SYSTEMS THEORY and the METAPHYSICS OF COMPOSITION

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ABSTRACT

Ideas from systems theory – recursive unity and emergent attributes – are applied to the metaphysical and meta-metaphysical debates about the ontological status of composites. These ideas suggest the rejection of both extremes of universalism and nihilism, favoring instead the intermediate position that some composites exist in a non-trivial sense – those having unity and emergent novelty – while others do not. Systems theory is egalitarian: it posits that what exist are systems, equal in their ontological status. Some systems are fundamental, but what exists is not merely the fundamental, and the fundamental is not merely the foundational. The status of composites raises non-trivial issues, but mereology – and metaphysics in general – would benefit from substantive interaction with scientifically interesting questions.

Keywords: mereology, metaphysics, meta-metaphysics, composites, systems theory, ontology, wholes and parts, unity, emergence

COMPOSITION

One question addressed by contemporary metaphysics and meta-metaphysics is whether composites – 'mereological sums' – should be said to exist (Harte 2002, Chalmers et al 2009). If there is A, and there is B, and there is a 'composite'– mathematically, a set, S – that contains A and B, should one say that S exists 'in addition to' A and B, or should one say that S doesn't exist, and only A and B exist? Taken to its extreme, the first position says that composites *always* exist, no matter what their constituents are. This position is called compositional *universalism* or unrestricted composition. Taken to its extreme, the second position says that composites never exist, no matter what their constituents are. This position is called compositional *nihilism*.

As Samuel Butler (1872) wrote, "Extremes are alone logical, but they are always absurd." The absurdity of universalism is its attribution of existence to arbitrary composites, for example, the coins in my pocket plus the Eiffel Tower. The absurdity of nihilism is its denial that ordinary objects exist. The two absurdities are codependent: each empowers the other. Between these two extremes, there are intermediate positions that assert the existence of some composites, e.g., organisms, but not others, e.g., pocket coins and the Eiffel Tower. An intermediate position escapes the absurdity of the extremes, but needs to provide a criterion for existence or non-existence that is not vague. Intermediate positions will here be called compositional *contingency*.

At a *meta*-metaphysical level, there is a second controversy. One position holds that the metaphysical debate about composites is meaningful, and that there may be a correct answer to the question of whether composites exist. This will be called the position of

legitimacy. An opposite position, called *deflationism*, is dismissive and holds that the metaphysical debate is meaningless or irresolvable or purely verbal or trivially obvious. (These dismissive positions are not the same, and there may yet be other arguments for dismissing the metaphysical debate, so disputes among deflationists define an additional level of meta-metaphysical disagreement.) An intermediate meta-metaphysical position asserts that the debate is ill-posed in its current form, and empty or irresolvable for this reason, but if reformulated, the debate could be significant. This third alternative will be called here the position of *reform*.

There is an extensive literature that directly or indirectly addresses the subject of mereological sums, but no consensus on the metaphysical or meta-metaphysical issues. This paper applies ideas from systems theory to make assertions about these issues. These assertions reflect the author's preference for realism over constructivism.

SYSTEMS

From a systems perspective, the notion of composites that predominates in metaphysical and meta-metaphysical debates is ill conceived. Proper candidates for existence are not entities (objects, often referred to as 'simples') and sets of entities, but rather systems, where a 'system' is a particular kind of set, namely one that contains not only elements but also relations between elements (Figure 1). Systems theory is not committed to an ontology of objects, so 'element' can mean either 'entity' or 'process.' Elements not organized by relations but merely collected in sets are inadequate for ontology.
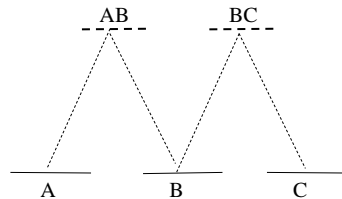
Figure 1 System. System, S, consists of three elements A, B, and C (solid lines) and two relations AB and BC (dotted lines), i.e., S = {A, B, C, AB, BC}. Since elements are encompassed in relations, the system can be written more simply as {AB, BC}.

