions relative to all others. Thus, it is a morphological whole, and a morphological whole that is *exact* insofar as its total state space consists of all finite combinations of letters, and nothing else can be added to its periphery. Within this total space, every natural language operates through strict rules of composition (e.g., phonetic and orthographic constraints) drastically limiting the number of permissible combinations—for instance, ruling out strings like "*cwtryr*." Against this framework, the lexical structure of a specific natural language functions as an exact subset formally derived from the total state space generated by the alphabet. When Petrus Ramus proposed differentiating the Latin letter *i* into *i* and *j*, and the letter *v* into *u* and *v*, he was not arbitrarily appending new letters to a supposed periphery. Rather, he was giving explicit graphic expression to an internal differentiation of phonetic value already operating within the system relative to the Latin letters *i* and *v*. Indeed, in an exact morphological whole, there are no contingent accretions; what appears as an "addition" is a strict rearticulation of the system's intrinsic architecture. This does not preclude historical evolution, creation, and change. The point is that *every* alphabet, *as currently constituted*, is an *exact* morphological whole.

The second example is the monetary system, which is definitely not a mereological sum of coins. Taking the Euro as an example, it involves dividing the unit by one hundred and admitting only non-zero values with at least one filled decimal place. The system's state space is infinite (unlike *finite* combinations of letters) and is rigidly determined. In this context, the monetary system constitutes an *exact* morphological whole that does not tolerate the addition of any peripheral *E, P* pair. By contrast, the accounting monetary system allows not only zero but also negative figures and divisions beyond the second decimal place. Thus, it is *another* exact morphological whole based on the set of real numbers. When a bank teller rounds the accounting figure of €10.769 to €10.77 or eliminates the third decimal place and pays only €10.76, they are applying a conversion rule from the exact accounting morphological whole to the exact monetary morphological whole. This is a conversion between two systems, not their merger or intersection.

One might think that water flowing in rivers, oceans, or falling from the clouds is no longer a morphologically exact whole due to the ions and minerals combining with it. I think not. For example, when sodium chloride dissolves in water, the resulting chemical reality is not a vague or porous molecule, but a solution represented as $NaCl(aq) \rightarrow Na^{+}_{(aq)} + Cl^{-}_{(aq)} +$

$H_2O$.The water molecule ($H_2O$) remains unchanged at its core; its internal *Morphé* is not altered. It simply becomes part of a broader, yet still rigidly ordered, exact morphological whole (the ionic solution), just as an exact mathematical equation can be combined into a larger system without losing its intrinsic rigidity.

Organisms are paradigmatic cases of *non-exact* morphological wholes: the periphery is always present and active. We see this not only in sexual reproduction, but even more fundamentally in metabolism. An organism continuously ingests external matter, integrates it into its structural and functional architecture, and expels waste. Its material parts are in constant flux of interactions with a periphery, yet the intrinsic *Morphé* defining the organism persists intact. Definitely, an organism is a structure designed to be essentially porous.

The social world offers perhaps more striking examples, such as legal systems. It has an internal core of normative production: parliament, government, courts, etc. (or other equivalent institutions). However, it also accommodates a periphery. One paradigmatic case is European law in the EU. Regulations and acts of the European Parliament, the Commission's directives, and rulings of the Court of Justice are incorporated into the legal system of each member country and overdetermine it (e.g., European citizen rights overdetermine national citizen rights), sometimes adding new elements to each state's legal system and sometimes repealing its laws, given the primacy of European law.

However, I wish to highlight consciousness as a notable example of this porosity of an inexact morphological whole. Consider a perceptual intentional act. It has a core: perceptual intention, doxic attitude, direction toward an object, givenness, fulfillment (*Erfüllung*), and continuous synthesis of unity within the temporal series of adumbrations (*Abschattungen*). This gives the core of a perception, supposedly close in itself. However, suppose someone urgently needs to use their car but cannot find the keys at home. The perceptual intention becomes overdetermined by anxiety (belonging to the thymic sphere) and by the desire to find the keys (belonging to the orectic sphere). The perceptual intention changes in character. From a simple grasping of what appears, it becomes interested, inspective, and selective, and is accompanied by presentifications (*Vergegenwärtigungen*) not only of the car keys but also of the places where one has been at home. When the keys are finally found somewhere in the home, perception does not merely experience the moment of its fulfillment, with the reinforcement of belief. This fulfillment has a retroactive effect on the thymic sphere, ending anxiety through relief, and on the orectic sphere, ending desire through satisfaction.[16]

[16] I use *thymos*, with a Platonic resonance, for what Husserl designates as the sphere of the *Gemüt*. On the other hand, for the *Willenssphäre*, I use the broader Aristotelian term *orexis*, since the will is a desire that has passed into the sphere of the "I can" (*Ich kann*) and from there into the sphere of "I do" (*Ich tue*).

In a nutshell, the perceptual core with its *E, P* composition remains intact. Yet, its structural boundaries prove essentially porous to these transient thymic and orectic connective elements and positions. Ultimately, we could say that all conscious life is a single whole whose structural backbone is a unique temporal *Morphé*, governing an intricate network of sub- and sub-*morphai* that, through the $\Phi$ function, continuously generate sub-wholes.

**5. Anatomy of Wholes: Analyzable versus Non-Analyzable**

Given that in CEM we proceed from parts to the whole by composition, it is a trivial truth that:

1. Wholes can be analyzed into their elements.
2. Proper parts are always identifiable.
3. Proper parts are always distinguishable from all others.
4. Wholes can, in principle, be denumerable, even if, for practical reasons, they are not (e.g., all cats, all stars in the universe).

Moreover, given the "ontological innocence" of a summative whole (${}^{s}W$), it follows that if a given spacetime slice forms an ${}^{s}W$, every entity contained within that slice is a proper part of it. For a morphological whole (${}^{m}W$), this is not the case. For example, if a given automobile is a summative whole (${}^{s}W$), then everything contained within it is a proper part of the ${}^{s}W$, even a suitcase in the trunk or a pair of sunglasses in the glove compartment. By contrast, for a ${}^{m}W$, if the whole is the car, the sunglasses and suitcase are not proper parts of it. This selectivity is incompatible with wholes formed from arbitrary parts, but perfectly understandable when defining wholes based on a network of connections, $E$, and positions, $P$, in which the function $\Phi$ selectively maps the proper parts of that whole. Now, imagine the car loses a wheel. From the perspective of mereological essentialism, this is a completely new whole. From the holomereological perspective, though, it is the same whole, but defective—it lost a part.