While the notion of relation is not absent in mereological discussion, it is not well articulated and is not given its metaphysical due. The way relations are usually invoked is illustrated by the question: if wood particles are arranged 'chair-wise,' is this equivalent to the existence of a chair? This formulation is often given to dismiss both universalism and nihilism. If universalists answer 'yes' and nihilists 'no,' and if their disagreement is only about how the term 'chair' should be used, the disagreement would be verbal and trivial, and deflationism would be appropriate. But this question does in fact suggest some substantive issues, such as whether arrangements have the unity that might be regarded as necessary for existence. Unity is discussed below, but a preliminary examination of this question is needed to lay the necessary groundwork.

The question itself is unsatisfactory, for at least two reasons. First, the ontological status of arrangements is unclear. Arrangements are commonly accorded a status subordinate to the status of the elements that are arranged, if indeed any status at all. So the question of whether wood particles arranged chair-wise instantiate a chair is biased in favor of nihilism. The unclear or weak ontological status of arrangements is compounded by the need to be able to speak of arrangements of arrangements, arrangements of arrangements of arrangements, and so on. Reference to such higher order arrangements does not conform to ordinary language usage, in which what are arranged are usually entities, not arrangements. Moreover when nihilists speak of an arrangement being "chair-wise," the chair as entity is being implicitly recognized.

As mere spatial relations, arrangement are not as substantive as, and do not adequately represent, other types of relations, such as constraints or forces. The lesser significance of arrangements reflects the lesser status that relations have in mereological discussions. In the systems perspective, however, the ontological status of relations is at least equal to the status of elements; in fact relations are often given greater salience.[1] For example, systems theories (e.g., game theory, automata theory) are typically "stuff-free" (Bunge 1973), where the materiality of elements is ignored.

Second, even if relations are given equal ontological status with the elements that they organize, more is involved in the ontological notion of 'system' than merely elements and relations between elements. This notion is normally augmented in at least two ways:

(a) Recursive unity: The definition of system is made recursive (fractal): a system is a set of elements and relations between elements, where the system is an element at a higher level and elements are systems at a lower level. If recursion is done properly, it carves nature at its joints.

(b) Emergent attributes: Relations organize elements via attributes (properties), which belong to elements or to relations or to both (with possible mismatch). Attributes of the system as a whole are either upwardly emergent from the relations that organize the elements or downwardly emergent from the higher level relations that the system participates in as an element.

Unity and emergent attributes are both ways that systems are 'more than the sum of their parts.' These augmentations favor contingency, rejecting both the extremes of nihilism and universalism. Meta-metaphysically, they support the position of reform, since they modify the terms of the debate.

3. RECURSIVE UNITY

The recursive unity of systems is illustrated in

Figure 2, where unity is implied in the idea that a system is equivalently an element at a higher level.

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[1] This conception bears some resemblances to "structural realism" (Landry et al 2012), which asserts that structure, interpreted here as a set of relations, is ontologically or epistemologically primitive.
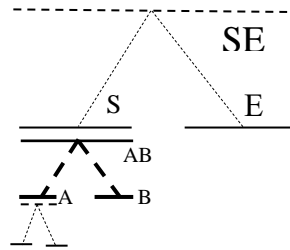
Figure 2 Systems are recursive. The system of Figure 1 is simplified here to two elements A and B and one relation AB (bold). System S and environment E are elements in relation SE (not shown are E as a system and SE as an element). Element A is also a system that organizes its internal elements (also true for B, but not shown). Recursion continues both above and below. Figure 1 is a 'closed-systems' view; this figure is an 'open-system' view.

Unity goes beyond mere arrangement, and is a basis for attributing existence – 'being' – to composites. As Augustine wrote in his Confessions,

> "To be is no other than to be one. In as far, therefore, as anything attains unity, in so far it 'is.' For unity worketh congruity and harmony, whereby things composite are, in so far as they are: for things uncompounded are in themselves, because they are one; but things compounded, imitate unity by the harmony of their parts, and, so far as then attain to unity, they are."