Another difference that will be discussed in detail now is the following: the principle of analyzability, stated in 1. above, along with principles 2. and 3., following from it, appears to be a truth whose contrary entails a contradiction. In fact, a whole without its own analyzable, identifiable, and distinguishable proper parts seems to be a *contradictio in adjecto*.

All the cases of ${}^{m}W$ we have mentioned so far satisfy the three principles, which apply to both exact (${}^{m}W^{E}$) and inexact (${}^{m}W^{NE}$) morphological wholes.

At first glance it must be so, because the notion of a "whole without parts" appears to be a blatant logical contradiction. However, when approached purely conceptually, this apparent

oxymoron is revealed in a new light as the supreme limit case of holomereological formal ontology. To grasp this, one could invoke a historical forerunner: Leibniz's genial insight into what he calls the “monad”, an indivisible totality possessing internal structure and complexity that goes to infinity and yet remains devoid of parts.

I designate this limit case of radical holism as the Monadic Whole (${}^{m}W_{NA}$). It represents a structural climax in which there is internal complexity, but no analyzability, thus no identifiability and no distinguishability into proper parts that could be conceived in isolation—whether as Husserlian independent pieces (*Stücke*) or as dependent moments (*Momente*). Indeed, unlike color and extension, which, as mutually dependent moments, are inseparable but remain conceptually abstractable, the internal differentiation of the Monadic Whole is defined by its absolute non-separability.

Regarding an Analyzable Whole (${}^{m}W_{A}$), its *Morphé* ($\mathfrak{M}$) is defined by a set of connective nexuses ($E$) that strictly generates a domain of discrete structural positions ($p_1, p_2, \dots, p_n$), open to distributive filling. In contrast, while the architectural matrix of the Monadic Whole preserves a highly complex internal dynamic of nexuses ($E$), these connective nexuses fail to generate a separable set of different positional valencies. Instead, the connective structure dictates a single, indivisible global position ($p_\Omega$):

$$\mathfrak{M}_{NA} = \langle E, p_\Omega \rangle$$

Consequently, the distributive filling operator gives way to a *holistic* filling operator ($\Phi_{hol}$). Since the matrix lacks discrete positions to anchor distinct proper parts, the structural demand dictates that a single, impartible entity ($x$) must fill the global position ($p_\Omega$). This case is formally defined by the strict impossibility of any mereological decomposition of the filling object:

$$\Phi_{hol}(x, p_\Omega) \rightarrow \neg\exists y PP(y, x)$$

Only after eidetically establishing this pure limit case of a non-analyzable morphological whole can we invoke examples illustrating it.

Quantum entanglement is a clear example of this—not as an ontological statement about physical reality (I set aside all debates regarding interpretations of quantum formalism), but strictly as proof of the *conceivability* of a monadic whole, utilized in the deepest realm of our natural sciences. To see how this limit case is mathematically operationalized, we need only look at the way quantum mechanics treats state vectors. A separable (analyzable) system is represented by a state vector that can be factored into the tensor product of its subsystems, such as $|\psi_{AB}\rangle = |\psi_A\rangle \otimes |\psi_B\rangle$. However, a pure entangled state—such as the Bell state $|\Phi^+\rangle =$

$\frac{1}{\sqrt{2}}(|00\rangle + |11\rangle)$—is defined precisely by the strict impossibility of factorization.[17] There are no individual state vectors for subsystems A and B that, when multiplied, yield the global state. Mathematically, the subsystems lack any isolated definability. The formalism thus proves that a complex, highly structured object can be conceived and operated upon without being resolvable into analyzable parts. It acts exactly as the Monadic Whole I am proposing as a limit case: a *Morphé* whose filling belongs entirely to the indivisible wholeness, not to a multiplicity of discrete positions.

A parallel instance of this monadic structure is found in the wave function. If we consider the state of a particle beam, defined by a state vector, $|\psi\rangle$, it does not comprise an aggregate of definite physical "proper parts" possessing distinct, localized positions or momenta. Instead, when expanded on a continuous basis—such as the position representation, $|x\rangle$—it encodes only a continuous distribution of probability amplitudes, $\psi(x) = \langle x|\psi\rangle$. This superposition integral, $|\psi\rangle = \int \psi(x)|x\rangle\, dx$, operates in a Hilbert space and cannot be equated to a mereological sum of independent spatial or kinematic pieces. As a result, the wave function cannot be sliced into discrete localized entities; the observables exist only as structurally bound potentialities within an undivided mathematical object. It also exemplifies the Monadic Whole I am proposing as a limit case of radical holism.[18]

While the pure formalism of quantum mechanics provides examples of Exact, Non-Analyzable Wholes, some contemporary applications of quantum probability to human psychology could be classified as Inexact, Non-Analyzable Wholes. In *Quantum Models of Cognition and Decision* (Busemeyer & Bruza, 2012, 2025), cognitive and decision-making states are modeled not as classical Boolean aggregates of independent variables, but as quantum-like superpositions. A decision-making state, for instance, functions as an indivisible systemic node that resists classical mereological factorization: it is accounted for as a "superposition," for which quantum probabilities are better suited for calculating the outcomes. When the superposition state "collapses," the actualization of a choice—say, option A—automatically rules out the opposite option, B. In other words, the "collapse" represents the transition from a non-analyzable totality into an entanglement-free, discrete state of A and not-B.

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[17] While the singlet state ($|\Psi^-\rangle$) serves as a paradigmatic example, this structural non-factorizability applies equally to all four maximally entangled states of the Bell basis ($|\Phi^\pm\rangle$ and $|\Psi^\pm\rangle$). None of these states can be decomposed into a simple tensor product of independent local states. In my holomereological terms, what happens here is that the specific Connective Nexus ($E$) corresponding to the cases of entanglement forbids their reduction to a classical extensional sum, thus characterizing them all, in my purely eidetic taxonomy, as Morphological, Exact, Monadic Wholes.

[18] I am grateful to Professor xxxxxxxxx from the XXXXXXXXXXXX (University of XXXXX) for verifying the correctness of the formalism and, furthermore, for pointing out that the exact, non-analyzable morphological whole bears a more than accidental similarity to the concept of *irreducible representation* ("irrep") in Group Theory.

However, because this cognitive matrix operates within the empirical realm of human psychology, it stands as an inexact monadic structure—an undivided core of subjective states continuously tolerating a fringe of contingent, real fluctuations and interconnections with the whole of mental life. I have characterized these latter as the intersecting variable $E, P$ pairs of the *Morphé.* As in quantum physics, I am not committing myself to claims about the real constitution of the mind, but merely intending to show that this is a concrete *example* of *possible structures* of non-exact, non-analyzable wholes establishable by eidetic analysis.

In conclusion, the difference between these two ontological realms rests definitively on the generative capacity of the Connective Nexus ($E$). For the Analyzable Whole, the structural rules demand a set of positions with a cardinality strictly greater than one ($|P| > 1$), ensuring the existence of distinct, separable loci ($p_i \neq p_j$) that allow for a distributive mereological filling. Inversely, the Monadic Whole characterizes the absolute limit where the connective complexity resolves into a strict positional singularity, $|P| = 1$, hence $P = \{p_\Omega\}$. This formal syntax clearly mirrors the former eidetic limit possibility: without generating multiple positional "slots," any attempt at mereological factorization of the whole is structurally prevented.[19]

Thus, my analysis of the morphological whole yields the following fourfold categorization regarding their kinds (exact versus inexact boundaries) and their anatomy (analyzable versus non-analyzable internal structures):

- ${}^{m}W_{A}^{E}$ *(Exact, Analyzable Morphological Whole):* A strict connective structure with closed, rigid boundaries generating a positional domain of distinct loci ($|P| > 1$). This matrix allows for the distributive filling of identifiable and distinguishable proper parts (e.g., an alphabet, an equation, a chemical solution).
- ${}^{m}W_{NA}^{E}$ *(Exact, Non-Analyzable Morphological Whole):* A monadic structure with closed boundaries but an absolute positional singularity ($|P| = 1$). It demands a holistic filling

[19] On this subject, it is interesting to consider an attempt at a taxonomy based on CEM in Näger and Strobach (2025). Cross-referencing the object models available in CEM (parts only, the whole only, or both) with the analysis of properties using the *lambda* operator, the authors conclude that there are exactly six distinct, exhaustive models: 1. Parsimonious Relational Holism: Only micro-objects (parts) exist; the entangled property is a fundamental binary/n-ary relation between them; 2. Rich Relational Holism: Both the parts and the whole exist (the whole is the mereological sum of the parts); the entangled property remains a fundamental relation between the parts; 3. Parsimonious Monistic Holism: The two-particle object (whole) exists as a whole without parts (undivided); therefore, micro-parts do not exist; the entangled property is a unary property of the whole; 4. Rich Monistic Holism: The parts and the whole exist; the entangled property is a unary property exclusive to the whole; 5. Parsimonious Pluralistic Holism: Only the parts exist; the entanglement property is a "plural unary" property collectively carried by the parts (using plural logic); 6. Rich Pluralistic Holism: The parts and the whole exist; the entangled property is a plural unary property collectively carried by the parts (Näger & Strobach, 2025, pp. 408–409). Needless to say, their taxonomic attempt is not fully conclusive. Their Parsimonious Monistic Holism is the one that most closely resembles the model I am proposing. Another extremely interesting article attempting to find a way out of CEM's limitations is Smith and Brogaard (2002).

($\Phi_{hol}$) that strictly forbids mereological decomposition or the isolation of proper parts (e.g., pure quantum entangled states, the wave function).

- ${}^{m}W_{A}^{NE}$ *(Non-exact, Analyzable Morphological Whole):* A cohesive internal core of discrete positional valencies ($|P| > 1$) whose structural boundaries are essentially porous. It constitutively accommodates a shifting periphery of intersecting connections with other *morphai* without losing its own (e.g., a biological organism, a legal system, conscious life).
- ${}^{m}W_{NA}^{NE}$ *(Non-exact, Non-Analyzable Morphological Whole):* An undivided, impartible systemic core ($|P| = 1$) that operates within a fluid realm. It resists mereological factorization while continuously tolerating a fringe of contingent, real fluctuations and intersections with the environment (e.g., supposed state superpositions in the stream of mental life).

**6. Parts, from the Point of View of the Whole: Filling and Foundation.**

The *morphai* we have brought to light are formal structures, simple eidetic singularities. As pure idealities (conceivable structural types), they are not yet the "whole" as such. This requires an operation of filling, which Husserl designates *Ausfüllung* (Husserl 1977: p. 32).

Filling is not a process of specification. Specification operates as the exact inverse of generalization, descending from the supreme material region down to the lowest species (*infima species*) and, ultimately, to the *tode ti* (for a concise yet precise presentation, see de Santis 2025). This descending process is an operation of adding successive, increasingly detailed material determinations that finally converge on the individual: the "this there."

This stands in stark contrast to formalization, where there are no (material) species and genera up to the formal region *objectum qua tale* (*Überhaupt*). Formal unities are themselves not genera but *infimae species* regarding their "concretization." The inverse of formalization is de-formalization (*Entformalisierung*). It is not a specification, but a filling of empty positions (*Leerstellen*). As Husserl states: "Filling in logical empty forms (and there is nothing other than empty forms in the *mathesis universalis*) is, therefore, a completely different "operation" from true specification leading to the final differentiation" (Husserl 1977: p. 32). This very filling gives rise, for the first time, to an *individual* whole that stands as an absolute concrete (*absolute Konkretum*: Husserl 1984: p. 274) in the sense of the independence (*Selbstständigkeit*) presented in the *Third Logical Investigation,* and more clearly in *Ideen I,* as an *Individuum*

(Husserl 1977: p. 35), even if such a concrete whole may still exhibit regional dependence, by belonging to a material region founded upon a more fundamental one

Yet what was said about "filling" is not a complete characterization or the best-suited account of the special case of wholes. Drawing the concept of *Ausfüllung* from formal apophantics—where a syntactic form is filled through a subjective judicative act—carries a specific risk. It might lead to the erroneous assumption that the filling of a morphological whole is inherently a constructive achievement of the subject, as if wholes were merely cognitive assemblages generated by our acts of *Ausfüllung* as *Entformalisierung*. From the standpoint of formal ontology, this is strictly not the case. We do not *create* a real whole by actively subsuming parts under a formal category. Rather, we *recognize* the whole as something already given. Just as we apprehend a specific trait of a concrete object by applying the formal category of "property" without thereby creating the object's property itself, the morphological whole is apprehended as a mind-independent unity. Even within the realm of *apophansis*, once a judicative act is performed, the resulting concrete judgment stands as an ideal object, intersubjectively available—it is no longer referred to an act of judgment but simply recognized as something given to any other subject. Therefore, in the context of morphological wholes (and elsewhere), filling operates as an objective ontological *recognition*, not a subjective construction (I set aside, as I already pointed out, the transcendental issue of *constitution*).

Consequently, I will not say that someone "deformalizes" an empty place in the *Morphé*, but that, *in a given whole*, a certain part *fills* a position *P* determined by a bundle of connections $e_1, \dots e_n$.