But unity, produced by the relations that organize the system, is a matter of degree. In the limit of zero unity, the relations confer upon the system an ontological status that is either weak or null. A system with zero unity – an Aristotelian "heap" – is at most a mere arrangement. Regarding such a system as a unitary element is not justified, and asserting the existence of the system is a mere façon de parler. But if the relations confer some unity on the system, regarding the system as an element is justified, and assertion of existence of the system 'in addition to' its elements is plausible. Both nihilism and universalism ignore the issue of unity, but unity provides the intermediate position of contingency with a criterion for existence vs. non-existence that is not vague. In the limit of maximal unity, the system resembles a 'mereological atom' and its existence is salient.

Unity can be quantified information-theoretically (Krippendorff 1986): relations are constraints of variable strength, quantified by mutual information. Let I(A:B) be the strength of relation AB relative to A and B being independent of one another. If I(A:B) $\approx$ 0, it is reasonable to say that the AB composite does not exist. However, if I(A:B) > 0, it is reasonable to say that AB exists. For a system of three elements, unity is also assessed by the degree to which the relation is decomposable into its projections. Such a system is completely non-decomposable, i.e., maximally 'holistic,' if the constraint in ABC is solely triadic, being completely absent in AB, AC, and BC, taken together (Figure 3).[2]

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[2] These rings are a metaphor for 'entanglement.' Chalmers (2009) refers to quantum entanglement but does not see that the priority that quantum laws give to the whole over its parts constitutes a denial of nihilism.
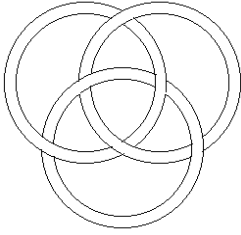
Figure 3 Borromean rings illustrating maximal topological unity The three interlocked rings are not separable, but if any one ring is first removed the other two are easily separated. The triadic relation is completely non-decomposable, i.e., there is triadic constraint but no dyadic constraint. *This* 'arrangement' is a substantial relation, and as close as a composite can come to being a mereological atom.

From the perspective of (an ontological rather than epistemological view of) systems theory, what exist are systems that have some minimal unity. Since systems are plainly composites, nihilism is rejected. There are systems all the way down and systems all the way up. Or: nearly all the way down or up: at the bottom, there may be mereological atoms that are not composite (elements that are not systems); at the top, there may be a totality that is a composite of everything (a system that is not an element of a larger whole). But these possible exceptions to recursiveness should be bracketed since nearly all the 'furniture of the world' lies between these extremes and since science does not speak with confidence about either extreme. It makes little sense to restrict the attribution of existence only to what is at best scientifically provisional.

4. EMERGENT ATTRIBUTES

A system is more than an arrangement in that relations constrain elements and thereby confer unity on the system. Transforming the dyad of elements and relations to the triad of elements, attributes, and relations (Figure 4, next page) introduces a second way that a system is more than the sum of its parts. The attributes of a composite can be different than those of its constituents – to assume the contrary is to succumb to the 'fallacy of composition.' Novel emergent attributes can be accommodated by nihilism only by acknowledging that arrangements not only have arrangements, etc., but also properties (attributes), which may be causally efficacious. And arrangements of arrangements have properties, and so on. If arrangements can have arrangements and properties and this is recursive, nihilism is faced with the challenge of explaining how exactly arrangements differ from entities.

Alternatively, the attributes of the system may not be novel and may be simply additive. The attributes of a coin-Tower composite are merely the attributes of the coins plus the attributes of the Tower. This is analogous to the absence of constraint and the topological decomposability of relations of a heap. Claims of existence for such composites are weak or null, and this undermines universalism (or justifies deflationism).