Now, as a general thesis requiring further elaboration, I state: *Like* summative wholes, what gives *concreteness* to morphological wholes are their parts; however, *unlike* summative wholes, what gives *identity* to a morphological whole is the *complete* system $\langle E, P \rangle$ that constitutes it.

A crucial distinction must be drawn regarding inexact wholes. If the identity of a morphological whole were exclusively exhausted by its core formal system $\langle E, P \rangle$, two distinct entities sharing, *ex hypothesi*, the same structural type would collapse into numerical identity. To prevent this, we must recognize two distinct dimensions of the *concrete* whole. First, it requires a principle of *individuation*. Spatio-temporal determination is the fundamental form of individuation grounding the *tode ti* (the "this-there"). It is the spatio-temporal position that ensures two wholes sharing the same characteristics remain numerically distinct. Second, filling (*Ausfüllung*) in inexact wholes inevitably brings forth accompanying parts or contingent determinations (*symbebekota*), i.e., sets of positions and connections that are there, do not

belong to the *morphé*'s core but do not destroy it either.[20] These elements are not prescribed by the core system $\langle E, P \rangle$. Yet they are prescribed by the very definition of *inexactness*: they accompany the whole, providing its characteristic material density, empirical noise, and structural porosity, that is, variableness. However, these mere contingent accompaniments (*symbebekota*) must be strictly distinguished from the active periphery of the whole (such as metabolic intersections in a living organism). While metabolism pertains to the essential structural porosity and dynamic boundary of the *morphé* itself, the *symbebekota* are merely external, transient variables that form a purely summative whole with the core

The other case needing elaboration is that of exact, non-analyzable morphological wholes (such as a quantum wave function or entangled particles). There, classical spatio-temporal individuation breaks down due to non-locality, and the whole lacks accompanying *symbebekota*, by definition of its exactness. In such extreme formal cases, we must tentatively state that numerical difference is either grounded in topological state spaces (e.g., Hilbert space), or, returning to the macroscopic world, indexed to the specific event of the system's physical preparation. However, the question remains open to theoretical refinement.

Thus, I will rephrase my former thesis. While the strict identity of a morphological whole across time and change is guaranteed exclusively by its core formal system ${}^{m}W^{NE}$, the concrete individuation of this whole requires something more: its spatio-temporal *principium individuationis* (which ensures its numerical persistence as *this* historical entity). As for the *symbebekota*, they do not define the whole's identity nor its individuation; they are merely contingent material accompaniments—the empirical noise of contingence—that the concrete whole temporarily hosts. They can fluctuate or be entirely replaced without the whole ceasing to be itself

Excluding this last case and viewing the parts from the perspective of the whole, two notable properties must be brought to light. First, *substitutability*; second, *capture* or constraint.

I define *substitutability* as follows: Each part of a whole functions as a determinate position ("vertex") in a network of connecting links ("edges"), and thereby it can always be *replaced* by another part, numerically distinct, that fulfills *exactly* the same function.

In formal terms:

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[20] I intentionally use the Aristotelean term *symbebekos* (literally, "that which comes with," "companion") so that I can refer collectively to elements that merely form a summative whole with a *morphé*—such as, for example, a person wearing a necklace or a car with a picture on its dashboard. From the perspective of graph theory, the *morphé* $\langle E, P \rangle$ is the necessary core graph, while these *symbebekota* function as additional, contingent vertices and edges that belong only to the *concrete* whole without individuating it. They can appear and disappear without altering the *core identity* of the *morphé* itself.

$$\forall x[(\Phi(p) = x \wedge x \ll^m W) \rightarrow \Diamond\exists x'(x' \neq x \wedge \Phi(p) = x' \wedge x' \ll^m W)]$$

For any part $x$, if $x$ fills position $p$ and is a proper part of the whole ${}^mW$, it is possible ($\Diamond$) that there exists an $x'$ such that $x'$ is numerically distinct from $x$ ($x' \neq x$), and $x'$ exactly fills that same position $p$, becoming a proper part of ${}^mW$.

This is a common phenomenon in multicellular organisms, which renew themselves almost entirely throughout their lives, without becoming a new organism each time. However, this extends to any type of morphological whole (except exact, non-analyzable wholes). Even with *total* substitution, it remains the *same* whole if and only if the *morphé* has remained actual and unchanged throughout the process.

Regarding *capture* or constraint, I define it as follows: a part *x*, as a member of a whole, loses the degrees of freedom it would have had if it were not embedded in the whole.

Formally:

$$\forall x\left[(\Phi(p) = x \wedge x \ll^m W) \rightarrow \exists\phi\left(\Diamond\phi(x) \wedge \Box\big(x \ll^m W \rightarrow \neg\Diamond\phi(x)\big)\right)\right]$$

For any part $x$, if $x$ fills position $p$ and is a proper part of the whole ${}^mW$, there exists at least one state or degree of freedom $\phi$ such that it is possible for $x$ to assume $\phi$ in principle ($\Diamond\phi(x)$); however, it is strictly necessary ($\Box$) that while $x$ remains a proper part of ${}^mW$, assuming state $\phi$ becomes impossible ($\neg\Diamond\phi(x)$).

For example, a free wheel can move in 3D space along the *x*, *y*, and *z* axes, and also rotate around each of them. However, when installed in a car, it can only move along the *z*-axis and rotate around the *x*-axis. In a cell, its constituents, if extracted, can enter into a range of combinations and reactions that are completely off-limits to them as members of the cell. Chemical bonds provide another blatant case (for a mereological approach to these cases, see Banchetti-Robino 2020). This happens even in logic. To return to the example of the universal affirmative sentence: "All men are mortal"—it can be converted ("Some mortals are men"), give rise to the subaltern ("Some men are mortal"), or enter into a myriad of logical and semantic connections with other sentences. However, when "trapped" in *Barbara's* syllogism, it is bound to the position of the major premise, and any modification of it would destroy the entire syllogistic structure of which it is a proper part.

Given these two properties, Theseus's ship is *always the same if the morphé remains actual and the same*, even undergoing a complete replacement, piece by piece. We can speak of a *renewed* Theseus's ship, but not of a "new" one. Conversely, when Hobbes's scavenger hammers the last nail into the ship he has been building from the old parts of Theseus's ship, he is creating a *new* ship, which begins to exist at that very moment and *is not* Theseus's ship.

I conclude this section by invoking two famous theses by Aristotle and a genial insight from Kant.

Aristotle famously stated that a hand separated from the body is a hand only by homonymy (Aristotle 1831: 1253a20–25). This holds true for any part. When separated, it ceases to fulfill its function *as a part* and becomes a thing alongside other things. Thus, a gear is a gear only as long as it is part of the clock's mechanism. Outside it, it is a simple piece of iron with teeth that could be anything else (including re-entering the clock *qua* gear wheel). Furthermore, Aristotle strangely—yet accurately—argued that parts exist only in *dynamis* within the whole (Aristotle 1831: 1040b5–10). Once captured within the whole, they lose their own independent *energeia*; their *ergon* is now entirely at the service of the *entelecheia* of the whole. The whole is what truly is, not each of the separate parts—the being of the whole suppresses, thus, the full, independent being of its parts.

As for Kant, his brilliant insight that in a whole (which, for him, was restricted exclusively to organic ones) each part maintains a *primary* and *fundamental* relationship with the whole itself (Kant 1913 AA 5:373) is precisely the insight that opens the door to the concept of *Foundation*.

**7. Foundation.**

Peter Simons magnificently resurrected and formalized Husserl's concept of *foundation* presented in the *Third Logical Investigation* (Simons, 1982, 1987).[21] His work remains a benchmark, particularly in the decisive step of recognizing that relations of dependence and independence cannot be treated as purely mereological, and in introducing modal logic for the corresponding relations of foundation (Simons 1982). In what follows, looking directly at the *Third Logical Investigation* with a focus on the concept of foundation, I do not intend to go beyond Peter Simons, but to draw attention to some points that seem crucial to me.

I. The first is a *double sense in the concept of foundation* as Husserl uses it. Indeed, for him, there is a unilateral foundation when a part depends on another that does not depend on

[21] It would be a profound injustice to mention Peter Simons's pioneering work without concurrently acknowledging the equally crucial contributions of Kevin Mulligan and Barry Smith. Together, they largely resurrected Husserl's *Third Logical Investigation* and demonstrated its paramount importance for contemporary formal ontology. This collective revival was decisively marked by the publication of the landmark volume *Parts and Moments: Studies in Logic and Formal Ontology* (Smith [ed.] 1982), which included their seminal joint paper, "Pieces of a Theory" (Mulligan, Simons, and Smith 1982). If I mention almost exclusively on Simons's contribution in this section, it is solely because my present concern is strictly limited to the detailed formalization of the concept of Foundation (*Fundierung*), which he specifically and extensively systematized in his subsequent work.

the former. The second case is multilateral dependance. Metaphorically, the second sense acts as a "horizontal" relationship among parts residing on the same ontological stratum, while the first operates as a "vertical" dependency building across strata.

On closer inspection, though, the two founding relationships possess fundamentally different logical characteristics, while having an identical departing core. Let us designate them as ${}^{u}\mathfrak{F}$ for unilateral foundation and ${}^{m}\mathfrak{F}$ for multilateral foundation.

From a formal logic perspective, defining a foundation concept that is simultaneously irreflexive (nothing founds itself[22]), transitive, and symmetric presents a classic mathematical paradox. In standard relation theory, if a relation is symmetric and transitive, it necessarily entails reflexivity ($R(x,y) \wedge R(y,x) \supset R(x,x)$).

To formalize *foundation* rigorously—respecting the Husserlian ontological framework without collapsing into logical contradiction—careful distinctions must be made. Following *Ideas I*, eidetic *necessity* does not belong to the relations of essence *per se*, but to the individuals that instantiate them. Therefore, the formalization must distinguish between the structural relation at the level of pure species ($\alpha, \beta$) and the modal necessity at the level of individual instances ($x, y$). Furthermore, to avoid *de dicto* formulations, a possibility that Peter Simons takes into account (Simons 1982: 118), necessity will be treated as a *de re* operator (E-Nec) intrinsically qualifying the existence of the dependent individual.

The formalization unfolds in two consecutive levels, followed by the bifurcation of the foundation concept:

*A. The Two Levels of the Foundation Relation*

The generic relation of foundation ($\mathfrak{F}$) operates as a primitive structural law at the level of essences or "species," which subsequently determines the modal necessity at the level of instantiation.

Among pure species, foundation is a primitive, *a priori* formal-ontological relation. To state that species $\alpha$ is founded upon species $\beta$ is to state a pure eidetic law:

$$\mathfrak{F}(\alpha, \beta)$$

When these species are instantiated, the pure eidetic law imposes a *de re* necessity upon the corresponding individuals. If $x$ is an instance of $\alpha$, its existence strictly demands the existence of the *corresponding* individual $y$, i.e., as Simons pointed out, the instance of $\beta$ that fits *x*, and not whatever instance of *β:*

[22] The only notable exception to this rule of irreflexivity that comes to my mind would be Descartes' God, who, being a substance that *nulla alia re indigeat ad existendum*, violates this axiom to found His own existence, and subsequently that of all *res creatae*. *Existentia per se* and *causa sui* are the Cartesian concepts for the abyssal unconditionality of Being.

$$\mathfrak{F}(x, y) \equiv E(x) \supset \text{E-Nec } E(y) \wedge (x \neq y)^{23}$$

If $x$ exists, it entails that it is intrinsically required a distinct, corresponding $y$ that possesses the *de re* property of being eidetically necessary to exist. The condition $x \neq y$ strictly guarantees irreflexivity.

*B. The Bifurcation: Multilateral vs. Unilateral Foundation*

From this generic ontological core, the concept of foundation bifurcates into two distinct logical structures,

Multilateral / Symmetric Foundation *(*$^{m}\mathfrak{F}$*)*:

$$^{m}\mathfrak{F}(\alpha, \beta) \equiv \mathfrak{F}(\alpha, \beta) \wedge \mathfrak{F}(\beta, \alpha)$$

Species $\alpha$ requires the completion of species $\beta$, and $\beta$ requires the completion of $\alpha$ (e.g., the mutually dependent species of “surface”, “color”, and “boundary” in perceptual space).

This “horizontal” relation can be more than bilateral. It extends to more than two elements, as in the Husserlian example I reshaped above. So, it is inevitable a logical resolution for $n > 2$ elements. To account for this multi-partite mutual dependence without falling into the paradox of self-foundation ($\mathfrak{F}(\alpha, \alpha)$), multilateral foundation should employ *weak transitivity* (restricted to non-identical terms). Transitivity successfully propagates across multiple mutually dependent parts, provided the initial and final species are distinct:

$$^{m}\mathfrak{F}(\alpha, \beta) \wedge {}^{m}\mathfrak{F}(\beta, \gamma) \wedge (\alpha \neq \gamma) \supset {}^{m}\mathfrak{F}(\alpha, \gamma)$$

This logically accommodates horizontal, co-dependent parts without violating irreflexivity.