So the fact that attributes can be either novel or not novel supports contingency. Of course, the very existence of attributes may itself be denied, but such a metaphysical position not only rejects the "best science available" but any science whatever.
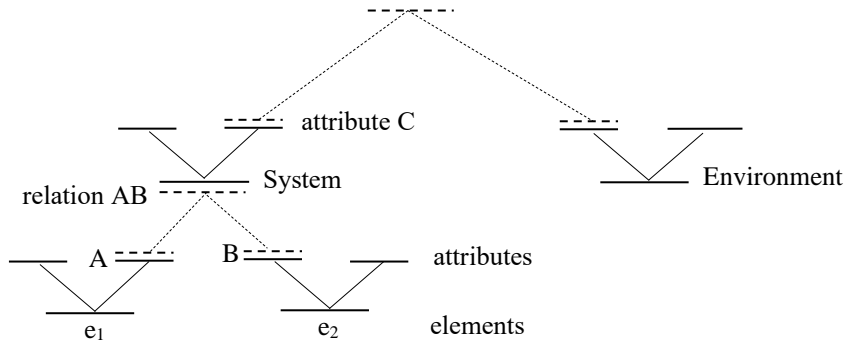
Figure 4 Attributes link elements and relations Attributes are shown belonging to both elements and relations. For simplicity, the system shown has one relation, AB, linking elements e_1 and e_2 via attributes A and B. The system as a higher level element has emergent attribute C, through which the system is related to its environment.

5. ONTOLOGICAL PARITY

Nihilism is a radical exaggeration – and distortion – of reductionism (or supervenience, which is reductionism-lite), since reductionism does not actually deny the existence of composites, only their fundamental nature.[3] One cannot, for example, imagine a physicist denying the existence of protons, especially since the quarks that compose protons cannot be detected separately, while protons themselves are readily observable. Given the fact that Quine's (1948) argument that metaphysics should be grounded in science stimulated the renewal of metaphysics within analytic philosophy, it is surprising that the existence of composites should ever have been doubted; there are, after all, no scientific theories that deny the existence of stars, organisms, organizations, etc. It is even more surprising that a discipline as dedicated as philosophy is to rectification of language could include a position that confuses what is 'fundamental' with what 'exists.'

Perhaps one should reinterpret nihilism to mean that composites are non-fundamental rather than non-existent. Nihilism would then be correct. But this would be a pyrrhic victory, with deflationism as its outcome: that composites are not fundamental is trivial, perhaps tautological. Such reinterpretation, however, would give inadequate weight to the fact that nihilism says more than merely that composites are not fundamental. And yet assertion of non-existence is too strong. Nihilism is probably best understood as a placeholder for the zero-unity limit of contingency.

Systems theory here introduces a deeper issue. That composites are not fundamental is not in fact a tautology, because 'fundamental' does not necessarily mean 'foundational.' The foundational is the bottom level of existence, but the fundamental is arguably bottom and top, both the 'atoms' of mereology and the upper limit of totality. More generally, because of the bi-directionality of recursiveness, parts are not prior to their whole, as reductionists assert, and the whole is not prior to its parts, as holists assert. Neither whole nor parts have

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[3] Schaffer (2009), following Aristotle, argues that metaphysics should be concerned not with what exists, but with what is fundamental and how the fundamental grounds what exists.

priority; unity of the whole and multiplicity of its parts are codependent, correlative. From a systems perspective, most discussions of the status of composites implicitly and illegitimately privilege parts over wholes.