Unilateral / Asymmetric Foundation ($^{u}\mathfrak{F}$):

$$^{u}\mathfrak{F}(\alpha, \beta) \equiv \mathfrak{F}(\alpha, \beta) \wedge \neg\mathfrak{F}(\beta, \alpha)$$

The species $\alpha$ requires the completion of species $\beta$, but $\beta$ can perfectly be without $\alpha$ (e.g., the species “evaluating act” is unilaterally founded upon the species “objectifying act”).

As a remarkable structural feature, unlike its multilateral counterpart, unilateral foundation is intrinsically and unrestrictedly transitive:

$$^{u}\mathfrak{F}(\alpha, \beta) \wedge {}^{u}\mathfrak{F}(\beta, \gamma) \supset {}^{u}\mathfrak{F}(\alpha, \gamma)$$

This asymmetric, irreflexive, and transitive relation constitutes the authentic engine of architectural stratification, allowing complex ontological layers to be erected structurally from the bottom up.

II. *Multilateral dependence must be highlighted,* and Husserl’s examples disambiguated.

Husserl’s canonical examples of mutually dependent parts (*Momente*)—such as color and surface, or the pitch and intensity of a sound—are historically and theoretically indebted to Carl

[23] At this generic level, the relation is strictly a single vector of dependency; it remains entirely indeterminate as to whether *y* reciprocally requires *x*.

Stumpf's *Tonpsychologie*. Consequently, they operate entirely within the psychic sphere, describing the immanent contents of perception. However, a persistent ambiguity arises in the subsequent mereological literature when these perceptual moments are treated as if they were objective material properties. Treating "surface" (a primary, geometric quality of the region *material thing*) and "color" (a consciousness's "primary content" or "hyletic *datum*) as mutually dependent parts of the same ontological level creates an unviable hybrid, mixing entities from different ontological regions.

This connects to another point I have already touched on: that the dependence can be multilateral, involving more than two elements. Husserl's own example suggests this: the unity of mutual dependence between surface and color implies a third dependent element that constitutes the field of spatial perception—the boundary (Husserl refers to "*Figur*" in 1984: p. 234). Thus, in Husserlian terms, one would have to say that color, surface, and boundary, or figure, form a trio of mutually dependent parts.

However, confining examples to the "psychological" sphere is limiting, given that the foundation relations—whether mutual or unilateral—have a universal scope as categories of formal ontology. Let us, thus, conclude with a purely physical example.

Consider the objective physical structure of a mechanical wave (see Figure 2). If we strip away the psychological phenomena of "sound" or "pitch," a physical wave (whether acoustic or not) presents a far more intricate foundational topology:

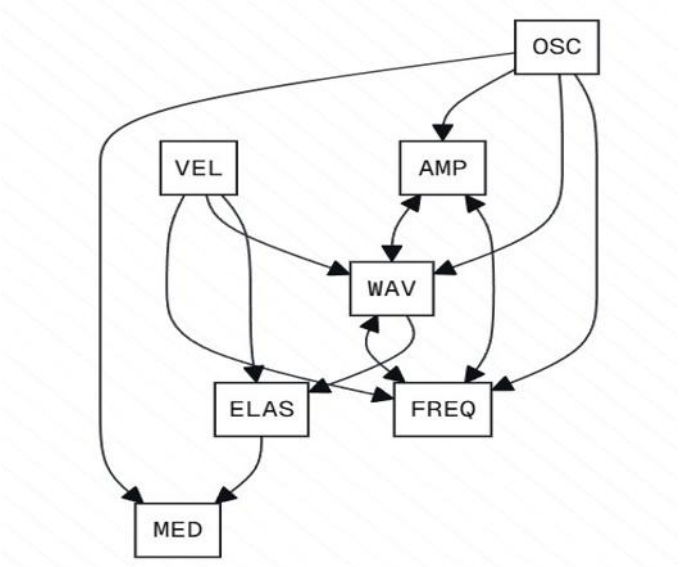



Figure 2: Foundational topology of a mechanical wave. (OSC = Oscillator; MED = Physical Medium; AMP = Amplitude; WAV = Wavelength; FREQ = Frequency; VEL = Velocity; ELAS = Elasticity. Lines with double arrows (↔) indicate multilateral/mutual dependence (^m F); lines with a single arrow (→) indicate unilateral dependence (^u F)).

The entire macro-system is anchored by the *Oscillator* (the driving source), which requires the *Physical Medium* to operate ($^{u}\mathfrak{F}$), and in turn unilaterally founds the core of the waveform. At this core, the wave demands a multilateral mutual foundation: Amplitude, Wavelength, and Frequency form an irreducible triad. A mechanical wave cannot exist if any one of these three moments is zero; they mutually require one another ($^{m}\mathfrak{F}$) to instantiate the morphological whole. Furthermore, from the relations within this core, a new dependent part emerges: *Velocity*. Velocity is not an independent piece added to the wave; it is systemically founded upon both frequency and wavelength ($^{u}\mathfrak{F}$). Finally, this entire morphological structure exhibits a unilateral material foundation. Both velocity and wavelength are unilaterally dependent on the *Elasticity* of the medium, which in turn is unilaterally founded upon the *Physical Medium* itself (the overarching body, such as air or water).

What this physical graph at last demonstrates is that the whole is not merely the sum of horizontal or vertical dependency relations among parts. The *wave,* i.e., the *whole qua tale,* is the *morphological unity* ($\mathfrak{M}$) supporting this entire exact topology.

III. Husserl was fully aware of  of "wholes" formed through the mere arbitrary operation of bringing things together. He named them *Inbegriffe*, which are identical to what I called summative wholes. He does not consider them as a *genuine case* of whole (*Ganz*).[24] Husserl's profound originality in the *Third Logical Investigation* lay in discovering an ontological "weld" between parts through the concepts of unilateral and multilateral dependence, giving rise to the concept of *Fundierung*. By demonstrating that certain parts (*Momente*) strictly require others to exist, Husserl successfully avoided the infinite regress famously formulated by F. H. Bradley. Indeed, Husserl expressly refuted treating the "moment of unity" (his second concept of whole) as an independent part. As he argues in § 22 (pp. 286–287), if the unity binding parts $a$ and $b$ together were treated as an additional part ($\epsilon$), it would require a new moment of unity ($\epsilon_1$) to bind it to the others, *ad infinitum*. This precise Husserlian insight definitively dismantles Kathrin Koslicki's recent attempt to treat structure as a "formal proper part"—a theoretical move that unwittingly resurrects the very logical regress Husserl (and Bradley) had already neutralized.

While this diagnosis correctly avoids Bradley's regress, Husserl adopted a somewhat "reductionistic" view of wholes. Indeed, for him, a whole in full and proper sense (Husserl 1984: p. 289) is entirely exhausted by these unilateral and multilateral foundation relations. The word "whole" becomes an innocuous label for the internal welding of parts (Husserl 1984: p. 281).

[24] Kit Fine states that "It is not clear to me whether Husserl would have accepted the existence of arbitrary sums" (Fine 1995: p. 471). With regard to *existence*, the doubt is quite legitimate, because Husserl states that *Inbegriff* "is the expression for a categorial unity corresponding to the mere "form" of thinking, [...] a certain *unity of intending* [...]" (Husserl, 1984: p. 289). "Artificial" sums, which Kit Fine refers to in the same paragraph, have no existence outside the very act of bringing them into unity, so they cannot be treated as *transcendent* unities.

Consequently, for Husserl, the whole is merely a bottom-up resultant—it is nothing more than the network of its dependencies.

Here, my proposal must partially part ways with Husserl. If we restrict the concept of foundation exclusively to an internal network (part A depends on part B), the whole vanishes into a mere web of connections. The whole is not simply the aggregate of the modal dependence relations between its parts. Rather, as I have argued, it is the overarching morphological unity ($\mathfrak{M}$) that assigns to these elements their very status as parts in the first place. Indeed, $a$ and $b$ can form a whole if they are dependent moments (*Momente*) that mutually penetrate (*durchdringen)*; $c$ and $d$ can, if they are pieces (*Stücke*), existing apart from each other (*ausser einander*) they form a whole through connection (*Verbindung, Verknüpfung*—a concept in which Husserl comes close to the $E_1 \ldots E_n$ network I presented: see Husserl 1984: p. 282). However, the "pieces" must be linked in a closed rather than an open manner, as Husserl tends to view it, to form an effective whole with internal connections. Moreover, a simple amalgam of "moments" and "pieces," the latter with their respective dependent parts, is not a whole in the authentic sense because it lacks closure and internal coherence. For them to truly be parts of a whole, they must have a global relationship of relative dependence, and this relativity of global dependence pertains to the structural matrix that ensures each element is precisely a part. As I have said, contrary to Husserl, a piece (a horse's head, a gear) is not the same when separated from the whole *as when embedded within* it. This overall dependence of the parts, pieces, and moments, as parts of a whole, is precisely the law that determines their total subordination to the structural matrix I have designated as *Morphé* ($\mathfrak{M}$).

Where, then, is the whole, if it is irreducible to Husserl's foundational web and cannot be exhibited as a Koslickian "formal *part*"? The whole is "visible" and ontologically operative because it stands as the exclusive logical subject of properties and predications that cannot—without committing the logical fallacy of division—be distributed among its parts.

Consider an airplane. It is the airplane, *qua* morphological whole, that possesses the property of flying. This top property is strictly non-distributive. The wings do not fly; they provide lift. The engines do not fly; they provide thrust. Or, to take a formal case. In topology, a closed curve possesses the global property of being knotted; no individual segment of the curve is knotted, as it is merely a linear arc. Or, to take a systemic and spatial case to finish my examples, consider a closed road network structured as a biconnected graph, where any two intersections are linked by at least two independent pathways. It is the network, *qua* morphological whole, that possesses the global property of systemic resilience and topological redundancy. This top property is strictly non-distributive: no individual road segment is resilient or capable of providing alternative routes on its own.

Similar cases appear in all fields of regional ontologies. Therefore, parts only possess these functional roles and properties exclusively by virtue of and for the sake of the whole. Consequently, a part is not merely founded upon another part; fundamentally, every part is founded upon the encompassing structural matrix of the whole itself. This is how we could give clear meaning to the old, sibylline saying that the whole is "greater" than the sum of its parts. Indeed, it is this ultimate *architectural foundation* (${}^{a}\mathfrak{F}$)—where the matrix ($\mathfrak{M}$) prescribes the positional connections of the parts while acting, *when filled*, as the sole *concrete, individual* bearer of top-level properties—that definitively bridges the gap between a mere network of dependent pieces and moments and a genuine, unified being.

Formally, this *Architectural Foundation* can be defined as follows:

$$ {}^{a}\mathfrak{F}(x, \mathfrak{M}) \equiv x \ll {}^{m}W \supset \text{E-Nec}(\mathfrak{M} \wedge \Phi(p) = x) $$

This formula states that for any material entity $x$ to be a proper part ($\ll$) of a morphological whole (${}^{m}W$), it is eidetically necessary (E-Nec) that the architectural *morphé* ($\mathfrak{M}$) exists and that the filling function ($\Phi$) maps $x$ into a specific structural position ($p$) prescribed by that very *morphé*. While $x$ might exist independently as a detached thing, its existence *as a part* is strictly founded upon the *morphé* that captures it.

Like unilateral foundation, Architectural Foundation ($a\mathfrak{F}$) establishes a strict partial ordering. It is irreflexive:

$$ \neg {}^{a}\mathfrak{F}(\mathfrak{M}, \mathfrak{M}) $$

asymmetric:

$$ {}^{a}\mathfrak{F}(x, \mathfrak{M}) \supset \neg {}^{a}\mathfrak{F}(\mathfrak{M}, x) $$

and transitive:

$$ {}^{a}\mathfrak{F}(x, \mathfrak{M}_1) \wedge {}^{a}\mathfrak{F}(\mathfrak{M}_1, \mathfrak{M}_2) \supset {}^{a}\mathfrak{F}(x, \mathfrak{M}_2) $$

Furthermore, morphological wholes are not isolated entities. They can interact and scale dynamically through two fundamental mechanisms: fusion, where distinct wholes merge their matrices to generate an entirely new morphological product, and hierarchical subordination. In the latter case, a complete whole is embedded into a higher order *morphé* ($\mathfrak{M}$). Crucially, once subordinated, the nested whole assumes the definitive ontological status of a part within the encompassing macro-structure, immediately acquiring both positional substitutability and structural constraint.[25]

[25] In a formal ontology, there is no way to determine whether an architectural foundation operates by design or through the "blind mechanisms" of nature. Therefore, Aristotelian questions regarding whether a whole arises *kata physin* or *kata technen*, as well as the Kantian concept of a *Technik der Natur*, along with other contemporary debates, do not fall within the purely abstract purview of formal ontology. Arguably, all human artifacts are by design. But what about nests or beaver dams? Are they a result of nature? And could human artifacts not also be considered a result of nature in a broader sense? The moment a prokaryotic cell engulfed a bacterium, a new architectural *morphé* came

To conclude where I began, "parthood" is not a univocal concept. Parts can be (i) core parts, (ii) peripheral or transient parts (in inexact wholes), or (iii) mere accompaniments within summative contexts. In the first two cases, speaking of a part requires specifying the $E, P$ system of which it acts as the "filling." Outside of that encapsulation, it is no longer a *part* and has a different state space.