To say that neither whole nor parts have priority is to say that the "arrow of scientific explanation" does not point only down,[4] i.e., from wholes to parts; it points up as well, to the larger wholes in which the focal system is a part. To explain life, for example, one needs biochemistry at small scales and planetary cosmology at large scales. In general, to explain any phenomenon, one needs to invoke both 'structure' – how relations internally organize the elements of the system into a unitary whole – and 'function' – how the system as a whole externally participates as an element in larger systems (Figure 5).[5]
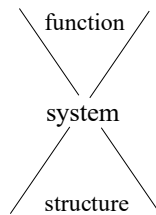
Figure 5 System as center of structure & function

These considerations are epistemological, but they can be taken ontologically: what exist are systems that are focal centers of structure and function. What systems theory offers instead of the hegemony of the fundamental is the generality of the central. It privileges the ubiquitous, the salient, namely…composition itself, looking up, and decomposition, looking down. Under the 'aspect of difference,' some systems are more fundamental than other systems (in either an upwards or downwards sense), but under the 'aspect of similarity' there is "ontological parity" (Ross 1980); or, more expressively, 'ontological egalitarianism.' All systems are equally existent. The existent is not the fundamental. The fundamental is not the foundational. Acceptance of the existence of composites is criticized for multiplying existents. The systems view sees no deficiency in plenitude but gives coherence to this multiplicity by elucidating the common character of composition (and decomposition).

6. SCIENTIFIC METAPHYSICS

Rejection of nihilism follows from ontological parity, but systems theory also rejects universalism, favoring the intermediate position of contingency, guided by Quine's injunction to base ontological commitments on the best available science. Different composite entities, i.e., system types, are studied by the different sciences, and the

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[4] Weinberg's (1992) formulation of the "arrow of explanation" fuses two ideas: down means smaller scales, and downwards also means from biology to chemistry to physics. These ideas need to be separated since physics also concerns the very large. Only the first meaning of 'down' is referred to above.
[5] The figure is synchronic and doesn't encompass diachronic change of structure and function. Because of recursion, the cones actually extend indefinitely downwards and upwards, but these extensions must be subject to some spatial 'discount factor' as they become more distant from the system as center.

ontological commitments of these sciences are not vague. Organisms are scientifically acknowledged entities; coin-Towers are not. So composites like organisms exist, and composites like coin-Towers do not. 6 As argued above, systems theory rejects universalism also because invented composites that have neither unity nor novel emergent attributes have at most existence that is trivial. Meta-metaphysically, systems theory favors reform since it seeks to change the terms of discussion, though it supports deflationism as the proper response to a metaphysical debate that allows only a binary choice between nihilism and universalism.

Quine's injunction is best not taken in the narrow sense of some hypothetical reformulation of science via first order logic, followed by the conferring of ontological legitimacy upon the terms that appear in this reformulation. One could aim at more than syntactic and semantic compatibility with science, but at actual pragmatic overlap with science. Mereological debates attract deflationism because the examples of wholes and parts analyzed in these debates are of interest only to those who gather in the "ontology room." But if mereology addressed scientifically important questions such as – in evolutionary theory – the units of selection or the consolidation of cooperation in individuality, it would be immune to simple dismissal and also warrant the attention of scientists. For example, a lichen is a composite organism consisting of a fungus and a photosynthetic partner. It has unity and novel emergent attributes. It surely exists. Metaphysics would benefit from being grounded in the analysis of such empirical phenomena.

Systems theory aims at such a different kind of scientific metaphysics, namely one consisting of theories about the most general features of reality (Bunge 1973). For example, game theory might be called metaphysical in that it is about competition and cooperation and rational action in general. In the ontology of game theory, relations are privileged, since the theory is not concerned with the nature of the elements (entities, i.e., agents) involved. A game is a composite, a set of relations (constraints), certainly more than a mere arrangement. If composites do not exist, there is no point to game theory, and no "tragedy of the commons"; indeed no tragedy of any kind: arrangements of simples cannot be tragic. But there is perhaps some virtue – some relief -- in nihilist unconcern:

The Buddha said that decay is inherent in all composite things.

Mereological nihilists tell us that there are no composite things.

So…not to worry!

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[6] More precisely, coin-Tower composites do exist, but only in the sense that unicorns exist, as creations of the imagination, by virtue of being discussed in papers such as this one. Debates over the existence of such imaginative creations understandably provoke the reaction of deflationism.

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