## 8. **Two concluding remarks.**

I draw two conclusive theses from the outline of holomereology presented here.

The first concerns Husserl's classical dichotomy between "exact" and "morphological" *essences*. In *Ideas I*, Husserl famously opposed the exact formal domain of mathematics and the "material" realm of geometry to the fluid character of consciousness, treating the latter as inherently "morphological," i.e., descriptive, because "vague" and "fluid" (Husserl 1977: pp. 154-156). Consequently, for Husserl, the exact and the morphological constitute mutually exclusive realms. However, the formal-ontological framework developed here reworks this opposition by radically redefining the scope of the morphological as concerned with *wholes* rather than *essences*. Instead of standing in opposition to the exact, the "morphological" is established here as the overarching *formal* category, which internally bifurcates into the exact ($^{m}W^{E}$) and the non-exact ($^{m}W^{NE}$). Consciousness is indeed morphological, but specifically as a non-exact morphological whole ($^{m}W^{NE}$), characterized by porous boundaries, transient intersections, and peripheral variability. Mathematics, on the other hand, is not a non-morphological realm; its systems are rigorously governed by a generative *Morphé*, rendering them exact morphological wholes ($^{m}W^{E}$). Thus, the exact and the morphological do not clash at the ontological formal level; exactitude is simply the condition of a morphological whole whose structural core admits no peripheral accretions.

The second remark concerns the status of Classical Extensional Mereology (CEM). Throughout this inquiry, the aim has never been to dismiss CEM or to patch it with *ad hoc,* internal restrictions to solve the Special Composition Question (SCQ). Instead, the goal has been to determine its exact systematic place. Once we propose Holomereology as the overarching formal ontology of wholes, CEM ceases to be the universal baseline of parthood and reveals its true nature: it is a *limit case* within a broader structural continuum.

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into being—the eukaryotic cell with its mitochondria—and this creation is indisputably a "work" of nature. However, as I said, these issues fall outside the scope of formal ontology.

If we take a morphological whole and completely subtract its structure—erasing the connective network ($E$), dissolving the positional constraints ($P$), and lifting the selective restrictions of the filling function ($\Phi$)—we reach a state of structural degree zero. In this absolute limit state of structural absence, composition becomes flat, ontologically cost-free, and unrestricted. This is precisely the domain of the purely Summative Whole (${}^{S}W$). CEM is therefore flawless, provided one recognizes its strict boundary: it is the supreme logic of the unstructured. To operate beyond this limit case, mereology requires a head. It requires the morphological architecture that Holomereology intends to provide.

If CEM were the *ultima ratio* regarding wholes and parts, its demand for a mereological equilibrium (where everything can be a part, and parthood is always the same) would mirror a reality in thermodynamic equilibrium, a state from which all structures vanished. Yet, in a universe reduced to thermodynamic equilibrium, no distinct entities would remain to be considered as parts, nor would a mind exist to forge a formal system as simple, elegant, and beautiful as CEM.

## Glossary of Symbols

### 1. Logical Connectives and Modal Operators

- $\neg$ : Negation (not)
- $\wedge$ : Conjunction (and)
- $\vee$ : Disjunction (or)
- $\rightarrow$ or $\supset$ : Material implication / Conditional
- $\leftrightarrow$ : Biconditional / Logical equivalence
- $\forall$ : Universal quantifier (for all)
- $\exists$ : Existential quantifier (there exists)
- $=$ : Numerical identity
- $\neq$ : Non-identity / Distinctness
- $\in$ : Set membership
- $\Box$ : Alethic necessity
- $\Diamond$ : Alethic possibility
- E-Nec : Eidetic necessity (de re modal operator qualifying the essential existential dependence of an individual)

### 2. Basic Mereological Relations

- $P(x, y)$ : Generic parthood ($x$ is a part of $y$)
- $PP(x, y)$ (or $\ll$) : Proper parthood ($x$ is a proper part of $y$)
- $Ox, y$ (or $\circ$) : Overlap ($x$ and $y$ share at least one common part)

### 3. Holomereological and Morphological Framework

- ${}^{s}W$ : Summative Whole (an arbitrary aggregate or extensional fusion, *Inbegriff*)
- ${}^{m}W$ : Morphological Whole (a structured whole governed by an intrinsic morphological matrix)
- ${}^{m}W^{E}$ : Exact Morphological Whole (tight, non-porous morphological structure)
- ${}^{m}W^{NE}$ : Non-exact (inexact) Morphological Whole (porous structure with a shifting periphery)
- ${}^{m}W_{A}^{E}$ : Exact, Analyzable Morphological Whole
- ${}^{m}W_{NA}^{E}$ : Exact, Non-Analyzable Morphological Whole (Monadic Whole)
- ${}^{m}W_{A}^{NE}$ : Non-exact, Analyzable Morphological Whole
- ${}^{m}W_{NA}^{NE}$ : Non-exact, Non-Analyzable Morphological Whole
- Core$(mW)$ : Core of a morphological whole (the set of elements necessary for its existence)
- ($\mathfrak{M}$): *Morphé* (the overarching structural matrix, comprising the core network of connections and positions)
- $E$ : Connective Nexus / Edges (generative structural relations linking positions)
- $P$ : Positions / Vertices (abstract structural slots within the network)
- $p_{\Omega}$ : Global single position (unitary positional valency in monadic wholes)

### 4. Functions and Mappings

- $\Phi$ : Filling function (mapping abstract structural positions to concrete material parts: $\Phi: P \rightarrow \{x_1, x_2, \ldots, x_n\}$)

- $\Phi_{hol}$ : Holistic filling operator (mapping a global, undivided position to an impartible entity in non-analyzable wholes)

**5. Foundation Relations ($\mathfrak{F}$ / $F$)**

- $F(\alpha, \beta)$ : Generic Foundation (pure a priori formal-ontological relation between species $\alpha$ and $\beta$)
- ${}^{u}\mathfrak{F}$ : Unilateral Foundation (asymmetric, irreflexive, and transitive dependence where $\alpha$ requires $\beta$, but not vice versa)
- ${}^{m}\mathfrak{F}$ : Multilateral Foundation (symmetric, interdependent relations where multiple elements mutually require one another)
- ${}^{a}\mathfrak{F}$ : Architectural Foundation (the structural matrix that prescribes positional connections and acts, when filled, as the sole bearer of top-level properties)

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